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Chapter 4

Sarcopenia and Malnutrition in the Elderly

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Abstract

Sarcopenia and malnutrition are both commonly occurring conditions in elderly population. As understood today, sarcopenia is a syndrome characterised by progressive and generalised loss of skeletal muscle mass, physical performance and/or strength, whereas malnutrition has been defined as a condition of an imbalance of energy, protein and other nutrients that can cause measurable negative effects. In many populations, malnutrition and sarcopenia are present simultaneously, and they appear clinically through a combination of decreased body weight and nutrient intake, along with a decrease in muscle mass and function. Moreover, malnutrition is one of the key pathophysiological causes of sarcopenia. Both entities result in numerous and substantial negative outcomes to the patients and the healthcare system, including decreased quality of life and functionality and increased healthcare costs, hospitalisation rates, morbidity and mortality. Early identification of sarcopenia would be of great clinical relevance because the loss of muscle mass and strength with ageing can be largely reversed by proper exercise and nutritional intervention. Clinicians should integrate nutritional assessment with sarcopenia screening for optimal evaluation of these two interrelated issues to help improve clinical outcomes.

Keywords: sarcopenia, malnutrition, muscle, prevalence, elderly people

1. Introduction

The aged population in the developed world is increasing rapidly. Ageing is accompanied by changes in body composition, including a decrease in muscle mass. From the age of 50 years onwards, muscle mass decreases by 1–2% annually and muscle strength is reduced by approximately 1.5% annually between the age of 50 and 60 years [1]. This age-related loss of skeletal muscle mass, resulting in loss of strength and function, is defined as sarcopenia. This

geriatric syndrome is associated with an increased risk for adverse outcomes, such as poor quality of life, risk of falls and death. Moreover, it is a major contributing factor of physical disability, frailty and loss of independence in the elderly. It may be thus an important and potentially reversible cause of morbidity and mortality in older persons [2].

On the other hand, malnutrition is described as a chronic or acute condition of the body in which a deficiency or imbalance of energy, protein and other nutrients leads to negative effects on function, clinical outcomes and body composition [3].

Sarcopenia and malnutrition have similar physiological mechanisms and are common and overlapping in older adults. Both entities result in numerous and substantial negative outcomes to the patients and the healthcare system, including decreased quality of life and functionality and increased healthcare costs, hospitalisation rates, morbidity and mortality. Both entities are highly prevalent among population over the age of 65 years and more, especially in those living in nursing homes or hospitalised [4].

Early identification of sarcopenia and malnutrition would seem to be of clinical relevance because the nutritional deficiencies and the loss of muscle mass and strength with ageing can be largely reversed by proper lifelong improvements in nutritional intervention and physical activity. They are probably the most effective intervention to improve physical functioning, prevent falls and disabilities and, consequently, improve the quality of life in the older population. This is especially important given that world is ageing and older adults will utilise healthcare services at an increased rate in the next years [4].

2. Sarcopenia

2.1. Definition, mechanisms, causes and prevalence of sarcopenia

The term sarcopenia is derived from the Greek words ‘sarx’ (flesh) and ‘penia’ (loss). Unlike earlier definitions of sarcopenia, focusing on measurements of low muscle mass only, the current definition of sarcopenia according to the European consensus of the EWGSOP (European Working Group on Sarcopenia in Older People) [5] requires the presence of both low muscle mass and low muscle function (muscle strength or physical performance), although they have not achieved consensus on the cut-off points of muscle mass indicating sarcopenia. The International Working Group on Sarcopenia (IWGS) also proposed an operational definition of sarcopenia, which was targeted to individuals with functional decline, mobility-related difficulties, history of recurrent falls, recent unintentional weight loss, post-hospitalisation and chronic conditions [6, 7].

In many older people, sarcopenia is a multifactorial process where several mechanisms can be involved. When the only evident cause of sarcopenia is the ageing, sarcopenia can be considered as primary (or age-related). In fact, malnutrition status is one of the main causes of sarcopenia (protein-poor diet determines a compensatory response characterised by a reduction in lean mass) [8].

Epidemiological data suggest that the prevalence of sarcopenia varies widely, depending on the different populations studied, gender, age, settings, diagnostic criteria used and the cut-off points chosen to define a low muscle mass. In a recent systematic review [9], five European studies were found using EWGSOP criteria to define sarcopenia in ageing people using BIA (bioelectrical impedance analysis) in different settings, with a prevalence of sarcopenia between 7.5 and 77.6%. The highest prevalence was found in people staying in convalescence and rehabilitation units, while community-dwelling older people had the lowest prevalence.

3. Malnutrition

3.1. Definition and aetiology of malnutrition

Malnutrition has been defined as a condition of an imbalance of energy, protein and other nutrients that can cause measurable negative effects on body composition, physical function and clinical outcomes [10].

Older adults are known to be at high risk of malnutrition. Advanced age is an independent risk factor for malnutrition and is associated with a lower body weight, body mass index (BMI) and serum albumin. Malnutrition is not an inevitable side effect of ageing, but many changes associated with the process of ageing can promote a poor nutritional status. The decline in taste acuity and smell, poor dentition and a decreased appetite are some factors that can affect nutrient intake and can lead to malnutrition and its potentially serious consequences. Other factors, such as an increased frequency and severity of acute and chronic medical conditions, multiple medications, social or economic challenges and cognitive decline, all play a role in the aetiology of malnutrition among older adults [11].

3.2. Nutritional assessment in the elderly

The best validated and most widely used test to measure nutritional status of older people is the Mini Nutritional Assessment (MNA). This includes 18 questions regarding weight change, dietary change, gastrointestinal symptoms, mobility, physical assessment and disease and its relationship with nutritional requirements, with a maximum score of 30 points. Patients who score >24 points are considered well nourished, those that score 17–23.5 points are classified as at risk of malnutrition and those who score <17 points are considered malnourished. Using MNA, Guigoz found 5–71% prevalence of malnutrition among 6821 elderly persons after a review of 32 studies and reported that malnutrition risk was higher in those living in nursing homes than in community-dwelling elderly [12].

Another nutritional assessment tool developed for the elderly population is the Nutritional Form for the Elderly (NUFFE). This instrument was designed as a form that contains items that reflect functional, social, nutritional and health-related aspects of nutritional intake [13].

On the other hand, ESPEN (The European Society for Clinical Nutrition and Metabolism) has recently proposed a new consensus definition of malnutrition [14]. According to this

definition, individuals identified as 'at risk' of malnutrition proceed in the diagnostic process, with two possible options: body mass index (BMI) <18.5 kg/m^2 or unintentional weight loss (>10% independent of time or >5% in last 3 months), this last option is always combined with either a low BMI <20 kg/m^2 (if <70 years old) or <22 kg/m^2 (if >70 years old) or a low fat-free mass index (FFMI) <15 kg/m^2 (women) and <17 kg/m^2 (men).

3.3. Prevalence of malnutrition

Depending on the method or parameters used for the nutritional assessment, prevalence rates of malnutrition among elderly subjects range between 6.5 and 85%. Early identification of older adults at nutritional risk, followed by adequate nutritional intervention, is expected to contribute to conservation of muscle function and muscle strength, and herewith to maintenance the functional independence, the quality of life and possibly to prolong the survival [15].

The prevalence of malnutrition depends on multiple factors, including the definition and the diagnostic criteria used. This prevalence is greater among older adults in healthcare settings. In fact, in hospital settings, malnutrition is approximately 56% in elderly patients [16].

3.4. Malnutrition-sarcopenia syndrome

Malnutrition is common across varying patient populations, particularly in older adults, and sarcopenia prevalence also increases with age. Moreover, malnutrition is regarded as one important contributing factor in the complex aetiology of sarcopenia, and it may be amenable to intervention. In fact, a diagnostic category of malnutrition-related sarcopenia has been proposed [5]. However, usually older people admitted to nursing homes are screened or assessed for either malnutrition or sarcopenia, but rarely for both conditions concurrently. In several populations, malnutrition and sarcopenia are present simultaneously and manifest clinically through a combination of decreased nutrient intake, decreased body weight, along with a decrease in muscle mass, strength and/or physical function [17].

Vanderwoude et al. [4] proposed the term 'malnutrition-sarcopenia syndrome', which embodies the inherent association of both entities, highlighting their combined impact on clinical outcomes, including increased morbidity, infection and complications (as falls and disability), length of hospital stay and rehospitalisation rates, mortality and healthcare costs, apart from decreased quality of life. Malnutrition and sarcopenia are each independently associated with negative health consequences that impact older adults across healthcare settings [18, 19].

There are few published data demonstrating the co-occurrence of malnutrition and sarcopenia in older adults. In a recent study [20], both entities have been studied in a post-acute care geriatric unit, applying the new ESPEN definition of malnutrition and EWGSOP criteria, assessing the potential clinical relationship between them. The prevalence of malnutrition in this population was 19.3%, and the prevalence of sarcopenia was significantly higher in patients with malnutrition: 82.3 versus 45.1% ($p = 0.03$), which means that most patients with sarcopenia fulfilled the ESPEN criteria for diagnosis of malnutrition. On the other hand, in the study of Senior et al. [21], sarcopenia was defined with EWGSOP criteria and nutritional

status was assessed with MNA short-form test. According to these criteria, 14.9% of participants with sarcopenia were malnourished and 48.5% were at risk of malnutrition. The prevalence of malnutrition was higher in subjects with low handgrip strength (62.8%) and in participants with severe sarcopenia (60.8%). Moreover, research has shown that reductions in handgrip strength are common in individuals who have sarcopenia as well as in individuals who are malnourished [5, 22].

4. Screening for malnutrition-sarcopenia

Clinicians should integrate nutrition assessment with sarcopenia screening for optimal evaluation of these two interrelated nutritional issues to help improve patients' clinical outcomes [4].

For sarcopenia screening, a simple clinician tool has been suggested by the EWGSOP [5]. This group has developed an algorithm based on gait speed measurement (a cut-off point of >0.8 m/s identifies risk for sarcopenia) as the easiest and most reliable way to begin sarcopenia screening in clinical practice.

Screening tools for malnutrition are intended for the quick identification of patients at risk of malnutrition, for more in-depth nutritional assessment, or for identifying patients at risk of developing complications or even increased risk of mortality. A variety of malnutrition screening tools are available such as the Malnutrition Screening Tool (MST), Malnutrition Universal Screening Tool (MUST) [23], the short form of the Mini Nutritional Assessment (SF-MNA) [24] and Nutrition Risk Screening-2002 (NRS-2002) [25]. Based on the evidence presented, the combination of screening and assessing for malnutrition and sarcopenia is recommended to screen for the presence of malnutrition-sarcopenia syndrome in at-risk patient populations, particularly older adults in clinical settings [4].

Clinicians are urged to screen, assess and treat these conditions currently. By examining aspects of both conditions, clinicians can more fully assess their patients' clinical and nutritional status and can design targeted therapies to meet their needs and improve outcomes [4].

Examining patient's nutritional and functional status through screening and assessment for both malnutrition and sarcopenia will enable clinical practitioners to determine the presence of both entities in their patients and to target interventions to prevent and avoid them [4].

5. Nutritional interventions to prevent sarcopenia

The relationship between muscle mass, strength, physical function and nutritional status has significant clinical implications regarding the therapeutic approaches [26].

Early identification of sarcopenia would be of great clinical relevance because the loss of muscle mass and strength with ageing can be largely reversed by proper exercise programs and nutritional intervention [27]. Of all the therapeutic options available, lifelong improvements in

physical activity and diet are probably the most effective public health intervention and the most important treatment option in nursing home residents for this condition, ongoing independence and autonomy in older people. The Society for Sarcopenia, Cachexia and Wasting Disease developed nutritional recommendations for the prevention and management of sarcopenia, which combined exercise with adequate protein and energy intake [28].

On the other hand, adequate caloric intake has to be considered as an essential requisite for any successful therapeutic approach in the institutionalised elderly participants, in terms of prevention and treatment of sarcopenia. Nutrient intake, especially adequate amounts of high-quality protein and amino acids, is the most important anabolic stimulus of skeletal muscle protein synthesis. Epidemiological studies suggest that a low protein intake is associated with sarcopenia. To prevent it, as optimal dietary protein intake, daily 1.0–1.2 g/kg with an optimal repartition over each daily meal or 25–30 g of high-quality protein per meal are recommended. Specifically, the amino acid leucine and meal-induced insulin, both independently stimulate muscle protein synthesis. It has been demonstrated that exercise and amino acid supplementation (3 g of a leucine-enriched balanced essential amino acid mixture twice a day) together may actually be effective in enhancing muscle strength, variables of muscle mass and walking speed in sarcopenic women [29]. Antioxidants and ω 3-polyunsaturated fatty acids may also contribute to the preservation of muscle function. Low 25-hydroxyvitamin D (25(OH)D) serum level in adults is also a potentially modifiable risk factor for sarcopenia [30]. In fact, nutritional interventions combining adequate amounts of vitamin D and proteins are promising strategies to attenuate sarcopenia development [31]. Some studies have shown the effectiveness of other nutritional factors, such as cheese and milk protein and beta-hydroxy-beta-methylbutyrate (HMB), as a potential supplement to improve muscle quality in sarcopenic elderly people [32, 33].

In a recent study [34], Mediterranean dietary pattern (high in olive, low-fat dairy, vegetable, fish, nut and vegetable oil) has demonstrated a favourable role in the prevention of sarcopenia in postmenopausal women, in comparison with a Western pattern (based on high commercial beverage, sugar and dessert, snacks, solid fat, potato, high-fat dairy, legume, organ meat, fast food and sweets). Another study [35] demonstrated that improvements in clinically relevant measures, such as strength and functionality, could be achieved by supplementation with high-quality oral nutritional supplementation.

Other treatments of sarcopenia currently under investigation include testosterone replacement therapy, oestrogens in women, growth hormone and other behavioural and pharmacological strategies. The main limitation of these treatments is the lack of long-term adherence [8].

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References

[1] Buford TW, Anton SD, Judge AR, Marzetti E, Wohlgemuth SE, Carter CS, et al. Models of accelerated sarcopenia: Critical pieces for solving the puzzle of age-related muscle atrophy. Ageing Research Reviews. 2010;**9**(4):369-383. DOI: 10.1016/j.arr.2010.04.004

[2] Serra Rexach JA. Clinical consequences of sarcopenia. Nutrición Hospitalaria. 2006; **21**(3):46-50

[3] García de Lorenzo A, Álvarez-Hernández J, Planas M, Burgos R, Araujo K. The multidisciplinary consensus work-team on the approach to hospital malnutrition in Spain. Multidisciplinary consensus on the approach to hospital malnutrition in Spain. Nutrición Hospitalaria. 2011;**26**(4):701-710

[4] Vanderwoude MFJ, Alish CJ, Sauer AC, Hegazi RA. Malnutrition-sarcopenia syndrome: Is this the future of nutrition screening and assessment for older adults? Journal of Aging Research. 2012;**2012**:1-8. DOI: 10.1155/2012/651570

[5] Cruz-Jentoft AJ, Baeyens JM, Bauer JM, Boirie Y, Cederholm T, Landi F, et al. Sarcopenia: European consensus on definition and diagnosis: Report of the European Working Group on Sarcopenia in Older People. Age Aging. 2010;**39**:412-423. DOI: 10.1093/ageing/afq034

[6] Fielding RA, Vellas B, Evans WJ, Bhasin S, Morley JE, Newman AB, et al. Sarcopenia: An undiagnosed condition in older adults. Current consensus definition: Prevalence, etiology, and consequences. International Working Group on Sarcopenia. Journal of the American Medical Directors Association. 2011;**12**(4):249-256. DOI: 10.1016/j.jamda.2011.01.003

[7] Visser M, Schaap LA. Consequences of sarcopenia. Clinics in Geriatric Medicine. 2011;**27**:387-399. DOI: 10.1016/j.cger.2011.03.006

[8] Rolland Y, Czerwinski S, Abellan Van Kan G, et al. Sarcopenia: Its assessment, etiology, pathogenesis, consequences and future perspectives. Journal of Nutrition Health and Aging. 2008;**12**:433-450

[9] Lardiés Sánchez B, Sanz-París A, Boj-Carceller D, Cruz-Jentoft AJ. Systematic review: Prevalence of sarcopenia in ageing people using bioelectrical impedance analysis to assess muscle mass. European Geriatric Medicine. 2016;**7**:256-261. DOI: 10.1016/j.eurger.2016.01.014

[10] Sttraton RJ, Green CJ, Elia M. Disease-Related Malnutrition: An Evidence-Based Approach to Treatment. Wallingford, UK; Cambridge, MA: CABI Pub; 2003.

[11] Jensen GL, Mirtallo J, Compher C, Dhaliwal R, Forbes A, Grijalba RF, et al. Adult starvation and disease related malnutrition: A proposal for etiology-based diagnosis in the clinical practice setting from the International Consensus Guideline Committee. Journal of Parenteral and Enteral Nutrition. 2010;**34**(2):156-159

[12] Guigoz Y. The Mini Nutritional Assessment (MNA) review of the literature: What does it tell us? Journal of Nutrition Health and Aging. 2006;**10**(6):466-485

[13] Söderhamn U, Söderhamn O. Reliability and validity of the nutritional form for the elderly (NUFFE). Journal of Advanced Nursing. 2002;**37**(1):28-34

[14] Cederholm T, Bosaeus I, Barazzoni R, Bauer J, Van Gossum A, Klek S, et al. Diagnostic criteria for malnutrition: An ESPEN Consensus Statement Clinical Nutrition. 2015;**34**(3): 335-340. DOI: 10.1016/j.clnu.2015.03.001

[15] Beck AM. Weight loss, mortality and associated potentially modifiable nutritional risk factors among nursing home residents: A Danish follow-up study. Journal of Nutrition Health and Aging. 2015;**19**(1):96-101

[16] Pirlich M, Schütz T, Norman K, et al. The German hospital malnutrition study. Clinical Nutrition. 2006;**25**(4):563-572

[17] Vivanti A, Ward N, Haines T. Nutritional status and associations with falls, balance, mobility and functionality during hospital admission. Journal of Nutrition Health and Aging. 2011;**15**:388-391

[18] Saka B, Ozkaya H, Karisik E, Akin S, Akpinar TS, Tufan F, et al. Malnutrition and sarcopenia are associated with increased mortality rate in nursing home residents: A prospective study. European Geriatric Medicine. 2016;**7**(3):232-238. DOI: 10.1016/j.eurger.2015.12.010

[19] Landi F, Cruz-Jentoft AJ, Liperoti R, Russo A, Giovanni S, Tosato M, et al. Sarcopenia and mortality risk in frail older persons aged 80 years and older: Results from ilSIRENTE study. Age Ageing. 2013;**42**(2):203-209. DOI: 10.1093/ageing/afs194

[20] Sánchez-Rodríguez D, Marco E, Ronquillo-Moreno N, Miralles R, Vázquez-Ibar O, Escalada F. Prevalence of malnutrition and sarcopenia in a post-acute care geriatric unit: Applying the new ESPEN definition and EWGSOP criteria. Clin Nutr. 2016 Sep 9. pii: S0261-5614(16)30233-3. DOI:10.1016/j.clnu.2016.08.024. [Epub ahead of print]

[21] Senior HE, Henwood TR, Beller EM, Mitchell GK, Keogh JW. Prevalence and risk factors of sarcopenia among adults living in nursing homes. Maturitas 2015;**82**(4):418-423. DOI: 10.1016/j.maturitas.2015.08.006

[22] Norman K, Stobäus N, González MC, Schulzke JD, Pirlich M. Hand grip strength: Outcome predictor and marker of nutritional status. Clinical Nutrition. 2006;**30**(2):135-142

[23] Stratton RJ, Hackston A, Longmore D, Dixon R, Price S, Stroud M, King C, Elia M. Malnutrition in hospital outpatients and inpatients: Prevalence, concurrent validity and ease of use of the "malnutrition universal screening tool" (MUST) for adults. British Journal of Nutrition. 2004;**92**(5):799-808

[24] Ranhoff AH, Gjoen AU, Mowé M. Screening for malnutrition in elderly acute medical patients: The usefulness of MNA-SF. Journal of Nutrition Health and Aging. 2005;**9**(4): 221-225

[25] Kondrup J, Rasmussen HH, Hamberg O, Stanga Z, Ad Hoc ESPEN Working Group. Nutritional risk screening (NRS 2002): A new method based on an analysis of controlled clinical trials. Clinical Nutrition. 2003;**22**(3):321-336

[26] Roubenoff R. Sarcopenia: Effects on body composition and function. The Journals of Gerontology. Series A, Biological Sciences and Medical Sciences. 2003;**58**:1012-1017

[27] Malafarina V, Uriz-Otano F, Iniesta R, Gil-Guerrero L. Effectiveness of nutritional supplementation on muscle mass in treatment of sarcopenia in old age: A systematic review. Journal of the American Medical Directors Association. 2013;**14**:10-17. DOI: 10.1016/j.jamda.2012.08.001

[28] Morley JE, Argiles JM, Evans WJ, et al. Nutritional recommendations for the management of sarcopenia. Journal of the American Medical Directors Association. 2010;**11**:391-396

[29] Yanai H. Nutrition for sarcopenia. Journal of Clinical Medicine and Research. 2015;**7**(12):926-931

[30] Visser M, Deeg DJ, Lips P. Longitudinal Aging Study. Low vitamin D and high parathyroid hormone levels as determinants of loss of muscle strength and muscle mass (sarcopenia): The Longitudinal Aging Study Amsterdam. Journal of Clinical Endocrinology and Metabolism. 2003;**88**(12):5766-5772

[31] Verlaan S, Maier AB, Bauer JM, Bautmans I, Brandt K, Donini LM, et al. Sufficient levels of 25-hydroxyvitamin D and protein intake required to increase muscle mass in sarcopenic older adults: The PROVIDE study. Clinical Nutrition. 2017;**pii:S0261-5614**(17):30010-30019. DOI: 10.1016/j.clnu.2017.01.005

[32] Makanae Y, Fujita S. Role of exercise and nutrition in the prevention of sarcopenia. Journal of Nutritional Science and Vitaminology. 2015;**61**:S125-S127

[33] Kim HK, Sazuki T, Saito K, et al. Effects of exercise and amino acid supplementation on body composition and physical function in community-dwelling elderly Japanese sarcopenic women: A randomized controlled trial. Journal of the American Geriatrics Society. 2012;**60**(1):16-23

[34] Mohseni R, Aliakbar S, Abdollahi A, Yekaninejad MS, Maghbooli Z, Mirzaei K. Relationship between major dietary patterns and sarcopenia among menopausal women. Aging Clin Exp Res. 2017 Feb 21. doi:10.1007/s40520-016-0721-4. [Epub ahead of print]

[35] Cramer JT, Cruz-Jentoft AJ, Landi F, Hickson M, Zamboni M, Pereira SL, et al. Impacts of high-protein oral nutritional supplements among malnourished men and women with sarcopenia: A multicenter, randomized, double-blinded, controlled trial. Journal of the American Medical Directors Association. 2016;**17**(11):1044-1055. DOI: 10.1016/j.jamda.2016.08.009

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