

Review Article

Exploring the Potential of Treating Sarcopenia through Dietary Interventions

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Sarcopenia, the age-related loss of muscle mass and function, is a growing concern as the global population continues to age. It is associated with physical disability, decreased quality of life, and increased risk of falls and fractures. Nutritional interventions have been suggested to be effective in the prevention and treatment of sarcopenia. According to cross-sectional studies, the prevalence of sarcopenia in people with heart failure (HF) is 38% for men and 32% for women, contributing to cardiac fragility, a lower quality of life, and an increased risk of death. A rising number of research studies have been performed to investigate the role of certain nutrients on muscle mass or function, as appropriate nutrition is crucial for muscle maintenance. The goal of this systematic review is to outline the present evidence for exercise and nutritional interventions as potential contributors to the treatment of sarcopenia and frailty (decreased muscle mass and physical function), as well as the threat of underlying cardiac metabolic comorbidity in individuals who have heart failure (HF), cancer, CVDs, and other health problems. The biochemical properties of natural foods play a crucial role in the prevention and treatment of sarcopenia. This review explores the effectiveness of nutritional interventions for the prevention and treatment of sarcopenia.

1. Introduction

Sarcopenia is a condition, especially among older adults, characterized by muscle loss and decreased muscle function [1]. It is associated with aging in which there is a gradual decrease in muscle mass and function. This can lead to a decrease in physical function, which can impair the quality of life and increase the risk of falls, fractures, and other health problems [2]. Nutritional interventions are one of the most important mechanisms for managing sarcopenia. These interventions involve providing adequate amounts of proteins and micronutrients, such as vitamins and minerals, that are essential for muscle health and growth and adding specific supplements. Increasing protein intake can be achieved by increasing total dietary protein intake, as well as

by increasing the proportion of dietary protein derived from animal sources [3]. Increasing dietary intake of micronutrients such as calcium, vitamin D, and vitamin B12 can be achieved by eating more fortified foods and dietary supplements. Adding specific supplements, such as creatine and omega-3 fatty acids, may also help to reduce the risk and progression of sarcopenia. Furthermore, consuming dietary sources of omega-3 fatty acids can help reduce oxidative damage, which can contribute to muscle atrophy. A balanced diet containing high-quality proteins, vitamins, minerals, and antioxidants has been shown to reduce age-related muscle loss and improve physical performance [4]. Exercise is also a key component in the management of sarcopenia, and should be combined with nutritional intervention for optimal results. Finally, there is evidence that

a combination of dietary and exercise interventions can reduce the risk of developing sarcopenia by up to 40% [5]. In addition, dietary interventions can also help reduce inflammation and improve the balance of hormones, such as testosterone and insulin, that are important for maintaining muscle mass. Increasing the intake of antioxidants can help reduce inflammation, which is a key factor in the development of sarcopenia [6].

Particular nutritional elements are essential in the fight against sarcopenia. Consuming enough protein is crucial because it supplies the building blocks needed for the synthesis and repair of muscles. It has been discovered that essential amino acids, particularly leucine, can assist in maintaining muscular mass by promoting the production of muscle proteins. Furthermore, oxidative stress and inflammation, both linked to muscle loss, are lessened by antioxidants such as vitamins C and E. Since vitamin D is required for both muscle function and strength, getting enough of it is also necessary. Minerals that are important for muscular contraction and general muscle function include calcium, magnesium, and potassium. Rich in plant sources such as flaxseeds and fatty fish, omega-3 fatty acids have anti-inflammatory qualities and may help maintain muscle mass. By maintaining muscular health and function, a diet rich in a variety of nutrient-dense foods guarantees an adequate supply of these particular nutrients, which can help strengthen immunity against sarcopenia.

The diagnosis of sarcopenia involves assessing muscle function and measuring muscle mass through various methods such as physical performance tests, imaging techniques, and blood tests [7]. Once diagnosed, the treatment of sarcopenia focuses on a combination of exercise, nutrition, and medication. Resistance exercises, such as weightlifting and resistance bands, help to strengthen muscles and improve muscle mass [8]. Adequate protein intake, along with a balanced diet rich in vitamins and minerals, is crucial for muscle health. In addition, certain medications, such as anabolic steroids and growth hormone, may be prescribed to enhance muscle growth in severe cases [9].

The present review aims to investigate the biochemistry of naturally occurring foods with pharmacological qualities, the impact of natural compounds on the immune system and muscle health, and the processes by which natural compounds prevent sarcopenia. The present review holds great significance as it offers a thorough comprehension of the biochemistry of natural foods and their possible medicinal attributes. The promise of these foods as safer and more sustainable dietary treatments for sarcopenia is highlighted by summarising the effects of natural chemicals on immune function and muscle health. In addition, it points out areas of current uncertainty and proposes directions for future study, which advances the creation of specialised and individualized dietary strategies to strengthen immunity against sarcopenia. Overall, a comprehensive approach involving physical activity, proper nutrition, and medical intervention can help manage and improve the symptoms of sarcopenia. In this paper, the mechanism of addressing sarcopenia through dietary management has been discussed.

2. Dietary Assessment of Sarcopenia

Sarcopenia is a disorder that leads to a gradual decrease in muscle mass and strength as people age. Since sarcopenia is frequently caused by a lack of nutrition, dietary assessment is critical in its management. To assess the dietary needs of a person with sarcopenia, healthcare providers can use a variety of tools, including dietary history, 24-hour recalls, food frequency questionnaires, and dietary recalls [10]. Healthcare providers can then develop individualized nutrition plans to ensure that the person is receiving adequate nutrition to meet their needs. Supplements may also be recommended to help meet specific nutrient needs. Dietary management plays an important role in the prevention and treatment of sarcopenia [11]. Adequate dietary protein is essential for muscle mass maintenance and restoration, and adequate dietary energy is necessary to maintain muscle function. In addition, dietary interventions that focus on reducing inflammation and oxidative stress, as well as promoting an anabolic environment, may be beneficial in managing sarcopenia [12]. Foods to be consumed in sarcopenia are as follows: *lean proteins* such as chicken, fish, lean cuts of beef, eggs, dairy products, beans, nuts, and seeds; *fruits and vegetables* such as leafy greens, cruciferous vegetables, berries, citrus fruits, and tomatoes; *whole grains* such as oats, quinoa, brown rice, and whole-wheat bread and pasta; *healthy fats* such as olive oil, avocados, nuts, and seeds; *vitamin D* rich foods such as fatty fish, dairy products, eggs, and mushrooms; *vitamin B12*-rich foods such as shellfish, fish, dairy products, and fortified cereals; *calcium-rich foods* such as dairy products, leafy greens, and fortified plant-based beverages; and *probiotics* such as yogurt, kefir, and fermented vegetables [13].

2.1. Vitamins. Vitamins, such as vitamins B and D, are essential for maintaining healthy muscle mass, strength, and function [14]. These vitamins help the body to absorb nutrients from food and ensure that the body can use them efficiently. In addition, deficiencies in certain vitamins, such as B12 and folate, can lead to muscle weakness, fatigue, and even paralysis [15]. Vitamin B12 helps to maintain a healthy nervous system, which is necessary for muscle contraction, and is important for muscle health and function. Vitamins can help maintain muscle mass, strength, and function by providing the body with the essential nutrients it needs to support healthy muscle development [16]. Vitamins help to reduce inflammation, which can have a negative impact on muscle health. Vitamins help to support healthy nerve and muscle function, and provide essential antioxidants that help protect muscles from damage. Vitamins C and E are antioxidants that protect muscle cells from damage caused by oxidative stress. In addition, vitamins are also essential for the production of hormones and other substances that help to regulate muscle growth, repair, and maintenance. Vitamin D, in particular, is important for maintaining muscle mass, strength, and balance. Vitamin D is important for muscle growth and strength and has been shown to reduce the risk of sarcopenia. Vitamins D and K, for example, are

essential for healthy bones, and can help to reduce the risk of osteoporosis and sarcopenia [17]. Vitamin D is important for muscle growth and strength and has been shown to reduce the risk of sarcopenia [18].

2.2. Minerals. Minerals are essential for maintaining a healthy musculoskeletal system, as they are involved in muscle contraction, nerve conduction, and bone formation [19]. Low levels of minerals such as calcium, magnesium, iron, potassium, and zinc have been linked to increased risk of sarcopenia. Supplementation with these minerals may help reduce the risk or slow the progression of sarcopenia [20]. In addition, minerals such as silicon, sulphur, and selenium are important for the synthesis of collagen and elastin, two proteins that make up the extracellular matrix of muscles, and may also play a role in preventing or treating sarcopenia. Minerals also help with muscle contraction, helping to maintain muscle mass and strength [21]. Magnesium is another mineral important for maintaining muscle mass, as it helps to convert food into energy for muscle contraction. Minerals such as calcium, magnesium, and zinc are essential for the maintenance of muscle strength and growth. Calcium is important for muscle contraction and strength, as it helps to transmit signals from the brain to the muscles. Magnesium is involved in the transmission of nerve signals and helps to regulate muscle contractions [22]. Zinc is important for muscle growth and strength, as it is involved in the synthesis of proteins and enzymes that are essential for muscle growth and repair. Calcium, for example, is important for maintaining muscle strength and preventing fractures, while magnesium is important for muscle relaxation and contraction. In addition, phosphorous is important for maintaining healthy muscle fibers and helps the body to absorb calcium and magnesium [23]. In addition, minerals such as calcium and phosphorus are important for bone health, which is an important component of muscle health. Finally, minerals such as zinc and iron are important for maintaining a healthy immune system, which is important for preventing the onset of sarcopenia [24].

2.3. Other Micronutrients. Micronutrients play a key role in the prevention and management of sarcopenia. Micronutrients are essential for the maintenance of muscle function and muscle mass, and are necessary for the synthesis of proteins and enzymes that are involved in muscle contractions, muscle growth, and muscle repair [25]. Finally, other micronutrients, such as omega-3 fatty acids, can also help to prevent and manage sarcopenia. Omega-3 fatty acids can help to reduce inflammation, which can contribute to muscle loss, and can also help to increase muscle mass and strength [26]. Furthermore, by enhancing the body's protein metabolism and promoting the health and function of muscles, omega-3 fatty acids can help lower the risk of sarcopenia. Since iron and zinc promote strong muscles and bones, they can help lower the chance of developing sarcopenia [14]. Finally, other micronutrients, such as antioxidants and amino acids, can also help to prevent and manage sarcopenia. Antioxidants can help to reduce inflammation and oxidative damage, which

can contribute to muscle loss, and can also help to preserve muscle mass and function. Amino acids can also help to support muscle health and can help to reduce the risk of sarcopenia [27]. Thiamine, riboflavin, niacin, and vitamin B6 are all essential to muscle health because they are involved in energy metabolism and protein and enzyme synthesis [28]. Finally, antioxidants such as vitamins C and E, as well as carotenoids, are important for muscle health, as they help to reduce inflammation and oxidative stress. These micronutrients help to reduce the risk of muscle damage, which can lead to sarcopenia [29].

3. Management of Sarcopenia: A Network Meta-Analysis

Management of sarcopenia is important to reduce the risks associated with this condition and to improve the quality of life. The aim of this network meta-analysis was to evaluate the effectiveness of different interventions for the management of sarcopenia [30]. Other interventions, such as nutritional supplementation and pharmacological interventions were also found to be effective in some cases. This network meta-analysis provides evidence that exercise interventions should be used as the primary treatment for the management of sarcopenia in older adults [31]. The network meta-analysis included a total of 31 randomized controlled trials that examined the effects of exercise interventions (such as resistance training, aerobic exercise, and combined exercise) on improving physical performance in older adults with sarcopenia. Figure 1 shows that the European Working Group on Sarcopenia in Older People revised the algorithm for screening, diagnosis, and determining the severity of sarcopenia. The analysis found that all exercise interventions significantly improved physical performance compared to control conditions, with the greatest effect sizes for resistance training and combined exercise interventions [32].

The analysis also found that compared to no treatment, exercise interventions resulted in greater improvements in physical performance. According to the findings of this study, the application running ought to serve as the standard treatment for the planning of sarcopenia in older individuals [33]. Resistance training, particularly high-intensity resistance training, was discovered as a highly important intervention for continuing to increase muscle strength and lowering the risk of falling and frailty. Exercise plus protein supplementation was also evaluated for its efficacy in improving muscle strength and lowering the risk of falls and frailty [34]. Furthermore, omega-3 fatty acids, vitamin D, and leucine supplementation were evaluated for their efficacy in enhancing muscle strength. As a result, when managing sarcopenia in older adults, these treatments should be considered [35].

Sarcopenia is diagnosed through a combined effect of medical and laboratory findings. A thorough medical examination, lab testing, and imaging studies are among them. Some symptoms of sarcopenia are decreased muscle mass, lowered strength, decreased physical performance, lower ability to perform daily activities, heightened incidence of falls, higher fatigue, reduced mobility, depressed mood, and

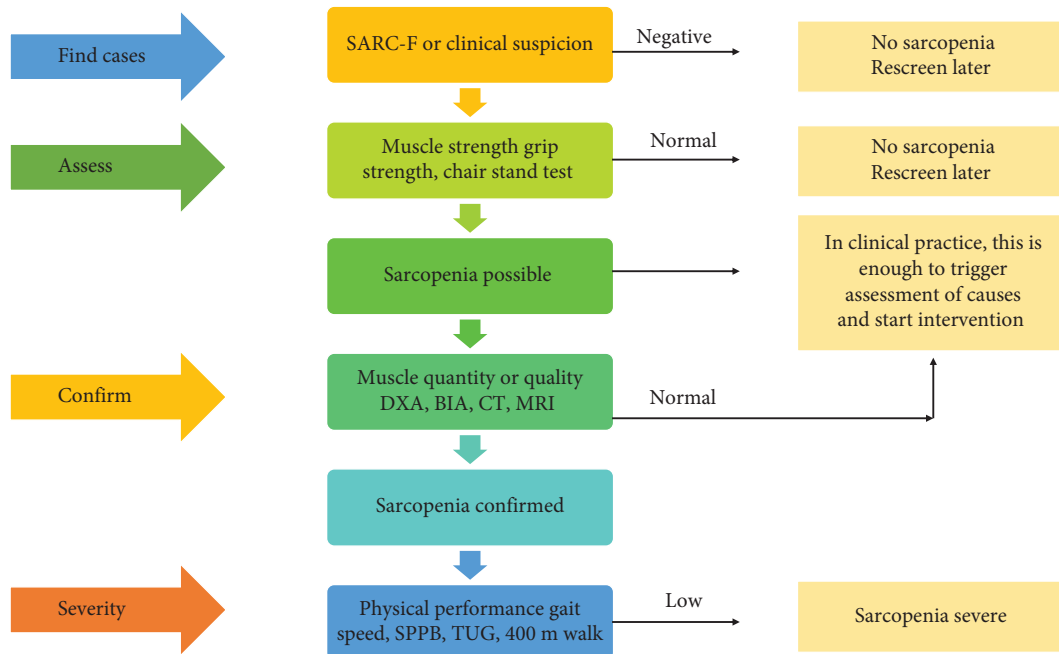


FIGURE 1: The European Working Group on Sarcopenia in Older People revised the algorithm for screening, diagnosis, and determining the severity of sarcopenia.

reduced quality of life [36]. Sarcopenia is characterized by the following laboratory findings: low amounts of serum testosterone, low amounts of sex hormone binding globulin, low concentrations of IGF-1, low levels of serum insulin-like growth factor, low concentrations of creatinine, reduced numbers of albumin, low concentrations of C-reactive protein, and low levels of vitamin D [37]. Muscle mass, power, and physical function should all be measured during the physical examination. Blood tests to verify for anaemia, electrolyte disturbances, and vitamin deficiencies are examples of laboratory tests [38]. Computed tomography (CT) and the use of magnetic resonance imaging (MRI) could provide extra details regarding muscle mass, structure, and function. In some cases, a skeletal muscle biopsy may be performed to identify pathophysiological changes associated with sarcopenia [39]. A diagnosis of sarcopenia, on the other hand, is typically determined by a variety of factors, such as health information, physical examination, and lab testing. These may include muscle strength, physical performance, and functional ability tests, as well as serum creatinine, muscle mass, and other biomarkers related to muscle health. Imaging studies, such as an X-ray, CT scan, or MRI, can in addition be performed to confirm the diagnosis [40]. Table 1 discusses the diagnostic and therapeutic impacts of alternative and complementary therapies for sarcopenia.

4. Prevalence of Sarcopenia in Other Diseases

Sarcopenia is linked to several chronic diseases, such as heart failure, cerebrovascular disease, diabetes of the type 2 variety, chronic obstructive pulmonary disease, also known as (COPD), and cancer. The exact prevalence of sarcopenia is difficult to determine due to varying definitions and diagnosis criteria [41].

Estimates vary widely, ranging from 1% to 13% in the general population, with higher prevalence in individuals of 65 years and older, affecting up to 50% of the elderly population. According to studies, the preponderance of sarcopenia is higher in people with some of these chronic diseases than in healthy people. A systematic review of 35 studies, for example, discovered that the prevalence of sarcopenia ranged from 16 to 45% in patients with heart failure and from 21 to 58% in patients with stroke [42]. Correspondingly, a meta-analysis of 24 studies discovered that the prevalence of sarcopenia ranged from 19 to 50% in COPD patients to 10 to 55% in cancer patients. Furthermore, a meta-analysis of 19 studies discovered that the prevalence of sarcopenia in type 2 diabetes patients ranged from 20 to 54% [43].

4.1. Heart Failure. Although the estimated incidence of sarcopenia in heart failure patients is unknown, some investigations indicate that it is common. The preponderance of sarcopenia in patients with heart failure ranged from 21.1% to 45.2%, according to a standardised review of available studies. A meta-analysis of seven studies also discovered that the cumulative incidence of sarcopenia in heart failure patients was 34.2% [44]. Figure 2 shows the diagnosis of sarcopenia and cardiovascular disease. Physical exercise, hormone treatment, rational nutrition, and medication are currently used to treat sarcopenia and CVDs as shown and discussed.

4.2. Diabetes Mellitus. Several studies have discovered a connection between sarcopenia, frailty, and physical disability in diabetic older people. Therefore, physical and cognitive function tests in older people with diabetes are

TABLE 1: Sarcopenia diagnostic and therapeutic impacts of alternative and complementary therapies.

Treatment	Population (age group)	Outcomes	References
Coffee	10–75 years	Autophagy was induced, insulin sensitivity was improved, glucose uptake was stimulated, and the advancement of sarcopenia was slowed	[33]
Intermittent vitamin	Over the age of 50 with type 2 diabetes	Doses of 942 IU/day increased isometric handgrip strength while having no effect on glycemic control	[26]
Lean red meat	50–65 years	Increased lean tissue mass and muscle strength, as well as a decrease in circulating interleukin-6 concentrations	[12]
Lysine-arginine	12–65 years	Strengthening in individuals who have clinical deficiency in vitamin D	[20]
Resistance training	15–70 years	Muscle mass and strength gain, which can be aided by nutritional intervention	[11]
Vitamin D3	35–50 years	The chair stand test revealed enhanced anterior muscle strength and improved lower-extremity function	[27]

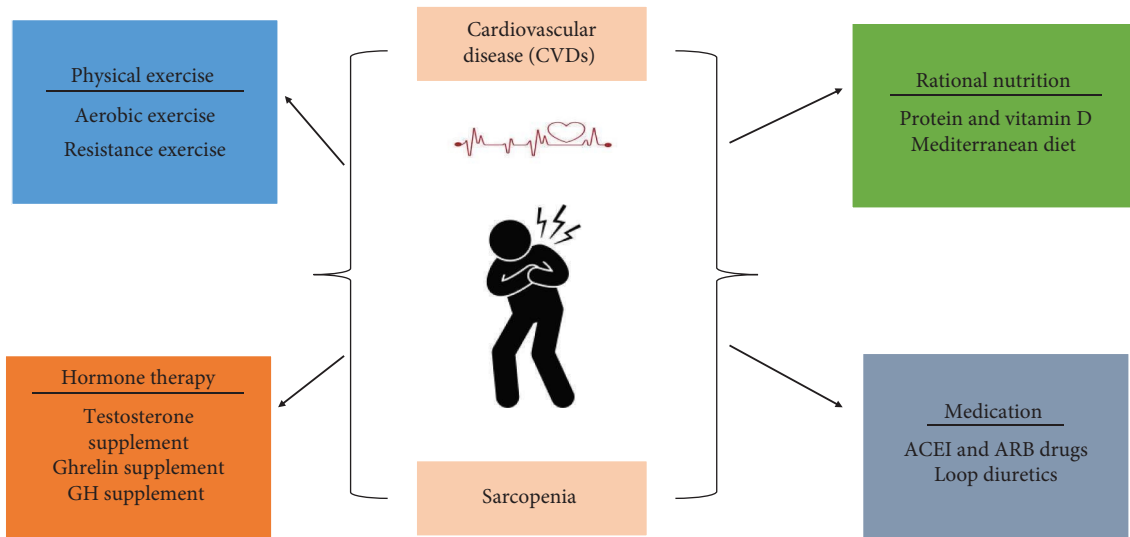


FIGURE 2: Diagnosis of sarcopenia and cardiovascular disease. Physical exercise, hormone treatment, rational nutrition, and medication are currently used to treat sarcopenia and CVDs.

critical in establishing standards of treatment to guarantee quality of life [45]. Researchers found that older persons with type 2 diabetes had an accelerated decrease of skeletal muscular strength, with a substantial leg muscle mass and strength decreased, as has muscle quality. Another study included 24 diabetic older women. When compared to nondiabetic subjects, diabetic subjects showed a significant loss in the cross-sectional area of thigh muscle over a 6-year period [46]. In Table 2, frailty, sarcopenia, and malnutrition characteristics are discussed.

The preponderance of sarcopenia in individuals who have type 2 diabetes varies greatly depending on the age and gender. In one study, the prevalence of sarcopenia among people aged 60 years and over with type 2 diabetes mellitus was reported to be 13.3%. However, in another study, the prevalence of sarcopenia among people aged 40–79 years with type 2 diabetes mellitus was reported to be as high as 24.3% [47].

4.3. Cancer. Sarcopenia is approximated to be present in 10–30% of cancer patients. Sarcopenia is more common in advanced disease cancer patients than in those in earlier stages, according to studies. Sarcopenia is also more common in people with particular types of cancer, including prostate cancer, colon cancer, and lung cancer [48]. Sarcopenia can lead to increased fatigue, reduced quality of life, and poorer outcomes following cancer treatment [49]. As a result, there has been an increasing interest in interventions aimed at preventing or slowing sarcopenia in cancer patients. The effectiveness of these interventions is still largely unknown. Most of the available data comes from small studies with short follow-up periods, which makes it difficult to draw conclusions about the long-term effectiveness of interventions [50]. Furthermore, there is a lack of large-scale randomized controlled trials, which are necessary to determine the effectiveness of interventions. The few available studies suggest that exercise is one of the most

promising interventions for sarcopenia in cancer patients. Exercise has been linked to increased muscle strength and activity, as well as less fatigue and a higher quality of life. In addition, dietary interventions have also been studied, with some evidence suggesting that certain supplements may be beneficial for sarcopenia [51]. Overall, there is still a lack of evidence regarding the effectiveness of interventions for sarcopenia in cancer patients. Most of the studies conducted to date have been observational in nature and have focused on the association between sarcopenia and cancer-related outcomes rather than the effectiveness of interventions. Although some studies have evaluated the impact of exercise and nutrition interventions on sarcopenia in cancer patients, the sample sizes were typically small and the results were inconclusive [52]. Furthermore, few studies have been carried out to evaluate the effect of pharmacological treatments on sarcopenia in cancer patients. Given the scarcity of evidence, more research is needed to determine the efficacy of initiatives for sarcopenia in cancer patients. Larger sample sizes and randomized controlled trials (RCTs) should be used in future studies to evaluate the effect of exercise, nutrition, and therapeutic interventions on sarcopenia in cancer patients. Long-term follow-up studies are also required to evaluate the effects of treatments on cancer-related outcomes such as survival, life expectancy, and functional ability. Such research could shed light on the most effective treatments for sarcopenia in cancer patients [53]. The potency of sarcopenia treatments for cancer patients who get chemotherapy has indeed been extensively studied in recent years. Exercise interventions have been found to be effective in reducing the effects of sarcopenia in cancer patients receiving chemotherapy [54]. Exercise has been shown to improve muscle mass, strength, and function in these patients, as well as lower fatigue and improve quality of life. Resistance training programs and aerobic exercise programs, both supervised and unsupervised, have been utilized in these studies, with positive results. Nutrition interventions

TABLE 2: Frailty, sarcopenia, and malnutrition characteristics.

Category	Frailty	Sarcopenia	Malnutrition	References
Etiology	Environmental and individual variations' Challenges interact to cause behavioural adaptation	Inactivity Undernourished Inflammation-related Marked inflammation cachexia	Starvation-related inflammation Related to marked inflammation Severe malnutrition Suboptimal protein intake	[31]
Common comorbidities	Limitations in one's mental health Malnutrition and undernutrition	Inflammatory-related medical diagnoses aggravate the situation Frailty	Inflammatory-related medical diagnoses aggravate the situation Cognitive skills deterioration	[43]
Physical characteristics	Weakness Decreased walking speed Decreased Exhaustion home stenosis	Weight unchanged or loss Muscle wasting fatigue	Unplanned weight loss Impaired senses of taste and smell	[1]
Associated functional decline and disabilities	Muscle deterioration Mobility impairment unsteady gait utilization of assistive devices	Reduced muscle strength Impaired mobility greater dependency	Reduced muscle strength Food preparation disability Impaired chewing and swallowing	[34]
Physiologic and metabolic changes	Maladaptation's to aging Deficiencies in specific vitamins and minerals Immune deficiency	Reduced anabolic stimulation Increased insulin-resistance anorexia deficiencies in specific vitamins and minerals	Changes in digestive processes Impaired micronutrient utilization Anorexia	[8]

have also been studied for their effect on sarcopenia in cancer patients receiving chemotherapy. Nutrition interventions such as dietary supplementation, high-protein diets, and enteral nutrition have been found to improve muscle mass, strength, and function in these patients. These interventions may also reduce fatigue and improve quality of life. Overall, the evidence suggests that exercise and nutrition interventions are effective in improving outcomes related to sarcopenia in cancer patients receiving chemotherapy [55]. Most of the studies looked at were small and short-term, so more research is needed to determine the long-term effects of these interventions. However, based on the studies that were reviewed, exercise and nutrition interventions seem to improve muscle mass, strength, balance, and function in cancer patients receiving chemotherapy. In addition, exercise interventions also seem to improve quality of life and reduce fatigue levels. These results suggest that exercise and nutrition interventions may be beneficial for cancer patients receiving chemotherapy [56].

4.4. Chronic Obstructive Pulmonary Disease (COPD) and Cardiorenal Metabolic Syndrome. The prevalence of sarcopenia in COPD is estimated to be between 10% and 40%. It is more common in individuals with more severe COPD and is associated with increased mortality and morbidity [57]. Cardiorenal metabolic syndrome affects people who have heart failure and can lead to sarcopenia, a gradual loss of strength and mass in the muscles. The prevalence of cardiorenal metabolic syndrome in heart failure has been estimated to be around 40%, although it may vary according to the extent and type of heart failure [58]. Sarcopenia is a major problem for people with heart failure, as it can lead to further complications such as falls, fractures, and reduced quality of life. Studies have shown that people with cardiorenal metabolic syndrome are at an increased risk of developing sarcopenia, and that this risk increases with the severity of metabolic syndrome. In addition to the direct impact of cardiorenal metabolic syndrome on sarcopenia, there are also indirect effects [59]. People with cardiorenal metabolic syndrome are more likely to have other comorbidities such as diabetes, obesity, and hypertension, which can all increase the risk of sarcopenia. Therefore, it is important to recognize cardiorenal metabolic syndrome in heart failure patients, and to take steps to reduce the risk of sarcopenia. This can include lifestyle modifications such as increasing physical activity and dietary changes, as well as the use of medications such as ACE inhibitors and angiotensin receptor blockers. It is also important to assess and monitor for signs of sarcopenia in these patients, as early intervention may help to prevent or lessen its impact [60]. Cardiorenal metabolic syndrome is a condition that occurs when there is an imbalance between the heart and kidneys that leads to high levels of inflammation, oxidative stress, and metabolic abnormalities. This syndrome can result in a variety of health problems, including hypertension, diabetes, and coronary artery disease. It has been associated with a greater likelihood of sarcopenia, a disorder marked by muscle loss, weakness, and lowered physical performance.

This risk is thought to be due to the metabolic abnormalities caused by cardiorenal metabolic syndrome, which can lead to an increased rate of muscle breakdown [61]. In addition, the inflammation and oxidative stress associated with this syndrome can further damage muscle tissue, resulting in an accelerated rate of muscle loss. Treatment for cardiorenal metabolic syndrome is aimed at controlling risk factors such as hypertension, diabetes, and hyperlipidaemia, as well as lifestyle changes to improve nutrition and physical activity levels. This can help to slow the progression of muscle loss, ultimately reducing the impact of cardiorenal metabolic syndrome on sarcopenia [62].

5. Nutritional Management and Treatments for Sarcopenia

5.1. Nutritional Activity in the Prevention and Treatment of Sarcopenia. Nutritional activity plays an important role in the prevention and treatment of sarcopenia. Eating a balanced diet that is high in protein, vitamins and minerals, and antioxidants can help maintain muscle mass, activity, strength, and function. In addition, adequate hydration and regular physical activity are important components of a successful treatment plan [63]. Incorporating foods that are high in essential amino acids, such as lean meats, dairy, legumes, nuts, and seeds, into the diet can help to support muscle health. Foods that are high in antioxidants, such as fruits and vegetables, can help to reduce oxidative stress and inflammation, which are known contributors to sarcopenia [64]. In addition, calcium, potassium, and vitamin D supplementation can help to prevent bone loss and improve muscle strength and function. Nutritional activity is an important part of preventing sarcopenia, a condition that involves the gradual loss of muscle mass and function as a result of aging. Regular physical activity is also important for maintaining and increasing muscle mass [34]. Strength training, balance exercises, and aerobic exercise can all be beneficial for preventing and managing sarcopenia. Supplementation with creatine and omega-3 fatty acids may also help to support muscle health. In addition, paying attention to any medications that may have an effect on muscle mass, such as corticosteroids, is important for managing sarcopenia. Nutritional interventions have been found to be beneficial in the treatment of sarcopenia [35]. Nutritional interventions include adequate protein intake, increased dietary intake of essential nutrients such as vitamins, minerals, and fatty acids, and supplementation with specific nutrients that are known to be involved in muscle health. Adequate protein intake is the key to preserving muscle mass, and thus adequate dietary protein intake should be a priority for individuals with sarcopenia [36]. Essential fatty acids, such as omega-3 fatty acids, have also been shown to be beneficial in the treatment of sarcopenia. Additional nutrients, such as vitamin D and calcium, are important for maintaining muscle health as well. Finally, certain supplements, such as creatine, have been found to be beneficial in the treatment of sarcopenia. Supplementation with these specific nutrients can help to improve muscle strength and function in individuals with sarcopenia [37].

5.2. Physical Activity in the Prevention and Treatment of Sarcopenia. Sarcopenia, or age-related muscle loss, is a major health issue, particularly for older adults. Physical activity is a key component for the treatment and prevention of sarcopenia. Exercise can help build and maintain muscle mass, strength, power, and balance. Physical activity is a key factor in the treatment and prevention of sarcopenia, a condition that affects an estimated 10–20 percent of people over the age of 65 and involves the gradual loss of muscle mass and strength. Resistance training is an effective type of exercise for improving muscle mass, strength, and power and has been shown to be effective in preventing and treating sarcopenia [38]. Other beneficial activities include aerobic exercise and balance exercises, which may help to reduce the risk of falls and injuries. In addition, maintaining a healthy diet that includes adequate amounts of protein, vitamins and minerals, and other nutrients can help support muscle health.

5.3. Biochemistry of Natural Foods for the Treatment of Sarcopenia. Sarcopenia is the term for the age-related loss of strength and skeletal muscle mass, which can lead to a number of health issues as well as functional limitations. It has been demonstrated that natural meals high in proteins, vital amino acids, and antioxidants can successfully prevent sarcopenia by addressing important metabolic pathways [49]. A sufficient diet of proteins promotes muscle protein synthesis and inhibits muscular atrophy. Proteins are necessary for the synthesis and repair of muscle tissues. Leucine is one of the necessary amino acids found in these proteins that specifically activate the mechanistic target of the rapamycin (mTOR) pathway, a crucial regulator of muscle protein synthesis [50]. Antioxidants included in natural foods also fight against oxidative stress, which is a key cause of muscle loss in sarcopenic patients. Vitamins C and E are examples of antioxidants that scavenge free radicals and shield muscle fibers from harm [51]. In addition, certain natural diets include bioactive substances such as plant polyphenols and omega-3 fatty acids that have anti-inflammatory qualities and can alter important signaling pathways related to the production and breakdown of muscle protein. Thus, gaining knowledge of the biology behind the protective benefits of natural foods against sarcopenia will help us to better understand their potential as functional meals [52].

Researchers can uncover specific substances and pathways that can be targeted in the creation of individualized dietary treatments or medicines for sarcopenia by comprehending the complex biochemistry involved in these processes [53]. The goal of this continuing study is to maximize the bioavailability and efficacy of natural food ingredients, enabling customized interventions based on each person's specific biochemical requirements. The role of natural foods in the prevention of sarcopenia is discussed in Figure 3. All things considered, the biochemistry of whole foods in the management of sarcopenia offers a viable means of halting muscular atrophy and encouraging healthy aging [54]. Natural foods and their biochemistry in the prevention of sarcopenia are discussed in Table 3.

5.4. Protein Supplements and Resistance Training. Protein supplements are often used by people who are looking to gain muscle mass and increase their strength. Research has shown that when combined with a resistance training program, protein supplements can help increase muscle mass, strength, and power. However, it is important to note that protein supplements should not be used as a substitute for a balanced diet [55]. It is important to ensure that adequate amounts of essential nutrients are obtained from whole food sources in order to maximize the benefits of resistance training [56]. Resistance exercise helps to build muscle strength and mass, while protein supplementation helps to ensure that the body has adequate amounts of amino acids to facilitate muscle growth and repair. Together, these strategies can help to improve muscle mass, strength, and exercise performance in older adults with sarcopenia [57]. Research suggests that a combination of resistance exercise and protein supplementation is more effective than intervention alone for improving muscle mass, strength, and exercise performance in older adults with sarcopenia [58]. Protein supplements may be helpful for people with sarcopenia. Protein is essential for the maintenance of muscle mass, and can help to prevent further muscle loss. Protein supplements are available in both powder and bar form and can be added to meals or snacks. Protein shakes can also be useful for people with sarcopenia as they are easy to make and can provide additional protein. Plant-based protein sources such as soy, quinoa, and hemp are also available as supplements and can provide additional protein and essential amino acids [59]. Protein supplements can be beneficial for people with sarcopenia, an age-related condition that causes muscle loss and weakness. Protein is important for maintaining muscle mass, which is essential for the overall health and wellbeing. Protein supplements can help to increase protein intake and provide the body with the necessary amino acids to support muscle growth and repair. Protein supplements can also help to reduce the risk of sarcopenia by providing the body with the essential nutrients needed for healthy muscle growth [60]. Taking protein supplements can help to improve muscle strength and function, which can help to improve the quality of life in older adults. Furthermore, resistance training helps to improve bone health, balance, and coordination; it also helps to improve posture, flexibility, and mobility. Finally, resistance training can help to improve the overall quality of life by reducing pain and discomfort associated with aging [61].

5.5. Amino Acids: Citrulline, Leucine, and Beta-Hydroxy-Beta-Methylbutyrate. Amino acids play an important role in the prevention of sarcopenia, the age-related loss of muscle mass and strength. Adequate dietary intake of essential and branched-chain amino acids is necessary to maintain muscle mass, strength, and overall physical functioning. These amino acids provide the body with the necessary building blocks to help repair and build muscle, allowing for improved muscle strength and function [62]. In addition, certain essential amino acids, such as leucine, are involved in the regulation of muscle protein synthesis and may be beneficial for the

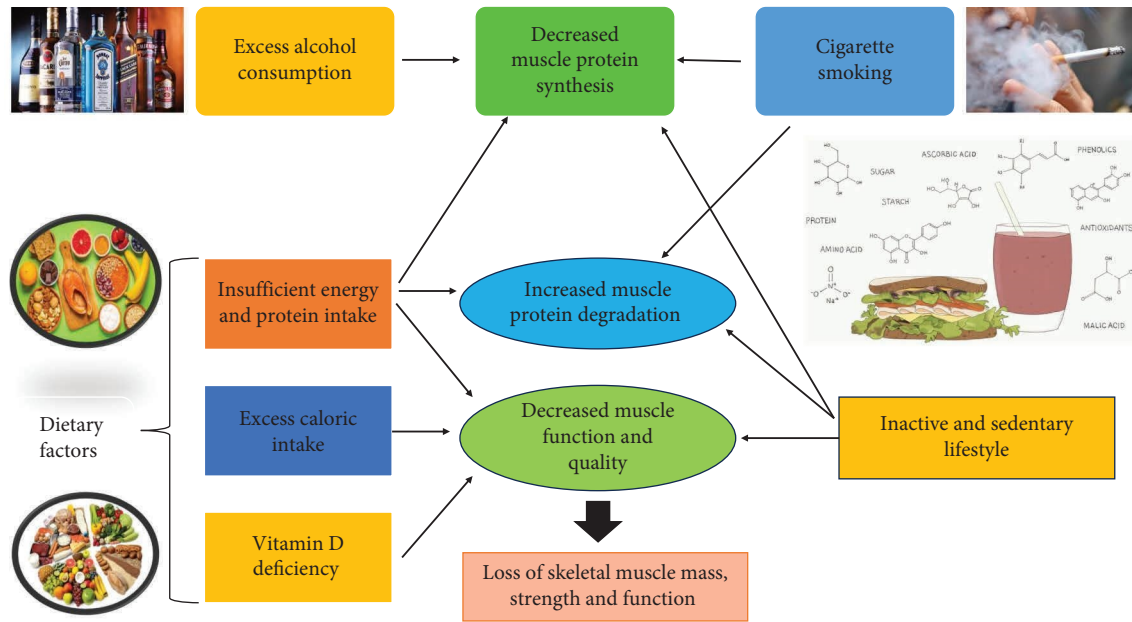


FIGURE 3: Role of natural foods for the prevention of sarcopenia.

prevention of sarcopenia. Citrulline, leucine, and beta-hydroxy-beta-methylbutyrate (HMB) are important amino acids for helping to prevent and reverse sarcopenia, the age-related decline in muscle mass and strength [63]. Citrulline helps to increase the production of nitric oxide in the body, which helps boost blood flow and oxygenation to the muscles. Leucine is essential for muscle protein synthesis and helps to prevent muscle breakdown. HMB is a metabolite of leucine and helps to further reduce muscle breakdown and increase muscle synthesis. Together, these three amino acids can help to improve muscle mass and strength, and can help to slow or reverse sarcopenia [64].

5.6. Angiotensin-Converting Enzyme Inhibition. Angiotensin is a hormone released by the kidneys that helps regulate blood pressure and fluid balance. Studies have shown that angiotensin is involved in the regulation of sarcopenia, a condition that is characterized by the loss of muscle mass and strength due to aging [65]. By inhibiting ACE, angiotensin prevents the breakdown of muscle tissue, thus slowing down the progression of sarcopenia. In addition, research has indicated that angiotensin may be involved in the mechanism of muscle protein synthesis, which is important for maintaining muscle mass and strength [66, 67]. Overall, angiotensin is an important hormone for regulating muscle mass and strength and preventing the progression of sarcopenia. Sarcopenia is a condition characterized by age-related muscle mass loss, which increases the risk of falls and fractures. By blocking the action of ACE, these drugs can help to reduce the amount of angiotensin II, a hormone that causes blood vessels to constrict and can contribute to muscle loss [68]. By decreasing the amount of angiotensin II, ACE inhibitors can help to reduce muscle loss and improve muscle strength, which can reduce the risk of

falls and fractures associated with sarcopenia. In addition, ACE inhibitors can also help to improve the effectiveness of resistance training, which can further help to slowdown the progression of sarcopenia [69, 70].

5.7. Creatine. Creatine is an important supplement for people suffering from sarcopenia, a condition that causes a decrease in muscle mass and strength with age. It can help to increase muscle mass and strength, reduce fatigue during exercise, and improve recovery time. Creatine helps to increase energy production and improve the efficiency of muscle contraction, which can help to slow the effects of sarcopenia [71]. In addition, it can help with muscle repair and regeneration, which can help to reduce the risk of injuries. Creatine has been studied extensively as a potential treatment for sarcopenia, or age-related muscle loss. Studies have shown that supplementation with creatine can help increase muscle strength, size, and power, which can help improve physical functioning in people with sarcopenia [72]. In addition, creatine can help increase muscle mass, which can reduce the risk of falls and fractures in older people. In summary, creatine supplementation can be an effective and safe way to improve muscle strength and reduce the risk of disability in people with sarcopenia [73, 74].

5.8. Omega-3-Fatty Acid-EPA Eicosapentaenoic Acid. Omega-3 fatty acids are important for muscle health and the maintenance of mass and strength. They have anti-inflammatory properties that help reduce the inflammation with sarcopenia and may also help improve the body's response to exercise [75]. Omega-3 fatty acids have also been linked to improved insulin sensitivity, can help to regulate metabolism, and improve muscle growth and repair [76]. Omega-3 fatty acid supplements may also be beneficial

TABLE 3: Natural foods and their biochemistry on the prevention of sarcopenia.

Natural foods	Bioactive compound	Biochemistry	References
Lean meats	Protein helps stimulate muscle growth and repair	Protein is essential for building and maintaining muscle mass	[38]
Fish	Omega-3 fatty acids	Omega-3 fatty acids reduce inflammation and support muscle protein synthesis, potentially preventing muscle loss	[8]
Eggs	Leucine	Leucine is an essential amino acid that plays a vital role in stimulating muscle protein synthesis, which is crucial for muscle maintenance and growth	[50]
Dairy products	Calcium and vitamin D	Calcium promotes muscle contraction, while vitamin D helps with calcium absorption and muscle function. Together, they support overall muscle health and strength	[44]
Legumes	Branched-chain amino acids (BCAAs)	BCAAs such as leucine, isoleucine, and valine are found in legumes and help stimulate muscle protein synthesis, aiding in the prevention of sarcopenia	[23]
Nuts and seeds	Vitamin E and antioxidants	They are present in nuts and seeds and can reduce muscle damage caused by oxidative stress, promoting muscle health and preventing sarcopenia	[30]
Whole grains	Complex carbohydrates	Complex carbohydrates found in whole grains provide a steady release of energy, supporting overall muscle function and preventing muscle wasting. They also contain essential nutrients such as B vitamins, which aid in energy production and muscle health	[21]
Leafy greens	Magnesium and vitamin C	Magnesium plays a crucial role in muscle contraction and relaxation, while vitamin C supports collagen production, which is essential for maintaining muscle strength and integrity	[36]
Berries	Anthocyanins	Rich in anthocyanins, which possess anti-inflammatory properties and help reduce muscle damage caused by exercise	[11]
Garlic	Sulphur compounds	They may also improve muscle recovery and contribute to the prevention of sarcopenia Garlic contains sulphur compounds that have been shown to improve muscle strength and exercise performance	[29]
Turmeric	Curcumin	They also have anti-inflammatory effects, potentially protecting against muscle loss Curcumin, the active compound in turmeric, has anti-inflammatory and antioxidant properties	[35]
		It may help reduce muscle wasting and inflammation associated with sarcopenia	

for people with sarcopenia. These supplements can help to reduce inflammation, which can help to slowdown the progression of muscle loss. In addition, omega-3 fatty acids can help to reduce oxidative stress, which contributes to muscle weakness and fatigue [77]. For these reasons, omega-3 fatty acids can be a beneficial supplement for those with sarcopenia, thus helping to maintain and even improve muscle health. Omega-3 fatty acid treatment for sarcopenia is important for several reasons [78]. First, it has been shown to improve muscle growth with reduced and healthy aging [79]. Second, it may help reduce age-related muscle loss, which is a common problem in the elderly. Finally, omega-3-fatty acid treatment can help to reduce the risk of developing chronic diseases associated with sarcopenia such as diabetes and cardiovascular disease. All of these benefits are important for maintaining good health as we age [80]. EPA, or eicosapentaenoic acid, is an omega-3 fatty acid that is essential for the maintenance of healthy muscles. It has been found to be particularly beneficial for the prevention and treatment of sarcopenia, a condition characterized by age-related muscle loss. EPA helps to reduce inflammation, which can lead to muscle loss, and helps to maintain muscle mass and strength [81, 82]. It also helps to regulate the body's hormones, which is important for muscle repair and growth. EPA has been shown to improve the balance between muscle proteins, which can help to reduce the risk of developing sarcopenia [83]. In addition, EPA has been found to improve the ability of the body to use energy, which can help to reduce fatigue and improve physical performance [84].

5.9. Naturally Occurring Phytochemicals from Fruits. Fruit phytochemicals have been demonstrated to have a beneficial impact on the early detection and management of sarcopenia. Fruits are high in phytochemicals such as polyphenols and carotenoids, which have anti-inflammatory, antioxidative, and antiaging properties [60]. These phytochemicals are able to protect against sarcopenia by reducing oxidative stress and inflammation, suppressing muscle wasting, and promoting muscle regeneration [85, 86]. Furthermore, they can also help to improve muscle strength and functional mobility. Thus, consuming a diet rich in naturally occurring phytochemicals from fruits can be beneficial for the prevention and treatment of sarcopenia. Naturally occurring phytochemicals, such as polyphenols, carotenoids, and flavonoids, have been shown to have beneficial effects on muscle health and may help to prevent sarcopenia [87]. These compounds have antioxidant, anti-inflammatory, and antiaging properties which can help protect against muscle fiber damage and promote muscle repair. In addition, they can assist with the regulation of glucose, insulin, and lipid metabolism, which can help to maintain muscle mass [88]. By providing the muscles with essential nutrients, these compounds can help to reduce muscle weakness and atrophy, and improve muscle strength. Furthermore, research has shown that naturally occurring phytochemicals can reduce the risk of developing sarcopenia, as well as other age-related diseases [89].

6. Benefits of Nutritional Interventions in Sarcopenia

Nutritional interventions for sarcopenia can provide several health benefits. These interventions may help slow the progression of sarcopenia by providing essential nutrients needed for muscle growth and repair [90]. Nutritional interventions can also provide additional support for bone health, reduce inflammation, and improve overall health and quality of life. In addition, nutritional interventions can help maintain lean muscle mass, which can help with mobility and balance, and reduce the risk of falls and fractures [91, 92]. Finally, nutritional interventions may improve cognitive function and reduce the risk of developing dementia [93].

6.1. Nutritional Interventions in Muscle Growth and Repair. Nutritional interventions in muscle growth and repair can have a positive impact on sarcopenia. A balanced diet that provides an adequate amount of protein, along with adequate amounts of vitamin D, calcium, and other essential vitamins and minerals, can help to promote muscle strength and healthy aging [94]. Adequate protein intake is particularly important for elderly adults and should be consumed throughout the day in order to maintain muscle mass [95]. In addition, research shows that supplementation with omega-3 fatty acids and antioxidants can help reduce the risk of sarcopenia [96]. Finally, regular physical activity, such as strength training and aerobic exercises, can help maintain muscle strength and slow the progression of sarcopenia. Nutritional intervention can be beneficial in the prevention and management of sarcopenia, which is the age-related decline in muscle mass and strength [97]. Adequate protein and calorie intake and resistance exercise are important components of nutritional intervention for sarcopenia [98, 99]. Protein is essential for maintaining muscle mass, and providing an adequate amount of high-quality protein throughout the day is critical for maintaining muscle mass and strength [100]. Calorie intake is also important as it provides the body with the energy needed for muscle growth and repair [101]. Figure 4 shows a schematic representation of the main factors that contribute to the development and progression of sarcopenia, as well as its consequences. In addition, resistance exercise is important for stimulating muscle growth and strength. A combination of adequate protein, calorie intake, and resistance exercise is essential for preventing and managing sarcopenia [102].

6.2. Reducing Inflammation. Sarcopenia is a clinical syndrome characterized by aging-related muscle mass and power loss. It is associated with a higher likelihood of falls and fractures, as well as a lower quality of life [103]. The much more efficient means of avoiding and managing sarcopenia is to exercise. Regular exercise can help reduce inflammation, improve balance and coordination, and increase muscle mass and strength [104]. In addition, eating

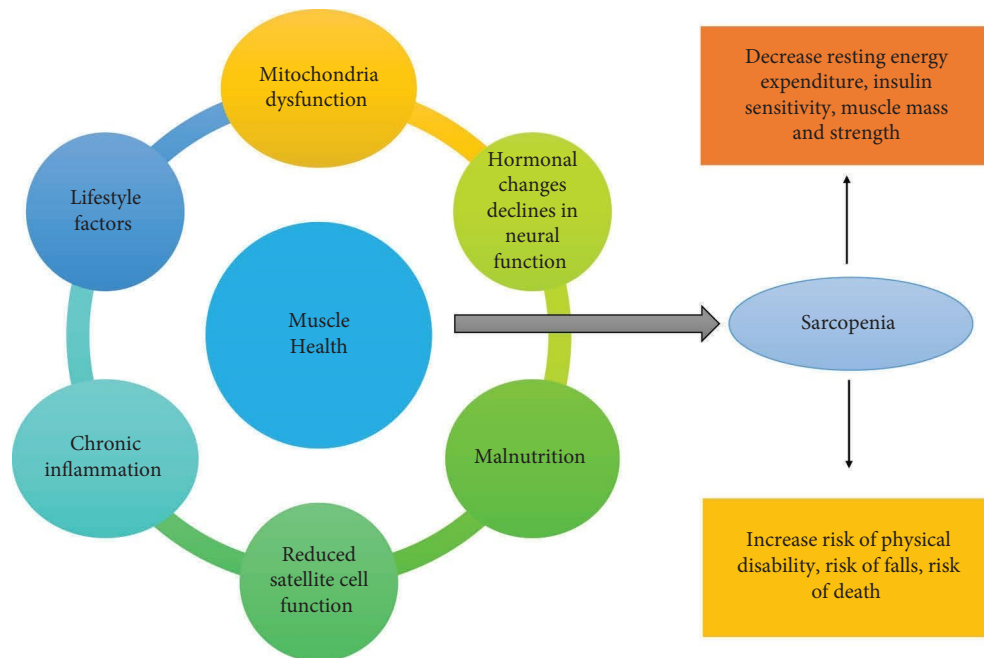


FIGURE 4: Schematic representation of the main factors that contribute to the development and progression of sarcopenia, as well as its consequences.

a healthy diet that includes adequate amounts of protein and other essential nutrients can help maintain muscle mass and strength. Finally, supplementing with vitamin D and calcium can help in improving the muscle strength and reducing the risk of fractures. Sarcopenia may help reduce inflammation in several ways. Regular physical activity has been linked to decreased levels of proinflammatory cytokines, which are molecules that regulate inflammation [105]. In addition, exercise increases levels of anti-inflammatory cytokines, which act to suppress inflammation. Furthermore, physical activity can help reduce levels of adipose tissue, which is a major source of inflammatory molecules. Finally, sarcopenia can increase muscle mass and strength, which can help reduce the risk of falls and other injuries that can cause inflammation [106].

6.3. Improving Health Benefits. Regular physical activity is one of the best ways to improve and maintain muscle strength and function. This includes resistance exercises such as weightlifting, as well as aerobic exercises such as walking or cycling. Eating a healthy, balanced diet that includes enough protein, carbohydrates, and other essential nutrients can help prevent sarcopenia [107]. Certain supplements, such as creatine, protein, and essential fatty acids, can help improve muscle strength and function in people with sarcopenia. Testosterone or other hormone therapies may be beneficial in some cases. Certain medications, such as anabolic steroids, may help improve muscle strength and function. Physical therapy may help improve muscle strength and function. Using assistive devices, such as walkers or canes, can help improve mobility and reduce the risk of falls [108].

6.4. Quality of Life. Sarcopenia is a condition characterized by the gradual loss of muscle mass, strength, and function with age. It can have a serious impact on a person's quality of life, as it can lead to an increased risk of falls, fractures, and disability, as well as decreased mobility and physical activity. It can also cause feelings of depression and loneliness due to a decreased ability to participate in activities that they previously enjoyed [109]. Sarcopenia can also lead to a decreased ability to perform activities of daily living, such as dressing, bathing, and cooking. In addition, it can lead to an increased risk of hospitalization and even death due to its associated medical conditions. Therefore, it is important to take steps to prevent and manage sarcopenia in order to improve the quality of life [110].

6.5. Maintaining Lean Muscle Mass. Exercise regularly is important for people with sarcopenia. Strength training and aerobic exercise are essential for maintaining lean muscle mass in sarcopenia. Resistance training such as weight lifting, yoga, Pilates, and other bodyweight exercises can help build and maintain muscle strength and size. Eat a balanced diet: Eating a healthy, balanced diet with adequate protein, carbohydrates, and other nutrients can help to support muscle health and prevent the breakdown of muscle tissue [111]. Get enough rest: Getting enough rest and sleep can help to ensure that the body is able to repair and rebuild muscle tissue. Taking supplements is also necessary, as certain dietary supplements, such as creatine and whey protein, can help support muscle health and strength. Stay hydrated: Staying hydrated is essential for maintaining strength and preventing muscle breakdown. Maintaining lean muscle mass is important in sarcopenia to help prevent

age-related muscle loss and to ensure overall health and wellbeing [112]. Lean muscle mass helps to improve strength and balance, which can help reduce the risk of falls and fractures. It also helps to maintain mobility and independence, increases metabolism, and can help to manage chronic conditions such as diabetes, heart disease, and osteoporosis. Lastly, maintaining lean muscle mass can help reduce the risk of injury, improve quality of life, and help slow the progression of sarcopenia [113].

6.6. Mobility and Balance. Mobility and balance are important for individuals with sarcopenia. Mobility is necessary for daily activities such as walking, standing, and other physical activities. Balance helps individuals stay upright and maintain their independence. With sarcopenia, individuals often lose the ability to control their movements and need assistance with mobility [114]. Exercises that improve balance and coordination can help individuals maintain their mobility and independence. These exercises can also help to strengthen muscles, improve posture, and reduce the risk of falls. In addition, good nutrition is essential for individuals with sarcopenia as it can help improve muscle health and reduce the risk of falls [115].

6.7. Reducing the Risk of Falls and Fractures. Falls and fractures are a major risk for people with sarcopenia, as muscle loss can lead to decreased stability and balance. Falls can cause serious injuries, including fractures, head trauma, and even death. Therefore, reducing the risk of falls and fractures in sarcopenia is an important part of maintaining the health and independence of people with this condition. Ways to reduce the risk of falls and fractures in sarcopenia include the following: regular exercise can help maintain muscle strength and improve balance, which can reduce the risk of falls; eating a balanced diet and ensuring adequate intake of protein can help maintain muscle mass and strength; certain medications, such as vitamin D and calcium supplements, can help maintain bone density and reduce the risk of fractures; assistive devices, such as walkers and canes, can help improve balance and stability, and reduce the risk of falls; and simple home modifications, such as adding handrails and nonskid flooring, can help reduce the risk of falls [116]. Reducing the risk of falls and fractures in sarcopenia is essential for maintaining the health and wellbeing of those living with the condition. Falls and fractures can lead to decreased mobility, loss of independence, and decreased quality of life. Furthermore, falls and fractures can increase the risk of hospitalization and mortality, so it is important to take steps to reduce the risk of these complications. Simple strategies such as exercising regularly, eating a healthy diet, and making sure to get enough sleep and rest can help to reduce the risk of falls and fractures in those with sarcopenia. In addition, regularly attending a physical therapist or other healthcare professionals can help to identify potential fall risks and provide advice on how to reduce them [117].

6.8. Improving Cognitive Function. Improving cognitive function in sarcopenia is important for maintaining an individual's quality of life. People with sarcopenia experience impairments in their cognitive abilities, such as memory, concentration, decision-making, and problem-solving, which can significantly impact their daily lives. By improving cognitive function, people with sarcopenia can maintain their independence, better manage their daily activities, and remain connected to family and friends. In addition, improving cognitive function can help to reduce the risk of falls, improve sleep quality, and reduce the risk of developing depression [118].

6.9. Reducing the Risk of Developing Dementia. Reducing the risk of developing dementia in sarcopenia is important because it can help reduce the burden of cognitive decline associated with aging. Dementia is a progressive, degenerative condition that affects memory, communication, and thinking. People with sarcopenia are at an increased risk for dementia due to the natural decline of muscle mass and strength that occurs with age [119]. Making lifestyle changes to reduce the risk of developing dementia in sarcopenia can help maintain cognitive health, improve quality of life, and reduce healthcare costs associated with dementia care. These lifestyle changes include staying physically active, eating a balanced diet, managing stress, and engaging in mentally stimulating activities. In addition, regular monitoring of physical and cognitive health can help identify any early signs of dementia, allowing for timely and effective treatment [120].

7. Conclusion

We highlighted existing understanding of physical activity and nutrition interventions aimed at improving physical capability, muscle mass, and quality of life among people in this review of comprehensive reviews and meta-analyses. According to current evidence, resistance and concurrent training may have a positive effect on lower limb strength and quality of life in people, whereas nutrition interventions such as supplementing with vitamin D may have an anticatabolic effect by reducing inflammatory markers that are responsible for enhancing muscle proteolytic pathways. Nonetheless, the effects of vitamin D supplementation on muscle mass and strength, as well as on people's quality of life, are beneficial in sarcopenia. With sarcopenia, protein and amino acid dietary supplements have a positive effect on physical ability and quality of life. Furthermore, no studies were identified in this review that looked at the cumulative effect of workout and nutrition interventions on lowering the likelihood of sarcopenia and frailty in individuals with HF. As a result, future research must look into the anabolic and catabolic effects of merged exercise and nutrition strategies in this population of patients.

Abbreviations

HF:	Heart failure
CVD:	Cardiovascular disease
DXA:	Dual-energy X-ray absorptiometry
SPPB:	Short physical performance battery
TUG:	Timed up and go test
IGP-1:	Insulin-like growth factor-1
CT:	Computed tomography
MRI:	Magnetic resonance imaging
COPD:	Chronic obstructive pulmonary disease
ACE inhibitors:	Angiotensin-converting enzyme
mTOR:	Mechanistic target of rapamycin
BCAA's:	Branched-chain amino acids
HMB:	Beta-hydroxy-beta-methylbutyrate
EPA:	Eicosapentaenoic acid
RCTs:	Randomised controlled trials.

Data Availability

Data sharing not applicable to this article as no datasets were generated or analysed during the current study.

Conflicts of Interest

The authors declare that they have no conflicts of interest or personal relationships that could have appeared to influence the work reported in this paper.

Authors' Contributions

Shivangi Srivastava conceptualized the study and wrote, reviewed, and edited the study. Vinay Kumar Pandey collected the resources, wrote the original draft, and reviewed and edited the manuscript. Anurag Singh collected the resources, wrote and prepared the original draft, and supervised the study. Amir Hussain Dar investigated and visualized the study and wrote the original draft.

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