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Review Article

Comprehensive Geriatric Assessment in the Management of Frailty and Multimorbidity in Older Adults: A Systematic Literature Review

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Abstract

Frailty and multimorbidity are prevalent, interrelated geriatric conditions whose co-occurrence substantially elevates the risk of disability, hospitalisation, and mortality in older adults. Comprehensive Geriatric Assessment (CGA) is a multidisciplinary diagnostic process proposed as the gold standard for managing these complex conditions. A systematic literature review was conducted following PRISMA 2020 guidelines, searching PubMed, MEDLINE, EMBASE, CINAHL, Web of Science, and Google Scholar for peer-reviewed articles published between 2018 and 2025. Fourteen articles meeting predefined inclusion and exclusion criteria were selected and appraised using the Critical Appraisal Skills Programme (CASP) framework and an evidence-grading matrix. Included studies confirmed a bidirectional relationship between frailty and multimorbidity, mediated by chronic low-grade inflammation, immunosenescence, hormonal dysregulation, and sarcopenia. CGA was consistently effective in quantifying frailty severity, guiding individualised care planning, reducing hospital length of stay, and delaying frailty progression. Updated evidence from 2024 and 2025 confirms that CGA significantly reduces mortality risk and preserves independence in activities of daily living across hospital and community settings. The geriatric triangle, the interplay between frailty, multimorbidity, and polypharmacy, represents an important emerging framework for integrated geriatric management. Standardised CGA implementation, supported by validated digital frailty indices and multidisciplinary teams, is recommended to optimise outcomes.

Keywords: Frailty, Multimorbidity, Comprehensive geriatric assessment, Sarcopenia, Older adults

Introduction

Population ageing is one of the most consequential demographic transformations of the twenty-first century. The World Health Organization projects that the proportion of the global population aged 60 years or older will nearly double from 12% to 22% between 2015 and 2050, with the fastest-growing cohort being those aged 80 years and above[1]. This epidemiological shift is driving a parallel rise in age-related syndromes, most prominently frailty and multimorbidity, which together impose substantial demands on health and social care systems worldwide.

Frailty is a clinically recognisable state characterised by reduced physiological reserve and increased vulnerability to stressors, manifesting as fatigue, unintentional weight loss, muscle weakness, slowness, and low physical activity[2]. It affects approximately 10% of community-dwelling adults aged 65 years and over, rising to 25–50% among those aged 85 years and older[3]. Critically, frailty is not an inevitable consequence of ageing but a dynamic, potentially modifiable condition whose trajectory can be altered through timely clinical intervention[4]. A landmark review by Kim and Rockwood published in the New England Journal of Medicine in 2024[29] reinforced that assessing frailty enables clinicians to tailor clinical care, including decisions

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about stressful treatments, and that frailty assessment should serve as a tool to facilitate patient-centred care rather than a mechanism to withhold potentially effective interventions.

Multimorbidity, defined as the simultaneous presence of two or more chronic conditions in the same individual, is the norm rather than the exception in older populations[6]. Its predisposing factors include advancing age, low socioeconomic status, smoking, physical inactivity, obesity, and hypertension[7]. The consequences are wide-ranging: frequent and prolonged hospitalisation, polypharmacy, reduced quality of life, progressive functional decline, and premature mortality[8]. Despite the centrality of multimorbidity to geriatric care, clinical practice guidelines continue to be predominantly organised around single-disease pathways, resulting in fragmented, potentially harmful care for patients with multiple co-existing conditions[9]. Umegaki[32] has proposed the concept of the "geriatric triangle", whereby frailty, multimorbidity, and polypharmacy are recognised as mutually reinforcing elements whose complexity demands holistic, integrated management through frameworks such as CGA.

The interrelationship between frailty and multimorbidity is well-recognised, though not fully elucidated. Frailty enhances susceptibility to multimorbidity by depleting physiological reserves, while multimorbidity in turn accelerates frailty progression through cumulative organ dysfunction and chronic systemic inflammation[10]. Sarcopenia, the progressive age-related loss of skeletal muscle mass and function, occupies a central role in this relationship, serving as both a hallmark of frailty and a mechanistic driver of adverse multimorbid outcomes[11].

CGA is a multidisciplinary diagnostic and treatment process evaluating the medical, functional, psychological, and social domains of older adults, producing a coordinated, individualised care plan associated with improved functional outcomes, reduced inappropriate hospitalisation, and better quality of life[12]. This systematic literature review was conducted to: (i) critically appraise the evidence for CGA as an intervention for frailty and multimorbidity, incorporating studies published through 2025; (ii) characterise the frailty-multimorbidity interrelationship including the role of sarcopenia; (iii) examine frailty assessment models relevant to CGA; and (iv) propose evidence-informed recommendations for enhancing CGA implementation.

Background

Frailty: Definition, Prevalence, and Pathophysiology

Frailty is characterised by decreased resilience and plasticity, reduced physiological reserve, and heightened vulnerability to adverse health outcomes following minor stressors[14]. The Fried frailty phenotype, defined by three or more of the following: exhaustion, unintentional weight loss, weakness, slowness, and low physical activity, remains the most widely applied operational definition, though broader multidimensional constructs incorporating psychological and social vulnerability are gaining traction[15]. A person meeting two of five Fried criteria is classified as pre-frail, representing a clinically significant transition state amenable to intervention[16]. Figure 1 illustrates the multidimensional concept of frailty across physical, psychological, and social domains.

The pathophysiology of frailty is multifactorial and incompletely understood. Chronic low-grade inflammation (inflammaging), evidenced by elevated interleukin-6 (IL-6), tumour necrosis factor-alpha (TNF-α), and C-reactive protein levels, impairs musculoskeletal, endocrine, and haematological systems. Immunosenescence further diminishes the body's capacity for tissue repair and resistance to infection. Age-associated hormonal changes including declining testosterone, oestrogen, and reduced 25(OH) vitamin D contribute to accelerated sarcopenia, anabolic resistance, and mitochondrial dysfunction[17]. Kim and Rockwood[29] further identify cellular senescence and epigenetic dysregulation as emerging mechanistic contributors to frailty, reinforcing the multisystem biological basis of the syndrome. Figure 2 maps these risk factors through biological mechanisms to clinical signs and adverse outcomes.

Multimorbidity: Epidemiology and Consequences

Multimorbidity affects the majority of adults aged 65 years and older in high-income countries, with estimates between 55% and 98% in European populations having two or more chronic conditions[18]. Individuals with multimorbidity experience prolonged inpatient stays, significant polypharmacy burden, and markedly lower health-related quality of life[19]. Multimorbidity clusters into cardiometabolic, musculoskeletal, and neuropsychiatric groupings with distinct implications for care organisation[20].

The management of multimorbidity remains poorly served by current healthcare systems, which are predominantly structured around single-disease guidelines, producing uncoordinated care and high rates of adverse events[9]. A paradigm shift towards horizontal, person-centred, multidisciplinary models of care is required, of which CGA represents the leading framework. The geriatric triangle concept[32] further underscores the need for integrated assessment tools capable of simultaneously addressing frailty, multimorbidity, and polypharmacy.

Sarcopenia and the Frailty-Multimorbidity Nexus

Sarcopenia, progressive generalised loss of skeletal muscle mass and function, is now recognised as a major geriatric syndrome and an independent contributor to frailty[21]. Its pathophysiology involves a convergence of age-related changes in motor unit innervation, hormonal axes, inflammatory signalling, and mitochondrial function, compounded by physical inactivity and nutritional deficiencies. Sarcopenia directly contributes

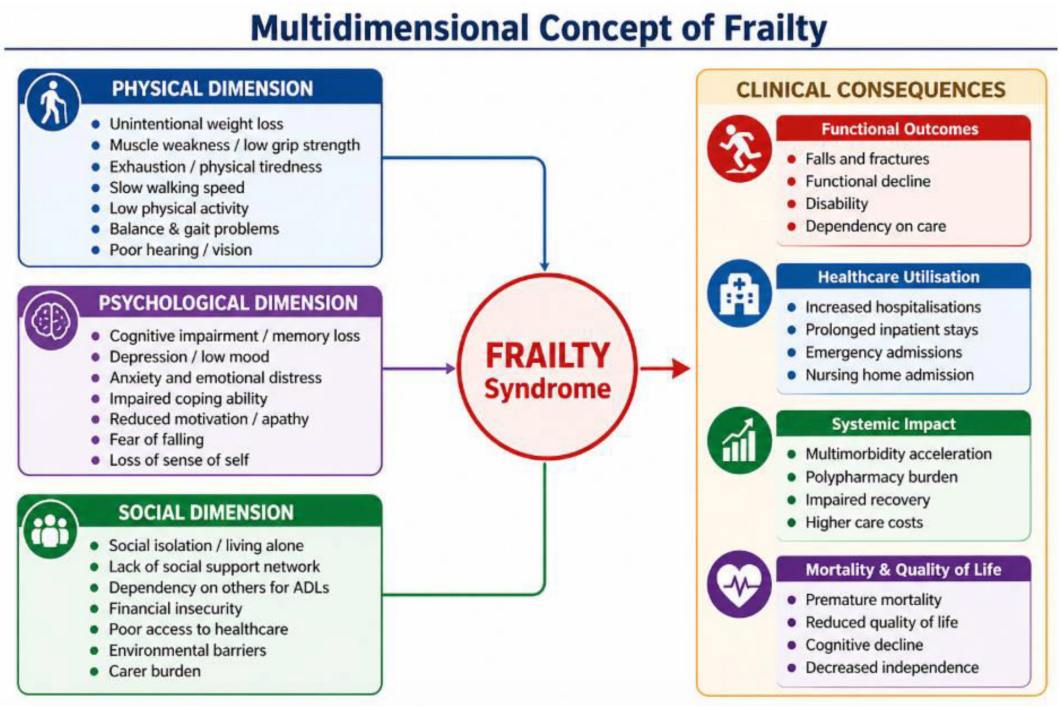

Figure 1. Multidimensional concept of frailty integrating physical, psychological, and social domains with associated clinical consequences.

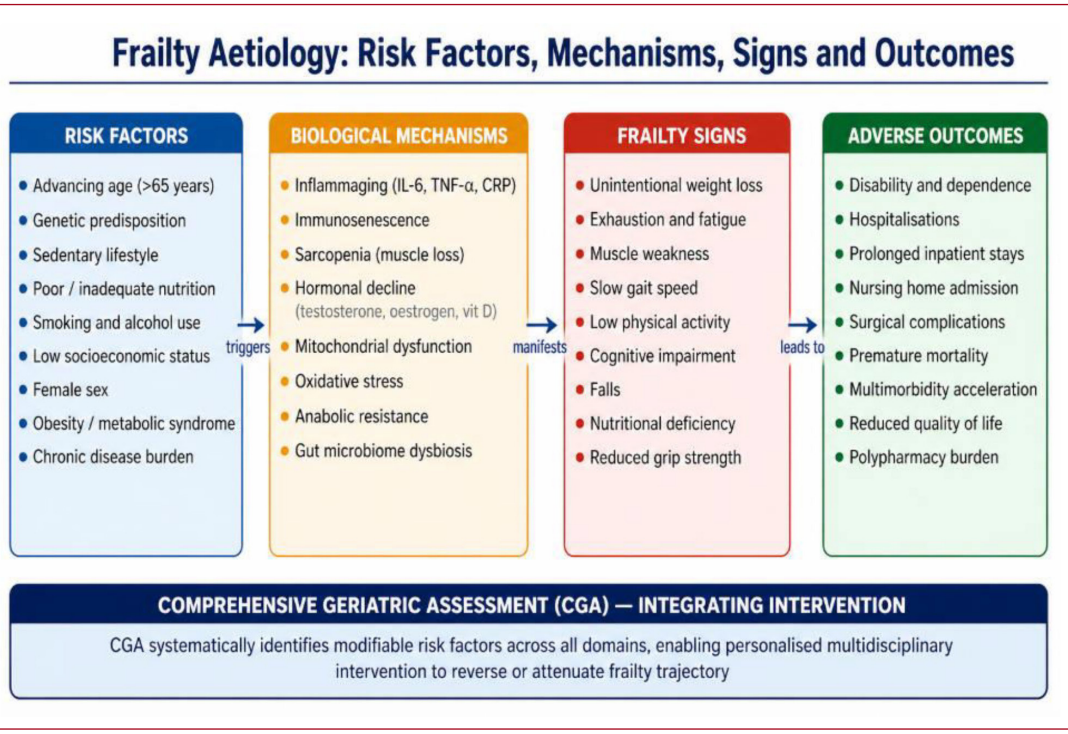

Figure 2. Frailty aetiology framework: from modifiable risk factors through biological mechanisms and clinical signs to adverse outcomes, with CGA as the targeted intervention.

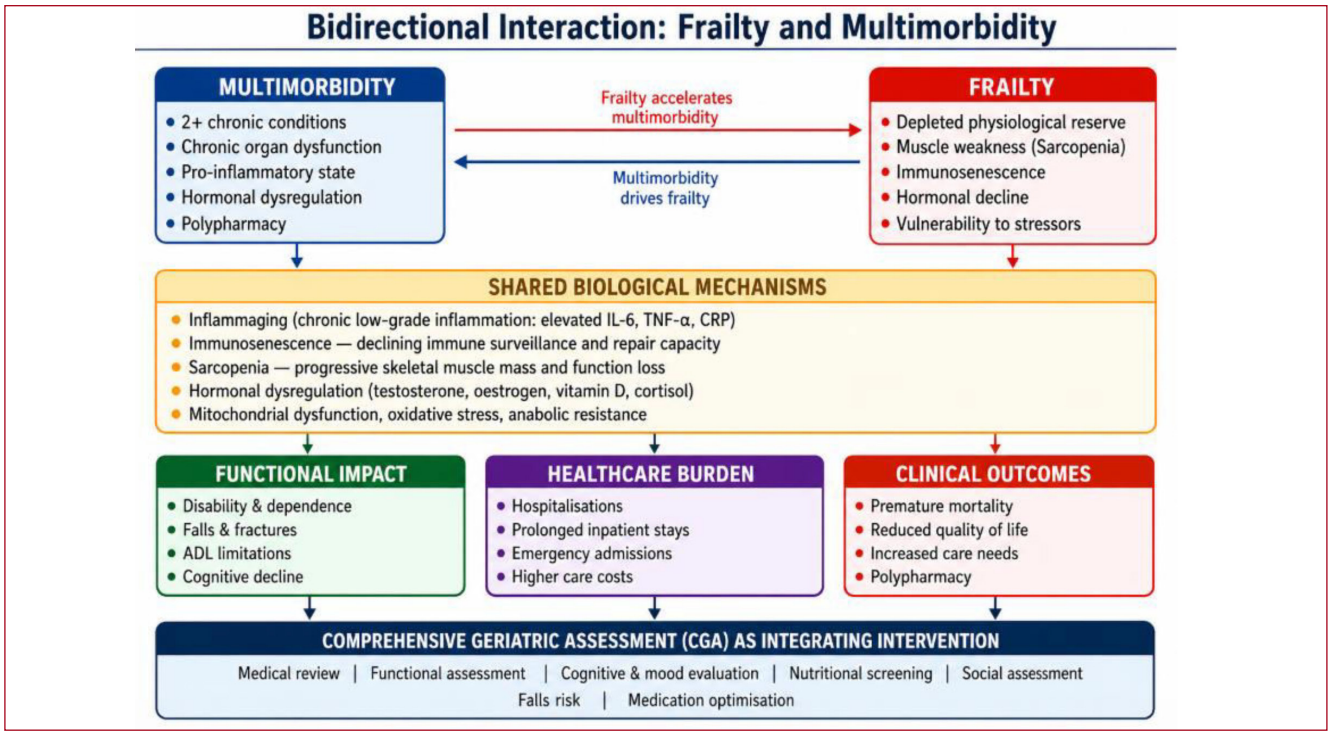

Figure 3. Bidirectional interaction between frailty and multimorbidity, mediated by shared biological mechanisms, with CGA as the integrating clinical intervention.

to multimorbidity by impairing metabolic regulation and increasing susceptibility to non-communicable diseases[22]. The bidirectional frailty-multimorbidity relationship, mediated through sarcopenia and shared inflammatory mechanisms, is illustrated in Figure 3. Interventions targeting sarcopenia, principally resistance exercise training and nutritional supplementation, demonstrably attenuate frailty trajectories[23].

Comprehensive Geriatric Assessment: Principles and Evidence

CGA is a multidisciplinary diagnostic and treatment process that identifies medical, functional, psychological, and social problems in frail older adults, and develops a comprehensive, coordinated plan for addressing them[24]. Core CGA domains include medical comorbidity review, medication optimisation, cognitive and mood assessment, functional capacity evaluation, nutritional assessment, gait and falls risk analysis, and social and environmental assessment[25]. Figure 4 illustrates these six domains and their integration into a coordinated care plan output.

The evidence base for CGA has expanded considerably since earlier syntheses. Hospital-based RCTs have demonstrated reductions in mortality, functional decline, nursing home admission, and length of stay among frail older patients. More recent systematic reviews and meta-analyses confirm these benefits extend to outpatient, home-based, and community settings, representing a significant strengthening of the evidence base[30,31].

Methods

Study Design

This study adopted a systematic literature review (SLR) methodology, conducted in accordance with PRISMA 2020 reporting guidelines. A pragmatic research philosophy guided the review, acknowledging that multiple realities exist across the frailty-multimorbidity-CGA literature and that interpretive synthesis is necessary to integrate qualitative, quantitative, and mixed-method findings. Given the breadth of the review's objectives and the heterogeneity of the evidence base, the review was designed to incorporate both primary research (RCTs, observational studies, and qualitative studies) and secondary synthesis evidence (systematic reviews, meta-analyses, and narrative reviews). Secondary synthesis studies were included selectively, on the basis of meeting predefined quality thresholds and

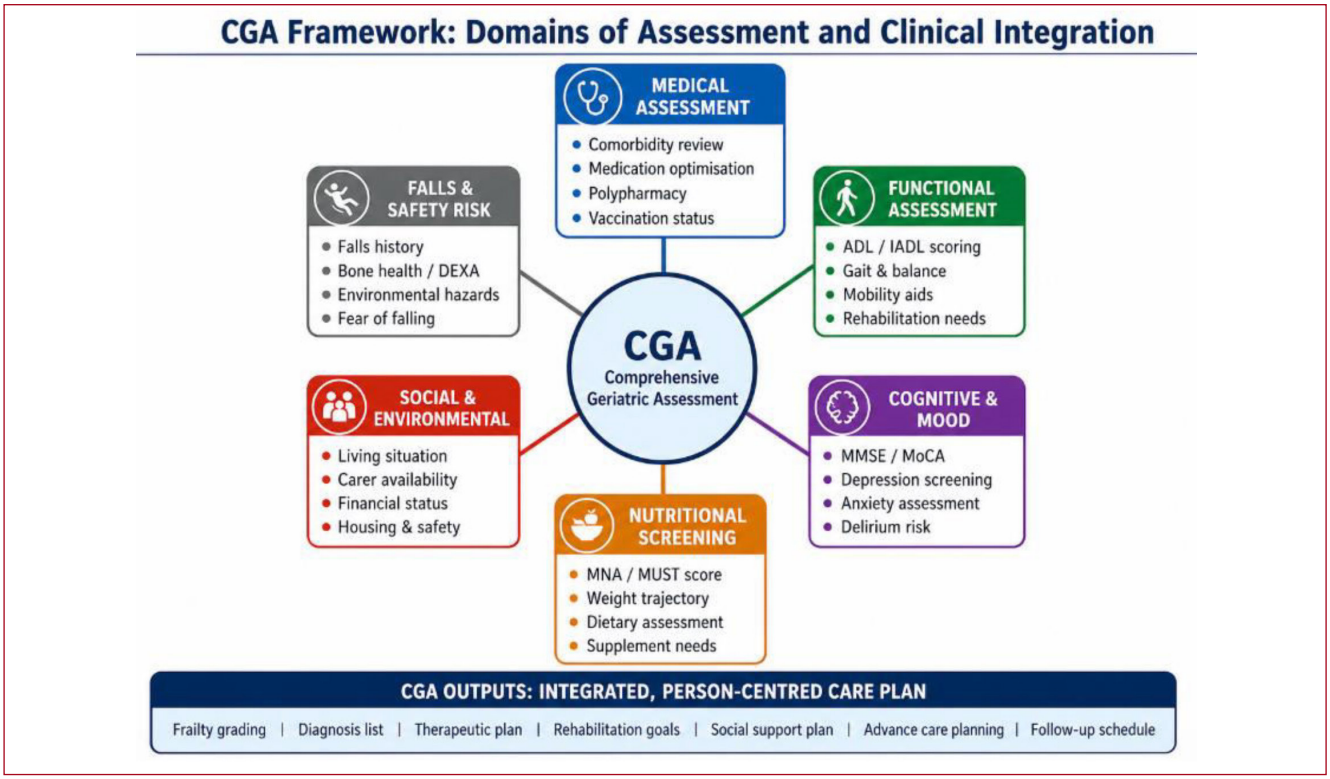

Figure 4. Comprehensive Geriatric Assessment (CGA) framework showing the six core assessment domains and their integration into a coordinated person-centred care plan.

contributing evidence not directly replicated within the primary studies included in the synthesis. This approach is consistent with established practice for complex evidence syntheses in geriatric medicine, where the most authoritative and clinically relevant evidence frequently resides in high-quality systematic reviews rather than individual primary studies alone. The risk of data overlap inherent in combining primary and secondary sources was managed through transparent reporting of study design classifications, design-specific quality assessment, and explicit attribution of findings to their respective evidence levels within the narrative synthesis.

Eligibility Criteria

Inclusion Criteria

- Peer-reviewed journal articles published between 2018 and 2025
- Studies reporting on frailty, multimorbidity, and/or CGA in adults aged 65 years or older (focus on those aged 75+ years)
- Studies conducted in or directly applicable to UK or comparable high-income country healthcare contexts
- Articles in the English language with full-text available
- Studies addressing frailty assessment/management, CGA implementation, frailty-multimorbidity interrelationship, or sarcopenia in frailty
- Secondary synthesis studies (systematic reviews, meta-analyses, and narrative reviews) provided they met predefined quality thresholds on design-specific appraisal tools and addressed the review objectives directly

Exclusion Criteria

- Articles published before January 2018 or not in English
- Conference abstracts, editorials, commentaries, and grey literature
- Studies not addressing older adult populations (aged < 65 years) as primary focus
- Studies rated as high risk of bias or critically low quality on the relevant design-specific quality appraisal instrument (see Section "Quality Assessment")

Search Strategy

Searches were conducted in PubMed/MEDLINE, EMBASE, CINAHL, Web of Science, Cochrane Library,

and Google Scholar using structured MeSH and free-text keywords including: "frailty", "multimorbidity", "comorbidity", "comprehensive geriatric assessment", "CGA", "sarcopenia", "frailty syndrome", "geriatric giant", "older adults", "functional impairment", and "dementia". Boolean operators (AND, OR) were applied.

Study Selection and Data Extraction

Following duplicate removal, two-stage screening was performed: (1) title and abstract screening; (2) full-text review of potentially eligible articles. The PRISMA flow diagram (Figure 5) illustrates the complete selection process across both search phases. Data extraction captured study design, sample characteristics, frailty and multimorbidity assessment methods, CGA modality, key outcomes, and methodological quality indicators.

Quality Assessment

Given the mixed-design composition of the included study set, a design-specific quality appraisal strategy was applied to ensure methodologically appropriate evaluation of each study type. The following instruments were used: (i) AMSTAR-2 (A Measurement Tool to Assess Systematic Reviews, version 2) for systematic reviews and meta-analyses (studies #3, #8, #30, #31); (ii) the SANRA (Scale for the Assessment of Narrative Review Articles) for narrative reviews (studies #11, #14); (iii) the Cochrane Risk of Bias tool version 2 (RoB2) for the randomised controlled trial (study #2); (iv) the CASP Qualitative Checklist for qualitative and mixed-method studies (studies #5, #7); and (v) the Newcastle–Ottawa Scale (NOS) for observational, cross-sectional, and longitudinal cohort studies (studies #1, #4, #6, #9, #10). In addition, all studies were evaluated against a seven-criterion evidence-grading matrix assessing systematic approach, time efficiency, objective alignment, accessibility, clarity, and evidence impact, to facilitate a standardised assessment of each study's contribution to the review objectives. Results of the design-specific quality appraisal are reported in Table 1. No included study was rated as high risk of bias or critically low quality on its respective instrument; all studies were thus retained in the final synthesis.

Data Synthesis

A narrative synthesis approach was adopted given the heterogeneity of study designs. Thematic analysis identified five primary analytical themes: (1) frailty-multimorbidity interrelationship; (2) sarcopenia as a mechanistic link; (3) CGA efficacy and modality; (4) person-centred care and clinical uncertainty; and (5) frailty assessment tools and models.

Results

Study Selection

The initial database searches yielded 50 records. Following identification of 10 additional records through supplementary searches, 60 records underwent screening. After duplicate removal (n = 25), 35 records underwent title and abstract screening, of which 20 were taken to full-text review. Seven articles were excluded at the full-text stage (n = 3 language/date; n = 2 population mismatch; n = 2 insufficient CGA/frailty focus). A further three were excluded following eligibility assessment (n = 1 high bias risk; n = 2 insufficient outcome reporting to permit meaningful data extraction), yielding 10 included studies from the initial search window.

The supplementary search across six databases yielded 28 additional records. After removal of 8 duplicates, 20 records underwent title and abstract screening. Twelve proceeded to full-text review, of which 8 were excluded (n = 2 population mismatch; n = 3 insufficient CGA focus; n = 2 conference proceedings; n = 1 high bias risk). Four studies met all eligibility criteria and were added to the review, bringing the total number of included studies to fourteen. The complete PRISMA flow is illustrated in Figure 5.

Characteristics of Included Studies

The fourteen included studies were published between 2019 and 2025, originating from the United Kingdom, Sweden, Spain, Japan, Italy, Ireland, China, and the United States. Study designs comprised: RCTs (n = 1), qualitative and mixed-method studies (n = 2), observational and cross-sectional studies (n = 4), systematic reviews and meta-analyses (n = 5), a longitudinal cohort study (n = 1), and narrative reviews (n = 2). Sample sizes ranged from 100 to 382 participants in primary studies; meta-analytic studies encompassed data from up to 22 trials. All primary studies included participants aged 65 years and above, with six studies focusing on those aged 75 years and over. Table 1 presents the evidence-grading outcomes and design-specific quality assessment ratings for all fourteen included studies. Studies 11–14 (shown in bold) represent new inclusions from the updated search.

Thematic Synthesis

Theme 1: The Frailty-Multimorbidity Interrelationship

Across all included studies, frailty and multimorbidity were confirmed as distinct yet deeply intertwined conditions. Vetrano et al.[3] reported in a systematic review and meta-analysis that the large majority of frail individuals met criteria for multimorbidity, whereas the converse was substantially weaker, consistent with frailty representing a more severe state of systemic vulnerability. Jedrzejczyk et al.[10] demonstrated, in a four-month longitudinal study of 100 patients, that rising comorbidity count directly corresponded with declining independence in activities of daily living, with the relationship more pronounced in participants with concurrent frailty syndrome.

Umegaki[32] extended this framing by proposing the geriatric triangle, positioning frailty, multimorbidity, and polypharmacy as a triadic, mutually reinforcing system.

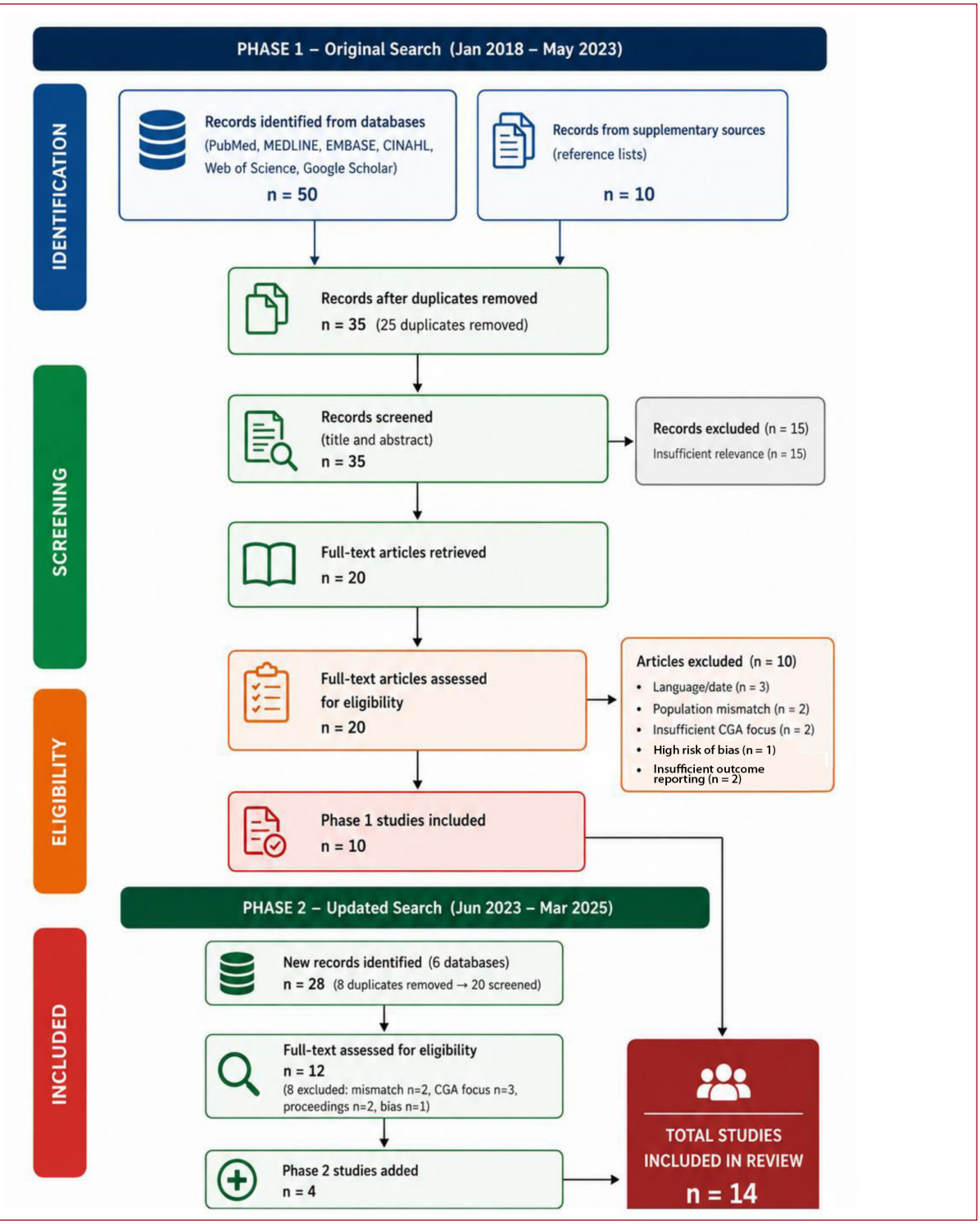

Figure 5. PRISMA 2020 flow diagram illustrating the article identification, screening, eligibility, and inclu-sion process across the original search (2018–2023) and updated search (2023– 2025). Total included studies: n = 14.

Polypharmacy, arising from the clinical management of multimorbid conditions, independently accelerates frailty through adverse drug reactions, drug–drug interactions, and progressive deconditioning. This triangular conceptualisation has important implications for CGA, which is uniquely positioned to address all three elements concurrently. Kim and Rockwood[29] similarly emphasise the multilevel biological basis of frailty, including cellular senescence and inflammatory dysregulation, as key targets for CGA-guided, patient-centred intervention.

Theme 2: Sarcopenia as a Mechanistic Bridge

Sarcopenia emerged as a central mechanistic link between frailty and multimorbidity. Alvarez-Bustos et al.[6] demonstrated using DEXA measurements that reduced muscle mass was significantly associated with adverse hospitalisation outcomes and higher healthcare costs. Waite et al.[8] established that sarcopenia and frailty together predict dementia risk, and that declines in extremity function and mobility typically precede clinical dementia diagnosis, with considerable implications for early screening. Hirai et al.[9] found the Kihon Checklist (KCL) outperformed comparator frailty and sarcopenia models in identifying mood disorders and frailty prevalence in COPD patients, suggesting that multidimensional frailty tools better capture the sarcopenia-multimorbidity intersection.

The updated review further contextualises sarcopenia within the geriatric triangle framework[32], recognising that sarcopenia-related nutritional deficiency and reduced physical activity are both a driver of polypharmacy and a consequence of it. This bidirectional relationship reinforces the importance of structured sarcopenia screening within CGA protocols, consistent with EWGSOP2 recommendations.

Theme 3: CGA Efficacy and Clinical Utility

CGA was consistently validated as an effective, multidimensional intervention. Mazya et al.[2] provided the strongest direct primary evidence through the AGe-FIT RCT (n = 382): at 24-month follow-up, the proportion of frail and deceased participants was lower in the outpatient CGA group versus usual care alone, despite 90% being pre-frail or frail at baseline. Cooper et al.[4] reported that the FI-CGA, embedded within EHR systems, demonstrated increasing up-take across multiple co-management services, with the majority of clinicians reporting improved assessment accuracy and more precise decision-making. Gordon et al.[28] called for a shift from asking whether CGA works to understanding how it can be most effectively implemented across diverse contexts.

Xu et al.[30], in a systematic review and meta-analysis of 18 RCTs searching databases to February 2024, found that CGA significantly reduced the risk of decreased activities of daily living among frail older adults in hospital settings (RR = 0.55, 95% CI: 0.33 to 0.92; p = 0.021) and was associated with reduced mortality risk, assessed using the RoB2 tool and GRADE framework. While the certainty of evidence was rated as low, reflecting heterogeneity across trials, the consistency of direction across 18 independent RCTs is clinically meaningful.

Hayes et al.[31], in a meta-analysis of 22 trials across 12 countries published in the Journal of the American Geriatrics Society in 2025, demonstrated that home-based CGA delivered by a comprehensive multidisciplinary team enhances functional status among community-dwelling frail older adults, with benefits sustained over 6 to 24-month follow-up periods. Home-based CGA was also identified as a promising acute admission avoidance strategy, directly addressing the longstanding evidence gap for community and home settings.

Theme 4: Person-Centred Care and Clinical Uncertainty

Yi et al.[5], using a Discrete Choice Experiment and stakeholder consultations, found that patients and carers consistently prioritised family engagement, person-centred communication, and continuity of care across settings. Van Oppen et al.[7], in a qualitative NHS emergency department study, found that fear of deterioration and loss of independence were the primary concerns of older adults living with frailty. These findings underscore that effective CGA must integrate person-centred values alongside clinical assessment, as subjective outcomes diverge substantially from traditional clinical metrics such as hospitalisation rates.

Kim and Rockwood[29] reinforce this theme, explicitly cautioning that frailty assessment should not function as a mechanism to withhold effective treatments but should instead serve as a scaffold for patient-centred, goal-concordant care. This framing is consistent with the person-centred priorities identified by Yi et al.[5] and van Oppen et al.[7].

Theme 5: Frailty Assessment Models and Emerging Tools

The review identified validated instruments applicable within CGA frameworks: the Tilburg Frailty Indicator (TFI), Edmonton Frail Scale (EFS), Groningen Frailty Indicator (GFI), Rockwood Frailty Index (FI), and Kihon Checklist (KCL). No single tool is universally optimal; selection should be guided by clinical setting and patient population. The Trauma-Specific Frailty Index (TSFI) is specifically validated for geriatric trauma patients, demonstrating superior predictive performance for complications, mortality, rehabilitation disposition, and 30-day readmission[27]. The Electronic Frailty Index (eFI), validated in UK primary care, enables longitudinal frailty trajectory monitoring using routine EHR data.

Kim and Rockwood[29] describe an expanding landscape of digital and web-based frailty assessment tools integrated with electronic health records, enabling time-efficient, standardised assessments at the point of care. Their

review endorses the frailty index approach as particularly suitable for frailty-guided clinical decision-making, given its continuous measurement properties and sensitivity to change over time.

Discussion

Principal Findings and Their Implications

This updated systematic review confirms that frailty and multimorbidity constitute an interdependent geriatric complex demanding an integrated, multidimensional management approach. The evidence, now incorporating studies through 2025, supports CGA as the most comprehensively evaluated and consistently effective intervention for this purpose. CGA demonstrates efficacy across hospital inpatient settings[30], outpatient programmes[2], and home-based community contexts[31], representing a qualitatively more robust evidence base than was available within the original search window.

The emergence of the geriatric triangle concept[32] is a significant theoretical development. By positioning polypharmacy as an equal partner to frailty and multimorbidity in a triadic, mutually reinforcing system, Umegaki[32] provides a compelling rationale for why single-domain or single-disease management approaches are structurally inadequate. CGA is uniquely equipped to operate within this triangular framework, and future CGA quality metrics should explicitly incorporate polypharmacy review as a core deliverable.

The landmark NEJM review by Kim and Rockwood[29] contextualises these findings within a contemporary biological and clinical framework, affirming that frailty assessment enables clinicians to tailor decisions about complex or stressful treatments, predict adverse outcomes across a spectrum of conditions, and target evidence-based interventions appropriately. This positions frailty-guided CGA not merely as a geriatric specialty concern but as a mainstream clinical necessity for any service caring for adults in the sixth decade of life and beyond.

CGA Implementation: Challenges and Opportunities

A recurring theme across the original and updated evidence is the gap between CGA's demonstrated efficacy and real-world implementation. CGA remains poorly understood and inconsistently applied by non-specialists, who constitute the majority of clinicians caring for frail older adults[26]. The FI-CGA tool[4] represents a promising solution: by embedding frailty quantification within EHR systems, it operationalises CGA principles for non-specialist services.

Home-based CGA, as demonstrated by Hayes et al.[31], offers a particularly promising delivery model for community-dwelling older adults. The meta-analytic finding that home-based CGA improves functional status with benefits sustained over 6 to 24 months, and reduces acute hospital admissions, aligns with NHS strategic priorities for integrated community care and early intervention. The British Geriatrics Society's 2024 "Be Proactive" guidance provides a policy framework within which home-based CGA can be systematically deployed across primary care networks. Person-centred outcome measures[5,7] should be routinely incorporated into CGA rather than treated as secondary to clinical metrics.

Sarcopenia: A Priority Intervention Target within CGA

The central role of sarcopenia in mediating frailty-multimorbidity interactions, further reinforced within the geriatric triangle framework[32], points to sarcopenia management as a high-priority CGA target. Current evidence supports resistance exercise training as the most effective intervention for muscle mass preservation[23], with nutritional interventions providing additive benefits. Future CGA protocols should incorporate standardised sarcopenia screening (SARC-F or EWGSOP2 criteria) with direct linkage to structured exercise and nutritional referral pathways.

Strengths and Limitations

Strengths include adherence to PRISMA 2020 methodology, a design-specific quality appraisal strategy employing five validated instruments (AMSTAR-2, SANRA, RoB2, CASP Qualitative Checklist, and Newcastle–Ottawa Scale) applied to their respective study design categories, thematic synthesis across diverse study designs, and integration of both quantitative and qualitative evidence. The expanded search window of 2018 to 2025, across six databases, ensures contemporaneous relevance and incorporates landmark evidence published in 2024 and 2025, including a pivotal NEJM narrative review[29], two systematic reviews with meta-analyses[30,31], and an important conceptual framework paper[32].

Limitations include restriction to English-language publications, exclusion of grey literature, and the necessarily narrative rather than meta-analytic synthesis approach given heterogeneity across study designs. The final included sample of fourteen studies, while larger than the original ten, remains modest for a review of this breadth. The newly included meta-analyses[30,31] report low-certainty GRADE evidence for some outcomes, indicating ongoing need for high-quality primary research. Additionally, while the eligibility criteria have been broadened to encompass high-income country contexts to accommodate the inclusion of high-quality evidence from Japan and China, the primarily European framing of the earlier studies means generalisability to non-European healthcare systems should be applied with caution. A further limitation relates to the mixed-design composition of the included study set, which incorporates both primary studies and secondary synthesis evidence (systematic reviews, meta-analyses, and narrative reviews). Including secondary studies alongside primary studies introduces a risk of data overlap, as individual primary studies may

No.	Study (First Author, Year)	Systematic Approach	Time Effective	Objective	Accessible / Clear	Quality Tool & Rating	High Impact	Ref
1	Gordon et al., 2021	✓	✓	✓	✓	NOS: 7/9	✓	28
2	Mazya et al., 2019 (RCT)	✓	✓	✓	✓	RoB2: Some concerns	✓	2
3	Vetrano et al., 2019	✓	✓	✓	✓	AMSTAR-2: Moderate	✓	3
4	Cooper et al., 2022	✓	✓	✓	✓	NOS: 7/9	✓	4
5	Yi et al., 2021	✓	✓	✓	✓	CASP-Q: Low risk	✓	5
6	Alvarez-Bustos et al., 2022	✓	✓	✓	✓	NOS: 7/9	✓	6
7	van Oppen et al., 2022	✓	✓	✓	✓	CASP-Q: Low risk	✓	7
8	Waite et al., 2021	✓	✓	✓	✓	AMSTAR-2: Moderate	✓	8
9	Hirai et al., 2019	✓	✓	✓	✓	NOS: 7/9	✓	9
10	Jedrzejczyk et al., 2022	✓	✓	✓	✓	NOS: 8/9	✓	10
11	**Kim & Rockwood, 2024 †**	✓	✓	✓	✓	SANRA: 10/12	✓	29
12	**Xu et al., 2024**	✓	✓	✓	✓	AMSTAR-2: Moderate	✓	30
13	**Hayes et al., 2025**	✓	✓	✓	✓	AMSTAR-2: Moderate	✓	31
14	**Umegaki, 2025 †**	✓	✓	✓	✓	SANRA: 9/12	✓	32

Quality Tool & Rating reflects the design-specific instrument applied to each study (see Section "Quality Assessment"). AMSTAR-2 "Moderate" indicates that no critical weaknesses were identified but one or more non-critical weaknesses were present. SANRA scores are reported out of 12; scores of 9–10 represent high narrative review quality. NOS scores are reported out of 9 (stars); scores of 6–9 reflect satisfactory to good methodological quality. RoB2 "Some concerns" indicates low randomisation risk but limited blinding of participants (inherent to open-label CGA trials). CASP-Q "Low risk" indicates that all ten criteria were judged as adequately met.

Table 1. Evidence-grading matrix for all included studies with design-specific quality assessment ratings. ✓ = criterion met; RCT = Randomised Controlled Trial; NOS = Newcastle–Ottawa Scale; AMSTAR-2 = A Measurement Tool to Assess Systematic Reviews version 2; SANRA = Scale for the Assessment of Narrative Review Articles; RoB2 = Cochrane Risk of Bias tool v2; CASP-Q = CASP Qualitative Checklist. Studies 11-14 (shown in bold) represent additional studies identified through a recent supplementary literature search conducted to strengthen the systematic review by incorporating the most recent published evidence and findings.

be represented both directly in the review and indirectly through the secondary syntheses that pooled them. This risk was managed through transparent classification of study design in Table 1, application of design-specific quality assessment instruments, and careful attribution of synthesised findings to their respective evidence source within the narrative. Findings attributable to primary studies and those attributable to secondary synthesis evidence are distinguished throughout the Results and Discussion. While this mixed-design approach is an acknowledged methodological limitation, it reflects the deliberate design choice to capture the most clinically relevant evidence across all levels of the evidence hierarchy relevant to the review objectives.

Situating Findings Within the Existing Literature

The findings extend prior systematic reviews on CGA efficacy[12,13] and the frailty-multimorbidity relationship[10]. The added value lies in the integrated examination of both phenomena, explicit incorporation of sarcopenia as a mechanistic link, recognition of inflammaging as a unifying biological concept, and the integration of 2024–2025 evidence. The geriatric triangle framework[32] and updated frailty-guided clinical care principles[29] are not reviewed in earlier syntheses and represent conceptual and clinical advances that this updated review is uniquely positioned to integrate.

Conclusions and Recommendations

Frailty and multimorbidity represent a clinically critical, mechanistically intertwined geriatric complex growing in prevalence with global population ageing. The updated evidence confirms CGA as an effective, evidence-based framework for their integrated management across hospital, outpatient, and community settings. The geriatric triangle concept, integrating polypharmacy as a third mutually reinforcing dimension, provides a refined theoretical rationale for CGA as the gold-standard integrative intervention. Novel digital tools, FI-CGA and eFI, extend CGA reach into non-specialist settings and enable scalable population-level frailty monitoring.

The following evidence-informed recommendations are made:

- Universal frailty screening: All patients aged 65 years and above should undergo standardised frailty screening (Clinical Frailty Scale, eFI, or KCL) as a component of routine primary care review and at every secondary care admission.
- CGA as standard of care: CGA should be operationalised as standard of care for all older adults identified as frail or pre-frail, delivered by designated multidisciplinary geriatric teams incorporating physical, functional, psychological, and social assessment domains.
- EHR-integrated frailty indices: Healthcare organisations should invest in EHR-embedded frailty indices (FI-CGA, eFI) for systematic CGA documentation, communication, and longitudinal monitoring across care settings.
- Polypharmacy review within CGA: Comprehensive medication review and optimisation should be operationalised as a mandatory CGA domain, with structured deprescribing pathways for frail older adults, reflecting the geriatric triangle evidence base [32].
- Sarcopenia management within CGA: CGA protocols should incorporate validated sarcopenia screening (SARC-F or EWGSOP2) with direct referral pathways to structured resistance exercise and nutritional intervention programmes.
- Home-based CGA deployment: Primary care networks should develop home-based CGA capacity as an acute admission avoidance strategy, supported by integrated community MDTs and digital connectivity with secondary care records.
- TSFI for geriatric trauma: Emergency and surgical services should implement TSFI as a perioperative clinical assessment tool for resource allocation, family communication, and discharge planning.
- Person-centred CGA goal-setting: CGA frameworks must routinely incorporate patient-reported outcome goals and carer preferences alongside clinical performance metrics.
- Multidisciplinary CGA teams: Organisations should invest in MDT infrastructure comprising geriatricians, nursing staff, pharmacists, physiotherapists, occupational therapists, dieticians, social workers, and specialist support services.

Future research should prioritise longitudinal, population-level primary studies; RCTs evaluating community-based and home-based CGA models; high-quality polypharmacy optimisation trials within CGA frameworks; and implementation science studies examining barriers to and facilitators of FI-CGA and eFI adoption in non-specialist settings.

Author contributions

SR: Conceptualisation, Methodology, Formal Analysis, Investigation, Writing – Original Draft, Writing – Review and Editing. The author has read and approved the final manuscript.

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Figures 1–4 were created entirely by the corresponding author using original illustrations. Figure 5 (PRISMA flow diagram) was updated to reflect the extended search window and is presented in accordance with PRISMA 2020 reporting guidelines. No figures were reproduced or adapted from previously published works.

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