



Review Article

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Frailty Among Older Adults with Knee Osteoarthritis: A Scoping Review of Prevalence, Risk Factors, and Functional Outcomes

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Abstract

Background: Frailty, an age-related syndrome with reduced physiological reserve, compounds KOA-related pain, disability, and functional decline. Evidence heterogeneity limits clear understanding of relationships and optimal interventions. **Objective:** To synthesize evidence on frailty among older adults with knee osteoarthritis (KOA) regarding prevalence, assessment, risk factors, and functional outcomes. **Methods:** Scoping review following PRISMA-ScR principles. Searches of Scopus, Web of Science, and PubMed (2010–2025) showed 101 records; 10 studies met inclusion criteria (cross-sectional, longitudinal, and one randomized controlled trial). **Results:** Frailty prevalence ranged from 4.39% to 12.9%, while pre-frailty prevalence reached 65.6% among community-dwelling older adults with KOA. Consistent risk factors included older age, female sex, severe knee symptoms, obesity, malnutrition, comorbidities, functional impairment, depression, low physical activity, and socioeconomic disadvantage. Longitudinal evidence showed bidirectional relationships: frailty predicted worse pain trajectories, and KOA increased incident frailty. Moderate-to-vigorous physical activity was associated with better symptoms; sedentary behavior was linked to worse stiffness. Chair yoga reduced pain, particularly in frailer participants, though short-term studies did not prove significant frailty improvement. **Conclusions:** Frailty and pre-frailty substantially affect pain, mobility, function, and quality of life in older adults with KOA. Clinical recommendations include: 1) routine frailty screening; 2) early pre-frailty identification; 3) multidomain interventions encompassing physical activity, muscle strengthening, nutrition optimization, pain management, and psychosocial support. Future high-quality longitudinal and intervention research is essential to elucidate causal mechanisms and establish evidence-based frailty management strategies tailored to KOA populations.

Keywords: Community-dwelling; Exercise; Frailty; Knee osteoarthritis; Older adults.

Key Messages

Frailty is common among older adults with knee osteoarthritis and is associated with worse pain, mobility, and physical function. Routine frailty screening may facilitate early identification of high-risk individuals. Multidomain interventions combining exercise, muscle strengthening, nutritional support, pain management, and psychosocial care have the potential to improve outcomes. Additional high-quality longitudinal and intervention studies are needed to strengthen the evidence for frailty management in people with knee osteoarthritis.

الهشاشة بين كبار السن المصابين بالتهاب المفاصل العظمي في الركبة: مراجعة شاملة للانتشار، وعوامل الخطر، والنتائج الوظيفية

الخلاصة

الخلفية: الهشاشة، متلازمة مرتبطة بالعمر مع انخفاض الاحتياطي الفسيولوجي، ومركبات الألم المرتبط بـ KOA، والإعاقة، وتدهور وظيفي. تحدد التباين في الأدلة الفهم الواضح للعلاقات والتدخلات المثلى. **الهدف:** تلخيص الأدلة حول الهشاشة لدى كبار السن المصابين بالتهاب المفاصل العظمي في الركبة (KOA) فيما يتعلق بالانتشار، والتقييم، وعوامل الخطر، والنتائج الوظيفية. **الطرائق:** مراجعة النطاق وفقاً لمبادئ PRISMA-ScR. حددت عمليات البحث في Scopus و Web of Science و PubMed (2010–2025) 101 سجلاً؛ استوفت 10 دراسات معايير الإدراج (مقطعية، طولية، وتجريبية عشوائية محكمة واحدة). **النتائج:** تراوح انتشار الهشاشة بين 4.39% و 12.9%، بينما بلغ معدل الانتشار قبل الهشاشة 65.6% بين كبار السن المصابين بمرض KOA في المجتمعات المقيمة. شملت عوامل الخطر المستمرة التقدم في السن، والإناث، وأعراض الركبة الشديدة، والسمنة، وسوء التغذية، والأمراض المصاحبة، والإعاقات الوظيفية، والاكتئاب، وقلة النشاط البدني، والضعف الاجتماعي والاقتصادي. أظهرت الأدلة الطولية علاقات ثنائية الاتجاه: حيث تنبأت الهشاشة بمسارات ألم أسوأ، وزاد KOA من مضاعفة الحالة. ارتبط النشاط البدني المتوسط إلى القوي بتحسين الأعراض؛ ارتبط السلوك الخامل بصلب أسوأ. قللت يوغا الكراسي من الألم، خاصة لدى المشاركين الأكثر ضعفاً، رغم أن الدراسات قصيرة الأمد لم تظهر تحسناً كبيراً في الهشاشة. **الاستنتاجات:** تؤثر الهشاشة وما قبل الهشاشة بشكل كبير على الألم والحركة والوظيفة وجودة الحياة لدى كبار السن المصابين بـ KOA. تشمل التوصيات السريرية: (1) الفحص الروتيني للهشاشة؛ (2) التعرف المبكر قبل الهشاشة؛ (3) التدخلات متعددة المجالات تشمل النشاط البدني، تقوية العضلات، تحسين التغذية، إدارة الألم، والدعم النفسي الاجتماعي. تعد الأبحاث المستقبلية عالية الجودة في الطول والتدخلات ضرورية لتوضيح الآليات السببية ووضع استراتيجيات إدارة هشاشة قائمة على الأدلة مصممة خصيصاً لسكان KOA.

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INTRODUCTION

Knee osteoarthritis (KOA) is a prevalent chronic musculoskeletal condition in older adults and is commonly associated with knee pain, stiffness, impaired mobility, and reduced participation in daily activities. Functional limitations in KOA are frequently measured using patient-reported outcomes and performance-based

tests, including the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), gait speed, sit-to-stand tests, and other physical function measures [1,2]. Evidence from large osteoarthritis cohorts indicates that KOA is not only a joint-specific condition but is also associated with broader health vulnerability in later life [3,4]. Frailty is a geriatric syndrome involving diminished physiological reserve, reduced resilience, and increased

susceptibility to adverse health outcomes [5]. In older adults with KOA, frailty is clinically relevant because pain, mobility restriction, reduced physical activity, muscle weakness, and comorbidity may interact to increase vulnerability. Conversely, frailty may worsen the impact of KOA by reducing an individual's capacity to maintain physical activity, recover from pain flare-ups, and preserve independence [3,4]. Several studies have examined the relationship between KOA, knee pain, frailty status, and functional outcomes. Longitudinal evidence suggests that frailty predicts unfavorable knee pain trajectories over time, and knee pain status is associated with incident pre-frailty and frailty [6,7]. More recent longitudinal evidence also suggests a bidirectional relationship in which frailty may contribute to future KOA risk, in which frailty may contribute to future KOA risk while KOA may contribute to frailty progression over time [8]. Potentially modifiable factors are central to this relationship. Studies have linked frailty in individuals with KOA or osteoarthritis to older age, female sex, obesity, malnutrition, functional dependence, low physical activity, depression, comorbidity burden, and poorer self-reported health [9-11]. Physical activity appears particularly important: moderate-to-vigorous physical activity may be associated with less pain and disability, while stationary or sedentary time may be associated with worse symptoms, especially among frailer individuals [12]. Despite growing research interest, findings remain difficult to interpret because studies differ in population characteristics, KOA definitions, frailty instruments, and outcome domains. A scoping review is therefore appropriate to map the breadth of evidence, clarify how frailty has been assessed, summarize reported prevalence and associated factors, and identify gaps for future research. This scoping review aimed to map evidence on frailty among older adults with KOA, focusing on prevalence, frailty assessment methods, associated risk factors, functional consequences, and available intervention-related evidence [13].

METHODS

Study design

This scoping review was guided by methodological recommendations for scoping studies described by Levac *et al.* [14]. The review was organized in accordance with PRISMA-ScR principles to improve transparency in reporting the search process, study selection, charting of evidence, and narrative synthesis. A scoping review approach was selected because the topic includes heterogeneous evidence sources, including prevalence studies, cross-sectional association studies, longitudinal cohort studies, and intervention-related evidence. The objective was not to pool effect estimates but to map the available evidence, identify recurring concepts and outcome domains, and highlight research gaps relevant to frailty and KOA.

Eligibility criteria

Eligibility criteria were structured using the Population-Concept-Context (PCC) framework. Studies were included if they involved adults aged 45 years and older,

with primary emphasis on older adults aged 60 years and above, who had KOA diagnosed clinically, radiographically, by physician diagnosis, or by symptomatic criteria. Studies involving mixed osteoarthritis or lower-extremity osteoarthritis populations were considered when KOA was clearly represented or when findings were directly relevant to older adults with knee or lower-limb osteoarthritis.

Exclusion criteria

Studies focused only on non-knee osteoarthritis populations without relevant knee or lower-extremity osteoarthritis data. Studies that assessed frailty, pre-frailty, frailty-related domains, or functional vulnerability were included. Studies limited to pharmacological or surgical interventions without frailty-related outcomes. Studies not published in English. Reviews, editorials, commentaries, protocols without outcome data, and other non-peer-reviewed sources.

Concept

The main concept of interest was frailty, including physical frailty, pre-frailty, cognitive frailty, frailty index-defined vulnerability, and frailty-related domains such as weakness, slowness, exhaustion, low physical activity, weight loss, reduced energy, functional dependence, and declining mobility. Eligible studies used validated or clearly described frailty-related measures, including the Fried Frailty Phenotype, Frailty Index, SHARE-FI, Study of Osteoporotic Fractures (SOF) Index, or comparable instruments.

Context

Studies conducted in community-dwelling, outpatient, or population-based settings were eligible. Studies conducted exclusively in hospitalized, institutionalized, perioperative, or post-operative populations were excluded unless baseline community-dwelling or outpatient status was clear.

Types of evidence

This scoping review included randomized controlled trials, quasi-experimental studies, prospective or retrospective cohort studies, and cross-sectional observational studies. Reviews, commentaries, editorials, case reports, conference abstracts without sufficient data, and non-peer-reviewed sources were excluded.

Outcome measurement

Studies were included if they reported frailty status, pre-frailty, cognitive frailty, frailty transition, frailty-related domains, or functional outcomes relevant to KOA. Outcomes of interest included gait speed, Timed Up and Go, sit-to-stand performance, muscle strength, WOMAC pain or function, disability, balance, physical activity, quality of life, and daily functioning. Secondary outcomes included pain severity, stiffness, depression, nutritional status, and comorbidity burden.

Study selection

The study selection process followed the PRISMA-ScR flow diagram. The database search identified 101 records: 11 from Scopus, 87 from Web of Science, and 3 from PubMed. After the removal of two duplicates, 99 unique records were screened by their title and abstract. During screening, 85 records were excluded because they were not relevant to the review objectives. Fourteen reports were sought for full-text retrieval; 4 reports could not be retrieved. Ten full-text articles were assessed for eligibility, and all 10 were included in the final scoping review. The study selection process is presented in Figure 1.

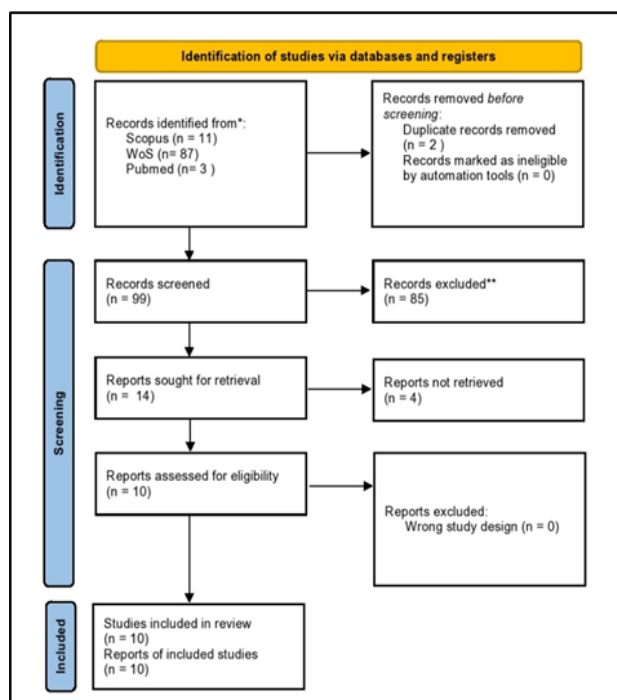


Figure 1: Diagram PRISMA Flow Chart.

Data extraction and charting

Data were charted using a standardized extraction form. Extracted information included the author (year), diagnosis/frailty with KOA, status of participants, and age (years). Charted information also included the main factors examined, such as demographic characteristics, knee pain, KOA severity, physical activity, body mass

index, nutrition, comorbidities, depression, and functional dependence.

RESULTS

Ten studies met the inclusion criteria and were included in this scoping review. The evidence base comprised cross-sectional observational studies, longitudinal cohort studies, secondary analyses of large cohort datasets, and one randomized controlled trial. Sample sizes ranged from 58 participants in a small osteoarthritis study to 4,419 participants in the Osteoarthritis Initiative analysis [6,11]. Most studies involved community-dwelling older adults, although some included adults aged 45 years and older who had KOA or were at increased risk of KOA [6-8,12]. The included studies varied in how they defined KOA. Some studies used clinical criteria, symptomatic KOA definitions, radiographic criteria such as Kellgren-Lawrence grading, or self-reported physician diagnosis with knee pain [3,8,15]. This variation is important because frailty estimates and functional outcomes may differ according to whether KOA is defined clinically, radiographically, symptomatically, or by self-report. The characteristics of the included studies are summarized in Table 1, whereas the main findings regarding frailty prevalence, risk factors, and functional outcomes are presented in Table 2.

Frailty assessment methods

Frailty was measured using several validated or widely used approaches. These included the Fried Frailty Phenotype, SHARE-FI, Frailty Index models, and the Study of Osteoporotic Fractures (SOF) Index [3,9,15]. Common frailty domains included weight loss, exhaustion or poor energy, weakness, slow gait speed, reduced physical activity, and accumulation of health deficits. Some studies also examined cognitive frailty, functional dependence, and psychosocial variables such as depression [10,11]. Functional outcomes were assessed using measures such as WOMAC pain, stiffness, and function; gait speed; sit-to-stand performance; physical activity questionnaires; accelerometry; health-related quality of life; and pain interference measures [1,2,6,9,12,16]. The diversity of instruments supports the need for a scoping approach and limits direct comparison of prevalence and effect estimates across studies.

Table 1: Extraction data of the study characteristics

Author (year)	Diagnosis/Frailty with KOA Status	Participants (n)	Age (year)
Rayner <i>et al.</i> (2025) [12]	KOA or at risk of KOA with baseline Frailty Index classification (non-frail, very mild frailty, mild frailty or greater)	1,351	Mean: 60.6
Tian <i>et al.</i> (2025) [8]	Symptomatic KOA and Frailty Index	3,560	≥45
Cai <i>et al.</i> (2023) [6]	KOA or at risk of KOA with frailty phenotype (non-frail, pre-frail, frail)	4,419	45–79
Salaffi <i>et al.</i> (2021) [9]	Symptomatic KOA assessed using SHARE-FI frailty criteria	170	Mean: 70.1
Park <i>et al.</i> (2021) [16]	Lower-extremity OA with baseline Frailty Index	112	Mean: 75.3
Wanaratna <i>et al.</i> (2019) [10]	Community-dwelling KOA patients categorized as non-frail, pre-frail, and frail	780	Mean: 69.4
Bindawas <i>et al.</i> (2018) [7]	Knee pain status and incident frailty (Fried phenotype)	3,053	45–79 years
Castell <i>et al.</i> (2015) [3]	Clinical knee OA and Fried frailty phenotype	2,455	65–85 years
Misra <i>et al.</i> (2015) [15]	Radiographic and symptomatic KOA with SOF frailty index	3,707 (cross-sectional); 2,980 (longitudinal)	Mean: ≈ 68
Song <i>et al.</i> (2015) [11]	Older adults at risk of physical frailty (OAI cohort)	1,333	55–83

Table 2: Data extracted from the 10 eligible studies

Author (year)	Study design	Factors examined	Outcome measures	Key results
Rayner <i>et al.</i> (2025) [12]	Longitudinal cohort	Frailty, Moderate-to-Vigorous Physical Activity (MVPA), sedentary behavior	WOMAC pain, stiffness, disability	MVPA improved symptoms; sedentary time worsened stiffness; frailty moderated effects.
Tian <i>et al.</i> (2025) [8]	Longitudinal population study	KOA, frailty, sarcopenia, sleep, sensory impairment	Frailty Index, KOA diagnosis	Bidirectional relationship observed; frailty had a stronger influence on future KOA.
Cai <i>et al.</i> (2023) [6]	Prospective cohort (9 years)	Frailty status and components	WOMAC pain, gait speed, PASE, CES-D	Pre-frailty and frailty predicted more severe knee pain trajectories over time.
Salaffi <i>et al.</i> (2021) [9]	Cross-sectional	Age, sex, BMI, pain, comorbidities, polypharmacy, HRQoL	SHARE-FI, WOMAC, SF-36	Symptomatic KOA associated with higher frailty burden, worse pain, function, and HRQoL.
Park <i>et al.</i> (2021) [16]	Assessor-blinded RCT	Chair yoga and baseline frailty	WOMAC Pain, PROMIS Pain Interference, Frailty Index	Frailer participants experienced greater pain reduction following chair yoga.
Wanaratna <i>et al.</i> (2019) [10]	Cross-sectional	KOA severity, nutrition, physical activity, cognition	Fried Frailty Phenotype, Mini-Cog, GPAQ	Frailty prevalence 12.9%, pre-frailty 65.6%; associated with severe OA symptoms and malnutrition.
Bindawas <i>et al.</i> (2018) [7]	Prospective cohort (6 years)	Knee pain status	Fried Frailty Phenotype	Unilateral and bilateral knee pain increased risk of incident pre-frailty and frailty.
Castell <i>et al.</i> (2015) [3]	Multinational cohort	Clinical knee OA, age, sex, obesity	Fried Frailty Phenotype, WOMAC	Clinical OA significantly associated with pre-frailty and frailty.
Misra <i>et al.</i> (2015) [15]	Observational cohort	KOA severity and symptom status	SOF Frailty Index	Symptomatic KOA associated with increased prevalence and incidence of frailty.
Song <i>et al.</i> (2015) [11]	Prospective longitudinal cohort study with 2-year follow-up	Sedentary behavior, physical activity, and health-related factors	Physical frailty, gait speed, chair stand performance	Higher sedentary time was associated with an increased risk of physical frailty independent of moderate physical activity.

Prevalence of frailty and pre-frailty

Frailty prevalence varied substantially across studies. In large KOA-specific cohort analyses, frailty prevalence was relatively low but consistently higher among individuals with KOA than among those without KOA. Misra *et al.* reported greater frailty prevalence among participants with radiographic KOA and symptomatic KOA compared with participants without KOA, and longitudinal analyses suggested higher incident frailty among those with KOA [15]. Other KOA-focused studies reported higher frailty estimates. Wanaratna *et al.* found frailty in 12.9% and pre-frailty in 65.6% of community-dwelling older adults with KOA in Thailand [10]. Castell *et al.* reported that clinical osteoarthritis was associated with increased odds of both pre-frailty and frailty among older adults in six European countries [3]. Smaller or mixed osteoarthritis samples reported even higher frailty burdens, although these estimates should be interpreted cautiously because of limited sample size and inclusion of hip and/or lower-extremity osteoarthritis rather than KOA alone [11,16]. Overall, the findings suggest that pre-frailty is particularly common among older adults with KOA and may represent an important window for early intervention [17]. However, direct comparison across studies is limited by differences in age range, study setting, KOA definition, frailty instrument, and outcome reporting.

Associated factors

The most frequently reported factors associated with frailty in KOA or osteoarthritis populations were older age, female sex, greater knee pain or symptom severity, higher body mass index or obesity, malnutrition, comorbidity burden, depression, physical inactivity, and functional dependence [9-11]. Wanaratna *et al.* found that severe osteoarthritis symptoms, older age, malnutrition, and functional dependence were strongly associated with frailty among community-dwelling older adults with KOA [10]. Pain and symptom burden appear to be especially important. Bindawas *et al.* reported that unilateral knee pain increased odds of incident pre-frailty

and frailty, while bilateral knee pain showed even stronger associations over six years of follow-up [7]. Cai *et al.* found that baseline pre-frailty and frailty were associated with progressively worse knee pain trajectories over nine years [6]. These findings suggest that frailty and knee pain may reinforce each other through reduced activity, weakness, fatigue, and functional decline.

Functional and clinical outcomes

Frailty was consistently associated with poorer functional and clinical outcomes. Frail individuals with KOA or osteoarthritis tended to report greater pain, worse WOMAC function, lower health-related quality of life, reduced physical activity, poorer mobility, greater depression burden, and lower fall-related self-efficacy [9,11]. In longitudinal studies, frailty predicted worse pain trajectories, and knee pain status predicted future pre-frailty and frailty [6,7]. Evidence also suggests that the relationship between frailty and KOA may be bidirectional. Tian *et al.* reported that frailty had a stronger effect on future KOA than KOA had on future frailty in a longitudinal Chinese population-based study, while KOA predicted frailty in longer-term follow-up [8]. This supports an integrated clinical perspective in which joint symptoms, muscle function, comorbidities, nutritional status, and systemic vulnerability are considered together.

Physical activity and intervention evidence

Physical activity emerged as a key modifiable factor. Rayner *et al.* found that moderate-to-vigorous physical activity was negatively associated with WOMAC total symptoms, pain, stiffness, and disability, while stationary time was positively associated with stiffness [18]. Frailty moderated some of these relationships, suggesting that frailer individuals may be especially vulnerable to the adverse effects of inactivity and may also benefit from appropriately adapted physical activity [12,19,20]. Intervention evidence was limited. Park *et al.* conducted a secondary analysis of a chair yoga trial among older adults with lower-extremity osteoarthritis and found that

frailer participants experienced greater pain reduction with chair yoga, although the intervention did not produce clear between-group or longitudinal improvements in frailty status [16]. Exercise guidance for frailty in older adults supports progressive, individualized, and multimodal approaches, but KOA-specific frailty interventions remain underdeveloped [4,21,22]. Recent protocol work also highlights ongoing interest in frailty prevention care management, although outcome evidence specific to KOA is still limited [23,25].

DISCUSSION

This scoping review shows that frailty and pre-frailty are important clinical issues among older adults with KOA. Although prevalence estimates varied, the direction of evidence was consistent: older adults with KOA or knee pain are more likely to show frailty-related vulnerability than those without KOA, and frailty is associated with worse pain, physical function, mobility, and quality-of-life outcomes [3,6,7,9,10,15]. The wide variation in prevalence should not be interpreted as a contradiction. Rather, it reflects methodological heterogeneity across studies. Frailty was measured using different tools, including phenotype-based, index-based, and deficit-accumulation approaches [26]. KOA was also defined differently across studies, ranging from clinical and radiographic criteria to self-reported physician diagnosis with knee pain. These differences affect who is classified as frail and who is classified as having KOA [27]. The findings support the integration of frailty screening into KOA care, especially in community and outpatient settings [28]. Screening for pre-frailty may be particularly useful because pre-frail individuals may still have sufficient physiological reserve to respond to early intervention. Practical screening should consider pain severity, gait speed or mobility performance, physical activity, nutrition, comorbidities, depression, and functional dependence [5,9,10]. Management should move beyond a joint-centered approach and adopt a multidomain model. Potentially modifiable targets include strengthening exercise, balance and mobility training, weight management where appropriate, nutritional optimization, pain management, depression screening, and reduction of sedentary behavior [23,4]. The association between moderate-to-vigorous physical activity and better KOA symptom profiles suggests that appropriately tailored exercise may be especially important, but programs must be adapted to pain severity, frailty status, and functional capacity [4,12,30]. Several gaps were identified. First, frailty instruments were inconsistent across studies, limiting comparability. Future studies should clearly justify the choice of frailty measures and report frailty and pre-frailty separately. Second, more longitudinal research is needed to clarify mechanisms linking pain, inactivity, muscle weakness, inflammation, nutrition, and frailty progression in KOA. Third, intervention evidence remains limited; larger randomized trials are needed to test multidomain interventions that combine exercise, nutrition, pain management, and behavioral strategies. Fourth, more evidence is needed from diverse populations, including low- and middle-income settings, because the majority of

large cohort data were derived from high-income or population-specific datasets.

Study Limitations

This review has limitations. Searches were limited to Scopus, Web of Science, and PubMed, and only English-language peer-reviewed articles were included. Some relevant studies may have been missed because grey literature and additional rehabilitation databases were not searched. The included studies were heterogeneous in design, KOA definition, frailty measure, and outcome reporting, which prevented meta-analysis. Some included evidence that involved mixed osteoarthritis or lower-extremity osteoarthritis populations rather than KOA alone. Finally, methodological quality was charted descriptively rather than assessed using a formal risk-of-bias tool, which is consistent with the mapping purpose of this scoping review but limits conclusions about certainty of evidence.

Conclusions

This scoping review demonstrates that frailty and pre-frailty are clinically relevant among older adults with KOA. Frailty is associated with greater pain, poorer physical function, lower mobility, reduced physical activity, and poorer quality of life. Longitudinal evidence suggests that frailty may predict worsening knee pain and that knee pain or KOA may increase the risk of future frailty, supporting a potentially bidirectional relationship. The evidence indicates that frailty in KOA is influenced not only by structural joint disease but also by modifiable clinical and functional factors, including physical inactivity, malnutrition, obesity, comorbidities, depression, and functional dependence. Early frailty screening and targeted multidomain management should therefore be considered within KOA care pathways. Interventions should address joint symptoms, muscle function, physical activity, nutrition, psychosocial health, and systemic resilience. Further high-quality longitudinal and intervention studies are required to determine which frailty-focused strategies are most effective for improving outcomes in older adults with KOA.

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Conflict of interests

The authors declared no conflict of interest.

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Data sharing statement

The data that supports the findings of this study are available from the corresponding author upon a reasonable request.

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