Postprint of a Scoping Review of Frailty Assessment Tools for Hospitalized Elderly Orthopedic Patients

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Abstract

Background: With the aging of China' s population, frailty is becoming increasingly prevalent and warrants growing attention among elderly patients undergoing orthopedic surgery. Early preoperative assessment of frailty status in older adults and timely intervention are of great significance.

Objective: To conduct a scoping review of frailty assessment tools used for elderly inpatients in orthopedic departments, providing a reference for selecting appropriate frailty assessment tools for these patients.

Methods: Various Chinese and English databases were systematically searched to extract information on frailty assessment tools from the literature (including name, study country, study type, scale dimensions, number of items, cutoff values, and assessment time).

Results: A total of 1733 articles were retrieved, with 25 studies ultimately included, encompassing 12 frailty assessment tools. The analysis indicates that current assessment tools are diverse, and using accurate and effective tools for frailty screening is crucial for enhancing preoperative risk stratification and improving postoperative prognosis.

Conclusion: For elderly orthopedic inpatients, selection of assessment tools should comprehensively consider patient characteristics, clinical resource availability, tool performance, and other factors to choose the optimal frailty assessment tool. Currently, there remains a lack of a "gold standard" for frailty assessment, and future research should evaluate the reliability and validity of existing scales or develop frailty assessment tools suitable for elderly orthopedic inpatients in China.

Full Text

Preamble

A Scoping Review of Frailty Assessment Tools for Elderly Inpatients in Orthopedics

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Abstract

Background: With the aging of China' s population, frailty is becoming increasingly common among elderly patients undergoing orthopedic surgery and has attracted growing attention. Early preoperative assessment of frailty status in older adults is of great significance for timely intervention.

Objective: To conduct a scoping review of frailty assessment tools used for elderly orthopedic inpatients and provide a reference for selecting appropriate frailty assessment instruments for this population.

Methods: We systematically searched Chinese and English databases to extract information on frailty assessment tools from the literature, including tool name, study country, research design, scale dimensions, number of items, assessment cutoff values, and evaluation time.

Results: A total of 1,733 articles were retrieved, with 25 studies encompassing 12 frailty assessment tools ultimately included. The analysis revealed a wide variety of available assessment tools, and the use of accurate and effective screening instruments is crucial for enhancing preoperative risk stratification and improving postoperative outcomes.

Conclusion: For elderly orthopedic inpatients, selecting an optimal frailty assessment tool requires comprehensive consideration of patient characteristics, clinical environmental resources, and tool performance. Currently, there remains a lack of a "gold standard" for frailty assessment. Future research should focus on evaluating the reliability and validity of existing scales or developing frailty assessment tools specifically tailored for elderly orthopedic inpatients in China.

[**Keywords**] Frailty; Orthopedics; Elderly; Tool; Scoping Review

Frailty represents an early manifestation of declining physical function and health status, constituting a geriatric syndrome characterized by reduced dis-

ease resistance and increased vulnerability to adverse health events in aging individuals [1]. With advances in medical technology, an increasing number of elderly patients with orthopedic conditions are opting for surgical treatment. Compared with younger patients, older adults exhibit significantly higher rates of postoperative complications and mortality [2-3]. Studies have shown that the prevalence of frailty among preoperative orthopedic patients in China reaches as high as 50.5% [4], and it has become a robust predictor of poor functional outcomes [5-7]. Therefore, early screening and assessment of frailty not only facilitate identification of high-risk populations for proactive intervention but also aid in surgical planning and treatment decision-making. Accurate and effective screening tools are key to frailty assessment. Currently, no review has systematically examined frailty assessment tools used specifically in elderly orthopedic inpatient populations. This study addresses this gap to provide guidance for selecting appropriate assessment instruments for elderly orthopedic patients.

1.2 Defining the Research Questions

Specific research questions were: (1) What frailty assessment tools have been used in elderly orthopedic inpatients? (2) Which frailty assessment tools are reliable and applicable for elderly orthopedic inpatients?

1.3 Identifying Relevant Studies and Developing Search Strategy

We conducted computerized searches of PubMed, CINAHL, PsycINFO, Scopus, and EMBASE databases using a combination of subject headings and free-text terms: "frailty," "orthopaedic," "instrument/measurement/scale/indicator," and "older adults."Chinese literature was searched in CNKI and Wanfang Data using the Chinese search strategy: ("衰弱" AND "评估" OR "筛查" OR "测量" AND "骨科"). The search timeframe spanned from January 2006 to December 2021, marking the period when frailty was first introduced as a subject heading in surgical populations.

1.4.1 Inclusion Criteria

Studies were included if they: (1) provided a clear definition of frailty and involved relevant assessment tools; (2) measured frailty through healthcare provider assessment or patient self-report during hospitalization; (3) were conducted in hospital orthopedic settings; and (4) studied older adults ($ $65 years).

1.4.2 Exclusion Criteria

Studies were excluded if they: (1) merely mentioned patient frailty without actual measurement; (2) were unpublished or non-peer-reviewed materials such as conference proceedings, preprints, policies, or grey literature; (3) represented duplicate publications; or (4) were unavailable in full text.

1.5 Literature Screening and Data Extraction

Two researchers independently extracted data from included studies, with disagreements resolved through discussion with a third reviewer. Extracted data included: assessment tool name, country of study, research design, scale dimensions, number of items, assessment time, and other relevant information.

2.1 Literature Search Results

The initial search yielded 1,733 articles. After abstract review and deduplication, 262 articles were selected for full-text review, resulting in final inclusion of 25 studies. The screening process is illustrated in the figure below.

2.2 Characteristics of Included Studies

The 25 included studies originated from seven countries: United States (n=8), United Kingdom (n=2), Canada (n=2), China (n=2), Singapore (n=2), South Korea (n=1), and Thailand (n=1), with six employing retrospective designs. Different studies utilized various frailty assessment tools (Table 1), ultimately identifying 12 distinct instruments (Table 2): Edmonton Frail Scale (EFS) [9-10], Modified Frailty Index (mFI) [11-18], Fried' s Phenotype Criteria (PF) [19-21], Frailty Index (FI) [19-23], Modified Fried Index [24], Modified Fried' s Criteria (MFC) [25], Reported Edmonton Frail Scale (REFS) [26], 5-Items FI [26-29], Clinical Frailty Scale (CFS) [24], FRAIL Scale [30-32], PRISMA-7 Questionnaire [9], and Groningen Frailty Indicator (GFI) [9,33]. Seven tools (EFS, FI, REFS, CFS, FRAIL Scale, PRISMA-7, GFI) underwent translation and cross-cultural validation. The number of items across these tools ranged from 5 (PF Criteria) to 51 (FI Scale), with most instruments yielding binary outcomes of frailty versus non-frailty. All studies focused on elderly populations (mean age 81 years) undergoing orthopedic surgery, predominantly for knee and hip conditions. Frailty assessment was typically performed preoperatively to predict short- and long-term outcomes, including postoperative complications, mortality, reoperation, and other adverse events.

Table 1 presents the included literature with corresponding frailty assessment tools, study populations, and outcome measures. For example, Sun Xiaoyun et al. [10] used EFS in elective orthopedic surgery patients (mean age 79) to assess length of stay, readmission, and postoperative complications, while Li Bin et al. [30] applied the FRAIL Scale in hip fracture patients (mean age 80.49) to evaluate postoperative medical complications and mortality.

Table 2 summarizes the basic characteristics of the assessment tools. The tools varied by research region, study design, dimensions, items, cutoff values, equipment requirements, professional training needs, timing of administration, and psychometric properties. Most tools required trained personnel or professional clinicians for administration (n=8), while some needed supplementary information (n=3) or specialized equipment (n=3). For instance, mFI, FI, and 5-Items

FI required additional information from medical records, and PF Criteria necessitated grip strength measurement. In contrast, only four tools (REFS, FRAIL Scale, PRISMA-7, and GFI) could be completed without specialized equipment or trained personnel.

2.4 Assessment Conditions and Requirements

The frailty assessment tools differed substantially in their conceptual models, dimensions, and items. Most instruments (n=8) required assessor training or administration by professional clinicians. Some tools (n=3) needed supplementary information or specialized equipment (n=3) for evaluation. For example, mFI, FI, and 5-Items FI required additional data from medical records, while PF Criteria utilized a dynamometer for grip strength measurement. In comparison, only four tools—REFS, FRAIL Scale, PRISMA-7, and GFI—could be administered without specialized equipment or trained assessors.

2.5 Assessment Timing and Completion Time

Patient frailty status was typically assessed before admission (n=11) across included studies, though studies using the FRAIL Scale did not report assessment timing. Only six studies reported completion time, which ranged from 1 to 10 minutes. Specifically, MFC and Modified Fried Index required less than 6 minutes, REFS approximately 5 minutes, and CFS could be completed within 3 minutes. The FI required the most time (10 minutes), while CFS was the quickest.

2.6 Measurement Properties of Assessment Tools

Nineteen studies reported criterion validity of frailty assessment tools in elderly orthopedic patients, frequently using American Society of Anesthesiologists (ASA) classification and Charlson Comorbidity Index (CCI) as validation benchmarks [12,15-16,20,26]. Regarding reliability, Cooper et al. [19] validated the FP Criteria and FI, demonstrating moderate agreement between them (K=0.42, 95% CI 0.36-0.49). Responsiveness analysis indicated moderate responsiveness for mFI [12,17], Modified Fried Index, and CFS [24]. The FI showed strong predictive ability for most adverse outcomes in elderly orthopedic patients [12]. PRISMA-7 and GFI, requiring no additional equipment or trained assessors, may represent practical and convenient tools for assessing frailty in elderly orthopedic patients.

3.1 Comprehensive Considerations for Tool Selection

The included studies employed various frailty assessment tools, reflecting the diversity of current measurement approaches. However, due to musculoskeletal injuries and pain-induced functional limitations in elderly orthopedic populations, not all tools are equally suitable. Our scoping review suggests that the

most relevant tools for elderly orthopedic inpatients include CFS, EFS, PF Criteria, FRAIL Scale, GFI, and mFI. Selection should consider equipment requirements, need for professional administration, and assessment time. In resource-limited settings, cost-effectiveness is crucial, and complex tools requiring supplementary information or equipment are difficult to implement in busy clinical environments. PF Criteria, Modified Fried Index, and MFC require objective grip strength measurement, which is time-consuming and challenging given that many elderly orthopedic patients have limb dysfunction. While self-report tools are simple to administer, they may introduce bias due to subjectivity. CFS and mFI require professional assessors or complex scoring. Therefore, we identified EFS, FRAIL Scale, and GFI as potentially most suitable for elderly orthopedic inpatients. Assessment time, which correlates with item number, assessor experience, musculoskeletal limitations, and evaluation complexity, ranged from 1-10 minutes across included tools. While most demonstrated adequate validity, further research on reliability is needed. Currently, insufficient evidence exists to identify a single optimal frailty assessment tool for elderly orthopedic inpatients.

3.2 Diverse Tool Landscape and Need for Culturally Adapted Instruments

This scoping review identified and evaluated 12 frailty assessment tools used in elderly orthopedic inpatients, each with distinct conceptual backgrounds, dimensions, and items. FI and PF Criteria were the most frequently used. Across studies, frailty—regardless of measurement tool—was consistently associated with adverse postoperative outcomes, reoperation, readmission, and mortality. In clinical orthopedic settings, poor physical function, muscle injury/weakness, and pain-induced mobility limitations may affect assessment accuracy. Researchers have adapted tools for this population by modifying cutoff values and items, as seen in modified PF Criteria and adapted FI indices. This aligns with previous research showing dozens of PF Criteria variants in current use [34-35], suggesting that musculoskeletal conditions may compromise assessment accuracy [36-37]. Existing tools may not accurately capture frailty in elderly orthopedic inpatients, necessitating future research to develop culturally appropriate assessment instruments for this population in China.

4 Summary

Current frailty assessment tools used in elderly orthopedic inpatients provide valuable insights for clinical intervention and highlight the importance of considering environmental resources and measurement requirements in tool selection. Despite the variety of available screening instruments, no "gold standard" exists, and comprehensive psychometric evaluation of tools based on different frailty models remains limited. Validation of reliability and validity in elderly orthopedic populations is still needed. Frailty research in China lags behind international efforts. Future work should draw on foreign experiences while adapting to

China's healthcare context to develop or identify suitable frailty assessment tools for elderly orthopedic inpatients. Additionally, incorporating frailty biomarkers into research may enable more accurate assessment and improve quality of life while reducing adverse outcomes such as readmission, mortality, and disability.

Author Contributions: QIN Lanfang was responsible for manuscript writing and literature retrieval; GUO Wenxi conducted data retrieval and literature organization; WANG Rui and LIU Chongbin handled editing, revision, and review.

Conflict of Interest: The authors declare no conflicts of interest.

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Note: Figure translations are in progress. See original paper for figures.