TAHUN 2024 *[MANUJU: MALAHAYATI NURSING JOURNAL, ISSN CETAK: 2655-2728 ISSN ONLINE: 2655-4712, VOLUME 6 NOMOR 2 TAHUN 2024] HAL 747-763*

EXPLORING THE COMPLEXITIES OF SARCOPENIC OBESITY AND NUTRITIONAL APPROACHES FOR PROMOTING HEALTHY AGING: A LITERATURE REVIEW

Michelle Ruth Natalie[1], Alexander Halim Santoso[2*]

[1-2]Faculty of Medicine, Tarumanagara University

Email Korespondensi: alexanders@fk.untar.ac.id

Disubmit: 02 November 2023 Diterima: 21 Desember 2023 Diterbitkan: 01 Februari 2024
Doi: https://doi.org/10.33024/mnj.v6i2.12882

ABSTRACT

The ongoing global demographic transition towards an aging population indicates that the proportion of individuals aged 60 and above is expected to reach 21% by the year 2050, with more than 5% of this group being 80 or older. As a result of this shift in demographics towards an increasingly elderly population, there has been a noticeable increase in the occurrence of a medical condition known as sarcopenic obesity. This academic paper thoroughly examines the existing body of literature by consolidating information from various reputable sources. The primary focus of this review is to investigate the implementation of therapies related to obesity, sarcopenia, and nutrition. The data for this assessment was systematically collected by conducting an extensive search of electronic databases, encompassing research publications and review papers. It is crucial to acknowledge that traditional measures like body weight and body mass index are not advisable for assessing body composition in older adults because they cannot distinguish between adipose tissue and muscle mass. Sarcopenia is closely linked to inadequate dietary intake, while obesity results from excessive energy consumption, creating an imbalance between daily energy intake and expenditure. When formulating a nutritional strategy to address sarcopenic obesity, it is essential to consider dual goals. The primary goal is to ensure a proper intake of nutrients that promotes the growth of skeletal muscle mass or reduces the risk of muscle loss. At the same time, it is crucial to achieve balance by advocating for sufficient nutrition and energy intake to prevent the accumulation of excess fat tissue.

Keywords: Sarcopenic Obesity, Elderly Population, Nutritional Therapeutic

INTRODUCTION

The current global demographic shift towards an aging population suggests that the percentage of adults aged 60 and beyond is projected to reach 21% by the year 2050, with over 5% of this group being 80 or older. Due to the demographic transition towards a progressively aging population, there has been a notable rise in the occurrence of a medical condition referred to as sarcopenic obesity. Sarcopenic obesity is a multifaceted geriatric condition distinguished by the concurrent manifestation of sarcopenia, characterized by a reduction in muscle mass, muscle strength, and compromised physical function in conjunction with an excessive accumulation of adipose tissue. This medical condition is linked to various adverse health

consequences, such as susceptibility, incidents of falling, impairment, limited mobility, fractures, cardiometabolic and respiratory disorders, cancer, and elevated death rates.(Cruz-Jentoft et al., 2010; Kaufman et al., 2002)

The European Working Group on Sarcopenia in Older People (EWGSOP) revised the operational definition of sarcopenia in 2018 to include the dual components of diminished muscle mass and weakened strength. In addition, the diagnosis of severe sarcopenia is established when there is concomitant evidence of a deterioration in physical performance. Sarcopenia is acknowledged as a multifaceted condition characterized by a range of underlying factors, and its incidence tends to rise in correlation with advancing age. Several characteristics in the elderly population have been recognized as potential determinants in the onset of sarcopenia, exhibiting resemblances to factors linked to obesity. The term "sarcopenic obesity" was coined to delineate the clinical and functional state characterized by the concurrent presence of obesity and sarcopenia.(Masanes Toran et al., 2012; Paddon-Jones & Leidy, 2014)

Despite the established risk factors associated with sarcopenia and obesity, a recent study underscores the significance of insufficient dietary practices, which can contribute to food insecurity. The prevalence of food insecurity in older adults, particularly in the United States, has witnessed a notable rise in the previous decade. This issue has been linked to the co-occurrence of obesity and sarcopenia. Nevertheless, there is a dearth of scientific research examining the correlation between food insecurity and the susceptibility to developing sarcopenic obesity among elderly adults. Hence, it is imperative to examine the potential impact of food insecurity on sarcopenic obesity among the senior demographic.(Paddon-Jones & Leidy, 2014; Zamboni et al., 2008)

THEORETICAL STUDY

Obesity, a multifaceted and pervasive public health issue, is characterized by the excessive accumulation of adipose tissue, generally defined by the World Health Organization using Body Mass Index (BMI) thresholds of 30 kg/m^2 or higher. Furthermore, central obesity, indicated by waist circumference measurements exceeding 102 cm in men and 88 cm in women, adds an additional dimension to its assessment. The clinical implications of obesity are far-reaching and well-documented, contributing significantly to a spectrum of health concerns, including cardiovascular diseases, type 2 diabetes, certain malignancies, and musculoskeletal disorders. Nevertheless, a pertinent matter of inquiry within medical discourse revolves around the applicability and precision of these standardized criteria, especially concerning their relevance in aging cohorts. Age-associated physiological alterations, not fully accounted for in these metrics, prompt warranted debate regarding their efficacy in evaluating the health risks associated with obesity in older individuals.(Holly et al., 2019; Tilinca et al., 2021)

In contrast, the term "sarcopenia," etymologically rooted in "sarx" (meaning flesh) and "penia" (meaning loss), delineates the age-related decline in skeletal muscle mass and function. Initially, the conceptual framework linking muscle strength decline to the

reduction in muscle mass formed the basis for defining sarcopenia. Early definitions relied heavily on measures such as the appendicular skeletal muscle mass index, often deviating significantly from standards established by younger, healthy populations. However, contemporary research challenges the simplistic correlation between declining muscle function and the reduction in muscle mass. Current understanding indicates that the decline in muscle function surpasses that which can be explained solely by a reduction in muscle mass. Underlying factors beyond mere mass, including alterations in muscle quality, neural control, and structural modifications within muscle fibers, are increasingly recognized as influential contributors to the declining muscle function observed in aging individuals.(Liu et al., 2023; Mathus-Vliegen et al., 2012)

The convergence of sarcopenia and obesity, a state termed "sarcopenic obesity," represents a complex intersection of health conditions presenting multifaceted challenges. Sarcopenic obesity, characterized by the coexistence of diminished muscle mass and elevated body fat, introduces distinct health risks, often exacerbating an individual's susceptibility to various health ailments. This confluence, where reduced muscle mass and increased adiposity co-occur, has been associated with heightened functional limitations, increased risks of metabolic dysregulation, and a greater propensity for adverse health outcomes in older adults. The intricate interplay between sarcopenia and obesity necessitates a comprehensive approach to health management strategies. Recognizing and addressing this dual burden becomes imperative in developing tailored and effective interventions and treatment modalities within the context of aging populations. This amalgamation of conditions warrants a holistic understanding and a multidisciplinary approach for optimal patient care and improved health outcomes.(Barazzoni et al., 2018; Liu et al., 2023)

RESEARCH METHOD

This paper thoroughly examines the existing literature, consolidating information from multiple credible sources. The primary focus of this review is to explore the implementation of therapies related to obesity, sarcopenia, and nutrition. The data for this evaluation was systematically gathered by conducting an extensive search of electronic databases, encompassing research publications and review papers. Key insights were rigorously gathered and synthesized from each selected article, emphasizing their pertinence to the primary subject matter. The synergy above facilitates the derivation of deductions about the pivotal significance of obesity, sarcopenia, and nutritional therapy approaches, as well as their corresponding outcomes.

RESULT AND DISCUSSION

Sarcopenia

Consequence of the worldwide phenomenon of population aging, it is anticipated that by the year 2050, the demographic segment comprising those aged 60 and above will constitute around 21% of the total population, while those aged 80 years or older will account for more than 5% of the population. The prevalence of sarcopenic obesity has experienced a substantial rise within the framework of the demographic

aging crisis. Sarcopenia, defined by reduced muscle mass, diminished muscle strength, and impaired physical function, is a prominent feature of the geriatric syndrome known as sarcopenic obesity. The presence of excess adipose tissue further characterizes this disease. The amalgamation of these factors gives rise to many adverse clinical outcomes, encompassing susceptibility, incidents of falling, impairment, restricted movement, fractures, and the development of cardiometabolic and respiratory ailments, malignancy, and heightened mortality rates.(Christensen et al., 2009; Lunenfeld & Stratton, 2013)

Sarcopenia is a pathological state defined by the gradual and widespread degeneration of skeletal muscle tissue. The range of prevalence may exhibit variability contingent upon the clinical situation and is frequently subject to the influence of disparities in evaluation methodologies, which arise from the rigorous scientific standards employed for research inclusion. The classification methods frequently employed include the European Working Group on Sarcopenia in Older People (EWGSOP) and the Asian Working Group on Sarcopenia (AWSP). Notwithstanding the methods employed for the diagnosis of sarcopenia, the prevalence of this condition has a reasonably stable pattern. The assessment of sarcopenia places significant emphasis on the evaluation of muscle functionality and strength, as these factors highly indicate negative consequences. Muscular strength plays a vital role in assessing sarcopenia, a medical disorder characterized by the loss of muscle mass.(Cruz-Jentoft et al., 2010; Donini et al., 2020)

The diagnosis of sarcopenia is established when there is observable evidence of a decline in muscle quantity, and in severe cases, additional confirmation is necessary to demonstrate damaged muscle quality. The conventional methods used to establish criteria for sarcopenia and obesity typically incorporate various indicators, including the ratio of appendicular skeletal muscle mass (ASM) to body weight (ASM/BW) or adjusted for height in square meters (ASM/m2). Additionally, measurements such as body mass index or percentage of body fat (PBF) are sometimes considered. It is imperative to acknowledge that conventional measures such as body weight and body mass index are not advisable for evaluating body composition in older adults due to their inability to differentiate between adipose tissue and muscle mass. Sarcopenia is distinguished by various parameters, encompassing skeletal muscle mass (SMM), muscle strength, and physical performance.(Donini et al., 2020; Ji et al., 2022) The process of determining social media marketing (SMM) encompasses the utilization of multiple metrics, including:

1. The ASM/ht^2 is a metric that quantifies the ratio between Appendicular Skeletal Muscle Mass and the square of an individual's height. This method offers a means to estimate skeletal muscle mass concerning an individual's height, facilitating the evaluation of muscle mass in proportion to body size.(Chen et al., 2020; Chuang et al., 2016)
2. The ASM/wt refers to Appendicular Skeletal Muscle Mass to body weight ratio. This metric assesses the ratio of skeletal muscle mass to an individual's overall body

weight.(Chuang et al., 2016; Cruz-Jentoft et al., 2010)

3. The proposed methodology entails the adjustment of skeletal muscle mass by factoring in residual height, accounting for the impact of height on muscle mass. Concurrently, this approach considers overall fat and muscle mass to ascertain the specific makeup of an individual's muscles.(Chen et al., 2020; Donini et al., 2020)
4. Adjusting Appendicular Skeletal Muscle Mass (ASM) with Body Mass Index entails modifying muscle mass measurements per an individual's BMI. This adjustment allows for a better understanding of the relationship between muscle mass and overall body composition.(Chen et al., 2020; Studenski et al., 2014)
5. The assessment of unadjusted appendicular skeletal muscle mass entails quantifying the amount of muscle mass in the body's extremities without making any changes. This examination provides a direct measurement of muscle mass in the appendages.(Cruz-Jentoft et al., 2010; Donini et al., 2020)

Research findings indicate a direct and straightforward correlation between skeletal muscle mass (SMM) and muscle strength does not exist. Specifically, the rate of reduction in muscle strength is typically more pronounced compared to skeletal muscle mass (SMM), rendering it a more prominent determinant of overall health among elderly adults. Muscle strength measurement can be conducted by using a hand dynamometer to measure grip strength or by examining the strength of knee extension. Although sarcopenia was formerly believed to affect older adults due to aging primarily, recent studies indicate that it can occur at all stages of life and is impacted by several factors, including lifestyle choices, genetic predisposition, and underlying medical ailments.(Li et al., 2017; Mathus-Vliegen et al., 2012)

Obesity

Obesity arises due to a disparity between the amount of energy consumed daily and the amount of energy expended, ultimately resulting in an excessive accumulation of body weight. The condition in question is complex, attributed to the intricate interplay of several elements, including genetic, cultural, and societal influences. Numerous genetic research has provided compelling evidence supporting the notion that obesity exhibits a substantial hereditary element. These investigations have identified numerous genes closely linked to body fat accumulation and the propensity for weight gain. Furthermore, other factors contribute to the development of obesity, including insufficient physical activity, disturbances in sleep patterns, endocrine abnormalities, the utilization of specific drugs, the prevalent accessibility and consumption of high-carbohydrate and high-sugar meals, and a decline in energy metabolism.(Holly et al., 2019; *No Title*, n.d.)

In 2017, the World Obesity Federation formally designated obesity as a chronic ailment, acknowledging its substantial implications for the well-being of the general population. The connection between obesity and host vulnerability is intrinsically intertwined, rendering it a subject of paramount significance. In recent

years, there has been a notable surge in the prevalence of obesity across several age cohorts. Obesity among older individuals is notably high, with rates of 37.5% for men and 39.4% for women, underscoring its significant occurrence within this demographic. The ongoing discussion concerns the correlation between excessive body fat in older individuals and its potential effects on overall mortality or death related to specific diseases. Irrespective of an individual's age, obesity is commonly characterized by a Body Mass Index equal to or exceeding 30 kg/m^2.(Després et al., 1989; Pasarica & Topping, 2017)

Nevertheless, a consensus has yet to be reached about the best appropriate measure of obesity for the elderly population. The Body Mass Index is a straightforward metric that exhibits a correlation with body fat percentage in individuals who are young and middle-aged. However, its accuracy diminishes with advancing age due to alterations in body composition. Modifications in body composition that occur with advancing age, particularly alterations in the distribution of adipose tissue, offer valuable insights into the association between adiposity and various health outcomes, including mortality, in older individuals. The existing body of research suggests that when assessing health concerns associated with obesity in older individuals, factors such as fat mass allocation (FM), visceral fat, and loss of lean mass (FFM) may hold greater significance compared to the traditional measure of body mass index.(Destra et al., 2023; Freiberger et al., 2015)

Obesity has been delineated based on diverse parameters. This entails meeting specific criteria, including a Body Mass Index of 30 kg/m^2 or higher and surpassing gender-specific thresholds for Body Fat Percentage (PBF). For instance, men would need to exceed 27% or 28% PBF, while women would need to exceed 35%, 38%, or 40% PBF, as outlined in the study. Additionally, individuals need to have waist circumference measurements that surpass specific population quartiles or exceed the waist circumference recommendations established by the World Health Organization (WHO). Specifically, men would need a waist circumference of ≥ 102 cm, while women would need a waist circumference of ≥ 88 cm.(Freiberger et al., 2015; Gunaidi et al., 2022)

The American Association of Clinical Endocrinologists (AACE) has recommended using Body Fat Percentage (PBF) as a criterion for diagnosing obesity. According to this proposal, obesity can be identified when the PBF surpasses 25% in males and 35% in females. It is imperative to underscore the absence of widely recognized standards for defining obesity, particularly in the older population, regardless of whether body mass index, percentage body fat (PBF), or waist circumference is utilized. While subcutaneous adipose tissue (SAT) and visceral adipose tissue (VAT) are recognized as separate components of adipose tissue, there is a notable lack of standardized criteria for identifying obesity based explicitly on SAT and VAT. Some scientists have advocated that future research should aim to discriminate between subcutaneous sarcopenic obesity and visceral sarcopenic obesity and suggest using a standard VAT/SAT ratio to diagnose sarcopenic obesity.(Destra et al., 2022; Gowd et al., 2019)

Sarcopenic Obesity

The aging process leads to significant alterations in older persons' body composition (BC),

regardless of their metabolic and physiological functions. A reduction in skeletal muscle tissue, also known as fat-free mass (FFM), distinguishes these alterations. Concurrently, there is a rise in adiposity, coupled with fat redistribution, transitioning from subcutaneous regions to intra-abdominal, intrahepatic, and intramuscular compartments. These alterations are intricately linked to medical problems such as diabetes and cardiovascular illnesses. In general, it is observed that elderly persons typically demonstrate a more significant body fat percentage (BFP) than their younger counterparts.(Barazzoni et al., 2018; Ng Tang Fui et al., 2016)

Furthermore, there are notable gender discrepancies observed in several anthropometric parameters and body fat percentage (BFP). For instance, it is commonly seen that women frequently exhibit elevated BMI values, subcutaneous fat levels, and body fat percentages, but older males tend to have notable gains in weight and muscle mass. The alterations observed in BC (body composition) render aging a significant risk factor for developing obesity and the possible occurrence of sarcopenia, independently or in combination. These circumstances can intensify incapacity and susceptibility, consequently augmenting the probability of health issues and fatalities.(Curioni & Lourenço, 2005; Zhang et al., 2019)

The etiology and pathogenesis of sarcopenic obesity are complex and interconnected. Several key biological factors are critical in developing sarcopenic obesity. These factors include age-related alterations in body composition, hormonal fluctuations, the complex interplay between metabolism and inflammation, environmental influences such as unhealthy dietary patterns and insufficient physical exercise, and chronic medical conditions. Both the process of aging and the condition of obesity are known to contribute to the phenomenon of atrophy in fast-twitch muscle fibers, a shift towards slow-twitch muscle fibers, and the occurrence of neurodegeneration. Consequently, this phenomenon gives rise to the deprivation of neurotrophic effects on muscular tissues and facilitates the formation of intramyocellular lipids (IMCL). A critical characteristic of sarcopenia is the presence of anabolic resistance (AR), characterized by a reduction in the rates of skeletal muscle protein synthesis and an elevation in the rates of skeletal muscle protein breakdown. The primary pathophysiological mechanism of systemic obesity entails a cyclic process of damage between myocytes, muscle cells, adipocytes, or fat cells. There needs to be a universally accepted and effective treatment for sarcopenic obesity. The primary way to prevent and manage sarcopenic obesity involves implementing nutritional interventions, such as a hypocaloric diet, exercise training, or physical therapy. These interventions aim to facilitate alterations in body composition by stimulating an increase in muscle mass and a decrease in fat while simultaneously improving functional capacity and overall well-being in elderly individuals. Nevertheless, it is imperative to acknowledge that only prioritizing weight reduction is not advisable for older individuals, as it engenders health hazards such as muscle and bone mass deterioration.(Gao et al., 2021; Ma et al., 2016; Russell et al., 2018)

Nutritional therapeutic strategies

The significance of nutrition is paramount in the etiology of sarcopenia and obesity, albeit with

distinct underlying mechanisms for each illness. Sarcopenia is strongly correlated with insufficient dietary intake, whereas obesity stems from excessive energy consumption, leading to a disparity between daily energy intake and expenditure. When formulating a nutritional approach to combat sarcopenic obesity, it is imperative to consider dual objectives. The primary objective is to guarantee an appropriate intake of nutrients that facilitates the augmentation of skeletal muscle mass or mitigates the risk of muscle atrophy. Simultaneously, it is imperative to attain equilibrium by advocating for adequate nutrition and energy consumption to mitigate the accumulation of excessive adipose tissue. Significant inquiries emerge regarding the strategies for preserving muscle anabolism inside the confines of energy deficits. This aspect assumes particular significance, principally in order to mitigate the risk of substantial weight loss in the form of lean mass, particularly among groups susceptible to muscle wasting.(Mathus-Vliegen et al., 2012; Weinheimer et al., 2010)

Hypocaloric Diet

Hypocaloric diet, commonly known as a calorie-restricted diet, is a dietary regimen that entails a deliberate and regulated decrease in daily caloric consumption below the estimated energy requirements of an individual. The purpose of this dietary plan is to establish a state of calorie deficit when the caloric intake is lower than the caloric expenditure to facilitate the weight reduction process. The underlying idea of the hypocaloric diet is to promote the utilization of stored energy (namely, adipose tissue) to fulfill the body's energy demands, reducing body weight. While these dietary approaches have demonstrated efficacy in promoting weight loss, it is imperative to exercise caution when adhering to them, as an excessively restricted calorie intake may result in inadequate food supply, muscle wasting, and several other health complications. It is advisable to engage in a hypocaloric diet with the supervision of a healthcare expert or a trained dietitian to achieve a well-rounded and secure strategy for weight control.(Waters et al., 2013; Weinheimer et al., 2010)

In the context of older persons experiencing sarcopenic obesity, it is generally recommended to maintain a safe and effective energy deficit within the range of around 200 to 700 calories per day. Hypocaloric diets have demonstrated notable efficacy in reducing excessive weight among elderly individuals. Nevertheless, a significant limitation of these dietary interventions is that although they successfully diminish adipose tissue, they frequently result in a concomitant reduction in skeletal muscle mass. An illustration provided by Villareal et al. exhibited a mean reduction in fat mass of 7.1 kg among elderly individuals who adhered to a hypocaloric diet, maintaining an energy deficit ranging from approximately 500 to 750 calories per day for 52 weeks. Nevertheless, the reduction in adipose tissue was concomitant with a corresponding decrease of 3.2 kg in skeletal muscle mass. The loss of skeletal muscle mass, a crucial factor impacting mobility and independence in patients with sarcopenic obesity, accounts for approximately 25% of the weight reduction attained with hypocaloric diets in older adults. Furthermore, an exclusive emphasis on reducing body weight might lead to negative consequences on the individual's micronutrient levels and bone

mineral density, diminishing its overall benefits. Hence, weight loss treatments for this demographic focus on retaining skeletal muscle mass, perhaps incorporating high-protein dietary regimens and the supplementation of essential micronutrients.

Protein Intake

The significance of amino acids in the dietary context, particularly essential amino acids (EAAs), in promoting the skeletal muscle protein synthesis process has been widely acknowledged. Nevertheless, the anabolic response to dietary protein consumption is frequently attenuated in older adults and persons who are obese. Hence, it may be necessary for older adults and individuals with obesity to consume a more significant amount of protein to efficiently stimulate muscle protein synthesis to preserve or restore skeletal muscle protein.(Hector et al., 2015; Malafarina et al., 2013)

In order to attain the long-term preservation and augmentation of skeletal muscle mass among individuals aged 65 and above, it is advisable to uphold a dietary protein consumption within the range of 1.0 to 1.2 grams per kilogram of body weight. Individuals afflicted with chronic illnesses may necessitate an elevated protein consumption, typically within the range of 1.2 to 1.5 grams per kilogram of body weight. An illustration of this may be seen in a study conducted on 104 older persons with sarcopenic obesity, all above 65. The study implemented a nutritional intervention over three months, specifically a high-protein hypocaloric diet. The diet consisted of 1.2 grams of protein per kilogram of body weight. The findings of the study revealed modest enhancements in the muscle mass index.

In contrast, implementing a hypocaloric diet with low protein intake, specifically at a rate of 0.8 grams per kilogram, resulted in a notable reduction in the muscle mass index. Additional long-term intervention studies are required to establish the most effective protein intake for individuals with sarcopenic obesity. However, a minimum intake of approximately 1.0 to 1.2 grams per kilogram of body weight is crucial for preserving muscle mass in this specific group, particularly when experiencing an energy deficit.(Malafarina et al., 2013; Porter Starr et al., 2014)

The significance of protein type and amino acid content is also recognized as crucial in preserving or auguring muscle mass when undergoing weight loss. Whey protein derived from milk has demonstrated efficacy in promoting skeletal muscle protein synthesis in older men following meal consumption. The efficacy of this substance can be ascribed to its rapid digestion and absorption kinetics, together with its elevated leucine concentration. Moreover, previous research has demonstrated that consuming around 2.0 to 2.5 grams of leucine per day, predominantly derived from animal sources, can effectively enhance skeletal muscle protein synthesis in older males following meals. The efficacy of various protein sources, specifically plant-based and animal-based, in facilitating weight loss or muscle building is a topic of ongoing discussion. However, there is a consensus that animal-derived dietary protein is more proficient in promoting skeletal muscle protein synthesis when compared to plant-derived sources. While the direct confirmation of these findings in persons with sarcopenic obesity is

lacking, it is worth noting that augmenting animal protein intake may potentially facilitate the accrual of muscle growth in this particular group.(Bouchonville & Villareal, 2013; Deer & Volpi, 2015)

The timing of meals is a critical factor in maximizing skeletal muscle protein synthesis. The findings of a study conducted on a sample of 1,279 elderly persons revealed that around 80% of their protein intake was ingested during their three primary meals. Notably, dinner emerged as the main meal with the highest protein consumption. Consuming protein at regular intervals, commonly known as 'distributed eating,' has been linked to increased protein synthesis rates. The dietary regimen is also associated with heightened muscular strength, enhanced physical performance, and augmented skeletal muscle mass among elderly individuals. Preliminary data also indicates that augmenting the frequency of daily meals may amplify general satiety, mitigate excessive food consumption, and conceivably diminish the likelihood of obesity. Hence, it is apparent that concentrating exclusively on the overall consumption of dietary protein may not be the most optimal strategy for improving indicators related to sarcopenic obesity. Optimizing the distribution of protein intake throughout the day may play a crucial role in increasing its efficacy.(Hector et al., 2015; Porter Starr et al., 2014)

An alternative methodology entails amalgamating diverse anabolic constituents, encompassing protein, amino acids, vitamin D, and omega-3. Recent research has indicated that a combination of whey protein supplemented with leucine and vitamin D has demonstrated efficacy in enhancing protein synthesis and promoting muscle mass accrual in elderly individuals. The efficacy of this particular combination has been demonstrated in persons aged 35 to 65, as well as in older adults who are dealing with obesity. In conclusion, it is imperative to maintain sufficient dietary protein consumption for patients with sarcopenic obesity, especially considering the reduced anabolic response. This reaction can be enhanced by incorporating a diet abundant in animal protein, particularly leucine, and by ensuring a balanced distribution of protein consumption throughout the day. When developing strategies to enhance skeletal muscle mass and function in individuals with sarcopenic obesity, it is essential to consider the following factors.(Mathus-Vliegen et al., 2012; Waters et al., 2013)

Micronutrients

Insufficient consumption and diminished concentrations of micronutrients have been linked to the onset of sarcopenia among elderly individuals. While primarily relying on observational studies, nutrients such as magnesium, selenium, and calcium possess the capacity to mitigate or prevent sarcopenia. Furthermore, there is a correlation between a deficiency in 25-hydroxyvitamin D and the development of sarcopenia. According to a systematic analysis by Muir and Montero-Odasso, vitamin D supplements at daily dosages ranging from 800 to 1000 IU have demonstrated the potential to enhance certain aspects of sarcopenia in the elderly. In elderly persons, the presence of micronutrient deficiencies can potentially indicate increased susceptibility to vulnerability and the development of sarcopenia. Individuals who are susceptible to

deficits in micronutrients should give precedence to enhancing their micronutrient levels in order to postpone the occurrence of sarcopenia.(Bouchonville & Villareal, 2013; Damms-Machado et al., 2012)

The prevalence of micronutrient insufficiency is comparatively elevated among persons who are classified as obese. Certain obese populations have shown lower levels of vitamin B6, vitamin C, 25-hydroxyvitamin D, vitamin E, selenium, magnesium, and zinc in comparison to persons with an average body weight. In addition, those who are obese and undergoing weight loss regimens are at a heightened risk of experiencing shortages in micronutrients. While there is a lack of causality evidence, it has been observed that inadequacies associated with obesity are also connected to a reduction in muscle mass, strength, and athletic performance. These factors can exacerbate the consequences of sarcopenia. In order to maintain sufficient intake of micronutrients while undergoing calorie restriction, it may be essential to consume meals that are high in nutrients or to supplement with micronutrients. The proposed dietary intervention involves the implementation of a hypocaloric diet characterized by a reduced calorie intake coupled with increased protein consumption.(Damms-Machado et al., 2012; Waters et al., 2013)

When considered in isolation, each of the techniques above needs to be improved in effectively addressing all aspects of obesity-related sarcopenia concurrently. Hypocaloric diets commonly reduce fat mass, but they also lead to a loss of skeletal muscle mass. However, it should be noted that dietary protein consumption to stimulate muscle protein synthesis does not yield significant results in resolving concerns associated with obesity. Hence, it is deemed advantageous to employ a comprehensive methodology that integrates several tactics to optimize the impact on adipose tissue and skeletal muscle mass and enhance muscle strength and physical performance. Within this particular setting, using a hypocaloric diet with heightened protein consumption presents itself as a potentially efficacious approach.(H. Kim et al., 2016; Porter Starr et al., 2014)

The study conducted by Kim et al. was a meta-analysis that aimed to investigate the impact of protein intake on changes in body mass, skeletal muscle mass, and fat composition in older persons under hypocaloric diets. Specifically, the research compared the effects of protein intake below 25% versus above 25% of energy intake and protein intake less than 1.0 g/kg/day versus 1.0 g/kg/day or more. The study revealed that elderly individuals exhibited a more excellent preservation of skeletal muscle mass, with an observed gain of 0.83 kg, and a more pronounced reduction in fat mass, with a decrease of 0.53 kg, while adhering to a high-protein diet, defined as an intake of 1.0 g/kg/day or above, in comparison to individuals following a low-protein diet. The findings of this study indicate potential benefits in addressing obesity-related sarcopenia. However, it is essential to note that there were varying outcomes reported among obese and physically restricted older individuals in the studies that examined the effects of high-protein hypocaloric diets utilizing protein sources derived from food for six months. The intervention group was provided with individualized hypocaloric dietary guidance, which included a minimum of 30 grams of

protein in every meal, predominantly derived from animal sources. As a result, the participants achieved a protein consumption of 1.2 grams per kilogram of body weight per day. The present investigation demonstrated a favorable influence on physical performance, although no statistically significant effect was observed on skeletal muscle mass.(H. Kim et al., 2016; J. E. Kim et al., 2016)

Furthermore, a study by Backx et al. examined the effects of different dietary interventions on older persons classified as overweight or obese. These individuals were randomly allocated to one of two groups: a high-protein diet group, where participants consumed 1.7 grams of protein per kilogram of body weight per day, or a standard protein diet group, where participants consumed 0.9 grams of protein per kilogram of body weight per day. This dietary intervention was implemented over 12 weeks, during which participants followed a hypocaloric diet. The implemented intervention did not yield favorable outcomes regarding maintaining muscle mass or strength. The research findings indicated no discernible muscle mass and strength disparity when comparing the two dietary interventions. In brief, although high-protein hypocaloric diets demonstrate efficacy in preventing obesity-related sarcopenia, their effectiveness in treating this condition is limited.(Backx et al., 2016; Porter Starr et al., 2014)

CONCLUSION

The incidence of Sarcopenic Obesity escalates with advancing age, impacting around ten percent of the geriatric population globally. The findings of this study have significant ramifications for the field of public health, as there is a strong correlation between sarcopenic obesity and many adverse outcomes such as decreased physical strength, heightened risk of falls, disability, elevated morbidity rates, and higher death rates. These consequences place a considerable burden on individuals, communities, and healthcare systems alike. In order to advance our comprehension of sarcopenic obesity, physicians and researchers must establish a universally agreed-upon definition and diagnostic criteria for sarcopenic obesity. Additionally, there should be a concerted effort to prioritize the screening of sarcopenic obesity to identify individuals who are susceptible to this condition at an early stage. In addition, additional research is necessary to clarify the underlying causes of sarcopenic obesity and develop optimal strategies for food and exercise interventions that may be customized to individual needs, thereby fostering the promotion of healthy aging. Although various strategies have been devised to tackle sarcopenia or obesity with efficacy, there has been a lack of adequate emphasis on concurrently managing both disorders. Developing efficient techniques to increase skeletal muscle mass and reduce fat mass simultaneously presents a significant challenge. Due to the concurrent and adverse influence of obesity on total physiological performance and well-being, there is a pressing necessity for efficacious strategies to address this phenomenon. The objective of this review is to synthesize and consolidate these efficacious tactics.

Furthermore, the diverse methodologies employed in delineating operating systems pose a significant obstacle in evaluating and

contrasting the efficacy of distinct research endeavors. Nevertheless, this analysis underscores the intricate nature of sarcopenic obesity as a disorder that necessitates a multifaceted approach. This resource offers a current and comprehensive examination of exercise and nutrition therapies designed to target body composition and physical function in patients with sarcopenic obesity. In line with this objective, the review suggests that the most promising approach for enhancing various sarcopenic obesity parameters involves implementing a comprehensive strategy encompassing carefully regulated weight loss diets, concurrent engagement in physical exercise, and a high intake of protein (at least 1.2 grams per kilogram per day). It is recommended to prioritize animal protein sources and ensure an even distribution of protein intake throughout the day. However, additional study is required to obtain a more thorough comprehension of the most effective ways to improve body composition and physical function in older persons with sarcopenic obesity.

REFERENCES

Backx, E. M. P., Tieland, M., Borgonjen-van den Berg, K. J., Claessen, P. R., van Loon, L. J. C., & de Groot, L. C. P. G. M. (2016). Protein intake and lean body mass preservation during energy intake restriction in overweight older adults. *International Journal of Obesity*, *40*(2), 299–304. https://doi.org/10.1038/ijo.2015.182

Barazzoni, R., Bischoff, S., Boirie, Y., Busetto, L., Cederholm, T., Dicker, D., Toplak, H., Van Gossum, A., Yumuk, V., & Vettor, R. (2018). Sarcopenic Obesity: Time to Meet the Challenge. *Obesity Facts*, *11*(4), 294–305. https://doi.org/10.1159/000490361

Bouchonville, M. F., & Villareal, D. T. (2013). Sarcopenic obesity. *Current Opinion in Endocrinology, Diabetes & Obesity*, *20*(5), 412–419. https://doi.org/10.1097/01.med.0000433071.11466.7f

Chen, L.-K., Woo, J., Assantachai, P., Auyeung, T.-W., Chou, M.-Y., Iijima, K., Jang, H. C., Kang, L., Kim, M., Kim, S., Kojima, T., Kuzuya, M., Lee, J. S. W., Lee, S. Y., Lee, W.-J., Lee, Y., Liang, C.-K., Lim, J.-Y., Lim, W. S., … Arai, H. (2020). Asian Working Group for Sarcopenia: 2019 Consensus Update on Sarcopenia Diagnosis and Treatment. *Journal of the American Medical Directors Association*, *21*(3), 300-307.e2. https://doi.org/10.1016/j.jamda.2019.12.012

Christensen, K., Doblhammer, G., Rau, R., & Vaupel, J. W. (2009). Ageing populations: the challenges ahead. *The Lancet*, *374*(9696), 1196–1208. https://doi.org/10.1016/S0140-6736(09)61460-4

Chuang, S.-Y., Hsu, Y.-Y., Chen, R. C.-Y., Liu, W.-L., & Pan, W.-H. (2016). Abdominal Obesity and Low Skeletal Muscle Mass Jointly Predict Total Mortality and Cardiovascular Mortality in an Elderly Asian Population. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences*, *71*(8), 1049–1055. https://doi.org/10.1093/gerona/glv192

Cruz-Jentoft, A. J., Baeyens, J. P., Bauer, J. M., Boirie, Y., Cederholm, T., Landi, F., Martin, F. C., Michel, J.-P., Rolland, Y., Schneider, S. M., Topinková, E., Vandewoude, M., & Zamboni, M. (2010). Sarcopenia: European consensus on definition and diagnosis. *Age and Ageing*, *39*(4), 412–423. https://doi.org/10.1093/ageing/afq034

Curioni, C. C., & Lourenço, P. M. (2005). Long-term weight loss after diet and exercise: a systematic review. *International Journal of Obesity*, *29*(10), 1168–1174. https://doi.org/10.1038/sj.ijo.0803015

Damms-Machado, A., Weser, G., & Bischoff, S. C. (2012). Micronutrient deficiency in obese subjects undergoing low calorie diet. *Nutrition Journal*, *11*(1), 34. https://doi.org/10.1186/1475-2891-11-34

Deer, R. R., & Volpi, E. (2015). Protein intake and muscle function in older adults. *Current Opinion in Clinical Nutrition and Metabolic Care*, *18*(3), 248–253. https://doi.org/10.1097/MCO.0000000000000162

Després, J.-P., Nadeau, A., Tremblay, A., Ferland, M., Moorjani, S., Lupien, P. J., Thériault, G., Pinault, S., & Bouchard, C. (1989). Role of Deep Abdominal Fat in the Association Between Regional Adipose Tissue Distribution and Glucose Tolerance in Obese Women. *Diabetes*, *38*(3), 304–309. https://doi.org/10.2337/diab.38.3.304

Destra, E., Anggraeni, N., Firmansyah, Y., & Santoso, A. H. (2023). Waist to hip ratio in Cardiovascular Disease Risk : A Review of the Literature. *MAHESA : Malahayati Health Student Journal*, *3*(6), 1770–1781. https://doi.org/10.33024/mahesa.v3i6.10595

Destra, E., Frisca, F., Santoso, A. H., & Firmansyah, Y. (2022). Hubungan Asupan Makanan Cepat Saji dengan Angka Kejadian Hipertensi pada Orang Dewasa dengan Aktifitas Fisik Ringan Hingga Sedang. *Jurnal Medika Hutama*, *3*(03 April), 2525–2529.

Donini, L. M., Busetto, L., Bauer, J. M., Bischoff, S., Boirie, Y., Cederholm, T., Cruz-Jentoft, A. J., Dicker, D., Frühbeck, G., Giustina, A., Gonzalez, M. C., Han, H.-S., Heymsfield, S. B., Higashiguchi, T., Laviano, A., Lenzi, A., Parrinello, E., Poggiogalle, E., Prado, C. M., … Barazzoni, R. (2020). Critical appraisal of definitions and diagnostic criteria for sarcopenic obesity based on a systematic review. *Clinical Nutrition*, *39*(8), 2368–2388. https://doi.org/10.1016/j.clnu.2019.11.024

Freiberger, E., Goisser, S., Porzel, S., Volkert, D., Kemmler, W., Sieber, C., & Bollheimer, C. (2015). Sarcopenic obesity and complex interventions with nutrition and exercise in community-dwelling older persons – a narrative review. *Clinical Interventions in Aging*, 1267. https://doi.org/10.2147/CIA.S82454

Gao, Q., Mei, F., Shang, Y., Hu, K., Chen, F., Zhao, L., & Ma, B. (2021). Global prevalence of sarcopenic obesity in older adults: A systematic review and meta-analysis. *Clinical*

Nutrition, *40*(7), 4633–4641. https://doi.org/10.1016/j.clnu.2021.06.009

Gowd, V., Xie, L., Zheng, X., & Chen, W. (2019). Dietary fibers as emerging nutritional factors against diabetes: focus on the involvement of gut microbiota. *Critical Reviews in Biotechnology*, *39*(4), 524–540. https://doi.org/10.1080/07388551.2019.1576025

Gunaidi, F. C., Destra, E., Frisca, F., & Santoso, A. H. (2022). Hubungan indeks massa tubuh dan lingkar pinggang dengan kejadian hipertensi pada orang dewasa dengan aktivitas ringan hingga sedang. *Jurnal Medika Hutama*, *3*(04 Juli), 2992–2996.

Hector, A. J., Marcotte, G. R., Churchward-Venne, T. A., Murphy, C. H., Breen, L., von Allmen, M., Baker, S. K., & Phillips, S. M. (2015). Whey Protein Supplementation Preserves Postprandial Myofibrillar Protein Synthesis during Short-Term Energy Restriction in Overweight and Obese Adults. *The Journal of Nutrition*, *145*(2), 246–252. https://doi.org/10.3945/jn.114.200832

Holly, J. M. P., Biernacka, K., & Perks, C. M. (2019). Systemic Metabolism, Its Regulators, and Cancer: Past Mistakes and Future Potential. *Frontiers in Endocrinology*, *10*, 65. https://doi.org/10.3389/fendo.2019.00065

Ji, T., Li, Y., & Ma, L. (2022). Sarcopenic Obesity: An Emerging Public Health Problem. *Aging and Disease*, *13*(2), 379. https://doi.org/10.14336/AD.2021.1006

Kaufman, D. W., Kelly, J. P., Rosenberg, L., Anderson, T. E., & Mitchell, A. A. (2002). Recent Patterns of Medication Use in the Ambulatory Adult Population of the United States. *JAMA*, *287*(3), 337. https://doi.org/10.1001/jama.287.3.337

Kim, H., Kim, M., Kojima, N., Fujino, K., Hosoi, E., Kobayashi, H., Somekawa, S., Niki, Y., Yamashiro, Y., & Yoshida, H. (2016). Exercise and Nutritional Supplementation on Community-Dwelling Elderly Japanese Women With Sarcopenic Obesity: A Randomized Controlled Trial. *Journal of the American Medical Directors Association*, *17*(11), 1011–1019. https://doi.org/10.1016/j.jamda.2016.06.016

Kim, J. E., O'Connor, L. E., Sands, L. P., Slebodnik, M. B., & Campbell, W. W. (2016). Effects of dietary protein intake on body composition changes after weight loss in older adults: a systematic review and meta-analysis. *Nutrition Reviews*, *74*(3), 210–224. https://doi.org/10.1093/nutrit/nuv065

Li, X., Huang, S., Jiao, A., Yang, X., Yun, J., Wang, Y., Xue, X., Chu, Y., Liu, F., Liu, Y., Ren, M., Chen, X., Li, N., Lu, Y., Mao, Z., Tian, L., & Xiang, H. (2017). Association between ambient fine particulate matter and preterm birth or term low birth weight: An updated systematic review and meta-analysis. *Environmental Pollution (Barking, Essex : 1987)*, *227*, 596–605. https://doi.org/10.1016/j.envpol.2017.03.055

Liu, C., Wong, P. Y., Chung, Y. L., Chow, S. K., Cheung, W. H., Law, S. W., Chan, J. C. N., & Wong, R. M. Y. (2023).

Deciphering the "obesity paradox" in the elderly: A systematic review and meta-analysis of sarcopenic obesity. *Obesity Reviews*, *24*(2). https://doi.org/10.1111/obr.13534

Lunenfeld, B., & Stratton, P. (2013). The clinical consequences of an ageing world and preventive strategies. *Best Practice & Research Clinical Obstetrics & Gynaecology*, *27*(5), 643–659. https://doi.org/10.1016/j.bpobgyn.2013.02.005

Ma, J., Hwang, S., McMahon, G. M., Curhan, G. C., Mclean, R. R., Murabito, J. M., & Fox, C. S. (2016). Mid-adulthood cardiometabolic risk factor profiles of sarcopenic obesity. *Obesity*, *24*(2), 526–534. https://doi.org/10.1002/oby.21356

Malafarina, V., Uriz-Otano, F., Iniesta, R., & Gil-Guerrero, L. (2013). Effectiveness of Nutritional Supplementation on Muscle Mass in Treatment of Sarcopenia in Old Age: A Systematic Review. *Journal of the American Medical Directors Association*, *14*(1), 10–17. https://doi.org/10.1016/j.jamda.2012.08.001

Masanes Toran, F., Culla, A., Navarro-Gonzalez, M., Navarro-Lopez, M., Sacanella, E., Torres, B., & Lopez-Soto, A. (2012). Prevalence of sarcopenia in healthy community-dwelling elderly in an urban area of Barcelona (Spain). *The Journal of Nutrition, Health & Aging*, *16*(2), 184–187. https://doi.org/10.1007/s12603-011-0108-3

Mathus-Vliegen, E. M. H., Basdevant, A., Finer, N., Hainer, V., Hauner, H., Micic, D., Maislos, M., Roman, G., Schutz, Y., Tsigos, C., Toplak, H., Yumuk, V., & Zahorska-Markiewicz, B. (2012). Prevalence, Pathophysiology, Health Consequences and Treatment Options of Obesity in the Elderly: A Guideline. *Obesity Facts*, *5*(3), 460–483. https://doi.org/10.1159/000341193

Ng Tang Fui, M., Prendergast, L. A., Dupuis, P., Raval, M., Strauss, B. J., Zajac, J. D., & Grossmann, M. (2016). Effects of testosterone treatment on body fat and lean mass in obese men on a hypocaloric diet: a randomised controlled trial. *BMC Medicine*, *14*(1), 153. https://doi.org/10.1186/s12916-016-0700-9

No Title. (n.d.). https://doi.org/10.24411/0042-8833-2019-10001

Paddon-Jones, D., & Leidy, H. (2014). Dietary protein and muscle in older persons. *Current Opinion in Clinical Nutrition and Metabolic Care*, *17*(1), 5–11. https://doi.org/10.1097/MCO.0000000000000011

Pasarica, M., & Topping, D. (2017). An Evidence-Based Approach to Teaching Obesity Management to Medical Students. *MedEdPORTAL : The Journal of Teaching and Learning Resources*, *13*, 10662. https://doi.org/10.15766/mep_2374-8265.10662

Porter Starr, K. N., McDonald, S. R., & Bales, C. W. (2014). Obesity and Physical Frailty in Older Adults: A Scoping Review of Lifestyle Intervention Trials. *Journal of the American Medical Directors Association*, *15*(4), 240–250. https://doi.org/10.1016/j.ja

mda.2013.11.008

Russell, C., Jones, M., O'Shea, D., Simpson, K., Mitchell, A., & Laurenson, I. (2018). Challenges in the Diagnosis of Leptospirosis Outwith Endemic Settings: A Scottish Single Centre Experience. *Journal of the Royal College of Physicians of Edinburgh*, *48*(1), 9–15. https://doi.org/10.4997/jrcpe.2018.102

Studenski, S. A., Peters, K. W., Alley, D. E., Cawthon, P. M., McLean, R. R., Harris, T. B., Ferrucci, L., Guralnik, J. M., Fragala, M. S., Kenny, A. M., Kiel, D. P., Kritchevsky, S. B., Shardell, M. D., Dam, T.-T. L., & Vassileva, M. T. (2014). The FNIH Sarcopenia Project: Rationale, Study Description, Conference Recommendations, and Final Estimates. *The Journals of Gerontology: Series A*, *69*(5), 547–558. https://doi.org/10.1093/gerona/glu010

Tilinca, M. C., Tiuca, R. A., Burlacu, A., & Varga, A. (2021). A 2021 Update on the Use of Liraglutide in the Modern Treatment of 'Diabesity': A Narrative Review. *Medicina*, *57*(7), 669. https://doi.org/10.3390/medicina57070669

Waters, D. L., Ward, A. L., & Villareal, D. T. (2013). Weight loss in obese adults 65years and older: A review of the controversy. *Experimental Gerontology*, *48*(10), 1054–1061. https://doi.org/10.1016/j.exger.2013.02.005

Weinheimer, E. M., Sands, L. P., & Campbell, W. W. (2010). A systematic review of the separate and combined effects of energy restriction and exercise on fat-free mass in middle-aged and older adults: implications for sarcopenic obesity. *Nutrition Reviews*, *68*(7), 375–388. https://doi.org/10.1111/j.1753-4887.2010.00298.x

Zamboni, M., Mazzali, G., Fantin, F., Rossi, A., & Di Francesco, V. (2008). Sarcopenic obesity: A new category of obesity in the elderly. *Nutrition, Metabolism and Cardiovascular Diseases*, *18*(5), 388–395. https://doi.org/10.1016/j.numecd.2007.10.002

Zhang, X., Xie, X., Dou, Q., Liu, C., Zhang, W., Yang, Y., Deng, R., & Cheng, A. S. K. (2019). Association of sarcopenic obesity with the risk of all-cause mortality among adults over a broad range of different settings: a updated meta-analysis. *BMC Geriatrics*, *19*(1), 183. https://doi.org/10.1186/s12877-019-1195-y