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Knee Osteoarthritis (KOA) and Its Relationship with Physical Frailty in Community-Dwelling Older Adults: A Narrative Review

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ABSTRACT

Background

Knee Osteoarthritis (KOA) is a common joint disease in older adults, leading to pain, reduced mobility, and disability. Frailty, a condition of physical decline, increases vulnerability to health issues. Research suggests a strong connection between KOA and frailty, but this relationship is not fully understood.

Objective

This review explores how KOA and frailty are linked, their shared risk factors, and the impact on older adults' health.

Methods

A literature search was conducted using databases such as PubMed, Scopus, and Google Scholar. Studies were selected based on relevance to KOA, frailty, and community-dwelling older adults.

Results

KOA contributes to frailty by causing chronic pain, muscle weakness, and mobility loss. Frailty, in turn, worsens KOA by reducing physical activity and increasing inflammation. People with both conditions have a higher risk of falls, disability, and poor quality of life. However, there is limited research on interventions addressing both conditions together.

Conclusion

KOA and frailty create a cycle of worsening health. Early screening and interventions, such as physiotherapy, strength training, and pain management, are essential to maintaining independence in older adults. More research is needed to develop targeted treatments for those affected.

INTRODUCTION

Aging is a complex biological process associated with gradual declines in physical and cognitive function. As the global population ages, the burden of age-related conditions increases significantly. According to the World Health Organization (WHO., 2024) by 2030, one in six individuals worldwide will be aged 60 or older, increasing from 1 billion in 2020 to 1.4 billion. By 2050, this number is projected to reach 2.1 billion, with the population aged 80 and over tripling to 426 million (WHO, 2024). While population aging was initially more prominent in high-income countries, low- and middle-income countries now experience the most rapid demographic transitions (United Nations, 2020) (United Nations & New York, 2019). With increased longevity, chronic musculoskeletal disorders such as knee osteoarthritis (KOA) and frailty have become major health concerns, significantly affecting mobility and independence in older adults (Oh et al., 2021).

KOA is one of the most common degenerative joint diseases, affecting an estimated 40% of individuals over the age of 60 (Michael et al., 2010; Bindawas et al., 2018). by (Osteoarthritis Research Society International (OARSI), 2016) It is characterized by progressive cartilage degradation, synovial inflammation, and subchondral bone remodeling, leading to joint stiffness, pain, and reduced mobility (Osteoarthritis Research Society International (OARSI), 2016). Unlike other forms of arthritis, KOA is primarily a wear-and-tear disease but is influenced by metabolic, genetic, and inflammatory factors (Ferrucci & Fabbri, 2018). As a leading cause of disability in older adults, KOA significantly limits physical activity, contributing to muscle weakness, increased fall risk, and reduced independence (Tian et al., 2025).

While KOA is often viewed as a local joint disorder, recent research highlights its systemic impact. Chronic inflammation associated with KOA contributes to increased frailty risk, particularly due to the release of pro-inflammatory cytokines such as interleukin-6 (IL-6) and C-reactive protein (CRP), which accelerate muscle loss, joint degeneration, and metabolic dysfunction (Muawanah & Juariah, 2023). This emerging perspective positions KOA not only as a mobility-limiting condition but also as a contributor to broader age-related decline (Joo et al., 2023).

Frailty is a common geriatric syndrome characterized by reduced physiological reserves, increased vulnerability to stressors, and higher risk of disability by World Health Organization, 2016. It is commonly assessed using the Fried Frailty Phenotype, which includes five core criteria: (i) fatigue, (ii) slowness (slow gait speed), (iii) muscle weakness, (iv) unintentional weight loss and (v) low physical activity (Tou et al., 2024).

Studies have consistently shown that frailty prevalence is higher in individuals with KOA. For example, a large-scale European cohort study (EPOSA Project) found that KOA patients had significantly higher odds of frailty and pre-frailty, particularly among women and those with multiple affected joints (Castell et al., 2015). Similarly, a longitudinal study by Joo et al. (2023) in the Korean National Health and Nutrition Examination Survey (KNHANES) found that KOA patients were nearly 7 times more likely to be frail (RRR = 7.28, 95% CI: 5.90–8.98) than non-KOA individuals. These findings suggest that KOA and frailty are strongly interconnected, with KOA increasing frailty risk and vice versa (Joo et al., 2023)

Frailty is also linked to poor muscle health, particularly through sarcopenia (age-related muscle loss), reduced balance, and joint instability (Barrachina-igual et al., 2022). While physical activity is generally protective against KOA-related disability, excessive joint stress or inadequate rehabilitation can exacerbate pain and worsen frailty symptoms. This bidirectional relationship suggests that interventions should focus on early detection and targeted therapies to prevent the progression of both conditions (Wanaratna et al., 2019).

Despite increasing evidence linking KOA and frailty, several key research gaps remain. While cross-sectional and longitudinal studies have documented their association (Salaffi et al., 2020), the causal relationship remains unclear. Additionally, few studies have examined intervention strategies that simultaneously target KOA and frailty (Park et al., 2021). Most research focuses on older adults in clinical settings, with limited data on community-dwelling individuals who may have different lifestyle, mobility, and rehabilitation needs (O'Brien et al., 2024).

Thus, this narrative review aims to; (i) synthesize existing evidence on the link between KOA and frailty in community-dwelling older adults ; (ii) identify shared risk factors and mechanisms

contributing to both conditions and (iii) discuss potential intervention strategies to mitigate KOA-related frailty. By addressing these gaps, this review seeks to contribute to a more integrated approach to geriatric musculoskeletal health, emphasizing preventive and rehabilitative measures to improve mobility, independence, and quality of life in aging populations.

METHODS

A comprehensive literature search was conducted using multiple electronic databases, including Web of Science, Scopus, and Google Scholar, to identify relevant studies examining the relationship between knee osteoarthritis (KOA) and frailty in community-dwelling older adults. The search included peer-reviewed original research articles, systematic reviews, meta-analyses, and longitudinal cohort studies. To ensure a thorough investigation, keywords such as “knee osteoarthritis,” “KOA,” “frailty,” “frailty syndrome,” “physical frailty,” “aging,” “older adults,” and “community-dwelling” were used in combination with Boolean operators (AND/OR). In databases where applicable, MeSH (Medical Subject Headings) terms were incorporated to refine the search results. The search was not restricted by publication year to capture a broad range of studies and trends in KOA-frailty research. However, only studies published in English were included to maintain consistency in data interpretation and avoid translation biases.

Studies were selected based on predefined inclusion and exclusion criteria. Eligible studies were those that focused on the association between KOA and frailty in community-dwelling older adults aged 60 and above. Research that employed validated frailty assessment tools, such as the Fried Frailty Phenotype, the Frailty Index (FI), or the Survey of Health, Ageing and Retirement in Europe-Frailty Instrument (SHARE-FI), was prioritized. Observational studies, longitudinal cohort studies, randomized controlled trials (RCTs), and meta-analyses were included to provide a diverse perspective on the relationship between KOA and frailty. In contrast, studies conducted on hospitalized patients or institutionalized older adults, as well as those examining frailty unrelated to KOA (e.g., cognitive frailty or cardiovascular frailty), were

excluded. Furthermore, articles that lacked full-text availability, as well as conference abstracts, editorials, and commentaries, were not considered.

The study selection process followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, ensuring a systematic approach to screening and evaluating literature. Initially, all identified articles were screened by reviewing titles and abstracts, and duplicates or irrelevant studies were removed. Following this, full-text articles were retrieved for detailed assessment to determine their eligibility.

Data extraction was performed using a structured framework, collecting information on study design, sample characteristics (including age, sex, KOA severity, and frailty assessment), key findings on KOA-frailty relationships, statistical methods, and effect sizes. This approach ensured that only the most relevant and methodologically sound studies were included in the review.

To assess the quality and reliability of the selected studies, different evaluation tools were used based on study design. Observational studies were appraised using the Newcastle-Ottawa Scale (NOS), randomized controlled trials were evaluated using the Cochrane Risk of Bias Tool, and systematic reviews or meta-analyses were assessed using the AMSTAR-2 criteria. These quality assessment tools helped identify potential biases, limitations, and strengths within the selected research, ensuring that conclusions drawn from this review were based on high-quality evidence.

Given the heterogeneity of study designs, sample populations, and frailty assessment methods, a narrative synthesis was chosen as the primary method of data synthesis instead of a meta-analysis. The extracted findings were categorized into key thematic areas, including the prevalence of frailty in KOA patients, shared risk factors and mechanisms underlying both conditions, the impact of KOA on frailty progression, and potential intervention strategies to mitigate these effects. These themes provided a structured approach to understanding the interrelationship between KOA and frailty in older

adults.

RESULT AND DISCUSSION

The increasing global burden of knee osteoarthritis (KOA) and frailty in aging populations highlights the need for a deeper understanding of their interrelationship and clinical implications. This review has synthesized existing evidence on the link between KOA and frailty, emphasizing shared pathophysiological mechanisms, risk factors, and the impact of these conditions on functional decline in community-dwelling older adults. While prior research has established an association between KOA and frailty, important questions remain regarding causality, progression, and the effectiveness of targeted interventions.

Mechanisms Linking KOA and Frailty

The relationship between KOA and frailty is bidirectional, with each condition potentially exacerbating the other. KOA contributes to frailty through chronic pain, reduced mobility, muscle atrophy, and systemic inflammation, while frailty worsens KOA outcomes by increasing sedentary behavior, promoting sarcopenia, and reducing the body's ability to repair joint damage (Cai et al., 2023). Several key mechanisms underlie this interaction:

1. Chronic Pain and Physical Inactivity

Pain is a hallmark symptom of KOA and is directly linked to frailty progression. Persistent knee pain leads to reduced physical activity, which in turn contributes to muscle weakness, weight gain, and balance impairments (Salaffi et al., 2020). A study by Bindawas et al. (2018) found that older adults with KOA-related knee pain were significantly more likely to develop

frailty over a six-year follow-up period, emphasizing the role of pain as a primary driver of frailty in this population (Bindawas et al., 2018).

2. Inflammation and "Inflammaging"

KOA is increasingly recognized as a low-grade inflammatory disease. Elevated levels of C-reactive protein (CRP), interleukin-6 (IL-6), and tumor necrosis factor-alpha (TNF- α) have been found in KOA patients, contributing to joint degradation and systemic frailty (Ferrucci et al., 2020). A meta-analysis by Huang et al. (2023) confirmed that inflammatory markers are higher in frail individuals compared to non-frail counterparts, suggesting that systemic inflammation may be a shared biological pathway between KOA and frailty (Huang et al., 2023).

3. Sarcopenia and Muscle Weakness

Frailty is characterized by progressive muscle loss (sarcopenia), which is worsened by KOA-induced physical inactivity. Research by Veronese et al. (2017) demonstrated that individuals with KOA had significantly lower muscle strength and endurance, placing them at higher risk for frailty and mobility limitations. This muscle deterioration reduces knee joint stability, leading to increased joint stress and further KOA progression (Veronese et al., 2020).

4. Nutritional Deficiencies and Weight Changes

Both KOA and frailty are influenced by body composition changes, including obesity-related joint stress and malnutrition-related muscle loss. A study from the EPOSA Project (Castell et al., 2015) found that frail older adults with KOA had higher BMI levels and poorer nutritional status, indicating that both undernutrition and obesity can accelerate KOA-frailty progression (Castell et al., 2015).

Clinical Implications and Management Strategies

Given the strong interconnection between KOA and frailty, integrated management approaches are necessary to improve outcomes in older adults. Current treatment strategies often focus on one condition in isolation, but emerging evidence suggests that multimodal interventions may be more effective.

1. Early Screening and Risk Assessment

Routine frailty screening in older adults with KOA can help identify high-risk individuals before significant disability occurs. Tools such as the Fried Frailty Phenotype and Frailty Index (FI) should be incorporated into KOA assessments to guide personalized treatment strategies (O'Brien et al., 2024).

2. Physical Rehabilitation and Exercise Interventions

Exercise is one of the most effective interventions for both KOA and frailty. Resistance training, balance exercises, and low-impact activities such as Tai Chi and aquatic therapy have been shown to improve muscle strength, joint function, and mobility in older adults with KOA (Tian et al., 2025). A study by Tarazona-Santabalbina et al. (2016) found that a multicomponent exercise program (MEP) led to significant improvements in gait, balance, and activities of daily living (ADLs) in frail older adults with KOA (Tarazona-Santabalbina et al., 2016).

3. Pain Management and Anti-Inflammatory Strategies

Effective pain management is essential to prevent mobility decline and subsequent frailty. Non-steroidal anti-inflammatory drugs (NSAIDs), intra-articular corticosteroids, and physical therapy are commonly used but may not be suitable for frail individuals due to side effects and increased fall risk (Michael et al., 2010). Recent research suggests that dietary interventions (e.g., omega-3 fatty acids, vitamin

D supplementation) and anti-inflammatory agents (e.g., curcumin, biologic therapies) may offer safer alternatives for reducing KOA-related inflammation and slowing frailty progression (Joo et al., 2023).

4. Multidisciplinary Care Approach

Given the complex interplay between KOA and frailty, a multidisciplinary approach involving physiotherapists, geriatricians, orthopedic specialists, and nutritionists is essential (Liotta et al., 2017). Personalized treatment plans that address both conditions simultaneously may lead to better mobility outcomes and improved quality of life for aging individuals (Tore et al., 2023).

Gaps in Research and Future Directions

Despite growing recognition of the KOA-frailty connection, several key research gaps remain. First, causality remains unclear, as most studies have been cross-sectional rather than longitudinal (Cássia et al., 2012). Future research should focus on prospective cohort studies to determine whether KOA directly accelerates frailty progression or if frailty predisposes individuals to worsening KOA symptoms (Miguel et al., 2012).

Second, there is a lack of targeted intervention studies that address both KOA and frailty concurrently. Most existing treatments focus on either KOA-related pain or frailty-related muscle loss separately, rather than integrating movement, nutrition, and pain management into a single therapeutic strategy (Park et al., 2021)

Additionally, sex-specific differences in KOA-frailty risk warrant further investigation. Women have a higher prevalence of both KOA and frailty, yet most studies do not stratify findings by gender. Understanding hormonal and biomechanical differences may lead to more effective, tailored interventions (Huang et al., 2023).

Finally, the role of psychosocial factors such as depression, social isolation, and cognitive impairment in the KOA-frailty relationship is understudied (Corral-Pérez et al., 2023). Addressing mental health and social engagement in KOA patients may help mitigate frailty risks and improve overall well-being (Zhang et al., 2021).

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Informed Consent Statement

As this study is a **literature review**, no human participants were involved, and informed consent was not required.

Data Availability Statement

The data presented in this study are derived from **previously published literature** and are available through the cited sources. No new datasets were generated or analyzed specifically for this study.

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Conflict of Interest Statement

The authors declare **no conflicts of interest** regarding the publication of this paper.

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