**Sarcopenia –A narrative review**

Da-Ming Liao1，Chieh Chen 2

Dental Department, Puli Christian Hospital 1

Anxing Clinic2

Corresponding author: Chieh Chen

Address: No. 36, Lane 100, Section 2, Zhongshan Road, Taiping District, Taichung City

[guppy5230@yahoo.com.tw](mailto:guppy5230@yahoo.com.tw)

\*Corresponding Author: Chieh Chen

Running title : Sarcopenia

**Abstract**

Primary sarcopenia is defined as a decrease in muscle mass or muscle strength. It is currently considered as an age-related pathological change. Primary sarcopenia mostly begins around the age of 40. As age increases, especially in older groups, the rate of muscle loss accelerates, and its prognosis is seen as a consequence of affecting physiological function and as a predictor of the patient's subsequent independent function in the activities of daily living. Lower muscle mass may occur at any age and may be in the context of acute or chronic disease. Sarcopenia is also associated with oxidative stress on body metabolism and can be a symptom of muscle (a metabolic organ of the body) and its dysfunction such as immune status, physiology of tissue or organ function performance, etc. Lower muscle mass not only leads to weakness, but also has different metabolic functions due to human skeletal muscles. The Global Leadership Initiative on Malnutrition (GLIM) considers sarcopenia to be a very important aging indicators, in which low muscle mass is defined as one of the indicators of malnutrition. This definition is regarded skeletal muscle as an indicator of nutrients and one of the role of the body's endocrine organs.

**Keywords**: sarcopenia, nutritional status, olderly, frailty, independent function of the activities of daily living.

**Introduction**

The term sarcopenia was first proposed by scientist Rosenberg in 1989. Primary sarcopenia is defined as an age-related reduction in skeletal muscle mass and muscle strength. Several prospective studies reported that the age of 40 Subsequent skeletal muscle mass decreases by 6-8% every decade. Aging-related muscle atrophy is the most common form of muscle atrophy in humans and is associated with significant physiological impairments such as slower walking speed and muscle weakness (reduced grip strength). ), muscle function is gradually being lost [1]; due to economic factors related to the aging of society and population development, as well as changes in living conditions, medical care, etc., the proportion of the elderly population continues to increase, and the importance of muscle function changes related to aging is also rapidly increasing. Ascending, sarcopenia is thought to involve a variety of pathophysiological changes, such as muscle denervation, myocyte mitochondrial dysfunction, chronic inflammation of the body, and hormonal changes. These changes may lead to adverse health effects. Results include: falls, loss of lean mass leading to decline in various body functions, weakness and disability. The main risk factors for sarcopenia also include lack of physical activity and sedentary lifestyle. The gradual decline in muscle fibers and strength begins before the age of 50. At the same time, the concentration of hormones in the body includes: growth hormone, gonadal hormones, thyroid hormones, and insulin-like growth factors, which will lead to a decline in muscle mass and strength [1,2].

**Community prevalence of sarcopenia**

According to research, the prevalence rate of sarcopenia in the elderly in community institutions is as high as 30%, and the prevalence rate of sarcopenia in the elderly over 80 years old is as high as 11-50%. Current research on aging and its impact on motor neuron changes and body composition changes As well as the mechanisms of frailty and intervention strategies, the relationship between specific neuromuscular diseases and aging is still unclear. Although the impact of aging is different on individual groups, aging mammals in experimental animals will all have the characteristics of sarcopenia. On the other hand, age-related factors, in addition to aging, also include development and maturation; sarcopenia will affect human skeletal muscle structure and functional aging-related changes. Compared with experimental animal models, it has been observed in humans The different results obtained may be related to differences between species [3]; in clinical medical treatment, if patients have symptoms of sarcopenia or reduced physical function, such as: falling, often feeling tired and weak, walking slowly, feeling uneasy when standing up from a chair, Difficulty, weight loss or significant muscle atrophy requires early detection (screening). In this case, in order to confirm the diagnosis, EWGSOP2 (the European Working Group on Sarcopenia in Older People) recommends using the five-item SARC-F questionnaire (muscle strength). , walking, rising from chairs, climbing stairs and falling) or Ishii's screening tools include: age, grip strength and calf circumference; in suspected cases use of arm standing instrument (Baby Machine), chair standing test (Sit and Stand test Repeat five times), test grip strength (skeletal muscle strength), muscle mass can be estimated by various techniques (dual-energy X-ray absorptiometry (DXA) or bioelectrical impedance analysis (BIA)), results can be based on height or weight Adjusted for body mass index, muscle mass can be expressed as total body skeletal muscle mass, limb skeletal muscle mass, or muscle cross-sectional area in a specific muscle group or body location (third lumbar vertebra or mid-thigh cross), or as measured by computed tomography or Measured by magnetic resonance imaging [1,4].

**The pathogenesis of sarcopenia**

Tumor necrosis factor α (TNF α) and interleukin 6 (IL-6) and other cytokines in the body promote inflammation. The inflammatory reaction caused by them may lead to severe muscle atrophy [2,5]. Others such as the body cannot synthesize Sufficient protein, or insufficient daily protein intake, will cause the serum albumin concentration in the body to decrease, which is one of the main causes of severe sarcopenia. At the same time, aging itself will cause the deterioration of motor neurons and muscle cells. The reduction of satellite cells reduces the body's physiological functions and the recovery of damaged muscle fibers; the treatment of sarcopenia should first be based on the understanding of the pathophysiology of the disease, including non-pharmacological and pharmaceutical methods. Non-drug treatment methods for sarcopenia include: regular resistance training and appropriate whey protein supplementation. Although the effect of exercise and nutritional intervention on improving sarcopenia is not yet clear, there is evidence that adequate protein intake such as: milk High-quality proteins such as albumin and soybeans, vitamin D, antioxidants (vitamin C, vitamin E, carotene, selenium) or long-chain unsaturated fatty acids can help reduce cell inflammation and preserve the body's lean mass. Resistance training has been proven to be effective as a major non-pharmacological treatment for sarcopenia.

Sarcopenia is overtaken by the occurrence of chronic diseases and associated cellular damage such as falls, resulting in musculoskeletal damage and even death. There is an urgent need to understand the mechanisms of structural and functional changes in skeletal muscle during aging. With the evolution of the population structure, the proportion of the elderly population suffering from aging-related movement disorders and dependence-related problems continues to increase. The consequent social and huge economic costs have led to people paying more and more attention to the importance of quality of life in the elderly. Aging affects skeletal muscle stability, leading to dysregulation of muscle synthesis and catabolism, processes in protein production pathways; sarcopenic cellular changes are characterized by reduced size and number of type II muscle fibers and fatty infiltration within and between muscles In addition, the number of satellite cells is reduced. The main function of muscle satellite cells is to replace and repair damaged muscle fibers. In the skeletal muscle of patients with sarcopenia, the function of the cells may be affected by systemic factors that regulate satellite cell activity and muscle production. Decreased by changes such as: muscle stem cell factor, transforming growth factor-β (TGF-β can protect blood vessels and nerve cells) and myogenin, etc. Myogenin is a transcription factor that can induce the growth of various cell types. Muscle synthesis, the effects on skeletal muscle of TGF-β, myostatin, and the development of osteoporosis are the most widely discussed; other factors leading to muscle loss include dysfunction of the neuromuscular junction and loss of motor neuron units , inflammation, insulin resistance, mitochondrial dysfunction, and oxidative stress. Denervation of a single muscle fiber can also lead to substantial atrophy of the entire muscle group, and then type II muscle fibers will be replaced by type I muscle fibers and fat. Organizational replacement[2,6].

**Clinical diagnosis of sarcopenia**

Confirmation of the diagnosis of sarcopenia requires the presence of reduced muscle mass and muscle strength or reduced physical fitness. The diagnosis of sarcopenia depends on the clinical definition. In 2010, the European Working Group on Sarcopenia in the Elderly in Older People, EWGSOP) proposed three diagnostic criteria for sarcopenia based on muscle mass, muscle strength and physical performance: mass, strength, and slowed movement. Low muscle mass is defined as a skeletal muscle mass index less than 8.90 kg/m2, The grip strength of men is less than 30 kg, and the grip strength of women is less than 20 kg. The muscle strength is reduced and the gait speed is less than 0.8 m/s[7]. EWGSOP divides sarcopenia into three categories based on whether there is low muscle mass and functional impairment: pre-sarcopenia, sarcopenia, and severe sarcopenia. In 2018, EWGSOP revised its diagnostic tool to include low muscle strength. As the main basis for the diagnosis of sarcopenia, muscle strength is currently considered the most reliable measure of muscle function. In the revised guidelines, it is recognized that strength is more useful in predicting adverse effects and that when low muscle strength is detected, sarcopenia is likely; the diagnosis of sarcopenia is based on lower muscle mass as the gold standard. However, due to technical limitations, the use of instruments to analyze muscle structure and composition of microscopic and macroscopic aspects of muscle mass as a means to define sarcopenia remains a challenge [7,8]. Muscle mass is positively correlated with a patient's height. Larger people usually have larger muscle mass. Therefore, when quantifying muscle mass, different methods can be used to adjust absolute skeletal muscle mass or ASM (Appendicular Skeletal Mass) according to body size. Muscle mass, limb skeletal muscle mass), use the square of height (meters) (ASM/height2), weight (ASM/weight) or BMI (ASM/BMI). Although calf circumference is not a good measure of muscle mass, it has been shown to predict sarcopenia and survival and physical performance in older adults (the cutoff for calf circumference is <34 cm). Sarcopenia also involves muscle and Central and peripheral nervous function can be screened by walking at a speed of 4 meters. Usually the walking speed test is positive (critical speed ≤ 0.8 m/s), or the Short Physical Performance Battery (SPPB) (critical score ≤ 8 points), stand-up and walk test timed test TUG (timed up and go) critical time ≤ 20 seconds or 400-meter walking test, etc. [9-11].

In 2014, AWGS (the Asian Working Group for Sarcopenia) proposed a method for diagnosing sarcopenia based on Asian data. The algorithm defines the cutoff value for each diagnosis by EWGSOP. AWGS recommends that muscle mass for men is 7.0 kg/ m2, women are 5.4 kg/m2; women using DXA are 7.0 kg/m2, if BIA is used as the measurement standard, men are 7.0 kg/m2, women are 5.7 kg/m2, grip strength is < 26 kg for men, < 18 for women kg, and gait speed < 0.8 m/s. AWGS revised the diagnosis and screening methods of sarcopenia at the consensus meeting held in Hong Kong in 2019. AWGS retained the previous definition of sarcopenia in 2019, but revised some diagnostic criteria, and the cutoff value of hand muscle strength (grip strength) for men <28.0 kg, female <18.0 kg, physical fitness test includes 6-meter walking test (speed ≤ 1.0 m/s), SPPB (cut-off score ≤ 9), 5 TUG tests (cut-off time ≥ 12 seconds) [12]; in addition The 2019 AWGS recommends using calf circumference (<34 cm for men and <33 cm for women) as the threshold or SARC-F (a 5-part assessment: strength, assistance with walking, rising from chair, climbing stairs, and falls, where scores are ≥4 is called sarcopenia) or SARC-CalF (consisting of SARC-F plus calf circumference, where a score of ≥11 is called sarcopenia), AWGS 2019 also added a definition of suspected sarcopenia, which is defined as accompanied by or LMS (low muscle strength) that is not accompanied by physical decline is called sarcopenia if ASM is low and LMS or LPP (low physical performance) is low. If ASM is low, it is called severe sarcopenia. AWGS 2019 retains sarcopenia The original thresholds of LMM (low muscle mass) in disease diagnosis are DXA: <7.0 kg/m2 for men and <5.4 kg/m2 for women; BIA is <7.0 kg/m2 for men and <5.7 kg/m2 for women [12,13].

**Nonpharmacological treatments for sarcopenia**

Treatment options for sarcopenia include nonpharmacological and pharmaceutical approaches. Nonpharmacological approaches include resistance exercise and adequate nutrition. Of the two, resistance exercise is the standard non-pharmacological treatment for sarcopenia, with significant positive evidence; some dietary approaches, such as intake of adequate protein, vitamin D, antioxidant nutrients and long-chain polyunsaturated fatty acids, have been Proven to have a positive effect on preventing sarcopenia. It is also important to supplement branched chain amino acids (BCAA) after weight training. BCAA, which is a raw material for muscle repair, includes Leucine, Isoleucine, and Valine. , these three amino acids cannot be synthesized by the human body, and must be supplemented to meet the body's needs [14]. Currently, the U.S. Food and Drug Administration has not approved specific drugs for the treatment of sarcopenia, but some drugs include: Growth hormone, anabolic or androgenic steroids, selective androgen receptor modulators, appetite stimulants, beta-blockers, protein anabolic drugs, angiotensin-converting enzyme inhibitors, etc., future research should focus on Biosynthetic pathways for sarcopenia and improved diagnostic modalities such as biomarkers for early screening, developing consistent treatments for patients with sarcopenia, and establishing sensitive instruments to predict response to sarcopenia treatments [15,16].

Resistance exercise is the most effective and affordable way to prevent the progression of sarcopenia and improve multiple aspects of overall health. It is worth noting that it may take at least 3 months or longer to obtain significant improvements in relevant clinical parameters; in addition, nutritional intervention may enhance the effects of resistance exercise on systemic skeletal muscle mass, and leucine-rich protein supplements or Whey protein, is effective in increasing muscle mass and to a lesser extent, muscle function. Vitamin D supplementation can increase muscle strength but has no effect on muscle mass. The combination of protein and vitamin D can, in addition to building muscle mass, Improve functions such as stair climbing; currently no specific drugs have been approved by the Food and Drug Administration for the treatment of sarcopenia, a variety of drugs are recommended, including: growth hormones, anabolic or androgenic hormones, selective androgen receptor modulators , protein anabolic drugs, appetite stimulants, myostatin inhibitors, ACE II receptor activating drugs, beta-blockers, angiotensin-converting enzyme inhibitors and troponin activators, however treatment methods The effectiveness of anabolic steroid supplements is mixed. Growth hormone increases muscle protein synthesis and increases muscle mass, but does not improve muscle strength or function. The effects of anabolic steroid supplements vary by gender, with men losing weight and losing lean mass. Weight gain occurs, and weight gain in women is primarily due to increased fat mass. Testosterone supplementation increases muscle strength in both men and women. The effect of testosterone on muscle mass (but not strength) is greater in men with lower serum testosterone levels. Other nutritional supplements such as: curcumin, alkaloids, catechins, proanthocyanidins, curcumin and curcumenol also have a certain impact on the function of skeletal muscles. Growth hormone-releasing peptide and Megest (megestrol acetate) are used Used to stimulate appetite, it can increase body weight and muscle mass [14, 15, 17]. Long-term bed rest or sitting lifestyle will increase the concentration of myostatin, which is produced by muscles, resulting in decreased muscle strength. Prevents muscle anabolism and metabolism and is associated with loss of muscle mass. Resistance exercise and myostatin inhibitors, beta-blockers, ACE inhibitors and troponin activators can have an impact on muscle mass and grip strength. It has been shown to be effective in increasing muscle mass [14,15].

**Conclusion**

Sarcopenia is an aging-related decrease in muscle mass, strength, and function. It is a multifactorial disease that reduces a patient's mobility and may lead to falls. The decrease in muscle mass with age is primarily due to exercise. Progressive loss of neurons, associated with a reduction in the number and size of muscle fibers, progressive decline in muscle function, falls and fall-related bed rest are common in older adults, women are at higher risk than men, and falls and fall-related injuries in older adults are common. Complex, involving damage to the neuromuscular, peripheral and central nervous systems [18]. Falls can be divided into two parts: the onset of the fall and the recovery of the disrupted balance ability. Aging-related changes in proprioception, vision, and vestibular function have a negative impact on maintaining postural balance, leading to an increased risk of falls, from severe falls to The ability to recover also declines in old age, especially in older women, but this has nothing to do with changes in proprioceptive processes or muscle contraction in the central nervous system. On the other hand, these processes mainly occur after depolarization of muscle cell membranes (muscle force production and Muscle contraction), aging-related loss of muscle function involves quantitative and qualitative changes in skeletal muscle structure and function. This process is usually slow, and loss of function varies greatly between individuals. Decreases in muscle mass and function may represent The most significant and significant of all changes in the aging process is called sarcopenia. If these interventions can improve mobility and help reduce sarcopenia in the elderly, it will provide medical care. Huge cost savings on expenses.

**Reference**

1. Bhasin S, Travison TG, Manini TM, Patel S, Pencina KM, Fielding RA, et al. Sarcopenia definition: the position statements of the sarcopenia definition and outcomes consortium. Journal of the American Geriatrics Society 2020; 68(7): 1410-1418.
2. Wiedmer P, Jung T, Castro JP, Pomatto LC, Sun PY, Davies KJ, et al. Sarcopenia-molecular mechanisms and open questions. Ageing research reviews 2021; 65: 101200.
3. Yuan S, Larsson SC. Epidemiology of sarcopenia: Prevalence, risk factors, and consequences. Metabolism 2023; 155533.
4. Larsson L, Degens H, Li M, Salviati L, Lee YI, Thompson W, et al. Sarcopenia: aging-related loss of muscle mass and function. Physiological reviews 2019; 99(1): 427-511.
5. Cruz-Jentoft AJ, Gonzalez MC, Prado CM. Sarcopenia≠low muscle mass. European Geriatric Medicine 2023; 14(2): 225-228.
6. Joo SK, Kim W. Interaction between sarcopenia and nonalcoholic fatty liver disease. Clinical and Molecular Hepatology 2023; 29(Suppl): S68.
7. Zanker J, Sim M, Anderson K, Balogun S, Brennan‐Olsen SL, Dent E, et al. Consensus guidelines for sarcopenia prevention, diagnosis and management in Australia and New Zealand. Journal of Cachexia, Sarcopenia and Muscle 2023; 14(1): 142-156.
8. Cruz-Jentoft AJ, Landi F, Schneider SM, Zúñiga C, Arai H, Boirie Y, et al. Prevalence of and interventions for sarcopenia in ageing adults: a systematic review. Report of the International Sarcopenia Initiative (EWGSOP and IWGS). Age and ageing 2014; 43(6): 748-759.
9. Cruz-Jentoft AJ, Baeyens JP, 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 and ageing 2010; 39(4): 412-423.
10. Coletta G, Phillips SM. An elusive consensus definition of sarcopenia impedes research and clinical treatment: a narrative review. Ageing Research Reviews 2023; 101883.
11. Cruz-Jentoft AJ, Bahat G, Bauer J, Boirie Y, Bruyère O, Cederholm T, et al. Sarcopenia: revised European consensus on definition and diagnosis. Age and ageing 2019; 48(1): 16-31.
12. Cruz-Jentoft AJ, Kiesswetter E, Drey M, Sieber CC. Nutrition, frailty, and sarcopenia. Aging clinical and experimental research 2017, 29, 43-48.
13. Chen LK, Woo J, Assantachai P, Auyeung TW, Chou MY, Iijima K, et al. Asian Working Group for Sarcopenia: 2019 consensus update on sarcopenia diagnosis and treatment. Journal of the American Medical Directors Association 2020, 21(3), 300-307.
14. Ganapathy A, Nieves JW. Nutrition and sarcopenia-what do we know?. Nutrients 2020; 12(6): 1755.
15. Beaudart C, Dawson A, Shaw SC, Harvey NC, Kanis JA, Binkley N, et al. Nutrition and physical activity in the prevention and treatment of sarcopenia: systematic review. Osteoporosis International 2017; 28: 1817-1833.
16. Yamada M, Lee WJ, Akishita M, Yang M, Kang L, Kim S, et al. Clinical practice for sarcopenia in Asia: Online survey by the Asian Working Group for Sarcopenia. Archives of gerontology and geriatrics 2023; 115: 105132.
17. Stuck AK, Tsai LT, Freystaetter G, Vellas B, Kanis JA, Rizzoli R, et al. Comparing prevalence of sarcopenia using twelve sarcopenia definitions in a large multinational European population of community-dwelling older adults. The journal of nutrition, health & aging 2023; 27(3): 205-212.
18. Petermann‐Rocha F, Balntzi V, Gray SR, Lara J, Ho FK, Pell JP, et al. Global prevalence of sarcopenia and severe sarcopenia: a systematic review and meta‐analysis. Journal of cachexia, sarcopenia and muscle 2022; 13(1): 86-99.