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REVIEW ARTICLE

Physical activity for muscle rehabilitation in sarcopenia

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Abstract:

Background: sarcopenia is a progressive and generalized clinical condition associated with loss of mass, strength, and/or muscle function, impairing physical performance. The definition of sarcopenia is a dilemma, as several studies have been published in the last ten years by different societies. One of the most used definitions is the Guideline created by the European Working Group on Sarcopenia in Older People (EWGSOP) and updated in 2019 (EWGSOP2) to facilitate the understanding of sarcopenia and improve treatment proposals. This is the only definition supported by several international scientific societies for clinical practice and research in patients with sarcopenia. Treatment can be divided into non-pharmacological and pharmacological. There are no specific drugs approved for the treatment of sarcopenia. As for non-pharmacological interventions, physical exercise is the most effective intervention, especially resistance exercises. Nutritional intervention has a low level of evidence. **Objectives:** The objective of this article is to review data on the effect of physical exercise in the treatment of sarcopenia. **Method:** Reviews and systematic reviews were searched in different data sources, including PubMed, between the years 2010 and 2024, with the keywords (sarcopenia and non-pharmacological treatment; sarcopenia and exercise and sarcopenia). **Conclusions:** Physical exercise is the first-line treatment for sarcopenia. There is no drug released for the specific treatment of sarcopenia, and nutritional interventions have little clinical evidence in improving the quantitative and functional aspects of the muscular system in sarcopenic patients. Among the exercise modalities, resistive exercises alone showed the most significant benefit in the muscular rehabilitation of sarcopenic patients. Despite this, when evaluated with resistive exercise, aerobic and balance exercises brought additional benefits in some muscular functions. Nutritional intervention also appears to improve muscle strength when associated with resistive exercises. More studies are needed to elucidate the best physical activity program and whether other nutritional interventions could benefit the patient more.

Keywords: Sarcopenia; physical activity in sarcopenia; non-pharmacological treatment in sarcopenia.

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BACKGROUND

Sarcopenia is a term derived from the Greek expression "meat poverty" and was initially described in 1980(1). It is a progressive and generalized clinical condition associated with losing muscle mass, strength, or function, impairing physical performance(2). Bone mass peaks in youth, and over the years, there is a progressive decline, with muscle strength declining the fastest(2). Sarcopenia has a prevalence of 5-13% in patients aged 60-70 years and 11-50% in patients over 80 years of age(3).

Although it is more common in older populations, it can also occur in young people[4,5]. The risk of sarcopenia increases with age and with some associated factors such as multiple comorbidities and hospitalization. Some consequences of sarcopenia would be increased risk of falls, fractures, impaired ability to perform activities of daily living, association with heart disease, respiratory disease, cognitive impairment, mobility changes, decreased quality of life, loss of independence, increased patient cost to the healthcare system and mortality[5,6].

There are different definitions of sarcopenia made by societies over the years, which makes it difficult to unify scientific work and, therefore, a consensus on diagnosis, making treatment challenging. In 2016, sarcopenia was assigned an International Classification of Diseases code (ICD-10-CM M62.8)[5].

The most cited definition today is proposed by the European Working Group on sarcopenia in Older People (EWGSOP) and updated as EWGSOP2 in January 2019[2,7]. In clinical practice, EWGSOP2 states that a person with reduced strength, mass, or quality muscle will be diagnosed with sarcopenia. The decrease in muscle strength correlates more with unfavorable outcomes than the mass itself[8]. EWGSOP2 used defined cut-off points, and physical performance was used to assess the severity of the condition, according Table 1[3].

Table 1. Operational definition of sarcopenia

Probable sarcopenia is identified by criterion 1
Proven sarcopenia criterion 1 + criterion 2
Severe sarcopenia if criterion 1 + 2 + 3
(1) Low muscle mass
(2) Low muscle quality or quantity
(3) Low physical performance

Sarcopenia can occur acutely (such as in hospitalized patients) or chronically, can be found in both lean and obese patients (sarcopenic obesity), and can be primary (age-related) or secondary (some condition that triggers or worsens the sarcopenia process)[2,8].

Sarcopenia treatment can be divided into non-pharmacological and pharmacological. There is strong evidence recommending physical activity as a primary treatment for sarcopenia[2,9,10]. Physical activity significantly improves strength, mass, and balance. However, the number of clinical trials with groups of sarcopenic patients is still small, and the heterogeneity of the types of exercise, frequency, and duration makes it difficult to obtain consistent information[6,11,12,13]. Improvement in muscle strength and physical performance with resistance exercises exists, but the evidence on muscle mass gain is smaller and more controversial[14]. There are several proposals for resistive, aerobic, balance, and mixed exercises, but which program would be best is still unclear[15]. New work is needed for better evaluation[14]. The evidence for nutritional treatment is less consistent. A review of physical activity alone and physical activity and nutrition showed similar benefits in most physical functions[13].

DIAGNOSIS

Sarcopenia is diagnosed if there is a loss of strength, quality, or muscle mass, with the degree of loss of physical performance being a marker of severity. When all of these items are found, sarcopenia is considered severe[8].

The EWGSOP2 proposed a stepwise diagnosis (figure 1). Initially, patients to be investigated must be selected through clinical assessment, with a history of falls, weakness, slowness, self-report of muscle loss, and difficulties in activities of daily living or through the patient's completion of a questionnaire called SARC. -F, which evaluates five questions: strength, need for assistance when walking, difficulty getting up from a chair, climbing stairs, and falls[8]. If the screening is positive, the evaluation begins with measuring muscle strength (generally hand grip strength (¨hand Grip¨) or testing the time to get up from a chair five times (¨chair rise test¨). If the grip strength is lower than the reference values for gender (table 2), sarcopenia should be suspected[2].

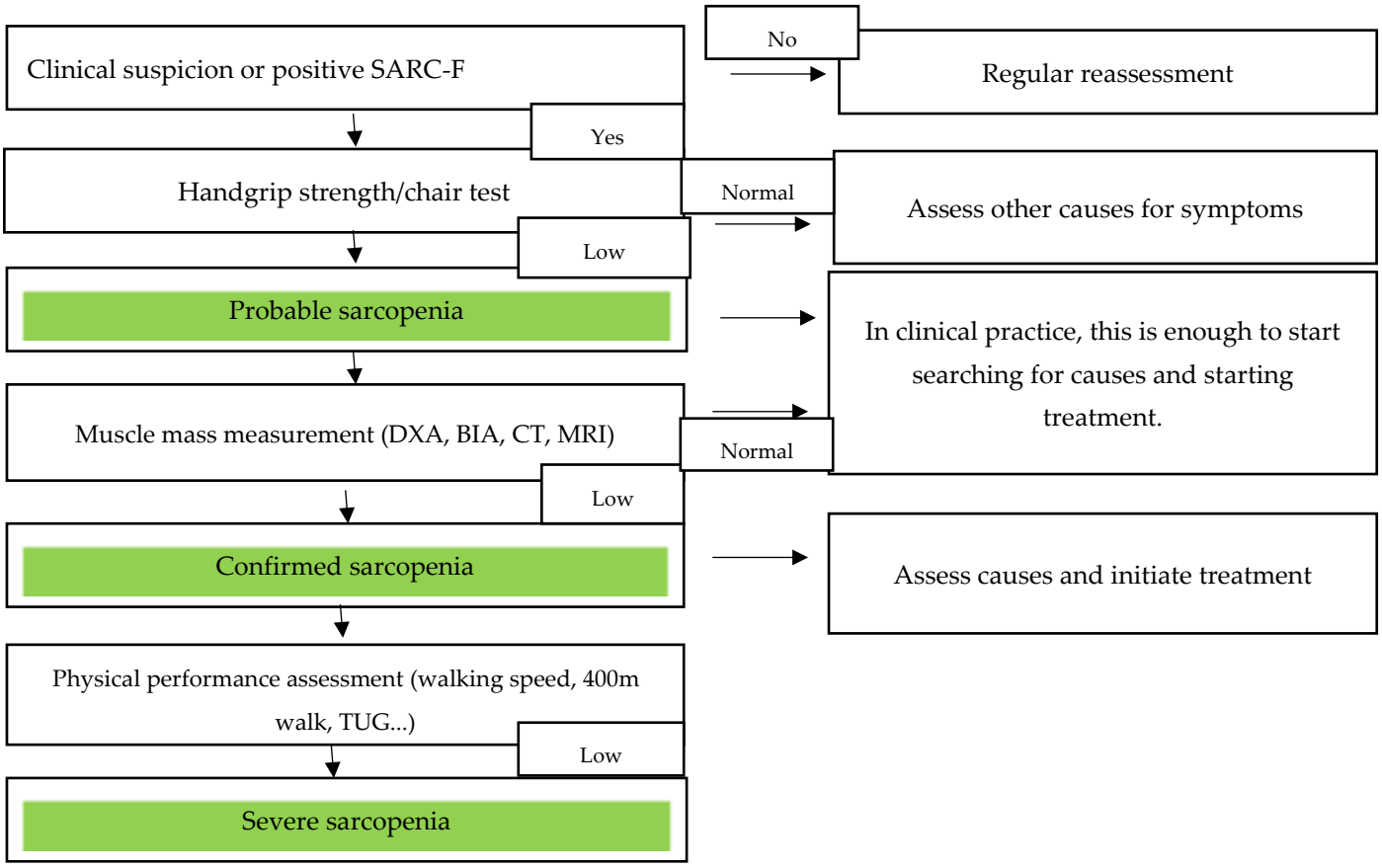

Figure 1. Algorithm for diagnosing sarcopenia - European Working Group on sarcopenia in Older People (EWGSOP2)

The assessment methods[13] available to obtain the results necessary for diagnosis are shown in Table 3. Muscle quality refers to an association between strength and muscle mass and some characteristics related to micro and macroscopic aspects of muscle architecture and composition are observed, such as the amount of inter and intramuscular fat, and muscle mass measurements are controversial and must be corrected for body size, BMI, or height[2]. Skeletal muscle mass can be measured via D3 creatine. A dilution, which measures the concentration of methyl-d3 creatine A in fasting morning urine after an oral dose of D3 creatine A; however, due to difficulties in carrying it out, DXA (dual-energy x-ray) or some alternative such as bioimpedance measurement (BIA), computed tomography (CT) or magnetic resonance imaging (MRI) is generally used[2].

Table 2. Reference values used for the diagnosis of sarcopenia

	Men	Women
Palm grip strength	<27	<16
Time to get up from a chair five times	>15 seg	
Appendicular skeletal muscle mass Corrected for height (Kg/m²)	<7	<5,5
Skeletal muscle mass	< 20 kg	< 15 kg
Walking speed (m/seg) (4m)	≤ 0,8	≤ 0,8
400 m walk test	Do not complete it or complete it in ≥ 6 minutes.	
Timed Up and GO (TUG)	≥20	≥20

Note: Values recommended by the European Working Group on Sarcopenia in Older People (EWGSOP2).

Physical performance assesses the severity of sarcopenia and helps with therapeutic decisions. It involves skeletal muscle function, the integrity of the central and peripheral nervous system, and their integration[8]. To evaluate physical performance, there are several resources. The most used is walking speed (the usual thing is to ask the patient to walk 4 meters and time it); speed below 0.8 seconds/meter shows impairment of physical performance. Other tests that can be used are walking speed over a distance of 400m (20 laps of 20 meters, with the possibility of two rest stops), the timed test to get up and walk 3 meters, return, and sit down again (timed UP and test - TUG), the five-repetition chair stand test, among others[2,8]. Plasma biomarkers for sarcopenia are not yet established, although the number of studies in this area is increasing.

Table 3. Outcomes and assessment tools for interventions in patients with physical frailty and sarcopenia

Data evaluated	**Evaluation methods**
Muscular strength	Handgrip strength Knee flexion/extension Peak expiratory flow
Physical performance	Usual walking speed Timed get up and test (TEST UP and GO)(TUG) Stair climbing power test Low energy for physical activity
Muscle function: Strength and performance	Handgrip strength Knee flexion/extension Peak expiratory flow + Physical performance assessment
Muscle mass and muscle function	Bioimpedance analysis Dual-energy X-ray absorptiometry Computed tomography MRI Total or partial body potassium ratio per fat-free soft tissue Anthropometric measurements + Assessment of muscle function
Activities of daily living Barthel index	Barthel index Lawton Index
Falls	Falls

Note: DELPHI process , adapted from Lozano-Montoya[13]

Sarcopenia treatment

The treatment of sarcopenia is still very controversial and encompasses pharmacological and non-pharmacological treatments. There are no specific drugs approved for the treatment of sarcopenia[2]. Physical activity would be the first-line treatment for non-pharmacological treatment since there is still no strong clinical evidence for nutritional treatment[2,16].

Yanjiao Shen and collaborators conducted a systematic review and a network meta-analysis to compare the types of physical activity and the benefits of different functions. They observed that the quality of the studies is low, and the degree of clinical evidence in most studies is moderate to low[15,17]. Resistance exercises with or without nutritional intervention and combined resistance, aerobic, and balance exercises are the most effective interventions to improve quality of life compared to usual care (health education, Nutrition alone)[15].

Table 4 presents a summary of the effects of interventions on critical results. Interventions are categorized and the outcome was assessed as better or worse compared to usual care/or other interventions (confidence interval (CI) did not cross null effect). The most effective, intermediate and least effective categories showed the effect of each intervention, while the quality of evidence showed whether the effect was reliable. Nutrition associated with resistance exercises or resistance exercises associated with balance exercises showed additional improvement in muscle strength[2,15,17].

Shen's work mainly analyzed patients over 60 years of age. It showed that for quality of life, physical exercise, regardless of the combination of nutrition, was superior compared to the absence of physical activity. Resistance exercises or resistance exercises combined with aerobics and balance were those that obtained the best results[15].

In the study by Sharma and collaborators, isolated resistive activity showed an improvement in body composition ($p = 0.001$), physical performance (p 0.001), postural stability ($p = 0.005$), and muscle strength (p 0.001) in elderly sarcopenic patients[17]. The work of Cruz–Jentoft showed that physical activity improves muscular strength and physical performance, but the gain in muscle mass does not have much clinical evidence[14].

Assessing hand grip strength and resistance exercises alone or combined with aerobic exercises was the best way to gain muscle strength (moderate quality of evidence). The combination of nutritional care added benefit in gaining strength[15].

Regarding physical performance, resistance exercises associated with balance exercises and analyzing gait speed showed superior benefits, with moderate quality of evidence (nutritional factors did not show additional benefits). Evaluating the TUG test, this association showed intermediate effectiveness with moderate quality of evidence. The test of getting up from a chair five times was moderately effective, with high-quality evidence. In this regard, isolated resistance exercise was moderately effective[15].

Nutritional therapy showed a little additional effect on the quality of life and physical performance. However, it improved muscle strength compared to exercise alone[15,16,18]. Some studies, even with a low level of evidence, describe the benefits of using essential amino acids such as leucine and β-hydroxy β-methylbutyric acid (HMB) to help with muscle mass and some muscle functions[14].

Table 4. Effects of different exercises on different physical functions

Categories		**Results**				
		High/moderate certainty of evidence		**Low/very low certainty of evidence**		
More effective		It is more effective than at least one immediately effective intervention		It may be more effective than at least one intervention of intermediate effectiveness		
Intermediate		It is inferior to the most effective and superior to the least effective		It may be lower than the most effective and higher than the least effective		
Less effective		No more convincing than usual care		It may not be similar to usual care		
Interventions		**Quality of life**	**Muscle strength**	**Physical performance**		
		Quality of life (SMD scale, 95%CI)	**Hand grip strength (MD 95%IC)**	**Gait speed (MD 95%IC)**	**UP and test (TUGT) (MD 95%CI)**	**Chair stand test (MD 95 %CI)**
Resistance	Resistance	1,11(0,54-1,68)	2,69 (1,78-3,61)	0,11 (0,04-0,18)	-0,83 (-1,68-0,02)	-0,4 (-2,21-1,41)
	Resistance + nutrition	1,07 (0,23-1,91)	3,93 (2,22-5,65)	0,13 (0,01-0,25)	-0,77 (-2,16-0,63)	-0,75 (-2,58-1,07)
Resistance and balance	Resistance and balance	0,02 (-0,55-0,58)	1,23 (-0,16-2,62)	0,16 (0,08-0,24)	-1,85 (-3,22-0,49)	-1,79 (-2,79- -0,6)
	Resistance and balance + nutrition	0,36 (-0,36-0,98)	4,19 (2,55-5,83)	0,16 (0,06-0,26)	-1,54 (-3,33-0,25)	
Endurance and aerobics	Endurance and aerobics	-0,07 (-0,52-0,38)	1,94(0,79-3,08)	0,1(-0,01-0,22)		-1,72 (-3,17- -0,27)
	Endurance and aerobic + nutrition	0,12 (-0,34-0,58)	3,02(1,64-4,4)	0,06(-0,06-0,18)		-2,28(-3,73- -0,83)
Resistance and aerobic and balance	Resistance and aerobic and balance	0,68(0,32-1,04)	0,2(-3,5-3,9)	0,04(-0,14-0,22)	-1,7(-3,99-0,59)	
	Resistance and aerobics and balance + nutrition		1,3(-0,14-2,73)			
Aerobics	Aerobic	0,58(-0,06-1,23)	0,46(-1,13-2,24)			
Balance	Balance		0,38(-2,32-3,09)			

Note: Adapted from Y.Shen et al(15). Bold text shows statistical significance. MD: mean different mean; SMD: standardized mean difference.

DISCUSSION

Sarcopenia is the primary substrate for physical frailty and occurs mainly in older people[13]. Muscle mass, along with muscle strength and quality, declines progressively with age, with an approximate rate of decline of 3-8% per decade, impairing physical performance and increasing morbidity and mortality, falls, hospitalization, and reducing individual independence[15].

The diagnosis of sarcopenia is based on the reduction in muscle mass, strength, and quality with impairment in physical performance. Several scientific societies have different diagnostic criteria for sarcopenia, making it difficult to compile studies to evaluate results and making the degree of clinical certainty of interventions low/moderate[2]. There is no approved drug for the treatment of sarcopenia. As for non-pharmacological treatment, studies on nutritional interventions showed low clinical evidence, being more significant in special situations such as hospitalized sarcopenic patients[13]. To improve the quality of evidence on the impact of nutritional intervention, more studies are needed[15].

The practice of physical activity was the most effective intervention in the treatment of sarcopenic patients[15]. When evaluated in isolation, resistive exercise was the one that had the greatest benefit in different muscular functions, with less clinical evidence about muscle mass gain and strong clinical evidence about the quality of life. However, the association of resistance exercises with balance or aerobic exercises showed superior gains, mainly in muscular strength and physical performance[16]. Nutritional therapy associated with resistance exercise showed additional benefits in muscular strength compared to isolated exercise(16). Balance exercises associated with resistive exercises seem to be the best combination to start a physical activity program[15,16].

CONCLUSION

With current data, it is concluded that as an isolated treatment, resistive exercises obtained the best results in all areas of physical assessment. However, the association of resistive, aerobic, and balance exercises with a targeted nutritional intervention can benefit muscle function and the patient. Further studies are needed to optimize the non-pharmacological approach to sarcopenia treatment, identifying a physical activity program optimized and personalized to the individual's needs and a targeted nutritional intervention.

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