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INFLUENCE OF PAIN, RISK FACTORS AND FUNCTIONAL ABILITY ON PHYSICAL ACTIVITY LEVELS IN OBESE WOMEN WITH KNEE OSTEOARTHRITIS: A SYSTEMATIC REVIEW

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ABSTRACT

Background: Knee osteoarthritis (KOA) is among the most common causes of disability in women, and obesity has been identified as a major modifiable risk factor that can accelerate the progression of the disease. Increasing evidence suggests that the relationship between obesity, pain, functional impairment, and reduced physical activity is complex. These variables are often assessed separately. The purpose of this systematic review was to synthesize the current literature on the relationship between obesity-related variables, pain, functional ability, and physical activity in women with KOA.

Methods: This systematic review was conducted according to the PRISMA 2020 guidelines. The search was performed on PubMed, Scopus, Web of Science, and the Cochrane Library, as well as Google Scholar and ScienceDirect, for studies published between 2017 and 2024. The inclusion criteria were set using the PICOS approach and included cross-sectional studies in women aged 40 years and older with KOA. The studies included in the review evaluated obesity markers (BMI or body composition), pain, functional capacity, and physical activity. Seven studies were included in this systematic review. The quality of the studies was assessed using the AXIS.

Results: In all the studies included, higher BMI or higher fat mass was significantly associated with higher pain intensity, lower functional performance, and lower levels of physical activity. There was a dose-response relationship, where higher grades of obesity were associated with higher levels of clinical severity. Pain intensity, which is often measured using standardized tools such as VAS and WOMAC, was strongly associated with lower mobility and poorer functional performance on tests such as Timed Up and Go Test (TUG) and 6-Minute Walk Test (6MWT). Both higher BMI and pain-related fear were independent predictors of physical inactivity. However, higher skeletal muscle mass was associated with better functional performance. The quality of the studies included was moderate to high.

Conclusion: The results highlight a complex interplay between obesity, pain severity, functional impairment, and decreased physical activity in women with KOA. There is evidence of a vicious cycle where obesity contributes to increased pain and disability, resulting in inactivity and further deterioration. The condition requires a holistic and gender-responsive strategy that incorporates weight management, pain control, muscle strengthening, and psychosocial interventions for better long-term outcomes.

Keywords: Knee Osteoarthritis, Obesity, Body Mass Index, Pain, Functional Ability, Physical Activity, Women, Body Composition, WOMAC, Cross, Sectional Studies

1. INTRODUCTION

Knee osteoarthritis (KOA) is one of the most prevalent chronic musculoskeletal diseases globally and is among the highest in causing functional disability in older individuals. Its progression is characterised by degeneration of articular

cartilage, joint-space narrowing, osteophytosis and pain all causing disability and loss of independence. In recent decades, the global burden of KOA has greatly risen because of increased life span and growing obesity epidemic [8]. Studies consistently demonstrate a higher incidence rate in women compared with men, and the rate increases exponentially after 50 years of age [10,12].

The burden of KOA is particularly heavy in LMICs (low-and-middle income countries). In India, for example, about a half of the aged population are reported with knee OA indicating an emerging public health problem associated with aging and lifestyle [12]. As no definitive treatment exists for KOA, recognising modifiable risk factors at an early phase is essential to attenuate disease development and disability.

Obesity is a well-established, modifiable risk factor for KOA. Obesity may contribute to harm of the joint not only due to more mechanical load on the weight-bearing joints, but also secondary to metabolic and inflammatory mechanisms [5,8]. Furthermore, increased BMIs have been found to consistently correlate with more severe pain and impairment [5].

According to recent data, the association between obesity and KOA is not limited only to genetic/mechanical factors. More recently, other tissues as an "visceral organ", the adipose tissue has been implicated as well, since it is also an active endocrine organ able to produce proinflammatory cytokines and adipokines that may accelerate cartilage degeneration through pain sensations [8]. Obesity-related metabolic imbalance and chronic low-grade inflammation further contribute to joint damage and worsening symptoms [4,8]. These mechanisms help explain why obese individuals often experience more severe pain and disability, even when radiographic changes appear moderate [9].

Pain is the most prominent symptom of KOA and a key factor limiting daily activities. Indeed, studies have reported a robust association between higher BMI and elevated pain scores, as well as worse standardized measures including WOMAC (Western Ontario and McMaster Universities Osteoarthritis Index) [5,9]. In addition, an increasing BMI is associated with a graded relationship to functional decline, where those of a higher BMI category have more disability and reduced mobility [5].

Functional limitations have a direct impact on physical activity (PA), a crucial component of non-pharmacological therapy for KOA. Even though regular exercise and planned physical activity can reduce pain and improve joint stability, many individuals reduce their activity because they are uncomfortable or fear that their symptoms will worsen [1,3]. Research on body composition indicates that while fat mass is associated with increased pain and poorer functional outcomes, skeletal muscle mass is protective and enhances physical performance [9]. Moreover, individuals with higher body mass indices are more likely to be sedentary and not get the recommended amounts of exercise [3].

Gender differences introduce an additional layer of complexity. Compared to men with the same disease severity, women with KOA often report worse quality of life, slower walking speeds, and more severe symptoms [6,10]. Body composition differences, hormonal effects, and biomechanical factors could all contribute to these disparities [6].

Overall, the relationship between obesity, pain severity, functional limitation, and reduced physical activity is complex and interrelated. Excess body fat can worsen joint pain and inflammation; discomfort limits movement; reduced mobility weakens surrounding muscles; and muscular weakening increases joint stress, creating a vicious cycle that prolongs disability [5,8,9]. Few studies have examined the combined effects of these characteristics, even though many have examined them separately, particularly in obese women with milder stages of the disease, such as Grade II KOA.

Understanding these interactions is especially important in the moderate stage of KOA, when certain weight-control, muscle-strengthening, and physical activity-promoting strategies may help prevent more structural damage and long-term disability. Therefore, the most recent research on the relationships between pain, obesity-related factors, functional ability, and physical activity must be incorporated into the development of stage-specific and gender-sensitive care strategies for knee osteoarthritis.

2. REVIEW OF LITERATURE

2.1. PREVALENCE AND RISK FACTORS OF KNEE OSTEOARTHRITIS

Knee osteoarthritis (KOA) is one of the most prevalent chronic musculoskeletal disorders affecting older adults globally. According to epidemiological research, after the age of 50, its frequency sharply rises. In Korea, a thorough nationwide cross-sectional survey of 7,962 people revealed a 33.3% prevalence rate. The percentages were higher among women, older adults, obese individuals, and those with less education. These results show that the overall burden

of illness is significantly influenced by both modifiable (such as obesity) and non-modifiable (such as age and female gender) characteristics.

KOA is widely accepted as a degenerative joint disease which causes progressive cartilage erosion and joint pain and stiffness and results in gradual functional impairment. The worldwide rise in life expectancy and obesity rates has greatly contributed to the growing occurrence of KOA across all populations.

2.2. OBESITY AND CLINICAL CONSEQUENCES OF KOA

Obesity is one of the strongest modifiable risk factors for KOA. High body mass index (BMI) would appear to directly increase the severity of KOA symptoms and functional limitations in addition to its role in KOA incidence.

However, in a KOA census based cross sectional study assessing the relationship between severity and clinical outcomes, a different pattern was found people with more severe obesity phenotypes showed:

- elevated level of pain as determined by the Visual Analog Scale (VAS)
- Increased functional impairment on the WOMAC
- Decreased levels of physical activity

These findings support that the severity of obesity not only increases the structural stress on joints but also worsens subjective and objective functional outcomes.

Obesity may increase the risk of KOA through mechanisms besides the increase in joint loads. The inflammatory and other mediators released by fat may both promote cartilage loss, upregulate pain receptors (decrease the pain threshold), and possibly contribute to KOA progression. Metabolic and inflammatory factors influence disease severity.

2.3. PAIN AND FUNCTIONAL IMPAIRMENT IN KOA

Pain is the most prominent symptom of KOA and the main cause of disability. Pain has a significant influence on mobility, physical activity, and quality of life.

A study evaluating the relationship between pain and functional ability in older women with KOA concluded that women with KOA walked slower, took longer to perform the Timed Up and Go test, and had lower quality of life than women without KOA. They also had greater pain intensity and worse WOMAC scores.

In overweight and obese patients with mild to moderate KOA, BMI was positively correlated with WOMAC pain and functional limitation scores. Women in these studies reported higher pain severity and more severe functional impairment than men, indicating a possible gender-related difference in disease expression.

Functional impairment in KOA may include reduced joint motion, quadriceps weakness, reduced gait speed, and difficulty with daily activities such as climbing stairs, standing for prolonged periods, and rising from a sitting to a standing position.

2.4. BODY COMPOSITION AND PHYSICAL PERFORMANCE

However, emerging evidence suggests that body composition may offer greater insight into KOA outcomes than BMI alone.

In a cross-sectional study performed in China, the relationship between body fat mass, skeletal muscle index (SMI), and functional outcomes in patients with KOA was explored. The results showed that:

- Fat mass was positively related to knee pain and WOMAC functional status.
- Moderate physical activity was negatively related to bilateral knee pain.
- Skeletal muscle mass was positively related to objective functional status, as measured by the Five Times Sit-to-Stand Test (FTSST).

Crucially, patients who were obese reported greater knee pain and poorer self-reported functional status than non-obese patients.

These data indicate that adiposity contributes to symptom severity, while maintaining muscle mass may mitigate functional decline.

2.6. PHYSICAL ACTIVITY LEVELS IN KOA

Physical activity (PA) is a key component in the non-pharmacological treatment of KOA. Exercise can help alleviate pain, increase joint mobility, and increase the strength of the surrounding muscles. However, despite the benefits of exercise, many patients with KOA fail to meet the recommended levels of physical activity.

In an epidemiological study conducted among 548 patients with knee OA, physical activity was measured using the International Physical Activity Questionnaire (IPAQ). The results showed that:

- 18.8% of patients had low levels of physical activity.
- Inactivity was significantly related to BMI, gender, and behavioural factors.
- Increased sedentary behaviour was associated with higher risks of health problems.

In a similar study conducted on Thai women with KOA, 60% of patients had low levels of physical activity. In this study, BMI and pain-related fear were found to be significant predictors of inactivity, while age and social support were not significantly associated with inactivity.

The findings of these studies emphasize the role of both obesity and psychological factors in the prevention of physical activity among women with KOA.

2.6. FACTORS INFLUENCING PHYSICAL ACTIVITY IN WOMEN WITH KOA

Women are more commonly affected by KOA and often experience more severe symptoms than men. The evidence has clearly shown that female gender is a predictor of increased pain intensity and decreased functional performance.

Psychological factors, particularly pain-related fear and fear-avoidance beliefs, play an important role in influencing physical activity behavior. Women who believe that movement is potentially harmful may deliberately reduce their activity level, which in turn can further weaken muscle strength and joint stability.

The complex relationship between obesity, pain intensity, functional impairment, and psychological factors forms a vicious cycle. Obesity is known to increase the load on the joint, which in turn causes pain, which further leads to a decrease in activity, resulting in muscle weakness, and so on. This vicious cycle can be broken only by adopting a comprehensive management approach that tackles the physical, metabolic, and psychological aspects of the disease.

Author and Year	Key Findings	Limitations
Hanrungcharotorn et al., 2017	Stated that 60% of women with knee osteoarthritis (KOA) had low levels of physical activity. Body mass index (BMI) and pain-related fear were identified as significant predictors of physical inactivity. However, age, severity of knee pain, functional limitation, and social support were not statistically significant predictors.	The cross-sectional study design limits the assessment of causality. The study population was restricted to one country (Thailand) and physical activity was also measured by self-reporting, which may increase the risk of recall bias.
Akhavan et al., 2018	Found that there was a significant association between higher BMI and poor WOMAC pain and functional symptoms. Larger ROM was positively associated with improved walking ability. Women reported greater levels of pain and disability than men.	The trial had a small sample size (n=83), was restricted to patients with mild to moderate KOA, and did not have longitudinal follow-up.
Gay et al., 2019	Found that 18.8% of people with KOA had low levels of physical activity. BMI, gender, and biomedical barriers were found to be significant predictors of inactivity. Higher levels of sedentary behavior were also found in participants with KOA.	Physical activity was measured using the IPAQ questionnaire. The trial included patients with varying OA severity and, being cross-sectional, could not determine cause-and-effect relationships.
Raud et al., 2020	Showed a clear dose-response relationship between BMI category and clinical severity. Higher levels of obesity were associated with greater VAS pain scores, poorer WOMAC functional outcomes, lower levels of physical activity, and greater fear-avoidance beliefs.	The study only included overweight and obese participants (BMI ≥ 25 kg/m^2), which makes it difficult to compare with normal-weight individuals. The study is cross-sectional, which makes it difficult to determine causality. Psychological variables were not assessed thoroughly.
Santos et al., 2020	Demonstrated that older women with KOA had slower gait speed, longer Timed Up and Go (TUG) test performance, greater pain intensity, and poorer quality of life than controls.	The sample consisted only of women, which makes it difficult to generalize. The sample was relatively small, and BMI stratification was not conducted.

	KOA was shown to significantly affect functional performance and mobility.	
Tong et al., 2024	Found that higher body fat mass was significantly related to increased knee pain and poorer WOMAC scores. Greater skeletal muscle mass was associated with improved objective functional performance, as measured by the Five Times Sit-to-Stand Test (FTSST). Moderate-intensity physical activity was related to decreased bilateral knee pain.	Analysis of OA severity grading was not performed. The cross-sectional study design does not allow for causal analysis, and the use of questionnaires may lead to recall bias.
Lee, 2024	Estimated the prevalence of KOA at 33.3% in adults aged 50 years and older. Women, older people, and obese persons had a significantly higher risk. Socioeconomic variables were also associated with higher prevalence.	While population-based, the survey was not specific to KOA stage and used only a few functional outcome measures.

3. METHODOLOGY

3.1. STUDY DESIGN

This review was conducted as a systematic review of literature to synthesize existing evidence on the influence of pain, obesity – related risk factors, and functional ability on physical activity levels in women with knee osteoarthritis (KOA). The review was performed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines

3.2. ELIGIBILITY CRITERIA

This systematic review referenced the PICOS model in developing the inclusion and exclusion criteria for the literature, which is based on the concepts of P (Population), I (Intervention), C (Comparison), O (Outcomes) and S (Study design).

Articles that met the following criteria were included in this study (See Table 1):

Table 1

Table 1 Inclusion and Exclusion criteria were based on the PICOS model

Components	Inclusion Criteria	Exclusion Criteria
P (Population)	Women ≥ 40 years with knee osteoarthritis; overweight/obese	Inflammatory arthritis, paediatric population
I (Intervention)	BMI, body composition, pain, functional measures	Studies without obesity or pain assessment
C (Comparison)	BMI categories, PA levels, KOA	No analysis of associations
O (Outcomes)	Physical activity, pain, functional ability	No PA or functional outcomes reported
S (Study design)	Cross-sectional study	Case reports, cohort, observational, surgical –only studies

3.3. INFORMATION SOURCES

The literature search was conducted in four electronic databases (Scopus, Web of Science, PubMed and Cochrane) and two search engines (Google Scholar and Science Direct) from January 2017 and December 2024 (the date the search was last conducted). The search included research articles published online.

4. SEARCH STRATEGY

Peer-reviewed scientific published papers written in English are eligible for this systematic review. A comprehensive and organized search approach was designed using a combination of Medical Subject Headings (MeSH) and free-text keywords to ensure a thorough retrieval of relevant studies. Boolean operators like AND and OR were used to refine the search and combine relevant keywords.

The main keywords used in the search were: “knee osteoarthritis,” “obesity,” “body mass index,” “body composition,” “pain severity,” “WOMAC,” “VAS,” “functional ability,” “physical performance,” “physical activity,” “IPAQ,” “MET,” and “women.” A sample search string would be: (“knee osteoarthritis” AND “obesity” AND “pain” AND “functional ability” AND “physical activity” AND “women”).

Search filters were used to limit the search to studies involving human subjects and articles published in English to ensure relevance and ease of access. Table 2 demonstrate the search strategy of this study and Table 3 shows the results of different databases and search engines.

Table 2

Table 2 Keywords used for databases searches

Concept	Primary Keywords	Synonyms/Related Terms
Condition	Knee osteoarthritis	Knee OA, KOA
Exposure-obesity	Obesity	BMI, body mass index, overweight, body composition, fat mass
Functional ability	Functional ability	Functional limitations, physical performance,
		WOMAC,
Physical Activity	Physical activity	Exercise, Activity level, IPAQ, MET-minutes

Table 3

Table 3 Search Strategy for All Databases and Search Engines

Databases	Search strategy
PubMed	("Knee Osteoarthritis"[MeSH] OR "knee OA") AND ("Obesity"[MeSH] OR "Body Mass Index" OR BMI OR "body composition") AND ("Pain" OR VAS OR WOMAC) AND ("Functional ability" OR "physical performance" OR TUG OR 6MWT OR FTSST) AND ("Physical Activity" OR IPAQ OR MET) AND ("Women" OR Female)
Scopus	TITLE-ABS-KEY ("knee osteoarthritis" AND "obesity" AND "pain" AND "functional ability" AND "physical activity" AND "women")
Web of Science	TS= ("knee osteoarthritis" AND "obesity" AND "pain" AND "functional ability" AND "physical activity" AND "women")
Cochrane	("knee osteoarthritis") AND ("obesity" OR "body mass index") AND ("pain" OR "WOMAC") AND ("physical activity") AND ("women")
Google Scholar	"Knee osteoarthritis" AND "obesity" AND "pain" AND "functional limitation" AND "physical activity" AND "women"
Science Direct	("knee osteoarthritis" AND "obesity" AND "pain" AND "functional ability" AND "physical activity" AND "women")

5. SELECTION AND DATA COLLECTION PROCESS

The process of selecting studies was conducted following the guidelines provided by PRISMA 2020. All the records retrieved from the electronic database search (PubMed, Scopus, Web of Science, and Cochrane Library) as well as the search engines (Google Scholar and ScienceDirect) were exported and managed using a reference management software program.

Firstly, the records that were identified as duplicates were removed. After removing the duplicates, the titles and abstracts of the remaining records were independently screened to identify their relevance based on predefined eligibility criteria developed using the PICOS framework. The studies that were clearly not relevant to the criteria were excluded at this stage.

The full-text versions of the potentially relevant articles were then retrieved and carefully analysed. At the full-text analysis stage, the studies were excluded if they:(a) did not include women with knee osteoarthritis, (b) did not investigate obesity (BMI or body composition), (c) did not investigate pain or functional outcomes, (d) did not investigate physical activity levels

Any discrepancies that may have occurred during the screening process were addressed by discussion and re-evaluation of the criteria. The final selection included studies that met all criteria and directly addressed the objectives of the review.

6. DATA EXTRACTION

Upon completion of the data search, data eligible for the study was retrieved according to the following format:(a) author(s) and year of publication, (b) Country of study, (c) study design, (d) sample size and participants characteristics, (d) obesity assessment methods (BMI, body composition), (e) pain measurement tools (such as VAS, WOMAC), (f) functional assessment tools(such as WOMAC function, TUG, 6MWT), (g) physical activity assessment tools (such as IPAQ, MET-min/week), (h) key findings and (i) limitations. The process of data extraction was carried out with meticulous attention to detail to ensure accuracy and consistency. The data extracted was carefully cross-checked to avoid the possibility of errors in transcription. Where data seemed ambiguous or incomplete, the original full text article was referred to for verification and clarification of the necessary information.

7. QUALITY ASSESSMENT AND ADDRESSING THE RISK OF BIAS

The quality of the studies was appraised using the AXIS (Appraisal Tool for Cross-Sectional Studies), which is a specially designed tool for the evaluation of the quality of cross-sectional studies. The AXIS consists of few items that cover the aspects of research objectives, appropriateness of design, sampling method, validity of measurements, statistical analysis, and reporting. The studies were appraised for important aspects such as the clarity of research objectives, appropriateness of sample size, representativeness of the study population, use of validated outcome measures, and the control of potential confounding variables.

Most studies had clear research objectives and appropriate cross-sectional designs. Well-validated scales such as WOMAC, Visual Analog Scale (VAS), International Physical Activity Questionnaire (IPAQ), Timed Up and Go Test (TUG), and 6-Minute Walk Test (6MWT) were commonly used, which helped to minimize bias in measurements. Some studies also used multivariate regression analysis to control confounding variables such as age and BMI, which helped to improve the internal validity of the studies.

Table 4

Table 4 AXIS (Appraisal Tool for Cross-Sectional Studies)

Study	Clear Objectives	Appropriate Design	Sample Justified	Representative Sample	Clear Selection Criteria	Validated Measures	Confounder Adjustment	Appropriate Statistics	Response Rate Reported	Limitations Discussed	Total Score (Approx.)	Overall Quality
Hanrungcharotorn et al., 2017	Yes	Yes	No	Moderate	Yes	Yes	Yes	Yes	Unclear	Yes	14/20	Moderate
Akhavan et al., 2018	Yes	Yes	No	Moderate	Yes	Yes	Yes	Yes	Unclear	Yes	14/20	Moderate
Gay et al., 2019	Yes	Yes	No	Moderate	Yes	Yes	Yes	Yes	Yes	Yes	16/20	High
Raud et al., 2020	Yes	Yes	Yes	Moderate	Yes	Yes	Yes	Yes	Yes	Yes	17/20	High
Santos et al., 2020	Yes	Yes	No	Moderate	Yes	Yes	No	Yes	Unclear	Yes	13/20	Moderate
Tong et al., 2024	Yes	Yes	Yes	Moderate	Yes	Yes	Yes	Yes	Yes	Yes	17/20	High
Lee, 2024	Yes	Yes	Yes	High	Yes	Yes	Yes	Yes	Yes	Yes	18/20	High

8. DATA SYNTHESIS

Due to large degree of variability among the studies in terms of design, subjects, and outcome measures, a quantitative meta-analysis was deemed not suitable. A structured narrative synthesis was therefore conducted to systematically compare the findings of the included studies. Variability in the methods of defining obesity (using BMI versus comprehensive body composition analysis), measuring pain (using VAS and WOMAC), evaluating functional performance (using TUG, 6MWT, and FTSST), and measuring physical activity (using IPAQ and MET-min/week) was observed, making direct statistical comparisons difficult.

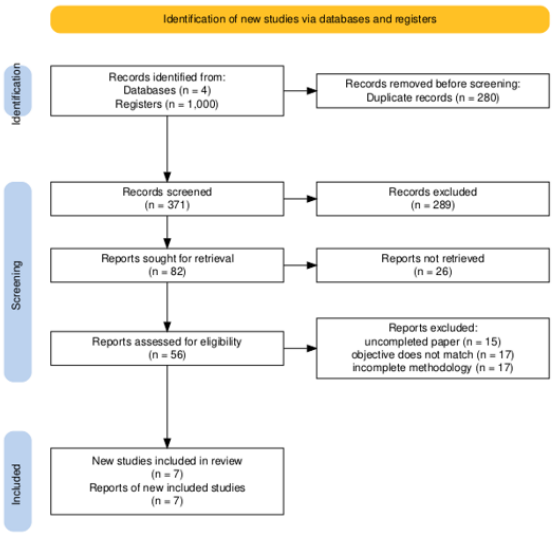
The extracted data was coded into thematic categories that were relevant to the objectives of the review: (a) the relationship between obesity and the severity of knee osteoarthritis, (b) the relationship between pain intensity and functional limitation, (c) the effect of body composition on physical performance, and (d) factors that determine physical activity levels in women with knee osteoarthritis. Findings were systematically compared within each thematic category to look for emerging trends, important associations, and inconsistencies.

Particular attention was given to research using multivariate regression analyses to determine independent predictors of physical inactivity. The direction and strength of associations between obesity, pain intensity, functional ability, and physical activity were described. This method allowed for the meaningful synthesis of disparate evidence while also pointing out the differences in methodologies and existing research gaps.

9. RESULT

14.1. STUDY SELECTION

We started with 1,000 records from the database search. After removing 280 duplicate records, there were 371 studies left for screening based on their titles and abstracts. From this pool, 289 records were removed since they were not relevant to the study. This left us with 82 reports for full-text screening, but 26 of these could not be accessed. Consequently, 56 full-text articles were thoroughly screened for inclusion. Of these, 49 studies were removed for specific reasons: 15 were incomplete studies, 17 did not match the goals of the review, and 17 had incomplete methodologies. Finally, 7 studies met all the inclusion criteria and were selected for the final review.



14.2. STUDY CHARACTERISTICS

A total of seven cross-sectional studies were identified for this review, and these studies were carried out in Thailand, the USA, France, Brazil, China, and Korea. The sample size for these studies ranged from 83 participants in smaller clinical trials to 7,962 participants in larger population-based studies. The majority of the studies were carried out in women aged 40 years and older who had been diagnosed with knee osteoarthritis (KOA).

Obesity was measured using body mass index (BMI) in the majority of the studies, but one of the studies used body composition analysis to give further information about fat and muscle distribution. Pain intensity was measured using standardized questionnaires such as the Visual Analog Scale (VAS) and the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) in most of the studies. Functional status was measured using both self-administered questionnaires and objective physical performance tests such as the Timed Up and Go (TUG) test and the 6-Minute Walk Test (6MWT). Physical activity levels were measured using the International Physical Activity Questionnaire (IPAQ) in the majority of the studies.

Table 5

Table 5 Study characteristics of Included Studies

Author (Year)	Country	Study Design	Sample Size (n)	Population Characteristics	Obesity Measure	Pain Assessment	Functional Assessment	Physical Activity Measure
Hanrungcharotorn et al. (2017)	Thailand	Cross-sectional	242	Women aged ≥40 years with KOA	BMI	Knee pain scale	Functional limitation questionnaire	IPAQ
Akhavan et al. (2018)	USA	Cross-sectional	83	Overweight/obese adults with mild-to-moderate KOA	BMI	WOMAC pain subscale	WOMAC function, Range of Motion (ROM), 6-Minute Walk Test (6MWT)	Not primary focus
Gay et al. (2019)	France	Cross-sectional	548	Adults with symptomatic KOA	BMI	Pain assessment scale	Self-reported functional status	IPAQ
Raud et al. (2020)	France	Cross-sectional	391	Overweight/obese individuals with KOA	BMI categories	Visual Analog Scale (VAS)	WOMAC function	Physical activity questionnaire
Santos et al. (2020)	Brazil	Cross-sectional (comparative)	101 (50 KOA + 51 controls)	Older women diagnosed with KOA	BMI	Visual Analog Scale (VAS)	Timed Up and Go (TUG), gait speed, 6-Minute Walk Test (6MWT)	Not primary focus
Tong et al. (2024)	China	Cross-sectional	178	Symptomatic KOA patients (82% female)	Body fat mass, Skeletal Muscle Index (SMI)	WOMAC pain subscale	WOMAC function, Five-Time Sit-to-Stand Test (FTSST)	Physical activity questionnaire
Lee (2024)	Korea	National cross-sectional survey	7,962	Adults aged ≥50 years	BMI	Not primary focus	Not primary focus	Not primary focus

14.3. QUALITY ASSESSMENT RESULTS

The methodological quality of the included studies was evaluated using the AXIS (Appraisal Tool for Cross-Sectional Studies). In general, the evidence presented a moderate to high level of methodological quality. The studies were all clearly focused on their research aims and utilized cross-sectional study designs that were relevant to their research objectives. The fact that the studies tended to utilize standardized and validated measures of outcomes, such as WOMAC, Visual Analog Scale (VAS), International Physical Activity Questionnaire (IPAQ), Timed Up and Go (TUG), and 6-Minute Walk Test (6MWT), tended to reduce the bias of measurement and increase the reliability of the findings.

Four studies were considered to be of high quality, mainly because they had sufficient sample sizes, utilized proper statistical analysis, and controlled for confounding variables. The other three studies were of moderate quality, mainly because they tended to have smaller sample sizes and were based on convenience sampling, with less information provided about response rates and sample size justification.

Common methodological issues included the use of self-administered physical activity measures, which could potentially raise the risk of recall and reporting biases, as well as the natural limitations of cross-sectional study designs that do not allow for causal inferences. Notably, there were no studies with critical methodological issues that would

render them ineligible for inclusion. In general, the body of evidence was felt to be methodologically robust with a moderate risk of bias primarily due to study design and sampling strategies.

14.4. OUTCOMES

1) Obesity and Knee Osteoarthritis Severity

Among the studies included, higher BMI was found to be significantly associated with increased pain intensity and more severe functional impairment in women with knee osteoarthritis (KOA). Some studies also found a dose-response relationship, which showed that the more obese the patients, the worse their WOMAC scores and mobility were.

Moreover, in a study that assessed the body composition of patients with KOA, it was found that higher body fat mass was positively correlated with higher pain intensity. However, higher skeletal muscle mass was associated with better objective functional performance, which indicated that the preservation of muscle mass has a protective effect on maintaining mobility and preventing disability.

2) Pain and Functional Limitations

The intensity of pain, most commonly assessed using the Visual Analog Scale (VAS) and the WOMAC scale, showed a strong positive correlation with reduced functional ability. Women who reported greater pain intensity were found to have slower gait speed, take longer to complete the Timed Up and Go test, and have lower walking endurance.

Functional impairment was assessed using both subjective and objective measures, which adds to the validity of the correlation between pain intensity and functional impairment.

3) Physical Activity levels

A substantial proportion of women with knee osteoarthritis (KOA) had been identified to have low levels of physical activity. Results from studies using the International Physical Activity Questionnaire (IPAQ) showed that obesity and pain severity were established predictors of physical inactivity. In particular, higher BMI and greater pain intensity were found to be associated with lower MET-minutes per week and greater sedentary time, indicating the combined effect of obesity and pain severity on physical activity participation.

4) Predictors of Physical Inactivity

Besides BMI and pain severity, other variables were also shown to affect levels of physical activity. For instance, fear-avoidance beliefs and behavioral barriers were identified as important variables by a number of studies that used multivariate regression analysis and showed that both high BMI and pain-related fear were independent predictors of low levels of physical activity.

10. DISCUSSION

This systematic review combines the results of seven cross-sectional studies examining the interrelations between obesity, pain intensity, functional capacity, and physical activity in women with knee osteoarthritis (KOA). In all studies, the evidence was clear: higher body mass index (BMI) and poor body composition were consistently associated with greater pain intensity, poorer functional performance, and lower levels of physical activity.

Obesity emerged as a major determinant of symptom severity. Several studies demonstrated that as BMI rose, WOMAC pain and function subscales worsened, indicating a dose-response relationship between obesity and clinical impairment [2,5]. Higher BMI was also found to be a powerful predictor of physical inactivity [1,3]. Focusing on more than just BMI, body composition analysis showed that higher fat mass was related to greater knee pain, but higher skeletal muscle mass was related to better objective functional performance [9]. These findings are consistent with both mechanical and metabolic theories. Excess body weight is a major stress on the knee joint, leading to accelerated cartilage degradation, while adipose tissue may contribute to chronic low-grade systemic inflammation, further contributing to joint damage.

The severity of pain was always associated with decreased functional capacity. Validated studies using tools such as the Visual Analog Scale (VAS) and WOMAC have shown that women who reported higher levels of pain walked slower, took longer to perform the Timed Up and Go test, and had lower walking endurance (Santos et al., 2020). Functional impairment was shown in both subjective assessments (WOMAC function) and objective tests (6MWT, FTSST), further

increasing confidence in this relationship. Pain can also cause behavioral responses such as fear-avoidance, which can further impede participation in physical activities [1].

Low levels of physical activity were a concern in all studies. A high proportion of women with KOA did not meet guidelines for physical activity based on IPAQ scoring [1,3]. Higher BMI and pain intensity were associated with lower MET-minutes per week and increased sedentary time [5]. Taken together, these results demonstrate a vicious cycle in which obesity fuels pain and disability, which in turn reduces physical activity, perpetuating further weight gain and muscle deconditioning.

Psychosocial variables also contributed significantly. Fear avoidance beliefs and perceived barriers to exercise were significant predictors of lower levels of physical activity, independent of BMI [1]. This indicates that interventions should not only target physical variables but also address psychosocial issues related to physical activity.

Despite the consistency of the results, some methodological issues need to be taken into consideration. All the studies included in the analysis had cross-sectional designs, which make it difficult to establish causality or directionality. The use of self-reported physical activity scales like IPAQ may also be prone to recall and reporting biases [3]. Moreover, the use of convenience sampling in some studies may also affect generalizability. However, the universal use of validated scales and regression analysis helps to strengthen the findings on the associations.

In conclusion, the findings suggest a complex and interrelated relationship between obesity, pain severity, functional impairment, and physical inactivity among women with KOA. Multifaceted approaches that target weight management, pain, and behavioural issues simultaneously may be required for enhancing functional recovery and promoting physical activity in the long term.

11. RESEARCH GAP

Although current cross-sectional studies have found significant associations between obesity, pain intensity, functional limitation, and decreased levels of physical activity in women with knee osteoarthritis, there are still some important gaps in the literature that need to be addressed.

First, most of the existing studies are cross-sectional [1,5,9]. This makes it difficult to establish cause-and-effect relationships. Although it is clear that obesity and pain are both related to decreased levels of physical activity, it is not clear whether obesity and pain cause inactivity or whether inactivity, over time, contributes to the development of obesity.

Second, most of the literature is based on body mass index, or BMI, as the main measure of obesity. While BMI is a popular measure, it does not differentiate between fat mass and muscle mass. Very few studies have looked at the role of body composition and its independent effects on pain and function [9]. Specifically, the interaction between sarcopenia, muscle strength, and obesity in women with KOA has not been adequately investigated.

Third, physical activity is usually measured by self-administered tools like the International Physical Activity Questionnaire (IPAQ) [3], which could be prone to recall bias. Objective measures like accelerometers are hardly ever used. Moreover, psychological factors, like fear-avoidance beliefs, have been variably investigated [1], pointing to the need for more holistic biopsychosocial models that take into account physical, behavioral, and psychological aspects.

Lastly, very few studies have been conducted on women with well-defined radiographic severity of KOA. This makes it difficult to design interventions based on disease stages or severity. Future studies are necessary to better understand the underlying causal associations and develop interventions based on modifiable risk factors.

12. CONCLUSION

This systematic review highlights the interrelated and robust association between obesity, pain intensity, functional impairment, and physical inactivity in women with knee osteoarthritis (KOA). In the various cross-sectional studies included in this systematic review, there was a consistent association between higher body mass index (BMI) and body fat percentage, and greater pain intensity and functional performance. In turn, higher pain intensity and functional impairment were strongly associated with lower levels of physical activity and higher levels of sedentary behavior. These observations collectively suggest the presence of a vicious cycle, wherein obesity is a contributing factor to pain and disability, which in turn reduces mobility, resulting in further weight gain and possibly disease progression.

Notably, the findings from the evidence indicate that the problem is not only related to mechanical joint loading. Body composition variables, including excess fat mass and decreased muscle mass, as well as psychosocial factors, including fear-avoidance beliefs, seem to play an important role in levels of physical activity. Although most of the included studies showed moderate to high methodological quality, the cross-sectional design of the studies makes it difficult to establish clear causal relationships.

In conclusion, the current findings emphasize the need for comprehensive management approaches that address weight loss, pain control, muscle strengthening, and behavioral issues concurrently. Future studies are warranted to investigate causal relationships and to develop rehabilitation programs that can effectively promote physical activity participation and functional improvement in women with KOA.

CONFLICT OF INTERESTS

None.

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