International Journal of Innovative Technologies in Social Science

e-ISSN: 2544-9435

Operating Publisher
SciFormat Publishing Inc.
ISNI: 0000 0005 1449 8214

2734 17 Avenue SW,
Calgary, Alberta, T3E0A7,
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ARTICLE TITLE	BODY COMPOSITION ASSESSMENT AS A TOOL FOR MONITORING DISEASE ACTIVITY AND TREATMENT EFFECTS IN INFLAMMATORY RHEUMATIC DISEASES: A NARRATIVE REVIEW
DOI	https://doi.org/10.31435/ijitss.1(49).2026.5077
RECEIVED	08 January 2026
ACCEPTED	12 March 2026
PUBLISHED	23 March 2026
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BODY COMPOSITION ASSESSMENT AS A TOOL FOR MONITORING DISEASE ACTIVITY AND TREATMENT EFFECTS IN INFLAMMATORY RHEUMATIC DISEASES: A NARRATIVE REVIEW

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ABSTRACT

Background: Inflammatory rheumatic diseases are systemic conditions associated not only with joint inflammation but also with significant alterations in body composition, including loss of lean mass, increased fat mass, and the development of rheumatoid cachexia or sarcopenic obesity. These changes are often independent of body weight or body mass index (BMI) and contribute to functional impairment, increased cardiometabolic risk, and worse clinical outcomes. Despite their clinical relevance, body composition abnormalities remain underrecognized in routine rheumatology practice.
Aim: The aim of this narrative review was to summarize current evidence on the pathophysiology, assessment methods, diagnostic criteria, prevalence, clinical significance, and therapeutic implications of body composition abnormalities in inflammatory rheumatic diseases.
Material and methods: A narrative review of the literature published between 2004 and 2025 was conducted. Relevant studies, systematic reviews, and clinical guidelines addressing body composition in rheumatoid arthritis, spondyloarthritis, psoriatic arthritis, systemic lupus erythematosus, and other connective tissue diseases were analyzed. Particular attention was given to assessment methods (anthropometry, BIA, DXA, CT, MRI), diagnostic criteria for sarcopenia and cachexia, and the relationship between body composition, disease activity, and treatment. This review was conducted as a narrative synthesis without formal systematic review methodology or quality assessment.
Results: Chronic systemic inflammation, physical inactivity, pain, and pharmacotherapy (especially long-term glucocorticoid use) contribute to muscle catabolism, fat redistribution, and the development of unfavorable body composition phenotypes. Sarcopenia prevalence ranges from approximately 15–40% in rheumatoid arthritis and 10–20% in systemic lupus erythematosus. Reduced lean mass and increased visceral adiposity are associated with higher disease activity, greater disability, poorer quality of life, and increased mortality. Advanced assessment techniques such as DXA and imaging modalities allow early detection and monitoring, while effective inflammation control with targeted therapies may partially improve lean mass.
Conclusions: Body composition abnormalities are common and clinically significant systemic manifestations of IRDs. Routine assessment using appropriate screening and confirmatory methods may improve risk stratification, support personalized management, and help prevent functional decline and metabolic complications. Integration of body composition evaluation into standard disease monitoring may contribute to more comprehensive and patient-centered care.

KEYWORDS

Inflammatory Rheumatic Diseases, Body Composition, Sarcopenia, Cachexia, Sarcopenic Obesity

CITATION

Wiktor Daniszewski, Jakub Rodziewicz, Viktoria Kretschmer, Magdalena Baranowska, Ewa Sobolewska, Markowski Daniel, Zuzanna Dynowska, Dominik Poszwa, Patryk Kondracki, Wiktoria Knobelsdorf. (2026) Body Composition Assessment as a Tool for Monitoring Disease Activity and Treatment Effects in Inflammatory Rheumatic Diseases: a Narrative Review. *International Journal of Innovative Technologies in Social Science*. 1(49). doi: 10.31435/ijitss.1(49).2026.5077

1. Introduction

Inflammatory rheumatic diseases (IRDs), including rheumatoid arthritis, spondyloarthritis, and systemic connective tissue disorders, are traditionally characterized by chronic joint inflammation and progressive structural damage. However, increasing evidence indicates that these conditions exert systemic effects extending beyond the musculoskeletal system. Chronic inflammation, reduced physical activity, pain, and long-term pharmacotherapy contribute to profound metabolic and functional alterations, particularly affecting skeletal muscle and adipose tissue (Letarouilly et al. 2021; Tournadre et al. 2019). Patients with IRDs frequently develop unfavorable body composition phenotypes such as reduced lean body mass, increased fat mass, and altered fat distribution. These changes may occur even in individuals with normal or elevated body mass index (BMI), leading to clinical entities such as rheumatoid cachexia and sarcopenic obesity. Importantly, such abnormalities are associated with decreased physical performance, increased disability, higher cardiometabolic risk, and poorer long-term outcomes (Letarouilly et al. 2021; Baker et al. 2022). Despite their clinical significance, body composition disturbances remain underdiagnosed in routine practice, as standard assessment often relies on body weight or BMI alone. Advances in measurement techniques, including bioelectrical impedance analysis (BIA), dual-energy X-ray absorptiometry (DXA), and imaging-based methods, enable more accurate evaluation of muscle and fat compartments. A comprehensive understanding of the mechanisms, prevalence, and clinical implications of body composition abnormalities may support earlier detection and more holistic management of patients with IRD (Letarouilly et al. 2021; Shepherd et al. 2017).

Research problems

1. Are the components of devices in rheumatic diseases underestimated in routine practice, given the existence of anthropometric indicators such as BMI?
2. What pathophysiological mechanisms and effects (inflammation, risk mitigation, pharmacological treatment) are responsible for the development of sarcopenia, rheumatoid cachexia, and sarcopenic risk in IRD?
3. Can body composition assessment provide additional prognostic information and complement standardized testing for disease and infection?

Research hypotheses:

1. Body composition abnormalities, including reduced lean mass and increased fat mass, are common in inflammatory rheumatic diseases and may occur despite normal or elevated BMI (Letarouilly et al. 2021; Baker et al. 2022).
2. Higher inflammatory activity is associated with muscle loss and adverse fat distribution, while effective anti-inflammatory treatment may partially improve lean mass (Letarouilly et al. 2021; Mena-Vázquez et al. 2025).
3. Unfavorable body composition is associated with worse functional status, higher disease burden, and increased risk of adverse clinical outcomes in patients with inflammatory rheumatic diseases (Baker et al. 2022; Ouyang et al. 2025).

2. Research materials and methods

2.1 Search strategy

A literature search was conducted in PubMed/MEDLINE, Scopus, and Google Scholar to identify relevant publications on body composition in inflammatory rheumatic diseases. The search included articles published between January 2004 and March 2025. Keywords and their combinations included: rheumatoid arthritis, spondyloarthritis, systemic lupus erythematosus, body composition, sarcopenia, cachexia, sarcopenic obesity, DXA, bioelectrical impedance, CT, MRI, glucocorticoids and disease activity. Reference lists of selected articles were also screened to identify additional relevant studies.

2.2 Selection criteria

Original research articles, systematic reviews, meta-analyses, and clinical guidelines published in English were included. Studies focusing on adult patients with inflammatory rheumatic diseases and addressing body composition, its assessment, clinical implications, or treatment effects were considered eligible. Case reports, conference abstracts without full text, and studies not directly related to inflammatory rheumatic diseases or body composition were excluded.

2.3 Data Collection

Relevant data were extracted manually from eligible studies, including study design, population characteristics, methods of body composition assessment, key findings related to prevalence, pathophysiology, clinical outcomes, and treatment effects. The collected information was synthesized narratively to provide a comprehensive overview of the current evidence.

3. Pathophysiology of Body Composition Alterations in Inflammatory Rheumatic Diseases

Alterations in body composition observed in IRDs result from a complex interaction between chronic systemic inflammation, reduced physical activity, and treatment-related metabolic effects. These conditions promote a characteristic phenotype including reduced lean body mass (LBM), increased fat mass, and the development of rheumatoid cachexia or sarcopenic obesity, even in patients with normal BMI (Letarouilly et al. 2021; Shepherd et al. 2017).

3.1 Chronic inflammation and muscle catabolism

Persistent systemic inflammation plays a central role in muscle wasting in IRDs. Pro-inflammatory cytokines such as tumor necrosis factor-α (TNF-α), interleukin-6 (IL-6), and interleukin-1β activate proteolytic pathways, particularly the ubiquitin-proteasome system, leading to accelerated muscle protein degradation (Tournadre et al. 2019; Bonaldo et al. 2013). TNF-α additionally inhibits muscle protein synthesis through suppression of the insulin-like growth factor-1/Akt/mTOR signaling pathway, thereby shifting muscle metabolism toward a catabolic state (Bonaldo et al. 2013). Elevated IL-6 levels have been associated with reduced muscle mass and strength, as well as increased fatigue and functional decline in patients with rheumatoid arthritis and other IRDs (Tournadre et al. 2019). Chronic inflammation also promotes mitochondrial dysfunction and increased oxidative stress within skeletal muscle, further impairing muscle regeneration and contractile function (Tournadre et al. 2019). In parallel, inflammatory mediators contribute to alterations in adipose tissue distribution. Cytokine-induced lipolysis and impaired lipid oxidation promote the accumulation of visceral fat and ectopic fat deposition within muscle (myosteatosis), which further exacerbates insulin resistance and systemic inflammation (Baker et al. 2022, Ferguson et al. 2021). This bidirectional relationship between adiposity and inflammation creates a self-perpetuating cycle that accelerates functional deterioration.

3.2 Physical inactivity, pain and functional limitation

Reduced physical activity represents another major contributor to unfavorable body composition changes. Joint pain, stiffness, fatigue, and fear of movement lead to sedentary behavior, which accelerates muscle atrophy and reduces aerobic capacity (Sveaas et al. 2014). Even short periods of reduced activity have been shown to decrease muscle protein synthesis and promote anabolic resistance in chronic inflammatory conditions (Wall et al. 2016). Observational studies demonstrate that patients with active rheumatoid arthritis or axial spondyloarthritis exhibit significantly lower levels of physical activity compared with healthy controls, which correlates with lower lean mass and poorer physical performance (Ceolin et al. 2025; Sveaas et al. 2014). Functional impairment further reinforces this process. Muscle weakness, joint damage, and reduced mobility limit participation in daily activities, leading to progressive deconditioning and increased fat accumulation (Baker et al. 2022). Importantly, reduced muscle mass is independently associated with disability, lower quality of life, and increased risk of frailty and falls in IRDs (Ceolin et al. 2025).

3.3 Impact of pharmacotherapy

Pharmacological treatment may both negatively and positively influence body composition. Long-term glucocorticoid therapy is a well-recognized risk factor for muscle loss and adverse fat redistribution. Glucocorticoids stimulate muscle proteolysis, inhibit protein synthesis, and induce steroid myopathy, particularly affecting proximal muscles (Schakman et al. 2013). They also promote central adiposity, insulin resistance, and dyslipidemia, contributing to the development of sarcopenic obesity and increased cardiometabolic risk (Güler-Yüksel et al. 2023). Even low-dose chronic glucocorticoid therapy has been associated with measurable changes in body composition over time (Güler-Yüksel et al. 2023). In contrast, effective control of systemic inflammation with conventional synthetic disease-modifying antirheumatic drugs (csDMARDs) and biologic therapies may mitigate muscle catabolism. Treatment with TNF inhibitors and other targeted agents has been associated with increases in lean mass and reductions in inflammatory burden, suggesting that suppression of cytokine activity can partially reverse rheumatoid cachexia (Mena-Vázquez et al. 2025, de Souza et al. 2022). However, weight gain during biologic therapy may reflect increased fat mass rather than improvements in muscle, highlighting the importance of body composition monitoring rather than reliance on BMI alone (Mena-Vázquez et al. 2025).

Overall, body composition abnormalities in IRDs arise from the combined effects of inflammation-driven catabolism, reduced physical activity, and treatment-related metabolic changes. Understanding these mechanisms is essential for identifying patients at risk and for integrating body composition assessment into comprehensive disease monitoring.

4. Methods for Assessing Body Composition

Accurate assessment of body composition is essential in IRDs, as traditional measures of nutritional status and body weight often fail to reflect disease-related changes such as reduced lean mass and increased fat mass. The coexistence of muscle wasting and excess adiposity, frequently described as rheumatoid cachexia or sarcopenic obesity, requires tools capable of distinguishing between body compartments rather than relying solely on total body weight (Letarouilly et al. 2021; Baker et al. 2022).

4.1 Anthropometric measures

BMI remains the most commonly used anthropometric indicator in clinical practice due to its simplicity and wide availability. However, BMI does not differentiate between fat mass and fat-free mass and may therefore underestimate the prevalence of muscle loss in patients with IRDs (Tournadre et al. 2019; Baker et al. 2022). Several studies have demonstrated that individuals with rheumatoid arthritis may present with normal or elevated BMI despite significant reductions in lean body mass, highlighting the limited sensitivity of this measure for detecting cachexia or sarcopenia (Letarouilly et al. 2021; Tournadre et al. 2019). Moreover, systemic inflammation and glucocorticoid therapy may promote fat redistribution without substantial changes in total body weight, further reducing the clinical utility of BMI as a monitoring tool (Güler-Yüksel et al. 2023). Waist circumference and waist-to-hip ratio provide additional information regarding central adiposity, which is particularly relevant given the association between visceral fat and cardiometabolic risk in IRDs (Després et al. 2012). Increased abdominal fat accumulation has been reported in rheumatoid arthritis and psoriatic arthritis and correlates with inflammatory markers and disease activity (Ferguson et al. 2020). Visceral adipose tissue is metabolically active and contributes to systemic inflammation through the secretion of pro-inflammatory adipokines, potentially amplifying disease burden and functional impairment (Després et al. 2012). Despite these advantages, anthropometric measures remain indirect indicators of body composition and are influenced by factors such as age, sex, and fluid status, limiting their precision for longitudinal monitoring (Tournadre et al. 2019).

4.2 Bioelectrical impedance analysis (BIA)

Bioelectrical impedance analysis (BIA) is a non-invasive, rapid, and relatively inexpensive method for estimating body composition. The technique is based on the principle that lean tissue, which contains a high proportion of water and electrolytes, conducts electrical current more efficiently than adipose tissue, which has higher resistance (Kyle et al. 2004). By measuring impedance and applying predictive equations, BIA provides estimates of fat mass, fat-free mass, and total body water. In patients with IRDs, BIA has been used to identify reduced lean mass, increased fat mass, and altered hydration status associated with chronic inflammation and treatment effects (Letarouilly et al. 2021; Lindqvist et al. 2022). Studies comparing BIA with DXA in rheumatoid arthritis populations have shown moderate to good agreement for fat-free mass estimates, supporting its potential role as a screening tool in clinical settings (Lindqvist et al. 2022). The portability and ease of use of BIA make it particularly suitable for routine assessment and for monitoring changes over time, especially in outpatient rheumatology practice. However, several limitations must be considered when interpreting BIA results in inflammatory diseases. The accuracy of the method is strongly influenced by hydration status, which may be altered by inflammation, edema, renal dysfunction, or glucocorticoid therapy (Kyle et al. 2004). Acute-phase responses and fluid shifts can lead to overestimation of lean mass and underestimation of fat mass, potentially masking clinically relevant changes (Earthman et al. 2015). Additionally, predictive equations used in many devices are derived from healthy populations and may not be fully applicable to patients with chronic inflammatory conditions or altered body composition phenotypes such as sarcopenic obesity (Letarouilly et al. 2021). Despite these limitations, BIA represents a practical tool for preliminary assessment and longitudinal follow-up when standardized measurement conditions are applied. In clinical practice, its greatest value lies in identifying patients at risk of muscle loss or unfavorable body composition who may benefit from more precise evaluation using reference methods such as DXA or imaging techniques (Lindqvist et al. 2022).

Anthropometric measures and BIA provide accessible approaches for initial body composition assessment in IRDs. However, their limitations underscore the need for cautious interpretation and, when possible, confirmation with more accurate techniques, particularly in patients with active disease, significant inflammation, or exposure to therapies known to affect fluid balance and tissue distribution.

5. Advanced Imaging Techniques for Body Composition Assessment: DXA, CT and MRI

Precise evaluation of body composition in IRDs often requires imaging-based techniques that allow direct quantification of lean mass, fat mass, and tissue distribution. Compared with anthropometric measures and BIA, imaging modalities provide higher accuracy and enable the detection of clinically relevant changes such as appendicular muscle loss, visceral adiposity, and intramuscular fat infiltration. These parameters are increasingly recognized as important indicators of functional status, metabolic risk, and disease burden in IRDs (Letarouilly et al. 2021; Tournadre et al. 2019).

5.1 Dual-energy X-ray absorptiometry (DXA)

Dual-energy X-ray absorptiometry (DXA) is widely considered the reference method for body composition assessment in clinical research and practice. DXA provides precise measurements of total and regional fat mass, lean mass, and bone mineral density, allowing simultaneous evaluation of osteoporosis and sarcopenia, which frequently coexist in patients with chronic inflammatory diseases (Shepherd et al. 2017). In rheumatology, DXA is commonly used to assess appendicular lean mass (ALM), a key parameter for the diagnosis of sarcopenia according to the European Working Group on Sarcopenia in Older People (EWGSOP2) criteria (Cruz-Jentoft et al. 2019). Studies in rheumatoid arthritis and spondyloarthritis have demonstrated that DXA can identify reduced lean mass and increased fat mass even in patients with normal BMI, supporting its role in detecting rheumatoid cachexia and sarcopenic obesity (Letarouilly et al. 2021; Baker et al. 2022). Regional analysis enables the identification of preferential muscle loss in the limbs and increased trunk fat, patterns associated with reduced physical performance and higher cardiometabolic risk (Baker et al. 2022). Furthermore, DXA has been used in longitudinal studies to monitor changes in body composition during pharmacological treatment, including glucocorticoids and biologic therapies, providing insight into treatment-related metabolic effects (Güler-Yüksel et al. 2023). Despite its advantages, DXA has certain limitations. The technique cannot distinguish between intracellular and extracellular water, and changes in hydration status related to inflammation or fluid retention may influence lean mass estimates (Shepherd et al. 2017). In addition, DXA provides limited information on muscle quality, such as fatty infiltration or fibrosis, which may be important determinants of muscle function (Tournadre et al. 2019).

5.2 Computed tomography (CT)

Computed tomography (CT) allows highly accurate assessment of muscle cross-sectional area, muscle density, and visceral and subcutaneous adipose tissue. Measurement of muscle attenuation values provides an indirect estimate of myosteatosis, which has been associated with reduced muscle strength, functional impairment, and increased mortality in various chronic diseases (Garcia-Diez et al. 2024). In IRDs, CT-based analyses have demonstrated increased visceral adiposity and reduced muscle density, reflecting both quantitative and qualitative muscle alterations (Ferguson et al. 2020). An important advantage of CT in clinical practice is the possibility of opportunistic assessment. Body composition parameters can be extracted from routine diagnostic scans performed for other indications, such as chest or abdominal imaging, without additional radiation exposure or cost (da Rocha et al. 2023). This approach has been successfully applied in systemic sclerosis and other connective tissue diseases to evaluate muscle mass and quality (da Rocha et al. 2023). However, the use of CT is limited by radiation exposure when performed solely for body composition analysis and by the need for specialized software and expertise.

5.3 Magnetic resonance imaging (MRI)

Magnetic resonance imaging (MRI) is considered the most accurate technique for evaluating muscle volume and composition without exposure to ionizing radiation. MRI enables detailed assessment of muscle morphology, including quantification of intramuscular fat infiltration and detection of inflammatory or edematous changes (Smith et al. 2025). These features are particularly relevant in IRDs, where both inflammatory myopathy and chronic disuse contribute to muscle dysfunction. MRI-based studies in inflammatory arthritis have demonstrated reduced muscle volume and increased fat infiltration in patients with active disease, changes that correlate with physical performance and functional limitation (Tournadre et al.

2019; Smith et al. 2025). Advanced techniques such as Dixon imaging allow precise separation of fat and water signals, improving the quantification of muscle quality and ectopic fat deposition (Smith et al. 2025). Despite its high accuracy, the routine clinical use of MRI for body composition assessment is limited by cost, availability, and longer examination time.

Imaging-based methods provide complementary information on both the quantity and distribution of muscle and adipose tissue, allowing more comprehensive characterization of body composition abnormalities in IRDs. DXA remains the most practical reference method for clinical monitoring and research, while CT and MRI offer additional insights into muscle quality and visceral fat that may improve risk stratification. The integration of these techniques into clinical practice may facilitate early identification of patients at risk of functional decline and enable more individualized therapeutic strategies. Collective comparison of methods mentioned above were presented in table 1.

Table 1. Methods for body composition assessment in inflammatory rheumatic diseases

Method	Measured parameters	Advantages	Limitations	Clinical application
BMI	total body mass relative to height squared	simple, widely available	does not distinguish fat and muscle	initial screening
Waist circumference	central adiposity	reflects cardiometabolic risk	indirect measure	initial screening
BIA	fat mass, fat-free mass, body water	non-invasive, inexpensive	affected by hydration and inflammation	screening and follow-up
DXA	total and regional lean and fat mass	reference clinical method	limited availability, radiation exposure	diagnostic confirmation
CT	muscle area, visceral fat, muscle density	high accuracy	radiation, expensive	detailed assessment
MRI	muscle volume and fat infiltration	no radiation	expensive, long examination time	research purposes

6. Diagnostic Criteria: Sarcopenia, Cachexia and Sarcopenic Obesity in Inflammatory Rheumatic Diseases

Standardized diagnostic criteria are essential for the identification and monitoring of body composition abnormalities in IRDs. However, the recognition of muscle wasting and metabolic alterations in these conditions remains challenging due to the coexistence of inflammation, fluid shifts, and changes in fat distribution. Current diagnostic approaches rely largely on general consensus definitions of sarcopenia and cachexia, complemented by rheumatology-specific recommendations from professional societies such as The European Alliance of Associations for Rheumatology (EULAR) and the American College of Rheumatology (ACR), which emphasize the importance of functional assessment and comprehensive disease evaluation (Letarouilly et al. 2021; Smolen et al. 2020).

The most widely used definition of sarcopenia in clinical research is provided by the revised EWGSOP2. According to this consensus, low muscle strength is considered the primary indicator of probable sarcopenia, while the diagnosis is confirmed by the presence of low muscle quantity or quality measured by techniques such as DXA, CT, or MRI (Cruz-Jentoft et al. 2019). Severe sarcopenia is defined when reduced physical performance, assessed by gait speed or functional tests, is also present (Cruz-Jentoft et al. 2019). Cut-off values commonly used include appendicular skeletal muscle mass (ASM) adjusted for height squared (<7.0 kg/m² in men and <5.5 kg/m² in women), although population-specific thresholds may be required (Cruz-Jentoft et al. 2019). The EWGSOP2 algorithm emphasizes a stepwise approach (respectively: case finding, muscle strength, muscle mass, physical performance), which is particularly relevant for patients with IRDs, in whom functional impairment may precede measurable loss of muscle mass (Dent et al. 2018). In rheumatology populations, the prevalence of sarcopenia varies widely depending on the diagnostic criteria and measurement method, reflecting the need for standardized assessment strategies (Baker et al. 2022). Importantly, studies have shown that reduced muscle mass and strength are associated with higher disease activity, disability, and poorer quality of life in rheumatoid arthritis and spondyloarthritis (Baker et al. 2022).

Cachexia is defined as a complex metabolic syndrome characterized by ongoing muscle loss, with or without fat loss, driven by chronic disease and systemic inflammation. Consensus criteria proposed by Evans and colleagues include unintentional weight loss (>5% within 12 months or BMI <20 kg/m²) accompanied by at least three additional features such as reduced muscle strength, fatigue, anorexia, low fat-free mass, or abnormal inflammatory markers (Evans et al. 2008).

In IRDs, a specific phenotype known as rheumatoid cachexia has been described. Unlike classical cachexia, this condition is characterized by loss of lean mass accompanied by preserved or increased fat mass, resulting in stable or even elevated body weight (Tournadre et al. 2019). Engval et al. defines it as coexistence FFMI (fat-free mass index divided by height squared) below the 10th percentile and FMI (total fat mass divided by height squared) above the 25th percentile (Engvall et al. 2008). Consequently, weight-based criteria alone may fail to identify affected patients. DXA-derived indices of fat-free mass and appendicular lean mass are therefore recommended for detection (Tournadre et al. 2019). Systemic inflammation, particularly elevated TNF-α and IL-6 levels, is considered the primary driver of rheumatoid cachexia, linking disease activity to progressive muscle catabolism and functional decline (Letarouilly et al. 2021). Because of the absence of universally accepted rheumatology-specific thresholds, the condition remains underdiagnosed in routine practice.

Sarcopenic obesity, defined as the coexistence of excess adiposity and reduced muscle mass or function, represents another clinically relevant phenotype in IRDs. Chronic inflammation, physical inactivity, and glucocorticoid exposure contribute to this unfavorable body composition pattern (Barazzoni et al. 2018). Although no universally accepted diagnostic criteria exist, most studies combine measures of low muscle mass (EWGSOP2-based) with elevated body fat percentage assessed by DXA or other imaging methods (Barazzoni et al. 2018). This phenotype is associated with greater disability, higher cardiometabolic risk, and increased inflammatory burden compared with either obesity or sarcopenia alone (Baker et al. 2022). Importantly, reliance on BMI alone may misclassify these patients as overweight or obese without recognizing the underlying muscle deficit.

While EULAR and ACR have not issued specific diagnostic criteria for cachexia or sarcopenia in IRDs, their management recommendations increasingly recognize the importance of functional status, physical performance, and comorbidity assessment. EULAR guidelines for the management of rheumatoid arthritis emphasize regular evaluation of physical function and patient-reported outcomes alongside disease activity measures (Smolen et al. 2020). Similarly, ACR recommendations highlight the role of comprehensive assessment, including disability indices and health-related quality of life, which indirectly reflect the impact of muscle loss and altered body composition (Fraenkel et al. 2021). EULAR task force statements on comorbidity management further identify sarcopenia, frailty, and metabolic complications as important systemic consequences of chronic inflammatory diseases that should be considered in routine care (Gwinnutt et al. 2021). These recommendations support the integration of body composition assessment into holistic disease monitoring, particularly in patients receiving long-term glucocorticoid therapy or presenting with persistent functional limitation.

The application of standardized criteria for sarcopenia and cachexia enables early identification of high-risk patients and improves comparability across studies. In IRDs, combining structural measures (DXA or imaging) with functional assessment provides the most clinically meaningful evaluation. Given the limitations of BMI and weight-based measures, routine screening using validated algorithms such as EWGSOP2 may help identify patients with occult muscle loss and guide individualized management strategies. Collective criteria for each body composition abnormality were gathered in Table 2.

Table 2. Proposed diagnostic criteria for sarcopenia, cachexia, rheumatoid cachexia and sarcopenic obesity

Condition	Diagnostic criteria	Clinical relevance
Sarcopenia	Coexistence of low muscle strength (eg. measured grip strength <27 kg for men and <16 kg for women) and low muscle quantity (ASM <20 kg for men and <15 kg for women) or quality (ASM/height^2 <7.0 kg/m^2 for men and <5.5 kg/m^2 for women). (Cruz-Jentoft et al. 2019)	Associated with disability, frailty, and reduced quality of life in IRDs
Cachexia	Weight loss >5% in 12 months or BMI <20 kg/m^2 plus at least three of the following: - decreased muscle strength, - fatigue, - anorexia, - low fat-free mass, - abnormal biochemistry (elevated CRP/IL-6, anemia, low albumin). (Evans et al. 2008)	Reflects systemic inflammatory burden and poor prognosis
Rheumatoid Cachexia	FFMI < 10th percentile and FMI > 25th percentile. (Letarouilly et al. 2021; Engvall et al. 2008)	May be missed when BMI is normal
Sarcopenic obesity	Coexistence of sarcopenia and obesity (BMI > 30 kg/m^2). (Barazzoni et al. 2018)	Associated with higher disability, cardiometabolic risk, and worse disease outcomes

7. Prevalence and Patterns of Body Composition Abnormalities in Inflammatory Rheumatic Diseases

Body composition abnormalities are highly prevalent across IRDs, although their patterns differ depending on disease phenotype, inflammatory burden, treatment exposure, and patient characteristics. Across conditions, a recurring finding is the dissociation between body weight or BMI and underlying alterations in muscle and fat compartments, reinforcing the concept that IRDs exert systemic metabolic effects extending beyond joint inflammation (Letarouilly et al. 2021; Tournadre et al. 2019).

Rheumatoid arthritis is the most extensively studied IRD with regard to body composition. Numerous studies have demonstrated a high prevalence of reduced lean mass in rheumatoid arthritis patients, even among those with normal or elevated BMI, consistent with the phenotype of rheumatoid cachexia (Letarouilly et al. 2021; Baker et al. 2022)). Depending on the diagnostic criteria and assessment method used, the reported prevalence of sarcopenia in rheumatoid arthritis ranges from approximately 15% to over 40% (Kulyk et al. 2025; Chaiamnuay et al. 2024). DXA-based studies consistently show lower appendicular lean mass and higher fat mass compared with age- and sex-matched controls (Baker et al. 2022). Rheumatoid cachexia, characterized by muscle loss with preserved or increased fat mass, is particularly common in patients with long-standing disease and persistent inflammatory activity (Baker et al. 2022). Elevated disease activity scores and higher circulating levels of inflammatory cytokines have been associated with greater reductions in fat-free mass (Baker et al. 2022). Importantly, several studies have shown that reduced muscle mass in rheumatoid arthritis correlates with worse physical function, higher disability scores, and increased mortality risk, underscoring its clinical relevance (Ouyang et al. 2025).

In spondyloarthritis, including axial spondyloarthritis and psoriatic arthritis PsA, body composition abnormalities are increasingly recognized. Patients with axial spondyloarthritis frequently exhibit reduced muscle mass and strength, which correlate with disease activity, spinal mobility limitations, and impaired physical performance (Ceolin et al. 2025). DXA-based studies have reported sarcopenia prevalence rates comparable to or slightly lower than those observed in rheumatoid arthritis, depending on age and disease duration (Ceolin et al. 2025; Chaiamnuay et al. 2024).

Psoriatic arthritis is often associated with increased adiposity, particularly visceral fat accumulation, reflecting the close link between psoriatic arthritis, obesity, and metabolic syndrome (Ferguson et al. 2020). Advanced imaging studies using CT and MRI have demonstrated an adverse body composition phenotype in psoriatic arthritis, characterized by increased visceral adipose tissue, ectopic fat deposition in muscle, and reduced muscle quality (Ferguson et al. 2020). The coexistence of obesity and reduced muscle mass suggests a high prevalence of sarcopenic obesity in PsA, which has been associated with higher inflammatory burden and poorer functional outcomes (Takami et al. 2025).

In systemic lupus erythematosus, body composition alterations are influenced by chronic inflammation, disease flares, and long-term glucocorticoid exposure. Studies using DXA and BIA have reported a high prevalence of reduced lean mass and increased fat mass in patients with systemic lupus erythematosus, even among relatively young individuals (Baker et al. 2022). Sarcopenia prevalence in systemic lupus erythematosus varies widely, with estimates ranging from 10% to 20%, depending on diagnostic criteria and population characteristics (Pena et al. 2025). Reduced muscle mass in systemic lupus erythematosus has been linked to fatigue, decreased physical performance, and impaired health-related quality of life (Pena et al. 2025).

Other connective tissue diseases, such as systemic sclerosis and primary Sjögren's syndrome, also demonstrate significant body composition abnormalities. In systemic sclerosis, muscle wasting and myosteatosis are common and have been associated with disease severity, organ involvement, and increased mortality (Giraudo et al. 2025). CT-based assessments have revealed reduced muscle cross-sectional area and lower muscle density, indicating both quantitative and qualitative muscle impairment (da Rocha et al. 2023). In Sjögren's syndrome, recent studies have highlighted increased visceral adiposity and unfavorable fat distribution, which correlate with disease activity and functional limitation (Franco et al. 2025).

Although the prevalence and patterns of body composition abnormalities vary among IRDs, several common features emerge. These include a high frequency of reduced lean mass, frequent coexistence of increased fat mass, and poor correlation between BMI and true body composition (Letarouilly et al. 2021; Tournadre et al. 2019). Disease-specific factors such as inflammatory pathways, patterns of physical limitation, and pharmacological treatment contribute to heterogeneity, but the systemic metabolic impact of chronic inflammation remains a unifying mechanism.

Collectively, these findings support the notion that assessment of body composition should be considered an integral component of clinical evaluation across IRDs. Recognizing disease-specific patterns may help identify patients at risk of functional decline and guide targeted monitoring and management strategies.

8. Relationship Between Body Composition and Disease Activity

Body composition abnormalities in IRDs are closely linked to inflammatory burden and disease severity. Increasing evidence suggests a bidirectional relationship in which systemic inflammation promotes unfavorable changes in muscle and fat compartments, while altered body composition may in turn contribute to persistent inflammation, metabolic dysregulation, and worse clinical outcomes. Understanding these interactions is essential for recognizing body composition parameters as potential markers of disease activity and prognosis (Letarouilly et al. 2021; Tournadre et al. 2019).

8.1. Lean mass and inflammatory burden

Loss of lean mass is strongly associated with inflammatory activity in several IRDs, particularly rheumatoid arthritis. Elevated levels of pro-inflammatory cytokines such as TNF-α and IL-6 promote muscle protein degradation and inhibit anabolic signaling, leading to progressive muscle wasting in patients with persistent disease activity (Letarouilly et al. 2021). Cross-sectional studies have demonstrated that lower appendicular lean mass is associated with higher Disease Activity Score (DAS28), increased CRP levels, and greater functional disability in rheumatoid arthritis populations (Baker et al. 2022). Similar associations have been reported in axial spondyloarthritis, where reduced muscle mass and strength correlate with higher disease activity indices and impaired spinal mobility (Ceolin et al. 2025). In systemic lupus erythematosus, decreased lean mass has been linked to higher disease damage scores and greater fatigue, suggesting that chronic inflammatory burden contributes to long-term musculoskeletal decline (Pena et al. 2025). Longitudinal studies further support the relationship between inflammation control and muscle preservation. Effective treatment with biologic agents has been associated with stabilization or modest increases in lean mass, reinforcing the concept that suppression of systemic inflammation may partially reverse catabolic processes (Mena-Vázquez et al. 2025). These findings highlight lean mass as a potential indicator of cumulative inflammatory exposure and treatment response.

8.2 Fat distribution and systemic inflammation

Beyond total adiposity, fat distribution plays a critical role in modulating systemic inflammation. Visceral adipose tissue is metabolically active and produces pro-inflammatory adipokines such as leptin, resistin, and IL-6, which may amplify systemic inflammatory pathways relevant to IRDs (Tournadre et al. 2019, Després et al. 2012). Several imaging-based studies have demonstrated increased visceral fat accumulation in rheumatoid arthritis and psoriatic arthritis, even in patients with normal BMI (Ferguson et al. 2020). In psoriatic arthritis, higher visceral fat volume has been associated with increased disease activity and reduced likelihood of achieving minimal disease activity, suggesting that central adiposity may negatively influence treatment outcomes (Ferguson et al. 2020). Similarly, in rheumatoid arthritis, greater trunk fat mass measured by DXA has been correlated with elevated CRP levels and worse functional status (Baker et al. 2022). The relationship between adiposity and inflammation appears to be bidirectional. Chronic systemic inflammation promotes changes in lipid metabolism and fat redistribution, while excess visceral fat contributes to a persistent low-grade inflammatory state that may sustain disease activity and increase cardiovascular risk (Després et al. 2012). This interaction may partly explain the higher prevalence of metabolic syndrome and adverse cardiometabolic outcomes observed in IRDs.

8.3 Prognostic value of body composition parameters

Accumulating evidence indicates that body composition measures provide prognostic information beyond traditional clinical and laboratory markers. Reduced muscle mass and strength have been associated with increased disability, poorer physical performance, and lower health-related quality of life across multiple IRDs (Kulyk et al. 2025). In rheumatoid arthritis, low lean mass has also been identified as an independent predictor of all-cause mortality, underscoring its clinical significance (Ouyang et al. 2025). Similarly, increased visceral adiposity and sarcopenic obesity have been linked to higher cardiovascular risk, greater disease burden, and reduced treatment response (Ferguson et al. 2020; Barazzoni et al. 2018). Patients with combined low muscle mass and high fat mass tend to experience worse functional outcomes than those with either abnormality alone, highlighting the importance of comprehensive body composition assessment (Kulyk et al. 2025). The changes in body composition may also reflect disease trajectory. Progressive muscle loss or increasing central adiposity during follow-up has been associated with persistent inflammation and cumulative disease damage, suggesting a potential role for body composition monitoring as part of routine disease assessment (Mena-Vázquez et al. 2025). The relationship between body composition and disease activity in IRDs reflects complex interactions between inflammation, metabolism, and physical function. Lean mass depletion and visceral fat accumulation are not only consequences of chronic inflammation but also markers of disease severity and predictors of adverse outcomes. These findings support the integration of body composition parameters into comprehensive clinical evaluation and risk stratification.

9. Impact of Treatment on Body Composition

Pharmacological treatment plays a significant role in shaping body composition in IRDs. While effective control of inflammation may mitigate catabolic processes and improve muscle mass, certain therapies (particularly glucocorticoids) can adversely affect muscle and adipose tissue. Understanding treatment-related changes in body composition is essential for interpreting longitudinal measurements and for optimizing long-term management strategies (Letarouilly et al. 2021; Baker et al. 2022).

Glucocorticoids remain widely used in the management of IRDs due to their rapid anti-inflammatory effects. However, chronic exposure is associated with multiple adverse effects on body composition, including muscle wasting, fat redistribution, and increased metabolic risk. Glucocorticoid-induced myopathy results primarily from stimulation of proteolytic pathways and inhibition of muscle protein synthesis, leading to preferential atrophy of type II muscle fibers and reduced muscle strength (Schakman et al. 2013; Pereira et al. 2011). Clinically, this manifests as proximal muscle weakness and functional impairment, particularly with prolonged or high-dose therapy. In addition to their effects on skeletal muscle, glucocorticoids promote adipocyte differentiation and lipid accumulation, resulting in characteristic fat redistribution. Increased visceral adiposity and truncal obesity have been documented in patients receiving long-term glucocorticoid therapy, even at relatively low doses (Güler-Yüksel et al. 2023). This central fat accumulation contributes to insulin resistance, dyslipidemia, and increased cardiovascular risk, which are already elevated in patients with IRDs (Després et al. 2012). Longitudinal studies using DXA have demonstrated that chronic low-dose prednisolone therapy may lead to modest increases in fat mass and body weight without corresponding improvements in lean mass (Güler-Yüksel et al. 2023). These findings highlight the importance of monitoring body composition rather than relying solely on weight or BMI during long-term glucocorticoid treatment. The combined effects of muscle loss and increased adiposity contribute to the development of sarcopenic obesity, a phenotype associated with worse functional and metabolic outcomes (Baker et al. 2022).

In contrast to glucocorticoids, disease-modifying antirheumatic drugs (DMARDs) and biologic therapies may exert beneficial effects on body composition by reducing systemic inflammation. Chronic inflammatory activity is a key driver of muscle catabolism; therefore, effective disease control has the potential to stabilize or partially reverse loss of lean mass (Letarouilly et al. 2021). Several longitudinal studies in rheumatoid arthritis have shown that treatment with tumor necrosis factor inhibitors (TNFi) is associated with increases in fat-free mass and improvements in physical function (van den Oever et al. 2021). However, weight gain observed during biologic therapy often reflects increases in fat mass rather than selective restoration of muscle, suggesting that improvements in body composition may be heterogeneous (Mena-Vázquez et al. 2025; van den Oever et al. 2021). Similar findings have been reported with other targeted therapies, including IL-6 inhibitors, which may reduce inflammatory catabolism but also influence lipid metabolism and body fat distribution (Tournadre et al. 2019). csDMARDs, such as methotrexate, may also contribute indirectly to improved body composition through disease control, although their specific metabolic effects are less well characterized (Letarouilly et al. 2021). Importantly, the magnitude of body composition changes appears to depend on baseline disease activity and the degree of inflammatory suppression achieved during treatment (Mena-Vázquez et al. 2025). Evidence from longitudinal imaging studies indicates that reductions in inflammatory markers during biologic therapy correlate with stabilization or modest increases in appendicular lean mass, supporting the concept that inflammation control is a key determinant of muscle preservation in IRDs (Tournadre et al. 2019). At the same time, persistent physical inactivity and glucocorticoid exposure may limit the recovery of muscle mass, emphasizing the multifactorial nature of body composition changes during treatment.

Treatment-related alterations in body composition reflect the balance between anti-inflammatory benefits and therapy-specific metabolic effects. While glucocorticoids are associated with muscle loss and central adiposity, effective disease control with DMARDs and biologic agents may mitigate inflammatory catabolism but does not necessarily normalize body composition. These findings underscore the importance of longitudinal body composition assessment during therapy, particularly in patients receiving long-term glucocorticoids or experiencing unexplained weight changes.

10. Discussion

The growing body of evidence demonstrating the high prevalence and clinical consequences of body composition abnormalities in IRDs supports the need for their integration into routine clinical practice. Loss of lean mass, increased visceral adiposity, and the development of sarcopenic obesity are associated with functional decline, higher cardiometabolic risk, and worse long-term outcomes, yet these abnormalities frequently remain unrecognized when assessment relies solely on body weight or BMI (Letarouilly et al. 2021; Baker et al. 2022).

Traditional clinical evaluation in IRDs focuses primarily on joint inflammation, structural damage, and patient-reported symptoms. However, systemic inflammation affects multiple organ systems, including skeletal muscle and adipose tissue, leading to metabolic and functional consequences that are not captured by standard disease activity measures (Tournadre et al. 2019). Several studies have shown that reduced lean mass is independently associated with physical disability, lower quality of life, and increased mortality in rheumatoid arthritis and other IRDs (Ouyang et al. 2025; Chaiamnuay et al. 2024). Importantly, BMI alone is an unreliable indicator of nutritional and functional status in these patients. Individuals with rheumatoid cachexia or sarcopenic obesity may present with normal or elevated BMI despite significant muscle loss and excess fat mass (Baker et al. 2022). Failure to recognize these alterations may delay interventions aimed at preventing functional decline and cardiometabolic complications. Routine assessment of body composition therefore provides clinically relevant information that complements traditional disease evaluation and supports a more comprehensive approach to patient management (Letarouilly et al. 2021).

A pragmatic stepwise strategy may facilitate the implementation of body composition assessment in routine care. Initial screening should focus on identifying patients at increased risk, including those with long-standing disease, persistent moderate or high disease activity, prolonged glucocorticoid exposure, unexplained weight changes, fatigue, or declining physical performance (Gwinnutt et al. 2021). Simple tools such as BMI trends, waist circumference, and functional tests (e.g., handgrip strength or gait speed) may be used as first-line screening measures in accordance with sarcopenia case-finding recommendations (Cruz-Jentoft et al.

2019). When screening suggests abnormal body composition, confirmation should be performed using more precise methods. DXA remains the most practical reference technique for clinical use, allowing assessment of appendicular lean mass, total and regional fat mass, and bone density in a single examination (Shepherd et al. 2017). In selected cases, particularly when detailed evaluation of muscle quality or visceral adiposity is required, CT or MRI may provide additional information (Wall et al. 2016). BIA may serve as an accessible alternative for longitudinal monitoring when standardized measurement conditions are maintained (Letarouilly et al. 2021). Follow-up assessment should be individualized based on disease activity, treatment changes, and baseline abnormalities. Periodic reassessment (typically every 6–12 months in high-risk patients) may help detect progressive muscle loss or increasing central adiposity and allow timely modification of therapeutic strategies (Gwinnutt et al. 2021).

Body composition parameters should be interpreted in conjunction with established measures of disease activity and functional status. Persistent inflammation, reflected by elevated composite scores such as DAS28 or ASDAS, has been associated with progressive muscle loss and unfavorable fat redistribution (Tournadre et al. 2019; Ceolin et al. 2025). Conversely, improvements in inflammatory control during effective treatment may stabilize or partially reverse catabolic changes (Mena-Vázquez et al. 2025). Functional assessment tools, including the Health Assessment Questionnaire (HAQ) and performance-based measures, provide important context for interpreting body composition findings, as reduced muscle mass is closely linked to physical disability and frailty (Kulyk et al. 2025). Current EULAR recommendations emphasize the importance of comprehensive patient evaluation, including physical function, comorbidities, and long-term health risks, rather than focusing exclusively on inflammatory activity (Smolen et al. 2020). Integrating body composition assessment into routine monitoring may therefore improve risk stratification and support personalized management. Identification of patients with low lean mass or excess visceral adiposity may prompt closer monitoring of disease control, optimization of pharmacotherapy, and implementation of targeted interventions aimed at preserving physical function and reducing metabolic risk.

Routine evaluation of body composition represents an important step toward a more holistic approach to the management of IRDs, recognizing their systemic nature and the central role of muscle and metabolic health in long-term outcomes.

11. Conclusions

IRDs are systemic conditions that extend beyond joint inflammation and structural damage, profoundly affecting muscle and adipose tissue. Accumulating evidence demonstrates that reduced lean mass, increased fat mass, and unfavorable fat distribution are common across multiple IRDs, often occurring independently of body weight or BMI (Letarouilly et al. 2021; Baker et al. 2022). These alterations contribute to functional impairment, reduced physical capacity, increased cardiometabolic risk, and poorer long-term outcomes. Chronic inflammation represents a central mechanism driving muscle catabolism and metabolic disturbances, while physical inactivity, pain, and pharmacological factors (particularly long-term glucocorticoid therapy) further exacerbate unfavorable body composition changes (Letarouilly et al. 2021; Tournadre et al. 2019). At the same time, effective control of disease activity with modern therapies may help stabilize or partially reverse inflammatory catabolism, highlighting the dynamic nature of body composition in IRDs (Mena-Vázquez et al. 2025). The limitations of conventional anthropometric measures underscore the need for more precise assessment methods. Techniques such as DXA, BIA, and advanced imaging modalities allow earlier identification of sarcopenia, cachexia, and sarcopenic obesity, conditions that are frequently underdiagnosed in routine practice (Baker et al. 2022; Cruz-Jentoft et al. 2019). Importantly, body composition parameters provide clinically meaningful information that complements traditional disease activity measures and improves risk stratification.Integrating body composition assessment into routine care may support a more comprehensive and patient-centered approach to IRD management. Early detection of muscle loss or excess visceral adiposity may facilitate timely therapeutic optimization, closer monitoring of disease control, and implementation of targeted interventions aimed at preserving physical function and reducing metabolic complications.

Recognition of body composition abnormalities reinforces the concept that IRDs are systemic disorders with significant metabolic and functional consequences. Incorporating body composition evaluation into clinical practice and future research may improve long-term outcomes and contribute to more holistic disease management strategies.

Disclosure: The author declares full responsibility for the content and preparation of this manuscript. All sources used in the preparation of this review have been appropriately cited.

Supplementary Materials: No supplementary materials were provided for this study.

Author Contributions: Supervision - Wiktor Daniszewski, review and editing - Wiktoria Knobelsdorf, Jakub Rodziewicz, conceptualization - Magdalena Baranowska, literature search - Viktoria Kretschmer, original draft preparation - Ewa Sobolewska, Daniel Markowski, data analysis - Zuzanna Dynowska, Dominik Poszwa.

Funding: This research received no external funding.

Informed Consent: Not applicable.

Data Availability Statement No new data were created or analyzed in this study. Data sharing is not applicable to this article.

Acknowledgements: The author would like to acknowledge the use of artificial intelligence tools for language editing and improvement of grammatical accuracy. All content was critically reviewed and supervised by the author to ensure scientific accuracy and logical consistency.

Conflicts of Interest: The author declares no conflict of interest.

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