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SARCOPENIA IN BREAST CANCER PATIENTS: PREVALENCE, CLINICAL IMPACT, AND PRACTICAL APPROACHES TO ASSESSMENT

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ABSTRACT

Sarcopenia has emerged as a prevalent and clinically significant condition among breast cancer patients, characterized by loss of skeletal muscle mass accompanied by declines in muscle strength and physical performance. Increasing evidence indicates that sarcopenia occurs across all stages of breast cancer and throughout the treatment continuum, including at diagnosis, during active therapy, and into survivorship. Tumour-related metabolic alterations, systemic inflammation, anticancer treatments, physical inactivity, and inadequate nutritional intake collectively contribute to muscle depletion in this population. In breast cancer patients, sarcopenia has been consistently associated with poorer treatment tolerance, increased cancer-related fatigue, functional decline, and adverse clinical outcomes, even in individuals with preserved body weight or coexisting obesity. The reported prevalence of sarcopenia varies widely depending on patient characteristics, treatment phase, and assessment methodology, with pooled estimates approaching nearly half of affected patients in some cohorts. While imaging-based techniques such as computed tomography and positron emission tomography–computed tomography provide precise quantification of muscle mass and quality, their routine clinical use is limited by cost, accessibility, and resource constraints. Consequently, practical bedside tools including bioelectrical impedance analysis, anthropometric measurements, and functional performance tests have gained increasing attention as feasible options for screening and longitudinal monitoring. This narrative review synthesizes current evidence on the prevalence, pathophysiology, clinical and functional consequences, and assessment approaches for sarcopenia in breast cancer patients. Emphasis is placed on the dynamic nature of sarcopenia across the disease trajectory and the importance of early recognition, comprehensive assessment, and integration of muscle health evaluation into standard breast cancer care. Adoption of practical assessment strategies may facilitate timely interventions, optimize functional outcomes, and improve quality of life during and after cancer treatment.

KEYWORDS: Sarcopenia, Breast cancer, Cancer-related fatigue, Muscle mass and strength, Functional performance, Body composition.

INTRODUCTION

Sarcopenia is characterized by a gradual decline in skeletal muscle mass, accompanied by decreased muscle strength and physical performance. It has recently been recognized as a distinct clinical condition rather than an expected consequence of aging.[1] Tumour-induced metabolic alterations, systemic inflammation, reduced physical activity, and the catabolic effects of anticancer treatments all contribute to sarcopenia in cancer patients. It has been associated with negative clinical outcomes, including a shorter lifespan and increased treatment toxicity.[2]

In the particular clinical setting of breast cancer, the consequences of sarcopenia are especially relevant. Longer survival rates have been achieved through advances in early detection and treatment; however, systemic treatments like chemotherapy, radiation, and endocrine therapy cause significant physiological stress that can accelerate muscle wasting and decline in function.[3] Importantly, muscle loss in breast cancer patients can occur even without weight loss and may coexist with overweight or obesity, a condition known as sarcopenic obesity, which has been linked to poorer treatment tolerance and outcomes.[4]

The prevalence of sarcopenia among breast cancer patients has been reported to range from approximately 25% to over 50%, depending on patient characteristics, treatment phase, and diagnostic methodology, with pooled estimates around 32.5% in non-metastatic breast cancer cohorts.[5] Skeletal muscle mass and composition can be quantitatively assessed using image based methods such as dual-energy X-ray absorptiometry (DXA), computed tomography (CT), magnetic resonance imaging (MRI), ultrasonography, and positron emission tomography computed tomography (PET-CT). Among these, CT- and PET-CT–derived measurements are commonly employed in oncology to quantify muscle cross-sectional area at standardized anatomical landmarks, while MRI offers high-resolution assessment without radiation exposure.[6,7] However, factors like cost, accessibility, radiation exposure, and the requirement for specialized knowledge limit the routine clinical application of imaging-based muscle assessment.[8]

As a result, alternative assessment strategies have gained attention in clinical practice. Bioelectrical impedance analysis provides a non-invasive and practical method for estimating skeletal muscle mass and fat-free mass and is suitable for repeated measurements in clinical settings.[9] In addition, simple anthropometric measures such as calf circumference and mid-upper arm circumference offer low-cost screening tools that correlate reasonably with muscle reserves.[10] Contemporary diagnostic frameworks emphasise that sarcopenia is a multidimensional condition, and that assessment of muscle strength and physical performance is essential alongside muscle quantity.[11]

Sarcopenia has also been increasingly linked to cancer-related fatigue, one of the most prevalent and distressing symptoms experienced by breast cancer patients during and after treatment.[12] Reduced muscle mass and impaired muscle function may increase perceived exertion, limit physical capacity, and contribute to a cycle of inactivity and worsening fatigue, further compounding functional impairment.[13]

Despite increasing recognition of its clinical importance, sarcopenia remains under-assessed in routine breast cancer care, and significant variability exists in assessment approaches and timing across the treatment course. [5] A comprehensive understanding of sarcopenia in breast cancer, therefore, requires integration of data on prevalence, mechanisms, clinical and functional consequences, and feasible assessment strategies.

Accordingly, this narrative review aims to synthesize current evidence on sarcopenia in breast cancer patients, focusing on its prevalence, pathophysiology, impact on functional performance and cancer-related fatigue, and practical approaches to assessment using both imaging-based and bedside tools.

PATHOPHYSIOLOGY

Sarcopenia in breast cancer is a multifactorial condition arising from the combined effects of tumour-related biological processes, systemic inflammation, anticancer therapies, reduced physical activity, and inadequate nutritional intake. Unlike age-related sarcopenia, cancer-associated sarcopenia can develop rapidly and may be present even before initiation of treatment, indicating a direct influence of malignancy on skeletal muscle metabolism and homeostasis.[14]

Chronic systemic inflammation is a central mechanism contributing to muscle wasting in cancer. Tumour host interactions lead to sustained elevations in pro-inflammatory cytokines, including interleukin-6 and tumour necrosis factor-α, which promote muscle protein degradation and inhibit anabolic signalling pathways involved in muscle regeneration. These inflammatory mediators activate proteolytic systems and impair insulin-like growth factor-1 signalling, resulting in accelerated loss of muscle mass and strength. Such inflammation-driven muscle catabolism has been consistently associated with poor clinical outcomes across cancer populations, including breast cancer patients.[15]

Anticancer treatments further intensify sarcopenic processes through direct and indirect effects on skeletal muscle. Chemotherapy induces oxidative stress, mitochondrial dysfunction, and muscle fibre damage, leading to reductions in muscle mass and physical performance. In breast cancer, commonly used agents such as anthracyclines and taxanes have been associated with neuromuscular toxicity and functional decline. Radiotherapy may also contribute to muscle damage and

fibrosis, particularly when regional lymphatic and chest wall fields are irradiated. These treatment-related mechanisms explain the observed increase in sarcopenia prevalence during active cancer therapy.[16]

Endocrine therapy, a cornerstone in the management of hormone receptor–positive breast cancer, may also contribute to sarcopenia development. Estrogen plays an important role in maintaining muscle mass and strength by supporting protein synthesis and neuromuscular function. Estrogen deprivation caused by aromatase inhibitors or ovarian suppression can therefore accelerate muscle loss, particularly in postmenopausal women undergoing long-term treatment. Although these changes may occur gradually, their cumulative effect can result in clinically significant functional impairment.[17]

Behavioural factors, especially reduced physical activity, play a crucial role in the progression of sarcopenia among breast cancer patients. Treatment-related fatigue, pain, anxiety, and psychological stress often lead to prolonged inactivity, which promotes disuse muscle atrophy and reduces neuromuscular efficiency. This inactivity–fatigue cycle contributes to worsening muscle loss and diminished functional capacity, reinforcing sarcopenia during and after cancer treatment.[18]

Nutritional factors further influence the pathogenesis of sarcopenia. Cancer-related anorexia, chemotherapy-induced nausea, taste alterations, and gastrointestinal side effects commonly lead to inadequate energy and protein intake. Insufficient dietary protein limits muscle protein synthesis and impairs recovery from catabolic stress. In breast cancer patients with overweight or obesity, this muscle loss may be masked by preserved or excess fat mass, resulting in sarcopenic obesity and under-recognition of underlying muscle depletion.[19]

Importantly, sarcopenia is not defined solely by reduced muscle mass but also by impairments in muscle strength and physical performance. Declines in muscle quality, characterized by fatty infiltration and mitochondrial dysfunction, lead to reduced force generation and endurance. Contemporary consensus guidelines emphasize that assessment of sarcopenia must include evaluation of muscle strength and functional performance, as these parameters are directly linked to mobility, independence, and treatment tolerance in cancer patients.[1]

In summary, the pathophysiology of sarcopenia in breast cancer reflects a complex interaction of inflammatory, treatment-related, hormonal, behavioural, and nutritional factors. Understanding these underlying mechanisms highlights the importance of early screening and comprehensive assessment strategies that integrate muscle mass, strength, and physical performance across the breast cancer treatment course.

PREVALENCE OF SARCOPENIA IN BREAST CANCER

The prevalence of sarcopenia among breast cancer patients varies widely across studies, reflecting differences in patient populations, disease stage, treatment phase, and assessment methodology. Unlike cancers traditionally associated with evident cachexia, sarcopenia in breast cancer is often underdiagnosed, as it may occur in patients with preserved body weight or coexisting overweight and obesity.

Sarcopenia is increasingly recognized as a common and clinically relevant condition in women with breast cancer. Evidence from a comprehensive systematic review and meta-analysis encompassing 5,497 patients across six studies indicates that the overall prevalence of sarcopenia is approximately 45%, underscoring the high burden of muscle loss in this population. Notably, sarcopenia was observed across a broad age range and in both non-metastatic and metastatic disease, suggesting that muscle depletion is not confined to advanced cancer stages. The substantial variability in reported prevalence further reflects differences in patient characteristics and assessment approaches, highlighting the need for greater consistency in identifying sarcopenia in breast cancer care.[20]

Population-specific studies further demonstrate variability in sarcopenia prevalence among women with breast cancer. An open-access observational study using detailed body composition assessment reported that 34% of patients had sarcopenia at the time of diagnosis, while 37% exhibited low skeletal muscle radio density, reflecting impaired muscle quality. Sarcopenia and low muscle radio density showed distinct associations with treatment exposure and body mass index, illustrating that reduced muscle quantity and quality can coexist across a wide spectrum of body weights. Importantly, greater muscle depletion was observed among patients receiving systemic therapy during follow-up, supporting the concept that treatment-related metabolic stress contributes to progressive muscle loss over the course of breast cancer care.[21]

The method used to assess sarcopenia significantly influences reported prevalence. Imaging-based techniques, such as computed tomography or positron emission tomography computed tomography typically yield higher prevalence estimates compared to anthropometric or bioelectrical impedance based approaches, as imaging can detect subtle reductions in muscle quantity and quality. However, practical tools such as bioelectrical impedance analysis have demonstrated reasonable agreement with imaging methods and offer a feasible alternative in routine clinical practice, particularly when repeated assessments are required.[22]

Timing of assessment along the breast cancer treatment course also plays a critical role. Several studies have

shown that sarcopenia prevalence increases during chemotherapy and radiotherapy, likely due to cumulative treatment toxicity, physical inactivity, and inadequate nutritional intake. Longitudinal evidence suggests that patients who are non-sarcopenic at baseline may develop sarcopenia during active treatment, highlighting the dynamic nature of muscle loss in this population.[23]

By comparing results across study groups, sarcopenic breast cancer patients were found to be older and to have significantly lower body weight than non-sarcopenic patients and controls. However, sarcopenia was not confined to elderly individuals, and a meaningful proportion of cases were identified among younger patients. This observation challenges the traditional view of sarcopenia as an age-restricted condition and underscores the need for routine assessment of muscle mass and function irrespective of chronological age, particularly in patients undergoing intensive systemic therapies.[24]

Overall, existing evidence indicates that sarcopenia is highly prevalent among breast cancer patients and that its occurrence is influenced by assessment modality, patient characteristics, and treatment exposure. These findings underscore the importance of early screening and longitudinal monitoring of muscle health to better identify patients at risk for functional decline and adverse clinical outcomes.[5]

Sarcopenia has emerged as an important predictor of adverse clinical and functional outcomes in breast cancer patients. Beyond its association with reduced muscle mass, sarcopenia reflects a broader decline in physiological reserve that compromises physical function, increases symptom burden, and negatively influences treatment tolerance. Increasing evidence suggests that sarcopenia should be viewed not merely as a body composition abnormality but as a clinically meaningful condition with direct implications for patient care.[20]

From a clinical perspective, sarcopenia has been consistently associated with poorer treatment tolerance and an increased risk of therapy-related complications in cancer patients. A systematic review and meta-analysis of breast cancer demonstrated that sarcopenic patients were significantly more likely to experience severe chemotherapy-related toxicities compared with non-sarcopenic individuals, suggesting that impaired skeletal muscle status compromises tolerance to systemic therapies.[3] Similarly, observational data from metastatic breast cancer cohorts found that sarcopenia predicted greater chemotherapy toxicity and adverse clinical profiles among women receiving capecitabine. These findings underscore the prognostic relevance of skeletal muscle depletion across oncology settings and support the integration of muscle assessment into clinical practice to better anticipate and manage treatment-related complications.[25]

Functional impairment is a well-established consequence of sarcopenia in breast cancer patients, as reduced muscle mass is accompanied by declines in muscle strength and physical performance that directly affect mobility and independence. In female breast cancer survivors, low handgrip strength and slow gait speed, core components of sarcopenia, have been documented and used alongside muscle mass measures in defining sarcopenia, indicating that impaired strength and performance are common and clinically relevant in this population.[26] Furthermore, performance based measures such as gait speed, grip strength, and the Short Physical Performance Battery have been shown to predict subsequent functional decline in women with breast cancer, underscoring the importance of incorporating these metrics into routine assessment to capture the full impact of muscle loss beyond mass alone.[27]

Cancer-related fatigue (CRF) represents one of the most clinically significant symptom-related consequences associated with sarcopenia in breast cancer patients. CRF is highly prevalent, often persistent, multifactorial in origin, and frequently shows limited response to pharmacological interventions. Evidence from a systematic review and meta-analysis indicates that impairments in muscle strength and physical function, rather than body composition alone, are key objective contributors to fatigue severity in cancer populations. Lower handgrip strength, knee extensor strength, and poorer sit-to-stand performance were consistently associated with higher fatigue levels, suggesting that reduced muscular capacity increases the perceived effort required for daily activities and limits functional reserve. These findings reinforce the close interplay between sarcopenia, functional impairment, and fatigue, and support the integration of performance-based muscle assessments into the routine evaluation of breast cancer patients experiencing CRF.[28]

The relationship between sarcopenia and fatigue appears to be bidirectional. Muscle loss contributes to reduced physical capacity and increased fatigability, while fatigue leads to decreased physical activity, further accelerating muscle wasting. This cycle reinforces functional decline and may persist even after completion of active treatment. Exercise-based interventions targeting muscle strength and endurance have been shown to mitigate fatigue and improve functional outcomes, supporting the biological link between muscle health and symptom burden.[29]

Imaging-based assessments further support the relationship between sarcopenia and adverse outcomes. Studies utilizing computed tomography or PET-CT derived muscle indices have demonstrated that reduced muscle cross-sectional area and increased muscle depletion are associated with poorer physical performance and increased treatment-limiting toxicity. These findings suggest that imaging-based measures of

sarcopenia capture clinically relevant changes in muscle quality that translate into functional impairment.[30]

Importantly, the clinical consequences of sarcopenia are not limited to older patients or those with advanced disease. Younger breast cancer patients and those with early-stage disease may also experience sarcopenia related functional decline, particularly during intensive systemic therapy. This challenges the traditional perception of sarcopenia as an age-related condition and supports the need for routine muscle assessment across all age groups and stages of breast cancer.[31]

Sarcopenia is strongly linked to poor clinical outcomes, impaired functional performance, and increased cancer-related fatigue in breast cancer patients, according to the collective evidence. These results highlight the significance of early detection and comprehensive assessment of sarcopenia, including evaluations of muscle mass, strength, and performance to better predict risk and direct supportive interventions in addition to cancer treatment.[1]

SARCOPENIA OVER THE COURSE OF TREATMENT FOR BREAST CANCER

Sarcopenia in breast cancer is a dynamic condition that can evolve across different phases of the disease and its treatment. Evidence indicates that sarcopenia may be present at diagnosis, even before initiation of therapy, reflecting the metabolic and inflammatory burden imposed by the malignancy itself. Early identification of sarcopenia at baseline is clinically relevant, as pre-treatment muscle depletion has been associated with poorer tolerance to systemic therapy and unfavorable outcomes.[32]

During active cancer treatment, particularly chemotherapy and radiotherapy, the prevalence and severity of sarcopenia tend to increase. Systemic therapies exacerbate muscle catabolism through cumulative metabolic stress, treatment-related toxicities, reduced nutritional intake, and prolonged physical inactivity. Longitudinal data suggest that patients who are non-sarcopenic at baseline may develop sarcopenia during treatment, highlighting the importance of repeated muscle assessment rather than reliance on a single time point.[33]

Endocrine therapy represents a prolonged treatment phase in hormone receptor–positive breast cancer and may contribute to gradual muscle loss over time. Although the effects of endocrine therapy on muscle mass are less acute compared to chemotherapy, estrogen deprivation has been associated with declines in muscle strength and physical performance, particularly in postmenopausal women. These changes may become clinically apparent during long-term follow-up and survivorship.[34]

In the survivorship phase, sarcopenia may persist or progress in the absence of targeted interventions. Residual treatment-related fatigue, reduced physical activity, and ongoing hormonal therapy contribute to sustained muscle impairment. Survivors with sarcopenia often experience long-term functional limitations, reduced quality of life, and increased risk of comorbidities, underscoring the need for continued monitoring beyond completion of active treatment.[35]

Overall, the information that currently exists shows that sarcopenia is a process that involves diagnosis, treatment, and survival instead of being limited to a single stage of breast cancer management. This highlights the significance of adaptable, long-term evaluation techniques that can support prompt intervention throughout all stages of care and take into consideration actual clinical timelines.

CLINICAL IMPLICATIONS AND FUTURE DIRECTIONS

Recognition of sarcopenia as a clinically meaningful condition in breast cancer has important implications for patient management. Early identification of sarcopenia enables risk stratification and may inform individualized treatment planning, supportive care strategies, and rehabilitation referrals. Incorporating routine muscle assessment into oncology practice has the potential to improve functional outcomes, reduce symptom burden, and enhance treatment tolerance.[21]

Exercise based interventions have emerged as one of the most effective strategies to mitigate sarcopenia and its associated consequences. Open-access evidence supports the role of combined resistance and aerobic exercise in improving muscle mass, muscle strength, and cancer-related fatigue among breast cancer patients and survivors. These interventions are feasible, safe, and associated with improvements in physical function and quality of life, supporting their integration into comprehensive cancer care programs.[36]

Nutritional support represents another key component of sarcopenia management. Adequate protein intake is essential for muscle maintenance and recovery, particularly during periods of heightened metabolic stress. Although nutritional interventions alone may be insufficient to reverse sarcopenia, their combination with structured exercise programs is likely to yield greater clinical benefit. Future research should focus on defining optimal multimodal intervention strategies tailored to breast cancer populations.[19]

Despite growing evidence, several gaps remain in the current literature. There is a need for standardized diagnostic criteria specific to breast cancer populations, greater representation of younger patients and diverse ethnic groups, and more longitudinal studies examining muscle changes across the treatment continuum. In resource-limited settings, further validation of practical

assessment tools such as bioelectrical impedance analysis and anthropometry is required to support widespread implementation.[22]

CONCLUSION

Sarcopenia is a prevalent and clinically significant condition among breast cancer patients, affecting muscle mass, physical function, and symptom burden across the treatment continuum. Accumulating evidence demonstrates that sarcopenia is associated with poorer treatment tolerance, increased cancer-related fatigue, and functional decline, underscoring the importance of early recognition and comprehensive assessment. Practical, bedside-friendly tools such as bioelectrical impedance analysis, anthropometric measurements, and functional performance tests provide feasible options for routine screening and longitudinal monitoring in clinical practice. Integrating sarcopenia assessment into standard breast cancer care pathways may enable timely supportive interventions, optimize functional outcomes, and ultimately improve quality of life during survivorship as well as active treatment.

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