

## ***Generalities of sarcopenia and its treatment through force training*** ***Generalidades de la sarcopenia y su tratamiento a través del entrenamiento de la fuerza***

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***Reception date:*** February 27, 2023

***Acceptance date:*** April 3, 2023

### ***ABSTRACT***

As a geriatric syndrome, sarcopenia is characterized by progressive, generalized loss and functional decline of skeletal muscles. It has an essential role in the pathogenesis of frailty in advanced ages, low muscle strength is its main parameter. This review aims to present some of its general characteristics, as well as the main benefits and peculiarities of strength training to prevent or counteract it. For this, a bibliographic search was carried out in databases such as Pubmed and SciELO, the Google Scholar search engine was obtained, reviewing 105 documents, of which 25 were referenced.

### ***RESUMEN***

Como síndrome geriátrico la sarcopenia se caracteriza por pérdida progresiva, generalizada y disminución funcional de la musculatura esquelética. Tiene un papel esencial en la patogénesis de la fragilidad en edades avanzadas, la baja fuerza muscular es su parámetro principal. En esta revisión se pretende exponer algunas de sus características generales, así como los principales beneficios y peculiaridades del entrenamiento de la fuerza para prevenirla o contrarrestarla. Para ello se realizó una búsqueda bibliográfica en bases de datos como Pubmed y SciELO, se utilizó el motor de búsqueda de Google Scholar, revisando 105 documentos, de los cuales 25 fueron referenciados.

### ***Keywords***

Sarcopenia; Muscle mass; Aging; Strength.

### ***Palabras clave***

Sarcopenia; Masa muscular; Envejecimiento; Fuerza.

## **INTRODUCTION**

The word muscle comes from the Latin *musculus*. These are considered the engines of the body. Properties such as excitability, contractility, elasticity allow them to generate force and movement, the nervous system being essential in their actions.

There are three types of muscle tissue that in turn form three types of muscles:

1- Smooth muscle tissue (described as visceral or involuntary). It is found in the walls of blood and lymphatic vessels, the digestive tract, respiratory tract, bladder, bile ducts, and uterus.

2- Cardiac muscle tissue (found only in the wall of the heart). It is not under voluntary control but by automation.

3- Skeletal muscle tissue (described as voluntary or striated muscle).

Precisely the latter represents a very high body mass, is responsible for postural retention and locomotion, and of course in the role of maintaining the physical activities of daily life. In addition, it has great responsibility in energy metabolism (large producer and consumer of energy).

Its detriment leads, among other problems, to a decrease in the activity of the immune system, altered metabolism, disability, injuries and fragility. Although some functions may arrive prematurely, aging is one of the main factors in the deterioration of its structure and decrease in its functions.

In the case of Cuba, the population aging rate exceeds 20%, it is estimated that by 2025 there will be 26% of people over 60 years of age and by 2030 there will be 3.3 million Cubans over 60 years of age. almost 30% of the total population, with men and women over 80 years of age also growing. As a perspective, there will be a decrease in absolute values of more than 200,000 people, moving the average age from 38 to 44 years (Fuentes 2020).

In this context, and with a deteriorated economy, effective ways must be sought that do not incur large costs for the health system. These have to provide adequate care and treatments to older adults, which guarantee a positive impact on quality of life indicators.

## **DEVELOPMENT**

### **1. Search methodology.**

A review of 105 documents was carried out, including articles, doctoral theses and master's theses through the Pubmed and SciELO databases, using the Google Scholar bibliographic search engine. 25 of these works were referenced, the search was carried out using English, Portuguese and Spanish, and 92% of the referenced works were published 5 or less years ago. Sarcopenia, muscle mass, aging and strength were used as search terms.

## 2.Sarcopenia. General characteristics.

Aging is associated with progressive degeneration and loss of health, and for Fuentes, Arrúe and Benítez (2021) “it constitutes a period of physiological decline in the person's development process where changes occur in physical condition, which reduce the capacity for effort and resistance to physical stress” (p.9). Therefore, the body structure made up of muscles will also be vulnerable, so its deterioration can cause relative disability.

As a general rule, life expectancy at birth increases in the world, and as Fuentes (2020) states, “*demographic evolution is accelerating a change in the age structure of the population*” (p.20). This will result, according to Dao et al. (2020) that “*health services will be under great pressure due to the increase in expenses for the care of this population*” (p. 717).

For some time now, skeletal muscle has been recognized as an important regulatory organ of other organs and itself thanks to the secretion of signaling molecules. These functions are given by the set of proteins and peptides that it produces during the course of muscle contraction to create force.

Mejías (2016) points out that:

*These biologically active molecules called myosins constitute a broad regulatory system that participate directly in almost all homeostatic processes of the muscle and organs remote from that muscle. The functions of skeletal muscle are modified by physical exercise and usually influence metabolic and endocrine function. As an endocrine organ, hormones produced in response to exercise give the muscle paracrine functions (p.120).*

The progressive decrease in skeletal muscles as we age is called sarcopenia, which represents a serious condition that accompanies us at this stage of life. This (in addition to the physiological decline of other components of physical fitness) plays an essential role in the pathogenesis of frailty in advanced ages.

Included since 2016 as a disease in the international classification of diseases and health-related problems of the World Health Organization (WHO), it is defined by Dent et al. (2018) in the International Clinical Practice Guidelines for Sarcopenia (ICFSR) as an age-related musculoskeletal disease, characterized by loss of muscle mass and function.

Since 1931 Mac-Donald Critchley referred to an inverse relationship between muscle mass and age. Years later, Nathan Sock detailed the pathophysiology of aging, and Irwin Rosenberg in 1989 proposed the term sarcopenia (from the Greek sarx carne and penia loss) to describe this clinical entity (Rendón and Osuna 2018).

Cruz-Jentoft (2017) believes that *“the term sarcopenia has gone from being hidden in a cluster of research articles to become, along with frailty, one of the fashionable terms in geriatrics, rapidly spreading to other specialties”* (p. 544).). In turn, Hernández and Licea (2017) state that to specify the term sarcopenia, *“it is necessary to understand the meaning of the word fragility. Different definitions have included physical, cognitive and psychosocial aspects, and most of them agree that it is a state related to aging”* (p.72).

The importance and interest aroused by the study of sarcopenia is caused by its association with functional decline and disability, and as a result a decreased quality of life, as well as, logically, increased mortality. Sarcopenic older adults have up to 5 times the risk of disability than those who are not sarcopenic (Vidarte et al. 2018)

As a syndrome, sarcopenia is characterized by a progressive and generalized decline in skeletal muscle mass and strength, increasing the risk of falls, fractures, physical disability and mortality. Shafiee et al. (2020) point out that *“although the topic of sarcopenia is very interesting for doctors and researchers, an operational definition that covers different ethnic backgrounds is still being developed”* (p.727).

On this topic, in 2010 the European Working Group on Sarcopenia in Older People (EWGSOP) released an operational definition for sarcopenia. At that time, the consensus was reached that the main predictor of this was low muscle mass.

Although at that time answers and solutions were not achieved to the global demand for the union of criteria and procedural models, it was a starting point for sarcopenia to gain greater attention in the medical community and demonstrated the need to delve into research to achieve advances in diagnosis and treatment.

Analyzing the definition provided by the EWGSOP, Frederick (2018) stated that *“Despite the fact that the term dynapenia more accurately describes the syndrome, the EWGSOP stated that a change in the established term sarcopenia may lead to further confusion”* (p.8).

In that same year, the researchers who form the European Working Group on Sarcopenia in Older People 2 (EWGSOP 2) met again, and updated the operational definition of sarcopenia, which uses *“low muscle strength as the main parameter”* (Cruz-Jentoft et al. 2018 p.3).

On this occasion, EWGSOP 2 stated that sarcopenia is probable when low muscle strength is detected. The diagnosis of sarcopenia is confirmed by the low quantity and quality of skeletal muscle mass. When there is low muscle strength, low quantity of skeletal muscle mass and quality, in addition to low physical performance, severe sarcopenia is present.

Similarly, the Asian Working Group for Sarcopenia (AWGS) agrees regarding the decrease in muscle strength and mass, in addition to a decrease in physical function, but established a minimum age according to the definition of elderly in each country.

Sarcopenia is not a state caused only by nutrient deficiency or a sedentary lifestyle, it is a natural consequence of aging, and coexisting with other diseases it can be accentuated. The loss of strength and muscle mass linked to age is universal and is observed even in older people who carry out intense sports activity.

For Musumeci (2017) “this process can be slowed down, interrupted and even reversed” (p. 2), although it is considered by many authors to be a biomarker of the aging process. Dent E et al. (2018) state that the prevalence of the disease in the population over 65 years of age is between 6 and 22%. In turn, Hernández, Arnold & Licea (2018) placed this prevalence at around 50% in people over 80 years of age.

It should be noted that the prevalence of sarcopenia is related to the diagnosis and this in turn obeys the particularities of the sample studied, the definitions used to diagnose it and methods to evaluate it (diagnostic criteria and detection strategies for sarcopenia proposed by the EWGSOP 2, the AWGS, the International Working Group on Sarcopenia, and the Foundation for the National Institutes of Health), so its incidence tends to vary. An example of this is that its prevalence is usually lower in older adults who live in the community compared to those who live in health institutions.

Sarcopenia for Rojas, Buckcanan and Benavides (2019) is a combination of genetic, physiological causes and environmental factors. According to Crushirira (2019):

*Genetic predisposition seems to be one of the factors that most influence the variability that exists between individuals in both muscle mass and function, so it would be logical to suspect that they contribute to the development of sarcopenia. Multiple genes have been related, such as those of the myostatin pathway, the vitamin D receptor, or the angiotensin-converting enzyme (p.75).*

According to Cruz-Jentoft (2017), “in clinical practice, three measurements are needed to diagnose sarcopenia: muscle mass, muscle strength and physical performance” (p.544).

Therefore, it is essential to measure or quantify these elements, considering what was stated by Rendón and Osuna (2018) where in “cases there is no decrease in weight or body mass index (BMI) due to an increase in fat mass, a condition which is called sarcopenic obesity” (p.24). This is related to an increase in severity and death.

This syndrome is also associated with a decrease in bone mineral density, in addition to being extraordinarily common in people with cardiovascular conditions, dementia, diabetes and respiratory disorders. (Dao et al. 2020)

It is classified according to its etiology as: primary (related to age and aging), secondary (occurs due to a systemic disease, mainly diseases that involve inflammatory processes such as neoplasms or organ failure. Other causes may be inadequate intake, anorexia and malabsorption) (Rojas et al. 2019).

According to its duration, it is classified as: acute (duration less than 6 months, commonly related to a secondary acute disease) and chronic (duration greater than 6 months, associated with progressive and chronic diseases. It represents a higher risk of mortality) (Rojas et al. al. 2019). The changes that occur in skeletal muscle with sarcopenia can then be reflected qualitatively and quantitatively. In this, the alterations that occur from a biochemical perspective are essential, where molecular changes are observed in both the myosin and actin chains, and, as expected, the decrease in skeletal muscle mass produces a decrease in metabolic expenditure and of course of protein replacement in the body.

It can be said that sarcopenia is then identified by a loss in the size and number of muscle fibers, causing a loss of muscle strength and also a deterioration in muscle quality, as well as physical performance. Furthermore, it shares similar characteristics to muscle atrophy and cachexia (these can be considered a component) but with differences in the biochemical processes that develop in them.

### **3. Strength training in older people.**

Previous research suggests that many of the risk factors for the appearance of sarcopenia (sedentary lifestyle, lack of physical activity, chronic diseases, some pharmacological procedures, malnutrition, anabolic resistance, infiltration of intermuscular adipose tissue, as well as decreased neuromuscular activation) are modifiable.

Therefore, once the pathophysiological mechanisms present in the development of sarcopenia are known, it is important to know what type of treatments should be present to prevent or counteract it. Among the different therapeutic actions are pharmacological measures (hormonal, biochemical or biological treatments), and non-pharmacological measures including nutritional measures and physical training.

In the latter, strength training must be included, as stated by Beckwee et al. (2019) High quality evidence for a significant effect of exercise on muscle mass and strength in the area of sarcopenia, prevention and treatment.

Strength training is one of the most effective methods to combat it, since even in the oldest people it is possible to increase muscle mass and strength, it also improves neuromuscular adaptation, and for Vidarte et al. (2018) *“strength levels, alone, can independently predict functional capacity in old age”* (p.172).

Since the 1990s, the study of strength training in older people has been gaining ground. The first studies investigated the characteristics of the evolution and behavior of strength taking into account age and sex. Padilla, Sánchez and Cuevas (2014) point out that *“strength training consists of the use of force to achieve muscle contraction, and thus increase anaerobic resistance, muscle strength and muscle size”* (p.983).

This training provides significant functional benefits, increases in cognitive and volitional abilities, as well as an improvement in general health, and in the opinion of Rubio and Gracia (2018) *“it probably constitutes in itself the most effective preventive measure to delay the appearance of sarcopenia and/or frailty and even to combat them when they have already appeared”* (p.135).

For Castro, Yazmin, Guzmán and García (2019) *“strength training can improve muscle strength itself, resistance and maintain lean mass, thereby optimizing the ability of older people to carry out activities of daily living.”* (p.64).

These noted benefits are related to the more intense functioning of the oxidative system and an improvement in resistance capacity, a product of the changes that occur at the skeletal muscle level, and the adaptations in the circulatory system that improve oxygen transport. In addition, it produces an increase in power and muscle mass thanks to the fact that it provokes the secretion of anabolic hormones.

It is important to note the study by Castro et al. (2019), in which they concluded that explosive strength training has a great influence on physical performance and reducing the risk of falls in this population. On the other hand, Lichtenberg, Stengel, Sieber & Kemmler (2019) believe that *“a combination of high-intensity resistance training and protein supplements is a favorable intervention strategy that reduces the risk of developing or progressing sarcopenia”* (p. 2183)

Strength training intensity is the training load relative to maximal dynamic strength (i.e., 1RM). Studies show similar strength gains between moderate to high intensity strength training

compared to moderate strength training. However, some meta-analyses and systematic reviews suggest greater effects of high-intensity resistance training on strength compared to moderate- and low-intensity strength training, as well as greater effects of moderate intensity on muscle strength compared with low-intensity strength training, even in frail older adults (Maren et al. 2019)

It is worth mentioning the study conducted by Kemmler et al. (2020) who, in 8 months periodized, constantly monitored and guided HIT-RT protocol combined with whey protein demonstrated a significant net gain of 3.3% (1.45 kg) in lean body mass. Where a comparable effect was observed for thigh lean mass (3.7%).

These latest trends in training against resistance at high speeds or power training with this type of population have been shown to be highly effective, since neuromuscular and muscle mass losses occur mainly in type II fibers, and it is necessary to carry out workouts that stimulate these fibers.

Although sometimes low-intensity, low-volume programs are the most convenient (in the beginning, for people with frailty or cardiovascular conditions), this training model of higher-intensity programs has even shown better results in functional tasks in older adults. compared to traditional training.

It should be noted that a strength training program designed appropriately for people over 60 years of age should contain an individualized and periodized approach that works towards 2-3 sets of 1-2 multi-joint exercises per major muscle group. Achieving intensities between 70 and 85% of 1 repetition maximum (1RM), 2-3 times per week, where power exercises are taken into account, executed at higher speeds in concentric movements and with moderate intensities (e.g., 40-60 % of 1RM) (Maren et al. 2019)

With this work methodology, results can be achieved after 2 weeks and an increase in strength is observed between 15 and more than 150% of the baseline, than in muscle mass (5–10% more). Training should be prolonged over time and is indicated even in very old people (Massanés, Navarro, Sacanella and López 2010).

Although there is solid evidence that supports the benefits of strength exercises to counteract age-related physiological decline such as sarcopenia, loss of mobility, chronic diseases and disability, there are absolute and relative contraindications in the prescription of this type of training.

Examples of absolute contraindications would be: decompensated arterial hypertension, unstable coronary heart disease, decompensated heart failure, uncontrolled arrhythmias, severe pulmonary hypertension, severe and symptomatic aortic stenosis, myocarditis, acute pericarditis, aortic dissection, Marfan syndrome and in people with active proliferative retinopathy. or non-proliferative diabetic retinopathy. Relative contraindications include significant risk factors for unstable coronary heart disease, diabetes at any age, low functional capacity, and people with pacemakers or defibrillators.

## CONCLUSIONS

We must point out that current studies show that compensating for muscle disuse through strength training is an indispensable tool to counteract sarcopenia, frailty and their effects on physical functioning. It acts very positively in the management of chronic diseases, providing improvements in quality of life indicators.

However, sarcopenia is not the only notable element that reveals the loss of strength in older people. We must keep in mind that aging affects the central nervous system and usually changes the properties of the neuromuscular system. This causes losses of motor units which decreases strength and power. Finally, it should be added that with the challenge of facing an older population, each country must develop its own methods for its treatment, based on those already established, but taking into account its own characteristics and medical potential.

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