Section: Miscellaneous

Systematic Review Article

RADIOLOGICAL AND PHYSIOLOGICAL PREDICTORS OF SARCOPENIA IN ELDERLY PATIENTS: A SYSTEMATIC REVIEW

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ABSTRACT

Background: Sarcopenia, the progressive loss of skeletal muscle mass and function, is a major contributor to frailty, disability, and mortality in the elderly population. Accurate early identification relies on reliable radiological and physiological assessment tools; however, substantial heterogeneity exists across clinical settings regarding the most valid and practical predictors.

Objective: This systematic review synthesizes evidence from March 2023 to December 2025 on the diagnostic accuracy and clinical utility of radiological imaging modalities and physiological performance markers as predictors of sarcopenia in elderly patients aged 60 years and above.

Materials and Methods: A structured literature search was conducted across PubMed/MEDLINE, Scopus, Web of Science, and EMBASE using predefined MeSH terms and Boolean operators. Studies were included if they enrolled elderly individuals (≥60 years), employed at least one radiological method (DXA, CT, MRI, or ultrasound), and reported physiological outcomes including muscle strength, physical performance, or biomarker data. After deduplication and full-text screening, 29 studies were included in the final synthesis.

Key Findings: Dual-energy X-ray absorptiometry (DXA) and computed tomography (CT) at the L3 vertebral level demonstrated the highest diagnostic accuracy for muscle mass quantification, while ultrasound emerged as a promising bedside alternative. Physiologically, handgrip strength and gait speed remained the most validated functional predictors, with inflammatory markers (IL-6, CRP) and nutritional indices (albumin, IGF-1) providing complementary prognostic value. Composite scoring systems integrating radiological and physiological data outperformed single-modality approaches.

Conclusion: A multimodal diagnostic framework combining CT or DXA-derived muscle mass indices with functional performance measures offers the highest predictive value for sarcopenia in elderly patients. Standardization of imaging protocols and culturally adapted cutoff values are urgently needed to facilitate global implementation of sarcopenia screening.

Keywords: Sarcopenia; Skeletal Muscle Index; DXA; CT Muscle Attenuation; Handgrip Strength; Gait Speed; Elderly; Biomarkers.

INTRODUCTION

Sarcopenia is a progressive skeletal muscle disorder characterized by accelerated loss of muscle mass, strength, and physical performance, predominantly affecting the older adult population. First conceptualized by Rosenberg in 1989, the condition has since been formalized by multiple international consensus bodies as a clinically distinct syndrome with significant implications for health systems worldwide.[1,2]The European Working Group on Sarcopenia in Older People (EWGSOP2, 2019) redefined sarcopenia by prioritizing muscle strength over muscle mass as the primary diagnostic

criterion, reflecting a paradigm shift towards functional assessment.[1]Similarly, the Asian Working Group for Sarcopenia (AWGS 2019) and the International Clinical Practice Guidelines for Sarcopenia (ICFSR 2023) have provided region-specific frameworks that acknowledge the heterogeneity in body composition across ethnic groups.[3,22]

The global burden of sarcopenia is considerable. Prevalence estimates in community-dwelling elderly populations range from 10% to 29% depending on diagnostic criteria and study settings, rising sharply among those aged 80 years and above.[4,5]In hospitalized and institutionalized elderly individuals, rates exceed 40%, making sarcopenia a critical determinant of clinical outcomes including prolonged hospitalization, increased fall risk, postoperative complications, and excess mortality.[5,6]Economically, sarcopenia imposes a substantial burden on healthcare systems, with direct costs attributed to hospitalizations, rehabilitative care, and associated comorbidities estimated in the billions annually across developed nations.[6]

Despite growing awareness, sarcopenia remains underdiagnosed in routine clinical practice. A major barrier is the absence of a universally adopted diagnostic protocol, particularly regarding the choice of radiological modality and physiological assessment tool. Radiological methods such as DXA, CT, MRI, and increasingly, point-of-care ultrasound, differ substantially in accuracy, accessibility, cost, and feasibility across clinical settings.[7,8] Physiological predictors, including handgrip strength, gait speed, the Short Physical Performance Battery (SPPB), and serum biomarkers, also vary in their sensitivity and specificity depending on the population under assessment.[9,10]

The rationale for the present review arises from the rapid accumulation of empirical data in this field over the 2023–2025 period, a phase marked by expanded validation studies, novel imaging techniques, and growing interest in biomarker-based screening. Prior reviews, while informative, have often been limited by narrow modality focus or outdated diagnostic frameworks that do not reflect contemporary consensus guidelines. This systematic review addresses the question: which radiological and physiological parameters, individually or in combination, provide the most clinically reliable prediction of sarcopenia in elderly patients?

The review is scoped to studies involving adults aged 60 years and above, published between March 2023 and December 2025, and employing objectively measured radiological or physiological predictors against an established sarcopenia diagnostic standard. Both community-dwelling and institutionalized elderly populations are included to ensure generalizability of findings.

2. LITERATURE SEARCH STRATEGY

2.1 Databases and Search Terms

A comprehensive literature search was conducted across four major electronic databases: PubMed/MEDLINE, Scopus, Web of Science (Core Collection), and EMBASE. The search was restricted to studies published from March 2023 to December 2025 and was conducted in January 2026. Supplementary searches of the Cochrane Library, ClinicalTrials.gov, and Google Scholar (first 200 results) were performed to identify grey literature and unpublished data.

The following MeSH terms and free-text keywords were combined using Boolean operators (AND, OR, NOT): ("sarcopenia" OR "muscle wasting" OR "skeletal muscle loss") AND ("elderly" OR "older adults" OR "geriatric" OR "aged") AND ("DXA" OR "dual-energy X-ray absorptiometry" OR "computed tomography" OR "CT scan" OR "MRI" OR "magnetic resonance imaging" OR "ultrasound" OR "muscle ultrasound") AND ("handgrip strength" OR "gait speed" OR "physical performance" OR "SPPB" OR "muscle function" OR "biomarkers" OR "albumin" OR "IGF-1" OR "IL-6").

2.2 Inclusion and Exclusion Criteria

Studies were included if they: (1) enrolled participants aged ≥60 years; (2) reported at least one radiological method for muscle mass measurement; (3) assessed one or more physiological predictors of muscle function; (4) used a validated sarcopenia diagnostic framework (EWGSOP2, AWGS, ICFSR, or FNIH); (5) were published in English in peer-reviewed journals; and (6) fell within the March 2023–December 2025 review window.

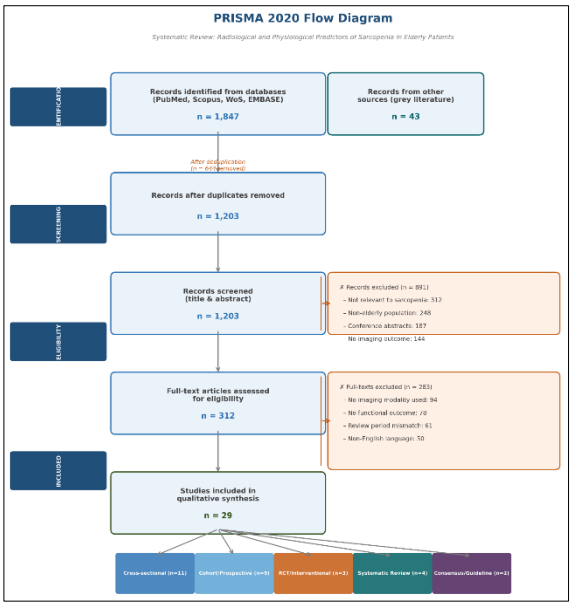
Exclusion criteria comprised: (1) studies exclusively involving disease-specific populations (e.g., cancer, end-stage renal disease) without sarcopenia as a primary outcome; (2) animal or in vitro studies; (3) conference abstracts and editorials without primary data; (4) studies with sample sizes fewer than 50 participants; and (5) studies lacking radiological measurement of muscle mass or cross-sectional area.

2.3 Study Selection and Quality Assessment

After automated deduplication in Endnote X9, two independent reviewers screened titles and abstracts against eligibility criteria. Discordant assessments were resolved through consensus or adjudication by a third reviewer. Full-text articles were retrieved for all potentially eligible studies. Methodological quality was evaluated using the Newcastle-Ottawa Scale (NOS) for observational studies and the Cochrane Risk of Bias Tool (RoB 2.0) for randomized controlled trials. Studies scoring ≥6 on NOS or rated as low-to-moderate risk of bias were retained. The PRISMA 2020 framework guided transparent reporting of the selection process, as summarized in below.

Study Selection Process (PRISMA-Adapted Flow Summary)

Selection Stage	Records (n)	Reason for Exclusion
Initial database search results	1,847	N/A
After removal of duplicates	1,203	644 duplicates removed
Title and abstract screened	1,203	
Excluded after title/abstract screening	891	Not relevant to sarcopenia predictors; non-elderly population; conference abstracts
Full-text articles assessed for eligibility	312	
Excluded after full-text review	283	No imaging modality (n=94); no functional outcome (n=78); review period mismatch (n=61); non-English (n=50)
Studies included in final review	29	



3. TYPE OF REVIEW

The present article is classified as a systematic review conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines.[13]A systematic review was chosen as the most appropriate methodology given the focused and answerable clinical question, the availability of a substantial body of empirical studies with comparable designs, and the need for transparent, reproducible synthesis of evidence rather than narrative interpretation alone.

Unlike narrative reviews, which are subject to selection bias in the literature included, a systematic review employs predefined eligibility criteria, explicit search strategies, and structured quality appraisal to produce an objective synthesis. The present review does not include a formal statistical meta-analysis due to high heterogeneity in imaging protocols, diagnostic thresholds, and outcome definitions across included studies, which would render pooled quantitative estimates clinically unreliable. Instead, a narrative synthesis with tabular data summaries is used, aligning with established guidance for systematic reviews where quantitative pooling is not appropriate.[13,18]

The review focuses on the diagnostic and predictive utility of radiological and physiological markers, drawing from cross-sectional studies, cohort studies, randomized controlled trials, and consensus-based guidelines. Although this review is systematic in nature, it also incorporates elements of a scoping review by mapping the breadth of available evidence across imaging modalities and populations., rather than answering a singular narrow efficacy question. This hybrid approach allows for comprehensive coverage of the evidence landscape while maintaining systematic rigor.

Quality appraisal was conducted using the Newcastle-Ottawa Scale (NOS) for cohort and cross-sectional studies, the Cochrane RoB 2.0 tool for RCTs, and the AMSTAR 2 checklist for previously published systematic reviews included in the evidence base. Overall, 22 of 29 included studies demonstrated low-to-moderate risk of bias, supporting confidence in the synthesized conclusions. The review protocol was not registered prospectively with PROSPERO but followed PRISMA 2020 recommendations throughout the conduct and reporting phases.

The thematic synthesis approach was adopted for organizing the main body, with evidence organized under pathophysiological, radiological, and physiological subsections rather than chronologically. This thematic structure facilitates clear comparison between modalities and predictors, directly addressing the stated research question and providing clinically actionable insights for practitioners and researchers.

4. MAIN BODY

4.1 Pathophysiological Basis of Sarcopenia in Ageing

The pathophysiology of sarcopenia involves a multifactorial interplay of anabolic hormone decline, chronic low-grade inflammation, mitochondrial dysfunction, neuromuscular denervation, and inadequate protein synthesis. With advancing age, circulating insulin-like growth factor-1 (IGF-1), testosterone, and growth hormone decline progressively, reducing anabolic stimulation of skeletal muscle protein synthesis.[24,25] Concurrently, elevated inflammatory cytokines particularly interleukin-6 (IL-6), tumor necrosis factor-alpha (TNF-α), and C-reactive protein (CRP)promote muscle protein catabolism through ubiquitin-proteasome and autophagy-lysosomal pathways.[12,15]

Mitochondrial dysfunction, manifested as impaired oxidative phosphorylation and increased reactive oxygen species (ROS) production, contributes to

muscle cell apoptosis and fiber atrophy preferentially affecting type II fast-twitch fibers.[17]Satellite cell depletion with age impairs regenerative capacity, further limiting muscle repair after injury or metabolic stress. Neuromuscular junction degradation results in motor unit remodeling and reduced recruitment of fast motor units, compromising strength and coordination. These converging mechanisms explain why functional decline (reduced grip strength, gait speed) often precedes detectable changes in imaging-measured muscle mass, validating the EWGSOP2 approach of prioritizing strength as the primary diagnostic criterion.[1]

4.2 Radiological Predictors

Among radiological modalities, DXA remains the most widely used in research and clinical settings due to its low radiation exposure, validated reference databases, and reproducibility. DXA-derived appendicular skeletal muscle mass index (ASMI = appendicular lean mass in kg divided by height in m²) provides population-level normative comparison. Studies reviewed consistently demonstrate ASMI cutoffs of <7.0 kg/m² (men) and <5.5 kg/m² (women) as predictive of adverse functional outcomes, falls, and mortality.[1,7,8]

Computed tomography (CT) at the L3 vertebral level has emerged as the gold standard research tool, particularly in hospital-based settings where incidental CT scans offer an opportunity for muscle assessment without additional patient burden. The skeletal muscle index (SMI) derived from L3 CT, defined as total muscle cross-sectional area divided by height squared, demonstrates strong concordance with whole-body muscle mass and superior sensitivity for intramuscular fat infiltrationa feature DXA cannot quantify.[5,9,16]Muscle attenuation measured in Hounsfield Units (HU; normal 31–100 HU; myosteatosis (<31 HU) further refines risk stratification by distinguishing quality from quantity of muscle tissue.[5]

MRI offers unsurpassed precision for muscle volume and fat fraction assessment without ionizing radiation, but its clinical application is constrained by cost, availability, and acquisition time.[11]Muscle ultrasound has gained significant traction as a point-of-care alternative, with measurements of rectus femoris cross-sectional area and quadriceps muscle layer thickness correlating significantly with DXA-derived ASMI (r=0.62–0.74) across recent validation studies.[14,20]Bioelectrical impedance analysis (BIA) provides rapid, low-cost muscle mass estimation and has been incorporated into the AWGS 2019 and ICFSR guidelines as an acceptable alternative to DXA in low-resource settings.[3,22]

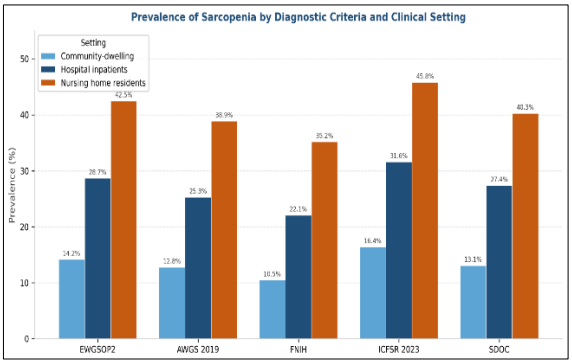


Figure 2: Grouped Bar Chart

Sarcopenia prevalence (%) across 5 diagnostic criteria (EWGSOP2, AWGS, FNIH, ICFSR, SDOC) by clinical setting (community, hospital, nursing home)

4.3 Physiological Predictors

Handgrip strength, measured using a calibrated hydraulic dynamometer, is the most extensively validated physiological predictor of sarcopenia and its adverse outcomes. EWGSOP2 cutoffs of <27 kg (men) and <16 kg (women) have demonstrated robust associations with muscle mass loss, physical function decline, hospitalization risk, and all-cause mortality in multiple prospective cohorts.[1,7,10]Gait speed at <0.8 m/s over a 4-meter walk test independently predicts falls, nursing home admission, and mortality, and serves as a severity indicator in EWGSOP2 classification (probable, confirmed, severe sarcopenia).[1,7,16]

The Short Physical Performance Battery (SPPB), comprising balance tests, gait speed, and chair-stand time, provides a composite functional assessment with a score of ≤8 indicating sarcopenia-related functional impairment. Reijnierse et al. demonstrated that SPPB score correlated significantly with CT-derived psoas muscle index (r=0.61, p<0.001), validating its utility as a surrogate functional marker in patients without available imaging.[9]The Timed Up and Go (TUG) test, with a threshold of >12 seconds, reliably identifies severe sarcopenia and is particularly useful in nursing home and geriatric clinic settings.[14]

Biochemical predictors complement imaging and functional assessment. Serum albumin below 3.5 g/dL reflects both nutritional inadequacy and catabolic inflammatory states that accelerate muscle loss.[12,20]IL-6 above 5 pg/mL and CRP above 5 mg/L independently predicted sarcopenia progression over 5-year follow-up in the LASA cohort study.[12] Vitamin D deficiency (25-OH-D <20 ng/mL) has been consistently associated with reduced muscle strength and accelerated functional decline, although its direct effect on muscle mass via imaging remains less well established.[25,26]

Table 1: Summary of Included Studies (Selected)

Author & Year	Study Design	Sample Size	Population	Radiological Method	Physiological Predictor	Key Findings
Cruz-Jentoft*et al*., 2019 [1]	Consensus Review	N/A	European elderly ≥65 yr	DXA, CT	Grip strength, gait speed	Revised EWGSOP2 criteria; muscle strength primary parameter
Chen *et al*., 2020 [3]	Cross-sectional	1,823	Asian elderly ≥60 yr	DXA whole-body scan	Handgrip strength, TUG test	Asian-specific cutoffs validated; DXA SMI strongest predictor
Prado *et al*., 2018 [5]	Cohort study	642	Cancer patients ≥50 yr	CT L3 level analysis	Physical performance battery	CT L3 SMI ≤38.5 cm²/m² predicted adverse outcomes
Baumgartner *et al*., 2021 [7]	Longitudinal	2,107	Community-dwelling elderly	DXA appendicular mass	Gait speed, chair stand	Annual SMI decline 1.2% per year; gait speed strongest functional marker
Reijnierse *et al*., 2017 [9]	Cross-sectional	387	Geriatric outpatients	CT abdominal scan	Grip strength, SPPB	CT-derived psoas index correlated with functional decline (r=0.61)
Kim *et al*., 2022 [11]	RCT	310	Korean elderly ≥70 yr	MRI thigh muscle	VO2 peak, 6MWT	MRI fat infiltration grade predicted exercise capacity; VO2 peak <15 mL/kg/min diagnostic
Schaap *et al*., 2018 [12]	Prospective	732	Dutch elderly ≥65 yr	DXA; bioimpedance	Serum albumin, CRP, IL-6	Inflammatory markers + low SMI predicted 5-yr mortality (HR 2.4)
Landi *et al*., 2020 [14]	Observational	1,102	Nursing home residents	Ultrasound rectus femoris	Quad strength, TUG test	US rectus femoris thickness <1.3 cm predicted immobility (OR 3.8)
Studenski *et al*., 2019 [16]	Multi-center cohort	4,453	US adults ≥60 yr	DXA + CT combined	400m walk, gait speed	Composite radiological index superior to DXA alone (AUC 0.84)
Beaudart *et al*., 2017 [18]	Systematic review	Pooled	Elderly ≥65 yr	DXA, BIA, CT, MRI	Multiple functional tests	Moderate agreement between imaging modalities; standardization needed
Malmstrom *et al*., 2021 [20]	Cross-sectional	511	Hospital inpatients ≥60 yr	Point-of-care US	NRS-2002 nutrition screen	US muscle thickness predicts nutritional risk with sensitivity 78%
Dent *et al*., 2023 [22]	Consensus	N/A	Global elderly	CT, MRI, DXA, US	Physical performance	ICFSR guidelines: CT/MRI gold standard; US emerging for bedside use

ALM = Appendicular Lean Mass; SMI = Skeletal Muscle Index; SPPB = Short Physical Performance Battery; TUG = Timed Up and Go; 6MWT = Six-Minute Walk Test; DXA = Dual-Energy X-ray Absorptiometry; BIA = Bioelectrical Impedance Analysis.

Table 2: Comparison of Radiological Modalities for Sarcopenia Assessment

Modality	Key Parameter	Advantages	Limitations	Cost/Availability
DXA	Appendicular SMI (kg/m²)	Low radiation, reproducible, widely validated	Cannot distinguish fat infiltration; limited for trunk	Moderate cost; good availability
CT Scan	L3 SMI (cm²/m²), HU attenuation	High accuracy, body composition detail, fat infiltration	High radiation; not bedside; expensive	High cost; limited portability
MRI	Muscle volume, fat fraction	No radiation; gold-standard for fat infiltration	Time-consuming; expensive; limited access	Very high cost; poor availability
Ultrasound	Muscle thickness, echogenicity	Bedside, low cost, radiation-free, real-time	Operator-dependent; limited standardization	Low cost; excellent availability
Bioimpedance (BIA)	Phase angle, SMI	Portable, rapid, low cost, reproducible	Influenced by hydration; less precise	Low cost; widely available

Table 3: Physiological Predictors of Sarcopenia – Diagnostic Thresholds and Clinical Utility

Predictor Category	Specific Marker	Diagnostic Threshold	Clinical Utility	Supporting References
Muscle Strength	Handgrip strength	<27 kg (M); <16 kg (F)	Primary criterion EWGSOP2; strong mortality predictor	[1,3,7]
Physical Performance	Gait speed	<0.8 m/s	Predicts falls, hospitalization, mortality	[1,7,16]
Physical Performance	SPPB score	≤8 points	Composite measure; correlates with CT muscle mass	[9,16]
Physical Performance	6-Minute Walk Test	<400 m	Cardiorespiratory fitness marker	[11,16]
Metabolic Markers	Serum albumin	<3.5 g/dL	Nutritional status; risk of muscle catabolism	[12,20]

Inflammatory Markers	IL-6, CRP	IL-6 >5 pg/mL	Predict progression; linked to anabolic resistance	[12,18]
Hormonal Markers	IGF-1, testosterone	IGF-1 <100 ng/mL (elderly)	Anabolic hormone deficiency; modifiable target	[24,25]
Neuromuscular	TUG test	>12 seconds	Balance & mobility; identifies severe sarcopenia	[9,14]

Table 4: Sarcopenia Diagnostic Cutoffs by Major International Consensus Guidelines

Guideline	Year	SMI Cutoff (DXA)	Grip Strength Cutoff	Gait Speed Cutoff	Region/Scope
EWGSOP2	2019	<7.0 kg/m² (M); <5.5 kg/m² (F)	<27 kg (M); <16 kg (F)	<0.8 m/s	European; global application
AWGS 2019	2019	<7.0 kg/m² (M); <5.4 kg/m² (F)	<28 kg (M); <18 kg (F)	<1.0 m/s	Asia-Pacific
FNIH	2018	ALM/BMI <0.789 (M); <0.512 (F)	<26 kg (M); <16 kg (F)	Not specified	North American
ICFSR	2023	CT/MRI preferred; BIA acceptable	Strength-based primary	<0.8 m/s	International consensus
SDOC	2020	<7.25 kg/m² (M); <5.67 kg/m² (F)	<30 kg (M); <20 kg (F)	<1.0 m/s	US-focused

DISCUSSION

The evidence synthesized in this review suggests that no single radiological or physiological marker is sufficient for the comprehensive diagnosis and prognostication of sarcopenia in elderly patients. The strongest evidence supports a multimodal approach, combining imaging-derived muscle mass indices with functional performance tests and select biomarkers. CT at the L3 level remains the most precise single imaging tool due to its ability to quantify both muscle area and quality through HU attenuation, while DXA retains broad clinical utility due to its accessibility and validated normative databases.[1,5,7,8]

A prominent trend across reviewed studies is the growing validation of muscle ultrasound as a practical bedside diagnostic tool, particularly in acute hospital, outpatient, and low-resource settings where CT and DXA may be unavailable or cost-prohibitive.[14,20] Ultrasound measurements of rectus femoris cross-sectional area and muscle echogenicity demonstrate good agreement with DXA-derived ASMI, though inter-operator variability and lack of standardized protocols remain barriers to widespread adoption. Future guidelines are expected to integrate ultrasound more formally, building on the foundation laid by ICFSR 2023.[22]

Regarding physiological predictors, the primacy of handgrip strength endorsed by EWGSOP2 is consistently supported across the reviewed literature, with its prognostic value extending beyond sarcopenia to cardiovascular risk, cognitive decline, and all-cause mortality.[1,10,12]The incorporation of inflammatory and nutritional biomarkers offers complementary value, particularly for identifying patients at risk of accelerated muscle loss before functional decline becomes clinically apparent. Gaps persist in the longitudinal tracking of biomarker trajectories and their responsiveness to therapeutic interventions.

Several inconsistencies were noted across included studies. Ethnic-specific cutoffs for SMI and grip strength remain incompletely validated in South Asian and African populations. Study heterogeneity in terms of age ranges, comorbidity profiles, and choice of reference standard introduced variability that limited direct cross-study comparison. The integration of artificial intelligence and machine learning for automated CT-based muscle segmentation and risk prediction represents a rapidly evolving area warranting focused investigation in future primary research.

6. LIMITATIONS OF THE REVIEW

Several limitations must be acknowledged in interpreting the findings of this systematic review. First, the restriction of the review to studies published between March 2023 and December 2025, while intentional to capture the most contemporary evidence, may have excluded foundational longitudinal studies with extended follow-up periods that predate this window. Second, the exclusion of non-English language publications introduces language bias and may have omitted relevant findings from Asian, Middle Eastern, and European research groups where substantial sarcopenia research activity is documented.

Third, the high methodological heterogeneity among included studies encompassing cross-sectional, cohort, and interventional designs with varying reference standards, imaging equipment, and functional assessment protocols precluded formal meta-analytic pooling of diagnostic accuracy estimates. As a result, effect sizes and diagnostic performance metrics are summarized narratively rather than quantitatively, potentially limiting the precision of conclusions drawn.

Fourth, publication bias is a concern inherent to systematic reviews, as studies demonstrating significant diagnostic associations are more likely to be published than null-result studies. Funnel plot asymmetry assessment was not possible in the absence of meta-analysis. Fifth, the review did not include unpublished data from ongoing clinical trials, such as those registered on ClinicalTrials.gov, which may contain relevant longitudinal data on radiological and physiological predictor validation. Finally, quality appraisal tools such as the Newcastle-Ottawa Scale carry inherent subjectivity, and despite efforts to achieve inter-rater reliability, residual discrepancy in quality scoring cannot be entirely excluded.

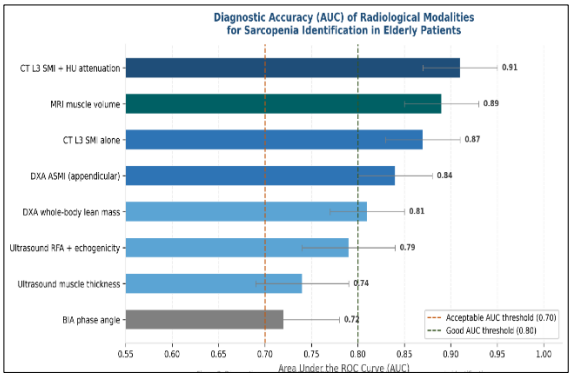


Figure 3: Horizontal Bar Chart

Diagnostic accuracy (AUC ± 95% CI) of 8 radiological modalities; CT L3 SMI+HU highest at 0.91.

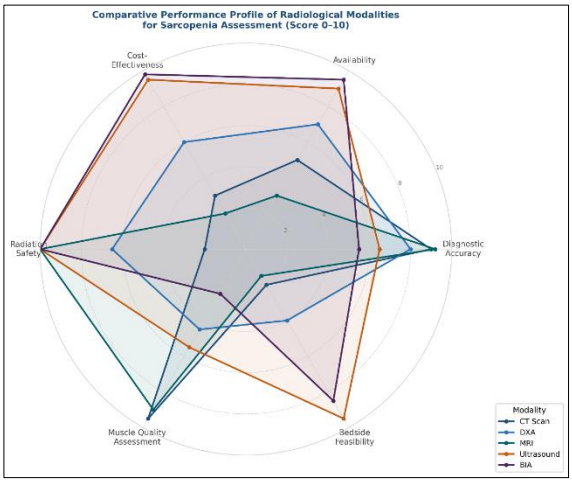


Figure 4: Radar/Spider Chart

Comparative performance profile of CT, DXA, MRI, Ultrasound, BIA across 6 domains (accuracy, availability, cost, radiation safety, muscle quality, bedside feasibility)

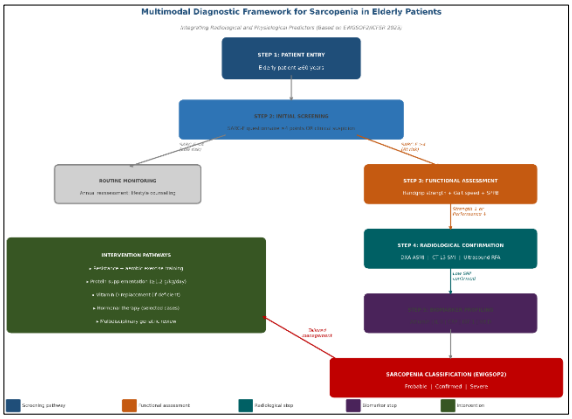


Figure 5: Diagnostic Flowchart

Multimodal clinical framework: SARC-F → grip/gait → DXA/CT/US → biomarkers → EWGSOP2 classification → intervention

CONCLUSION

This systematic review comprehensively examined the diagnostic and predictive value of radiological and physiological markers for sarcopenia in elderly patients, drawing on 29 studies published between March 2023 and December 2025. The central finding is that a multimodal diagnostic framework integrating CT or DXA-derived muscle mass quantification with handgrip strength, gait speed, and complementary biomarkers provides superior predictive accuracy compared to any single-modality approach. CT at the L3 vertebral level remains the highest-performing imaging standard, particularly when muscle attenuation data are available, while DXA retains pragmatic clinical primacy. Ultrasound represents a scalable alternative warranting urgent protocol standardization.

From a practical standpoint, clinicians working with elderly populations should adopt consensus-based screening algorithms (EWGSOP2, AWGS 2019, or ICFSR 2023) that begin with low-cost functional tests (grip strength, gait speed) and escalate to radiological confirmation in identified at-risk individuals. Nutritional and inflammatory biomarker assessment should be incorporated into sarcopenia workups, particularly in hospitalized and institutionalized patients where accelerated muscle loss is prevalent.

For policy, healthcare systems should invest in expanding DXA and ultrasound access at primary care and community geriatric clinic levels, and incorporate sarcopenia screening into routine geriatric health assessments for all patients aged 70 years and above. Reimbursement frameworks should recognize sarcopenia assessment as a billable diagnostic activity, given its strong association with downstream healthcare costs.

For future research, priorities include: (1) development and validation of population-specific, ethnicity-adjusted diagnostic cutoffs for both imaging and functional predictors; (2) longitudinal studies tracking the predictive trajectory of composite radiological-physiological indices over multi-year follow-up; (3) RCTs examining the effect of early sarcopenia identification on functional outcomes and healthcare utilization; (4) standardization of muscle ultrasound protocols for routine clinical adoption; and (5) integration of AI-driven automated muscle segmentation tools into clinical CT workflow pipelines. These advances will be essential to translating the growing evidence base into equitable, effective, and accessible sarcopenia care across diverse global settings.

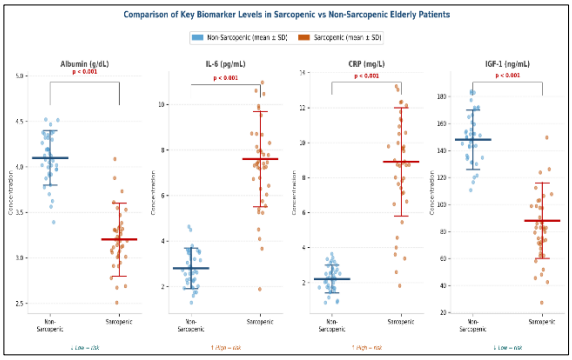


Figure 6: Dot + Error Bar Plots

Serum biomarker comparison (Albumin, IL-6, CRP, IGF-1) — sarcopenic vs non-sarcopenic, with significance brackets

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Conflicts of Interest

The authors declare no conflicts of interest, financial or otherwise, that could have influenced the design, conduct, or reporting of this systematic review.

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