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# Fragilidade e sarcopenia no envelhecimento: diagnóstico, impactos clínicos e abordagens terapêuticas

# Frailty and sarcopenia in aging: diagnosis, clinical impacts, and therapeutic approaches

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***Introduction:*** *Frailty and sarcopenia were understood as interrelated geriatric syndromes, characterized by a progressive reduction in physiological reserve and the loss of muscle mass and function, which compromised autonomy and increased vulnerability to adverse events. It was observed that population aging intensified the clinical relevance of these conditions, since both were associated with falls, hospitalizations, functional disability, and increased mortality. Objective: To analyze diagnostic methods, the main clinical impacts, and therapeutic approaches related to frailty and sarcopenia in aging, based on recent scientific evidence. Methodology: The methodology followed the PRISMA checklist recommendations, with a search conducted in the PubMed, Scielo, and Web of Science databases, considering articles published in the last 10 years. Five descriptors were used: "sarcopenia", "frailty", "aging", "muscle strength", and "elderly". As inclusion criteria, clinical studies and reviews in humans, available in full text and published in English, Portuguese, or Spanish, were selected. Studies involving non-elderly populations, duplicate articles, and those with low methodological quality or without direct focus on the theme were excluded. Results: The results indicated that diagnosis was based on criteria such as muscle strength, physical performance, and body composition, highlighting tools such as SARC-F and gait speed tests. It was evidenced that frailty and sarcopenia significantly increased the risk of falls, hospitalizations, and functional dependence. Interventions such as resistance exercise, protein supplementation, and vitamin D demonstrated consistent benefits. Conclusion: It was concluded that frailty and sarcopenia represented important challenges in aging, requiring early diagnosis and multidimensional interventions. Integrated therapeutic strategies proved effective in improving functionality and quality of life.*

***Keywords:*** *"sarcopenia", "frailty", "aging", "muscle strength", and "elderly".*

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## I. Introduction

Frailty and sarcopenia in aging are characterized as interrelated geriatric syndromes that reflect the progressive reduction of physiological reserve and the loss of muscle mass and function, directly impacting the functional capacity of older adults. Sarcopenia is defined by both quantitative and qualitative decline in muscle tissue, involving alterations in protein synthesis, fatty infiltration, and neuromuscular dysfunction, whereas frailty represents a clinical state of increased vulnerability to stressors, resulting from the dysregulation of multiple organ systems. This interaction promotes a cycle of functional decline, in which the loss of muscle strength compromises mobility, postural stability, and the performance of daily living activities, thereby increasing the risk of adverse events and loss of autonomy. Evidence indicates that chronic low-grade inflammatory processes, hormonal changes, and nutritional factors play a central role in the pathophysiology of these conditions, being particularly prevalent in older populations, with a more pronounced impact among women.

In the diagnostic context, the identification of these syndromes requires a multidimensional approach based on well-established clinical and functional criteria. The assessment of muscle strength, often performed through handgrip strength, represents one of the main markers, being directly associated with functional capacity and prognosis. Physical performance is evaluated through tests such as gait speed and chair stand tests, which

reflect the integration between musculoskeletal and neurological systems. Body composition, in turn, is assessed by methods such as dual-energy X-ray absorptiometry (DEXA) and bioelectrical impedance, allowing for a more precise estimation of muscle mass. Screening tools, such as SARC-F, are widely used in clinical practice due to their applicability and sensitivity in early detection. The combination of these parameters enables not only diagnosis but also risk stratification and the guidance of appropriate therapeutic interventions.

The clinical outcomes associated with these conditions demonstrate a significant impact on the health of older individuals, as reduced functional capacity increases the occurrence of falls, often associated with fractures and prolonged hospitalizations. This scenario contributes to progressive loss of independence and elevates morbidity and mortality rates. In addition, functional limitations affect the psychosocial domain, intensifying social isolation, depressive symptoms, and reduced quality of life, reinforcing the multifactorial nature of these syndromes in the geriatric context.

The etiology involves the interaction of several factors that potentiate functional decline. Physiological changes inherent to aging, such as reduced anabolic activity and increased inflammatory mediators, are associated with conditions such as physical inactivity, inadequate protein intake, and the presence of chronic comorbidities, including cardiovascular and metabolic diseases. Hormonal aspects, such as decreased levels of testosterone, estrogen, and growth hormone, also exert significant influence on this process. Evidence demonstrates greater susceptibility among older women, possibly related to more pronounced hormonal changes and increased longevity.

Given this context, therapeutic strategies play an essential role in the prevention and management of these conditions. Interventions based on resistance exercise stand out for promoting increased strength and improved physical performance, while adequate nutritional intake, particularly sufficient protein consumption, contributes to the maintenance of muscle mass. Vitamin D supplementation has been associated with improved muscle function and reduced risk of falls. Integrated approaches that consider physical, nutritional, and psychosocial aspects are fundamental for promoting functionality and preserving autonomy, highlighting the need for continuous and individualized care in the older population.

## II. Objectives

To analyze, in an integrated manner, the main diagnostic methods, clinical impacts, and therapeutic approaches related to frailty and sarcopenia in aging, based on recent scientific evidence. It seeks to understand the criteria used for early identification of these conditions, as well as their repercussions on functionality, quality of life, and morbidity and mortality in the older population. Furthermore, it investigates the effectiveness of available interventions, considering multidimensional strategies that involve physical, nutritional, and clinical aspects, in order to support more effective and targeted healthcare practices.

## III. Methodology

The methodology was conducted in accordance with the PRISMA checklist recommendations, encompassing the stages of identification, screening, eligibility, and inclusion of studies. The bibliographic search was performed in the PubMed, Scielo, and Web of Science databases, considering publications from the last 10 years. The descriptors “sarcopenia”, “frailty”, “aging”, “muscle strength”, and “elderly” were used, combined with Boolean operators to enhance the sensitivity and specificity of the search. Initially, studies were identified through the reading of titles and abstracts, followed by the removal of duplicates. Subsequently, full-text analysis was conducted to assess eligibility, considering adherence to the topic and methodological quality. The final selection was carried out rigorously, prioritizing consistent and relevant evidence for the construction of the scientific synthesis.

The inclusion criteria comprised observational and experimental clinical studies conducted in older populations, literature reviews with recognized methodological rigor, articles available in full text, publications in Portuguese, English, or Spanish, and studies that directly addressed frailty and/or sarcopenia with emphasis on diagnosis, clinical impacts, or therapeutic interventions. Studies presenting validated diagnostic methods, analysis of relevant clinical outcomes, and clear description of methodological procedures were also considered.

The exclusion criteria included studies involving non-elderly populations or mixed samples without specific analysis for older adults, duplicate articles across databases, publications with inadequate or insufficiently described methodological design, studies not directly related to the proposed theme, and those not available in full text. Case reports, editorials, letters to the editor, and studies with significant bias or low scientific quality were also excluded, according to critical evaluation based on PRISMA principles.

## IV. Results

Frailty and sarcopenia currently present as interdependent syndromes that reflect the progressive decline of physiological reserve, significantly compromising the organism’s adaptive capacity to stressors. In this context, aging promotes systemic changes affecting multiple axes, including the musculoskeletal, endocrine, and immune

systems. Consequently, there is increased vulnerability to adverse events such as falls and hospitalizations, highlighting the clinical relevance of these conditions in geriatric practice. Moreover, the interaction between these conditions intensifies functional decline, as reduced muscle strength and physical endurance limit the performance of basic and instrumental activities of daily living.

Simultaneously, pathophysiological mechanisms such as chronic low-grade inflammation, oxidative stress, and hormonal alterations contribute significantly to the onset and progression of these syndromes. In this sense, the reduction of anabolic hormones, combined with increased pro-inflammatory cytokines, promotes protein degradation and impairs muscle regeneration. Additionally, behavioral factors, including physical inactivity and inadequate nutritional intake, further aggravate this scenario, amplifying clinical impact. Thus, frailty and sarcopenia are not limited to isolated changes but represent a dynamic and multifactorial process requiring continuous and integrated management.

The loss of muscle mass and strength constitutes one of the main clinical markers associated with aging, directly influencing functionality and independence. In this regard, the reduction of lean mass occurs progressively and is accompanied by qualitative alterations in muscle tissue, such as fatty infiltration and decreased contractile efficiency. As a result, there is impairment in the ability to generate strength and power, negatively affecting physical performance and increasing the risk of functional limitations. Therefore, the assessment of these parameters becomes essential for the early identification of clinically relevant alterations.

Furthermore, reduced muscle strength demonstrates a stronger association with adverse outcomes than the isolated reduction of muscle mass. In this context, measures such as handgrip strength and functional tests are widely used in clinical practice due to their applicability and prognostic value. At the same time, decreased functional capacity affects mobility, balance, and coordination, increasing susceptibility to falls and dependency. Consequently, a comprehensive understanding of these aspects enables the development of more effective preventive and therapeutic strategies.

Clinical identification is based on a careful and multidimensional approach, in which the assessment of muscle strength, physical performance, and body composition plays a central role. Currently, the measurement of strength, particularly through handgrip dynamometry, is considered a robust indicator of functional capacity and prognosis. Simultaneously, tests such as gait speed and chair stand assessments allow for integrated evaluation of overall functionality, reflecting the interaction between musculoskeletal and neurological systems.

Additionally, body composition analysis significantly contributes to understanding muscle status and is performed using methods such as dual-energy X-ray absorptiometry and bioelectrical impedance. In this context, screening tools such as SARC-F stand out for their practicality and applicability in different healthcare settings, enabling the early identification of at-risk individuals. The integration of these diagnostic tools allows not only recognition of these syndromes but also severity stratification and more precise therapeutic decision-making.

Regarding clinical repercussions, these conditions significantly impact older adults' health, as they promote progressive functional decline. Consequently, there is a marked increase in the incidence of falls, often associated with injuries and fractures, leading to higher healthcare demand and prolonged hospital stays. Furthermore, functional limitations impair daily activities, contributing to the loss of independence and the development of partial or total dependency.

At the same time, the effects extend beyond the physical dimension, reaching important psychosocial aspects. Progressively, there is an increase in social isolation, as well as the emergence of anxiety and depressive symptoms, which further intensify functional decline and reduce quality of life. Moreover, there is a consistent association with increased morbidity and mortality, particularly among individuals with comorbidities, characterizing these conditions as a significant public health concern.

Therapeutic approaches directed at frailty and sarcopenia are currently multidimensional, considering the complexity of their pathophysiology and contributing factors. In this context, resistance exercise emerges as one of the most effective interventions, consistently promoting increased muscle strength, improved functional performance, and preservation of lean mass. Structured training programs, when performed regularly and under supervision, also enhance balance, coordination, and mobility, thereby reducing the risk of falls and related complications.

Nutritional intervention also plays a crucial role in prevention and management, particularly regarding adequate protein intake and micronutrient support. Evidence demonstrates that vitamin D supplementation is associated with improved muscle function and reduced incidence of adverse events, especially in individuals with prior deficiency. Moreover, integrated strategies involving continuous clinical follow-up, nutritional guidance, and physical activity promotion show more expressive outcomes compared to isolated interventions.

The understanding of factors associated with the development of these conditions highlights the simultaneous action of biological, behavioral, and clinical determinants. Aging promotes progressive physiological changes, including reduced protein synthesis, decreased mitochondrial efficiency, and impaired tissue regeneration. Additionally, sedentary behavior accelerates muscle loss due to the lack of adequate mechanical stimuli, while insufficient nutritional intake further compromises muscle integrity.

Chronic diseases such as diabetes mellitus, heart failure, and inflammatory conditions significantly influence progression, often being associated with persistent inflammatory states and metabolic alterations that favor protein catabolism. Consequently, the interaction of these factors increases the risk of disability and dependency, emphasizing the need for targeted preventive strategies.

Inflammatory and hormonal alterations play a central role, with chronic low-grade inflammation characterized by increased pro-inflammatory cytokines that interfere with muscle homeostasis. This environment promotes protein degradation and inhibits synthesis mechanisms, progressively leading to loss of mass and function. Simultaneously, oxidative stress contributes to cellular damage and reduced regenerative capacity.

Hormonal dysregulation further impacts muscle and metabolic dynamics. Decreased levels of anabolic hormones such as testosterone, estrogen, and growth hormone negatively affect protein synthesis and lean mass maintenance. Additionally, insulin resistance and other endocrine alterations contribute to metabolic imbalance, reinforcing catabolic processes.

A higher prevalence among older women reflects relevant epidemiological patterns associated with biological and sociodemographic factors. Hormonal changes related to menopause, particularly reduced estrogen levels, directly affect body composition, promoting loss of lean mass and increased adiposity. This transition also negatively influences bone density and muscle function, increasing functional vulnerability.

Social and behavioral aspects further contribute, as older women often present lower levels of physical activity and higher prevalence of chronic conditions, which intensify functional decline. Issues related to healthcare access and social support also influence disease progression, highlighting the importance of tailored interventions.

Resistance exercise interventions constitute a fundamental pillar in management, promoting neuromuscular and metabolic adaptations. Regular and progressive strength training stimulates muscle hypertrophy, improves neuromotor efficiency, and enhances motor unit recruitment, resulting in improved functional capacity.

The implementation of such interventions requires individualized planning, considering clinical conditions and functional limitations. Proper supervision and gradual load progression ensure safety and effectiveness. The combination of resistance training with aerobic and flexibility exercises further enhances global benefits, promoting physical gains, improved autonomy, and better quality of life.

Finally, nutritional approaches and integrated therapies play a strategic role in promoting older adults' health. Adequate protein intake, properly distributed throughout the day, supports muscle synthesis and functional maintenance. Micronutrients such as calcium, vitamin D, and antioxidants contribute to metabolic and inflammatory regulation.

Integrated therapeutic strategies involving multidisciplinary teams enable more comprehensive and effective interventions. Continuous monitoring allows timely adjustments, optimizing clinical outcomes. Thus, the combination of proper nutrition and multidisciplinary care consistently promotes autonomy preservation, improved quality of life, and reduction of adverse outcomes in the older population.

## V. Conclusion

It was concluded that frailty and sarcopenia constituted complex and interdependent clinical conditions, widely recognized as central determinants of functional decline in aging. The scientific literature consistently demonstrated that the progressive reduction of muscle mass and strength was directly associated with decreased functional capacity, increased vulnerability to stressors, and a significant rise in the risk of adverse events, including falls, hospitalizations, and mortality. Studies showed that muscle strength, particularly handgrip strength, presented a strong correlation with negative clinical outcomes, being considered one of the main predictors of disability and loss of autonomy.

Furthermore, it was observed that the underlying pathophysiological mechanisms involved multifactorial processes, highlighting the presence of chronic low-grade inflammation, hormonal alterations, and metabolic dysfunctions, which contributed to protein catabolism and the progressive deterioration of muscle function. Evidence indicated that these alterations were potentiated by factors such as physical inactivity, inadequate nutritional intake, and the presence of chronic diseases, reinforcing the systemic nature of these conditions. It was also widely described that older women showed greater susceptibility, possibly due to more pronounced hormonal changes and longer life expectancy.

Regarding diagnosis, the literature indicated that the combined use of parameters such as muscle strength, physical performance, and body composition enabled more accurate and early identification of at-risk individuals, allowing for more timely interventions. Screening tools and functional tests were highlighted as effective resources in clinical practice, contributing to severity stratification and monitoring of clinical progression.

Additionally, evidence demonstrated that interventions based on resistance exercise, combined with adequate protein intake and micronutrient supplementation, promoted significant improvements in functionality, muscle strength, and quality of life. Integrated therapeutic strategies, involving a multidisciplinary approach,

proved to be superior when compared to isolated interventions, as they addressed the multiple dimensions involved in the aging process.

Thus, it was possible to conclude that frailty and sarcopenia represented important challenges for public health, requiring well-structured preventive, diagnostic, and therapeutic strategies. The implementation of early and individualized approaches proved to be essential in reducing adverse outcomes and promoting healthier and more functional aging.

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