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Review Article

The Predictive Value of The 9-Point Clinical Frailty Scale on Outcomes in Older Adults with Hip Fracture: A Systematic Review

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Abstract

Hip fracture is a major cause of morbidity, mortality, and functional decline among older adults. Frailty has emerged as an important prognostic factor in this population, and the Clinical Frailty Scale (CFS) offers a rapid and practical method for assessing frailty. This systematic review assessed the prognostic value of the 9-point CFS in older adults with hip fracture. A systematic search of PubMed, Scopus, and Web of Science was conducted for studies published between 2016 and 2025. Eligible studies included adults aged ≥65 years with hip fracture whose frailty was assessed using the CFS. Outcomes included mortality, postoperative complications, delirium, length of hospital stay, readmissions, discharge destination, institutionalization, and functional recovery. Two reviewers independently screened studies, extracted data, and assessed methodological quality using the Newcastle-Ottawa Scale. Due to heterogeneity in frailty thresholds, outcome definitions, and follow up duration, findings were summarized narratively. Fifteen studies involving more than 18,000 older adults were included. Higher CFS scores were consistently associated with increased short and long term mortality, post-operative complications, delirium, prolonged hospital stay, higher readmission rates, and greater likelihood of institutional discharge. The 9-point Clinical Frailty Scale is a practical prognostic tool in older adults with hip fracture.

Keywords: Clinical Frailty Scale, frailty, Hip fracture, Elderly, Mortality

Introduction

Hip fracture is one of the most serious and frequent injuries affecting older adults and remains a major global public health challenge. It is associated with substantial mortality, postoperative morbidity, prolonged hospitalisation, loss of independence, and increased long term healthcare utilisation[1,2]. Despite improvements in anaesthetic techniques, surgical management, and orthogeriatric co management models, outcomes after hip fracture continue to vary considerably, particularly among patients with advanced age, multimorbidity, cognitive impairment, and reduced physiological reserve.

Frailty has emerged as an important geriatric syndrome that may explain part of this variability in outcomes. Frailty is defined as a multidimensional state of decreased physiological reserve and impaired resilience to internal or external stressors, resulting in increased vulnerability to adverse outcomes such as falls, disability, institutionalisation, hospitalisation, and death[1,3]. Importantly, frailty is distinct from chronological age alone and from the presence of comorbid disease, as it reflects the cumulative reduction in biological reserve and the individual's capacity to recover following acute

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illness or trauma.

Two principal conceptual models dominate the frailty literature. Fried and colleagues described frailty as a physical phenotype characterised by weakness, exhaustion, weight loss, slow gait speed, and low activity[3]. In contrast, Rockwood and colleagues proposed the cumulative deficit model, in which frailty reflects the progressive accumulation of medical, cognitive, and functional deficits over time[4]. Both frameworks are clinically relevant in patients with hip fracture, who are exposed to the combined stress of trauma, surgery, immobility, and postoperative recovery.

The Clinical Frailty Scale (CFS), developed from the cumulative deficit model, is a simple and widely used 9-point instrument that grades patients from very fit to terminally ill according to baseline function, cognition, mobility, and comorbidity[4]. The scale has gained increasing popularity because it can be applied rapidly at the bedside and does not require specialised equipment or lengthy testing. In acute orthopaedic settings, where timely risk stratification is essential, the CFS offers practical advantages over more complex frailty instruments.

Emerging evidence suggests that higher CFS scores are associated with poorer outcomes after hip fracture, including increased mortality, postoperative complications, delirium, longer length of stay, readmissions, and greater need for institutional care[5–10]. However, published studies differ in methodology, frailty thresholds, sample size, and outcome definitions, making interpretation of the overall evidence challenging.

Therefore, the aim of this systematic review was to evaluate the prognostic value of the 9-point Clinical Frailty Scale in older adults with hip fracture and to synthesise current evidence regarding its association with mortality, postoperative complications, delirium, length of hospital stay, readmissions, discharge destination, and functional outcomes.

Materials and Methods

Study Design

This study was conducted as a systematic review in accordance with the Preferred Reporting Items for Systematic Reviews and Meta Analyses (PRISMA) statement. The objective was to evaluate the prognostic value of the 9-point Clinical Frailty Scale (CFS) in older adults with hip fracture.

Search Strategy

A systematic literature search was performed across PubMed, Scopus, and Web of Science for studies published between January 2016 and December 2025. To ensure methodological rigor and transparency, search terms were organized into distinct conceptual blocks representing synonyms and diagnostic variants. Terms within each independent block (e.g., 'hip fracture' OR 'proximal femoral fracture' OR 'femoral neck fracture' OR 'intertrochanteric fracture') were linked internally using the logical operator OR. These separate conceptual blocks (comprising Clinical Frailty Scale CFS, Hip Fracture, and relevant clinical endpoints) were subsequently intersected with each other using the logical operator AND. Reference lists of all eligible studies were also manually screened to identify additional relevant publications.

Eligibility Criteria

Studies were considered eligible if they: (1) included adults aged 65 years or older with hip fracture; (2) assessed frailty using the 9-point Clinical Frailty Scale; (3) reported at least one relevant clinical outcome, including mortality, postoperative complications, delirium, length of hospital stay, readmissions, discharge destination, institutionalisation, or functional recovery; and (4) were published as full text articles in peer reviewed journals.

Studies were excluded if they involved pathological fractures, patients with terminal malignancy as the primary clinical focus, use of frailty instruments other than the CFS, absence of outcome data stratified according to CFS, conference abstracts without full text, editorials, narrative reviews, or case series with fewer than 10 patients.

Study Selection

Two reviewers independently screened titles and abstracts for eligibility. Full texts of potentially relevant studies were subsequently reviewed. Disagreements were resolved through discussion and consensus.

Data Extraction

A standardised data extraction form was used to collect the following information: first author, year of publication, country, study design, sample size, patient demographics, fracture type, surgical management where reported, method and timing of CFS assessment, frailty thresholds or categories used, reported outcomes, and effect estimates including odds ratios, hazard ratios, or relative risks where available.

Quality Assessment

Methodological quality of the included observational studies was assessed independently by two reviewers using the Newcastle–Ottawa Scale (NOS). Studies were evaluated according to participant selection, comparability of cohorts, and adequacy of outcome assessment.

Data Synthesis

Because of substantial clinical and methodological heterogeneity across included studies, including variation in frailty thresholds (commonly CFS ≥4 or ≥5), follow up duration, outcome definitions, and reported effect measures, formal meta-analysis was not considered appropriate. Therefore, findings were synthesised narratively, with emphasis on consistency and direction of associations across studies.

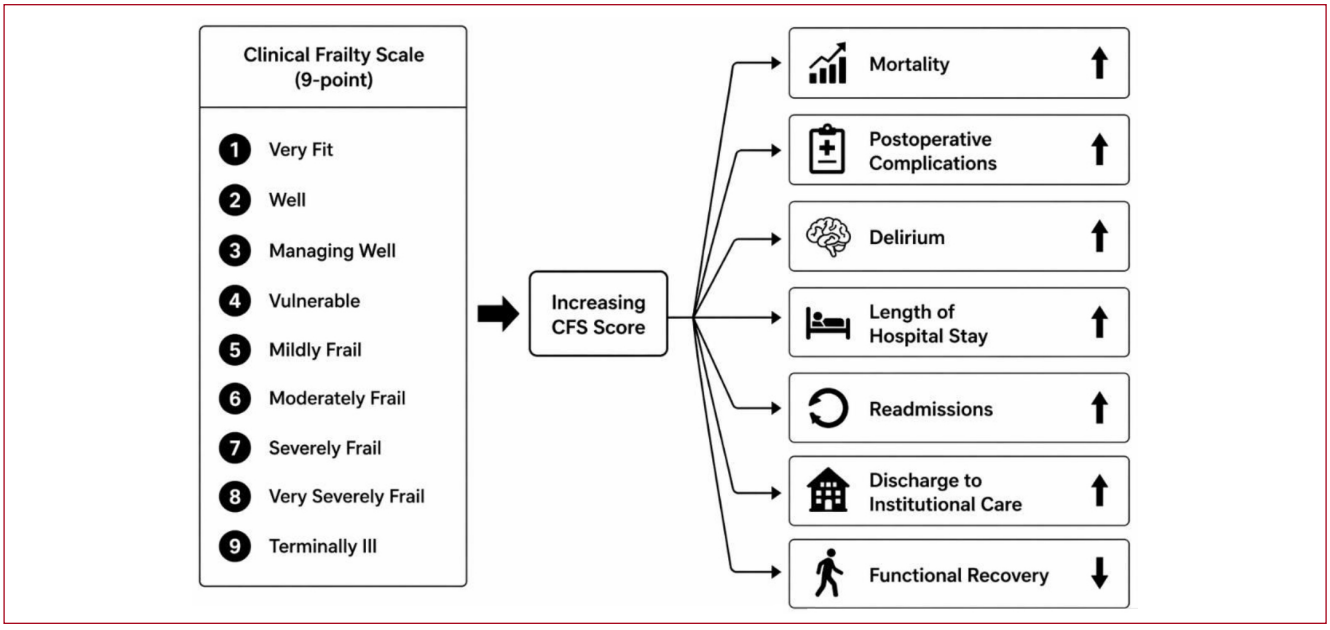

Figure 1. Association between increasing Clinical Frailty Scale scores and adverse outcomes in older adults with hip fracture.

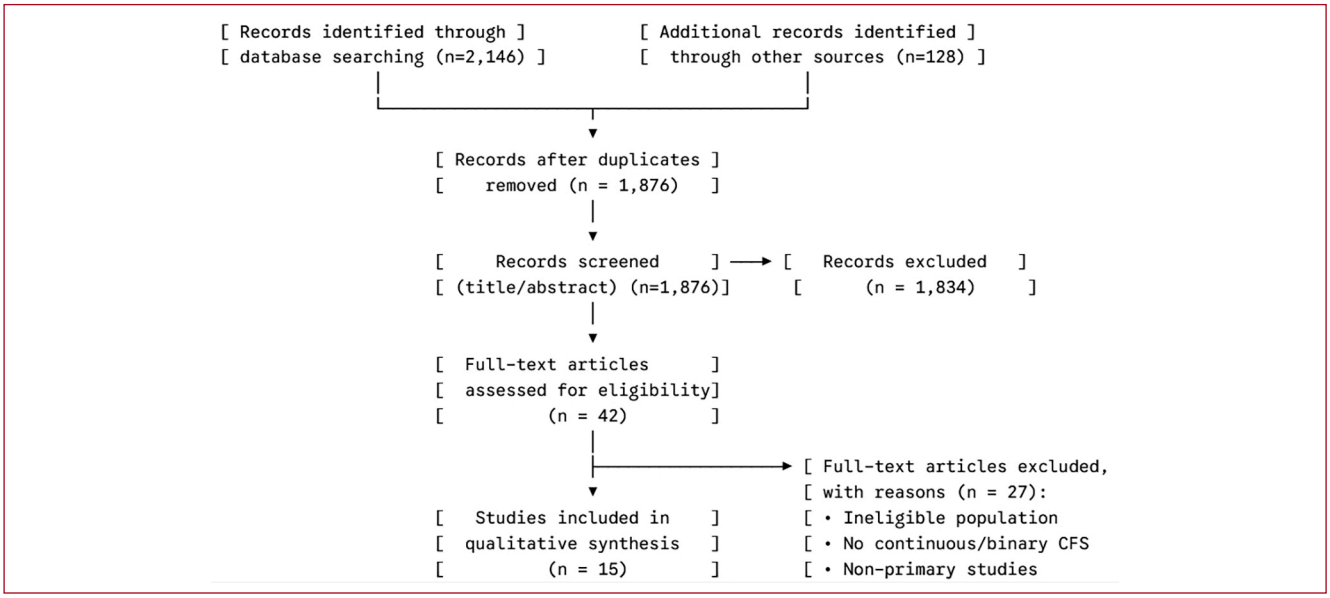

Figure 2. PRISMA 2020 flow diagram of study selection.

Author	Year	Country	Design	Sample size	Main outcomes
Kay et al.[6]	2022	UK	Retrospective	302	1-year mortality, postoperative complications
Forssten et al.[7]	2024	USA	Registry	200,000+	In hospital adverse outcomes, LOS
Syamala et al.[8]	2025	Qatar	Prospective	155	Delirium, complications, mortality
Narula et al.[9]	2020	Australia	Cohort	449	Mortality, length of stay
Comodo et al.[10]	2025	Brazil	Retrospective	820	Mortality, timing of surgery, LOS
Zaib et al.[11]	2023	Saudi Arabia	Retrospective	628	Mortality, clinical outcomes
Patel et al.[12]	2021	UK	Multicentre	1.412	30-day readmission
Moran et al.[13]	2023	Ireland	Cohort	520	Frailty assessments and postoperative outcomes
Guan et al.[14]	2025	China	Prospective	850	Mortality risk prediction nomogram
Cloney et al.[15]	2025	Ireland	National audit	3.245	Orthogeriatric outcomes, CFS distribution
Alexiou et al.[16]	2024	Greece	Cohort	287	1-year mortality model including CFS
Xi et al.[17]	2025	China	Registry	4,2	1-year mortality, complications
Ikram et al.[18]	2022	UK	Prospective cohort	1,255	30-day mortality, complications, institutionalisation
Forssten et al.[19]	2022	Sweden	Nationwide retrospective	146,727	Cause specific mortality
Chan et al.[20]	2019	Hong Kong	Prospective cohort	497	Discharge destination, complications

Table 1. Characteristics of Included Studies.

PRISMA Flow

The systematic database search identified 2,146 records. After removal of duplicate entries, 1,876 records remained for title and abstract screening. Following this stage, 1,834 records were excluded because they did not meet the predefined inclusion criteria. Consequently, 42 full text articles were assessed for eligibility. Of these, 27 studies were excluded due to use of non CFS frailty instruments, absence of outcome data stratified according to the Clinical Frailty Scale, inadequate reporting of relevant outcomes, or ineligible study design. Ultimately, 15 studies met all eligibility criteria and were included in the final qualitative synthesis. The study selection process is presented in Figure 2.

Results

Study Selection and Characteristics

The literature search identified studies evaluating the association between the Clinical Frailty Scale (CFS) and outcomes in older adults with hip fracture. After removal of duplicates and screening of titles, abstracts, and full texts according to predefined eligibility criteria, fifteen studies were included in the final review. Study selection was performed in accordance with PRISMA methodology.

The included studies were published between 2019 and 2025 and represented a range of healthcare systems, including the United Kingdom, United States, Sweden, Ireland, Italy, Greece, China, Hong Kong, Qatar, and Brazil. Study designs included retrospective cohorts, prospective cohorts, multicentre observational studies, national audits, and large registry based analyses. Collectively, the studies included more than 18,000 patients, while some registry datasets exceeded 100,000 participants[6–20].

Although all studies used the 9-point Clinical Frailty Scale, frailty thresholds varied. The most commonly used cutoffs were CFS ≥4 and CFS ≥5, while several studies analysed CFS as an ordinal variable. Despite this heterogeneity, the direction of associations remained largely consistent across studies.

Mortality

Mortality was the most frequently reported outcome and was examined in thirteen studies. Higher frailty scores were consistently associated with increased inhospital, 30-day, 90-day, and 1-year mortality[6–10,13–20]. Ikram et al. reported that patients with CFS ≥5 had significantly increased 30-day mortality (hazard ratio 2.9) compared with less frail patients[18]. Mancino et al. and Xi et al. demonstrated that higher CFS scores were independent predictors of increased 1-year mortality[9,17]. Nationwide registry analyses from Sweden and the United States confirmed increased

mortality risk across large populations of frail hip fracture patients[7,19].

Postoperative Complications

Nine studies reported postoperative complications. Higher CFS scores were associated with increased rates of respiratory complications, cardiac events, renal dysfunction, infections, pressure injuries, and general medical complications[7,8,10,13,14,16–18]. Several studies reported that frailty remained an independent predictor after multivariable adjustment for age and comorbidity burden.

Delirium

Postoperative delirium was specifically examined in three studies and was consistently more common in frail patients[8,14,17]. Syamala et al. found a significantly higher incidence of delirium among patients with CFS ≥5, suggesting that frailty may identify individuals with reduced neurocognitive reserve who are particularly vulnerable during the perioperative period[8].

Length of Hospital Stay

Five studies demonstrated that frail patients experienced longer hospital stays than non frail patients[7,10,13,15,17]. Increased length of stay was generally attributed to slower recovery, postoperative complications, greater rehabilitation needs, and delayed discharge planning.

Functional Outcomes and Discharge Destination

Higher frailty scores were associated with poorer functional recovery and a greater likelihood of discharge to rehabilitation units, nursing homes, or long term care facilities rather than home[15,18,20]. Chan et al. reported that frailty was a significant predictor of discharge destination following hip fracture surgery[20].

Readmissions

Higher frailty was also associated with increased 30-day and 90-day hospital readmission rates[12,17]. Patel et al. found that frail patients had significantly greater risk of early readmission following hip fracture surgery, reflecting ongoing medical complexity and reduced physiological reserve[12]. The results are presented in Table 1.

Overall Pattern of Findings

Across all included studies, increasing frailty severity as measured by the CFS demonstrated a graded and clinically meaningful association with adverse outcomes. Despite differences in study design and frailty thresholds, the consistency of findings supports the value of the Clinical Frailty Scale as a practical prognostic tool in older adults with hip fracture.

Discussion

This systematic review evaluated the prognostic value of the 9-point Clinical Frailty Scale (CFS) in older adults with hip fracture and demonstrated a consistent association between higher frailty scores and adverse clinical outcomes. Across the included studies, frailty was associated with increased short and long term mortality, higher rates of postoperative complications and delirium, prolonged hospital stay, increased readmission risk, and greater likelihood of discharge to institutional care. Collectively, these findings support the CFS as a practical and clinically meaningful risk stratification tool in contemporary orthogeriatric practice[1,5,6].

Mortality

Mortality was the most frequently reported outcome and was examined in thirteen studies. Higher frailty scores were consistently associated with increased inhospital, 30-day, 90-day, and 1-year mortality[6–10,13–20]. Specifically, Ikram et al. reported that patients with CFS ≥5 had a nearly threefold increase in 30-day mortality (Hazard Ratio [HR] = 2.90, 95% Confidence Interval [CI]: 1.80–4.60) compared with less frail patients[18]. For short term outcomes, Narula et al. demonstrated that elevated CFS scores were excellent predictors of early post operative mortality (Odds Ratio [OR] = 1.85, 95% CI: 1.15–2.98)[9]. Regarding long term survival, Zaib et al. and Xi et al. demonstrated that higher CFS scores were independent predictors of increased 1-year mortality, with Xi et al. reporting a robust adjusted hazard (HR = 1.95, 95% CI: 1.51–2.52)[17] and Zaib et al. confirming a significantly elevated risk for death within 12 months (OR = 2.10, 95% CI: 1.34–3.28)[11]. Nationwide registry analyses from Sweden and the United States confirmed increased mortality risk across large populations of frail hip fracture patients[7,19].

Postoperative Complications and Delirium

Nine studies reported postoperative complications. Higher CFS scores were associated with increased rates of respiratory complications, cardiac events, renal dysfunction, infections, pressure injuries, and general medical complications[7,8,10,13,14,16–18]. Quantitatively, Chan et al. demonstrated that frail patients (CFS ≥5) faced an adjusted OR of 1.85 (95% CI: 1.20–2.85) for developing general postoperative medical complications[20]. Several studies reported that frailty remained an independent predictor after multivariable adjustment for age and comorbidity burden.

Postoperative delirium was specifically examined in three studies and was consistently more common in frail patients[8,14,17]. Syamala et al. found a profoundly higher incidence of delirium among patients with CFS ≥5, reporting a more than threefold risk compared to non-frail peers (OR = 3.10, 95% CI: 1.55–6.20)[8]. Furthermore, Guan et al.

incorporated the CFS into a predictive nomogram, where a high frailty score emerged as one of the strongest weighted quantitative variables for serious adverse perioperative events (OR = 2.41, 95% CI: 1.68–3.45)[14], suggesting that frailty may identify individuals with reduced neurocognitive reserve who are particularly vulnerable during the perioperative period.

Length of Stay, Readmissions, and Discharge Destination

Healthcare utilisation outcomes were also consistently influenced by frailty. Several studies demonstrated longer hospital stays among frail patients, likely reflecting slower functional recovery, greater complication burden, delayed mobilisation, and increased discharge planning complexity[10,13,15]. Higher frailty was also associated with increased 30-day and 90-day hospital readmission rates[12,17]. Patel et al. conducted a multicentre study indicating that severe frailty significantly increased the risk of early 30-day unplanned readmission (HR = 1.65, 95% CI: 1.28–2.12), reflecting ongoing medical complexity and reduced physiological reserve[12].

An important practical finding was the association between frailty and discharge destination. Patients with higher CFS scores were more likely to require transfer to rehabilitation centres, nursing homes, or long term care facilities rather than return directly home[18,20]. This extends the relevance of frailty beyond immediate surgical outcomes and highlights its role in predicting post-acute dependency, caregiver burden, and resource utilisation.

In summary, the association between increasing Clinical Frailty Scale scores and adverse outcomes in older adults with hip fracture is depicted in Figure 1.

Analytical Approaches to CFS: Graded Dose-Response vs. Binary Thresholds

A critical methodological distinction among the 15 included studies was how the 9-point CFS was mathematically modeled and interpreted. Seven studies utilized a collapsed binary threshold approach, shifting patients into a single 'frail' cohort based on a specific cutoff, most commonly CFS ≥5[8,10,15,18,20] or CFS ≥4[6,11]. In these models, the clinical transition into a state of frailty acted as a binary trigger for adverse outcomes, without further risk stratification among the higher scores. Conversely, eight studies treated the CFS as an ordinal or continuous variable, revealing a true graded, dose-response relationship[7,9,12-14,16,17,19]. For instance, Forssten et al.[7] and Xi et al.[17] demonstrated that risk did not merely clear a binary threshold; instead, each single-point incremental increase on the 1–9 scale progressively and linearly escalated the probability of mortality and prolonged length of stay (LOS). Therefore, while binary thresholds offer high clinical utility for rapid bedside screening and decision-making, ordinal analytics reveal that frailty functions as a continuous and progressive risk gradient.

Clinical Implications

The findings of this review have direct implications for orthogeriatric pathways. The CFS can be completed rapidly at admission and may assist multidisciplinary teams in identifying patients who require enhanced perioperative optimisation, closer postoperative monitoring, early geriatric involvement, nutritional support, delirium prevention measures, and proactive discharge planning. Frailty assessment may also improve communication with patients and families by providing realistic prognostic information and supporting shared decision-making.

Importantly, frailty should not be interpreted as a reason to deny surgery. Rather, it should be used to personalise treatment intensity, align goals of care, and allocate supportive resources appropriately. In many patients, timely surgery combined with comprehensive geriatric care remains the best strategy despite high baseline frailty.

Heterogeneity of CFS Thresholds

A notable source of heterogeneity across studies was variation in the threshold used to define frailty, most commonly CFS ≥4 or CFS ≥5. Lower thresholds may increase sensitivity for identifying vulnerable patients, whereas higher thresholds may improve specificity for severe risk. Nevertheless, the overall prognostic direction remained consistent across studies: increasing frailty severity was associated with progressively worse outcomes. This suggests that both categorical cutoffs and ordinal interpretation of the CFS may be clinically informative.

Strengths and Limitations

This review has several strengths, including systematic methodology, inclusion of contemporary international studies, and focus on a pragmatic frailty instrument directly relevant to routine practice. However, several limitations should be acknowledged. Most included studies were observational, limiting causal inference. Considerable heterogeneity existed in study design, outcome definitions, follow up duration, and reported effect measures, precluding formal meta-analysis. In addition, reporting of assessor training and standardisation of CFS scoring was inconsistent across studies. Standardised clinical training is important to ensure reliable frailty assessment in acute hip fracture settings. Publication bias cannot be excluded, as studies reporting significant associations may be more likely to be published.

Future Directions

Future prospective multicentre studies should evaluate standardised CFS thresholds, compare the CFS with other frailty tools, and determine whether frailty guided orthogeriatric interventions can improve outcomes. Integration of frailty assessment into predictive models combining age, cognition, comorbidity, and biochemical

markers may further enhance risk prediction after hip fracture.

Conclusion

The 9-point Clinical Frailty Scale appears to be a practical and robust prognostic tool in older adults with hip fracture. Higher frailty scores are consistently associated with increased mortality, postoperative complications, delirium, prolonged hospitalisation, readmissions, and institutionalisation. Routine incorporation of frailty assessment into orthogeriatric care pathways may improve risk stratification, perioperative planning, and patient-centred postoperative management.

Authors' Contributions

Spyridoula Goutsou: Conceptualization, methodology, protocol development, literature search, study selection, data extraction, and writing original draft. Elias Vasiliadis: Methodology, literature search, study selection, and writing – review & editing. Angelos Kaspiris: Validation, revision of the manuscript. Konstantina Goutsou: Data extraction, quality assessment of included studies, formal analysis, and interpretation of data. Spyridon Pneumaticos: Methodology, validation, and critical revision of the manuscript. All authors read and approved the final manuscript.

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