Postprint of a Scoping Review of Frailty Assessment Tools for Elderly Orthopedic Inpatients

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Abstract

Background: As population aging intensifies in China, the number of elderly patients in the orthopedic perioperative period shows a yearly increasing trend. Frailty is becoming increasingly common and attracting growing attention among elderly patients undergoing orthopedic surgery. Early preoperative assessment of frailty status and timely intervention are of great significance for improving patient prognosis and reducing the occurrence of complications. Objective: To conduct a scoping review of frailty assessment tools used for elderly inpatients in orthopedics, providing a reference basis for the selection of frailty assessment tools for this population. Methods: A computerized search was conducted across seven databases including PubMed, CINAHL, PsycINFO, Scopus, Embase, CNKI, and Wanfang Data Knowledge Service Platform, with the search period from January 2006 to December 2021. Two researchers independently screened the literature and extracted basic characteristics of the included studies (publication date, country, basic information, research tools, and outcome measures) and basic features of the frailty assessment tools involved (name, research country, study type, scale dimensions, scale items, assessment cutoff values, assessment time, etc.). Results: A total of 1,733 articles were retrieved, with 25 studies ultimately included, encompassing 12 types of frailty assessment tools. The analysis results indicate that there is currently a wide variety of assessment tools, with different studies using different frailty assessment instruments. Fried's Frailty Phenotype (FP) and the Frailty Index (FI) are two commonly used frailty assessment tools. Using accurate and effective tools for frailty screening is crucial for enhancing preoperative risk stratification and improving postoperative prognosis. The Reported Edmonton Frail Scale (REFS), FRAIL questionnaire, PRISMA-7 questionnaire, and Groningen Frailty Indicator (GFI) do not require additional measurement equipment, and assessors do not need training to complete the evaluation, making them potentially practical and convenient tools for assessing

frailty in elderly orthopedic patients. However, the measurement properties of these relevant frailty screening tools in the population of elderly orthopedic inpatients still require further validation. Conclusion: When selecting frailty assessment tools for elderly orthopedic inpatients, it is necessary to comprehensively consider factors such as patient characteristics, clinical environment and resource conditions, and tool performance. However, there is currently still 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 suitable for elderly orthopedic inpatients in China.

Full Text

A Scoping Review of Frailty Assessment Tools for Elderly Orthopedic Inpatients

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Abstract

Background
With the intensification of population aging in China, the number of elderly perioperative orthopedic patients is increasing annually. Frailty is becoming increasingly common and concerning among older patients undergoing orthopedic surgery. Early preoperative assessment and intervention for frailty are crucial for improving postoperative prognosis and reducing complications.

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

Methods
Seven databases (PubMed, CINAHL, PsycINFO, Scopus, Embase, CNKI, and Wanfang Data) were systematically searched for studies on frailty assessment tools in older orthopedic inpatients from January 2006 to December 2021. Two researchers independently screened literature and extracted data on: (1) basic study characteristics (publication year, country, study design, tools used, outcome measures), and (2) frailty assessment tool characteristics (name, country

of development, study type, dimensions, number of items, cutoff values, assessment time, etc.).

Results
A total of 1,733 studies were retrieved, of which 25 studies involving 12 frailty assessment tools were included. The analysis revealed considerable heterogeneity in assessment tools across studies. Fried's Frailty Phenotype (FP) and Frailty Index (FI) were the most commonly used tools. Accurate and effective frailty screening is essential for enhancing preoperative risk stratification and improving postoperative outcomes. The Reported Edmonton Frail Scale (REFS), FRAIL Scale, PRISMA-7 Questionnaire, and Groningen Frailty Indicator (GFI) do not require additional equipment or trained personnel, making them potentially practical and convenient tools for assessing frailty in elderly orthopedic patients. However, the measurement properties of these screening tools require further validation in this specific population.

Conclusion
Selecting an optimal frailty assessment tool for elderly orthopedic inpatients requires comprehensive consideration of patient characteristics, clinical resource availability, and tool performance. Currently, no gold standard exists for frailty assessment. Future research should evaluate the reliability and validity of existing scales or develop new tools tailored to Chinese elderly orthopedic inpatients.

Keywords: frailty; aged; hospitals, osteopathic; evaluation tool; scoping review

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1. Methods

1.1 Research Questions This study was guided by the methodological framework of Arksey et al. [8], addressing two specific questions: (1) What frailty assessment tools have been used in elderly orthopedic inpatients? (2) Which frailty assessment tools are reliable and applicable in this population?

1.2 Search Strategy We systematically searched seven databases: PubMed, CINAHL, PsycINFO, Scopus, Embase, CNKI, and Wanfang Data Knowledge Service Platform. The search covered January 2006 to December 2021 (the first use of frailty as a MeSH term in surgical populations began in 2006). For English databases, we used a combination of subject headings and free-text terms: "frailty," "orthopaedic," "instrument/measurement/scale/indicator," and "older adults." For Chinese databases, the search strategy was ("frailty" AND "assessment" OR "screening" OR "measurement") AND "orthopedics."

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

1.4 Exclusion Criteria Studies were excluded if they: (1) only mentioned frailty without actual measurement or definition; (2) were unpublished or non-peer-reviewed (conference proceedings, preprints, policy documents, grey literature); (3) were duplicate publications; (4) had unavailable full text; or (5) were non-English foreign articles.

1.5 Literature Screening and Data Extraction Retrieved citations were imported into EndNote X9 for deduplication. Two researchers independently screened titles and abstracts against inclusion/exclusion criteria, then reviewed full texts for final selection. Discrepancies were resolved through discussion with a third reviewer. Two researchers independently extracted data from included studies, including: frailty assessment tools used, study population, outcome measures, geographic location, study design, scale dimensions, number of items, and measurement performance indicators of the assessment tools.

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2. Results

2.1 Literature Search Results The database search yielded 1,733 studies. After removing 127 duplicates, 1,606 studies remained. Title and abstract screening excluded 1,344 studies (unavailable full text, conference reports, case reports, grey literature). Full-text review was conducted on 262 studies, of which 237 were excluded (population not elderly [age $ $65], no frailty assessment/definition, non-hospital setting, no orthopedic surgery/musculoskeletal disease, non-English foreign articles). Ultimately, 25 studies were included [Figure 1: see original paper].

2.2 Basic Characteristics of Included Studies The 25 included studies [9-33] were published between 2016-2021 across 13 countries: United States (n=13) [11-12,14-15,17,19,23,26-29,31-32], Canada (n=3) [13,16,24], China (n=2) [10,30], United Kingdom (n=1) [9], Australia (n=1) [18], South Korea (n=1) [20], Germany (n=1) [21], Japan (n=1) [22], Singapore (n=1) [25], and Netherlands (n=1) [33]. Study designs included 12 retrospective studies [11-12,14-15,17-18,21-22,27-29,32] and 13 observational studies [9-10,13,16,19-20,23-26,30-31,33].

Twelve frailty assessment tools were identified: Edmonton Frail Scale (EFS) [9-10], Modified Frailty Index (mFI) [11-18], Fried's Phenotype Criteria (FP) [19-21], Frailty Index (FI) [19-23], Modified Fried Index [24], Modified Fried's Criteria (MFC) [25], Reported Edmonton Frail Scale (REFS) [26], 5-Item modified Frailty Index (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].

Twelve studies reported binary outcomes (frail vs. non-frail) [9-17,22-23,33], while six studies reported three-tier outcomes (pre-frail, frail, non-frail)

[19-21,30-32]. Ten studies involved patients with knee and/or hip conditions [11-12,14-15,17,23,25,28,30,33]. Seventeen studies examined various post-operative complications as outcomes [10-11,13-16,18,21-27,29-30,32], three studies assessed 30-day mortality [13,17,33], and detailed information on study characteristics, frailty assessment tools, and outcome measures is presented in .

2.3 Characteristics of Frailty Assessment Tools in Included Studies

2.3.1 Basic Tool Characteristics

Geographic distribution of tool development varied: five tools were studied in the United States (mFI, FP, FI, 5-Items FI, FRAIL), three in the United Kingdom (EFS, PRISMA-7, GFI) and Canada (mFI, Modified Fried Index, CFS), two in China (EFS, FRAIL) and Singapore (MFC, REFS), and one each in Australia (mFI), South Korea (FP), Japan (mFI), and Netherlands (GFI). Regarding study design, four tools were evaluated in retrospective studies and eight in observational studies. The number of dimensions assessed ranged from 4 to 11+, covering cognitive function, physical activity, social support, and emotional status. The number of items ranged from 5 to 51 .

2.3.2 Assessment Conditions and Requirements

Three tools required specialized equipment: FP, Modified Fried Index, and MFC needed grip strength dynamometers. Eight tools required trained professionals or clinical staff for administration. FP and FI required professional calculation of results, while mFI, FI, and 5-Items FI required additional information extraction from medical records. In contrast, four tools (REFS, FRAIL, PRISMA-7, and GFI) could be completed without specialized equipment or professional training.

2.3.3 Assessment Timing and Completion Duration

Among the 12 tools, only studies using the FRAIL Scale did not report assessment timing [30-32]; all other tools were administered pre-admission [9-29,33]. Four studies reported completion time, which ranged from 1-10 minutes. The FI required the most time (<10 minutes), while the CFS required the least (<1 minute).

2.3.4 Measurement Properties

Content validity was reported for EFS [9-10], FP [19], and REFS [25]. Content reliability was reported for FI [19-23], REFS [25], and GFI [9,23]. Criterion validity was examined in 11 tools, with mFI and FP validated against American Society of Anesthesiologists (ASA) classification and/or Charlson Comorbidity Index (CCI) [12,15-16,20,26]. Only REFS underwent construct validity testing. Cooper et al. [19] reported reliability analysis between FP and FI, showing moderate agreement (K=0.42, 95%CI: 0.36-0.49). Responsiveness was moderate for mFI [12,17], Modified Fried Index [24], and CFS [24] in four studies, while one study indicated FI had high predictive ability for most adverse outcomes in elderly orthopedic patients [12]. Seven tools underwent cross-cultural validation, with two studies adapting EFS [10] and FRAIL Scale [12] for Chinese

populations.

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3. Discussion

3.1 Considerations for Tool Selection: Patient Characteristics, Resources, and Assessment Time

Multiple measurement methods exist for screening and diagnosing frailty. However, due to musculoskeletal injuries and pain-related functional limitations in elderly orthopedic patients, not all tools are suitable. This scoping review identified CFS, EFS, FP, FRAIL, GFI, and mFI as relevant and recommended tools for elderly orthopedic inpatients. Tool selection should consider equipment requirements, need for trained personnel, and assessment duration. In resource-limited settings, cost-effectiveness is crucial. Complex tools requiring additional information or equipment are difficult to implement in busy clinical environments with limited staffing. FP, Modified Fried Index, and MFC require objective grip strength measurement, which is time-consuming and challenging in orthopedic patients with limb dysfunction. FP and FI require professional assessment or complex calculations, limiting their generalizability. While self-reported tools are simple to administer, their subjectivity may introduce bias. REFS, FRAIL, PRISMA-7, and GFI can be completed without specialized equipment or training, making them potentially practical for elderly orthopedic patients.

Assessment duration and measurement properties significantly affect evaluation quality. Completion times ranged from 1-10 minutes across tools, varying by item number, assessor experience, and disease complexity. Measurement properties are critical for accuracy. Only REFS underwent comprehensive evaluation of content validity, reliability, construct validity, reliability analysis, responsiveness, and cross-cultural validation. Other tools require further validation in elderly orthopedic populations. Currently, insufficient evidence exists to identify an optimal tool for this population.

3.2 Diverse Frailty Assessment Tools and Urgent Need for China-Specific Development

This review identified 12 frailty assessment tools with varying conceptual frameworks, dimensions, and items. FP and FI were most frequently used. Regardless of the specific tool, frailty measurements consistently correlated with adverse postoperative outcomes (reoperation, readmission, mortality). In orthopedic populations, functional limitations from musculoskeletal injury, weakness, and pain necessitate tool modifications. Researchers have adjusted cutoff values and items for FP and FI, resulting in variants like Modified FP, Modified Fried Index, mFI, and 5-Item FI. Previous studies confirm multiple FP variants are in clinical use [34-35], suggesting that musculoskeletal injury and clinical symptoms may affect assessment accuracy [36-37]. Existing tools may not precisely

measure frailty in elderly orthopedic inpatients.

Research on frailty assessment tools for elderly orthopedic inpatients remains limited in China compared to developed countries. Future studies should validate the clinical applicability and feasibility of these tools in Chinese populations. Drawing from international experience and adapting to China's healthcare context, researchers should develop or identify suitable tools for Chinese elderly orthopedic inpatients. Incorporating frailty biomarkers may enhance assessment accuracy, improve quality of life, and reduce adverse outcomes such as readmission, mortality, and disability.

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