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Association between Smoking and the Risk of Incidence and Progression of Osteoarthritis: A Systematic Review

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Abstract

Osteoarthritis is a degenerative joint disease that is one of the main causes of pain and disability in the adult population. Smoking has long been associated with various chronic diseases, but evidence regarding the specificity of osteoarthritis incidence still shows mixed results. This study aims to establish the relationship between cigarette smoke exposure and osteoarthritis incidence through a systematic approach. This study is a systematic observational study compiled in accordance with the PRISMA 2020 guidelines. A literature search was conducted on several scientific data bases to obtain relevant studies. Studies that met the inclusion criteria were systematically analyzed. Data synthesis was performed narratively by comparing the results and direction of the relationship between studies. The synthesis of the results showed that most studies reported a trend of increased risk of osteoarthritis in individuals exposed to cigarette smoke, although the reported effect sizes varied. The results of the synthesis of six studies showed that most studies pointed to an association between smoking and osteoarthritis, but the magnitude and direction of the association between studies were heterogeneous. This systematic review shows a trend of an association between cigarette smoke exposure and osteoarthritis incidence. A narrative synthesis of the available studies indicates an association between cigarette exposure and osteoarthritis. This systematic review suggests a trend toward an association between smoking exposure and osteoarthritis. However, evidence regarding disease progression remains variable and inconsistent.

Introduction

Osteoarthritis is a progressive joint disease that is a leading cause of chronic pain, functional disability, and economic burden in older adults worldwide. Therefore, understanding the risk factors that influence its incidence and progression is a current public health priority (Courties et al., 2024). In the prevention and treatment of osteoarthritis, particular attention is paid to lifestyle behaviors, including smoking, because of their potential impact on joint tissue, inflammatory processes, and coexisting risk factors that modulate the course of osteoarthritis (Wang et al., 2023).

Furthermore, causal genetic methods (e.g., Mendelian randomization) and several observational studies have shown some evidence indicating a causal relationship, underscoring the need for evidence synthesis that clearly distinguishes the effects of smoking on osteoarthritis incidence and disease progression (Wang et al., 2023). This combination of heterogeneous findings creates a methodological need for transparent systematic reviews that focus on the quality of the evidence (including stratification by study design, effect size on incidence versus progression, and subgroup analyses) to enable more evidence-based recommendations for prevention and clinical interventions (Salman et al., 2023).

Therefore, the aim of this study was to systematically assess the current evidence regarding the association between smoking and osteoarthritis risk. This review will combine the results of

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longitudinal studies, cohort studies, and appropriate causal analyses. It is hoped that the results of this review will provide a comprehensive picture of the association between smoking and the incidence and progression of osteoarthritis, based on a synthesis of available scientific evidence.

Method

Types and Design of Research

This study is a secondary study with a systematic review design. It aims to qualitatively synthesize scientific evidence from various primary studies on the relationship between smoking habits and the risk of osteoarthritis incidence and progression, using a narrative approach. The study used a systematic review design conducted in accordance with the Preferred Reporting Items for Systematic Reviews (PRISMA) guidelines.

Research Protocol and Registration

This systematic review was compiled based on a protocol established before the literature search and selection process. However, this research protocol was not registered on international registration platforms such as PROSPERO. This was due to time and access limitations during the study. Nevertheless, all stages of the study were carried out systematically and transparently, following the Preferred Reporting Items for Systematic Reviews (PRISMA) 2020 guidelines to minimize potential bias and increase the reproducibility of research results.

Research Methods

This study used the PICOS framework to search for articles by selecting and collecting articles based on five components of relevance to the research topic. The research questions in this systematic review were structured using the PICOS (Population, Intervention, Comparison, Outcome, Study Design) format to determine the focus of the problem and the inclusion criteria for relevant literature. Details of the PICOS components are presented in Table 31.

Table 1. PICOS Framework

Component	Description
Population (P)	Adult individuals (≥18 years), both the general population without osteoarthritis and patients with osteoarthritis, without gender and region restrictions.
Intervention (I)	Smoking exposure, including current smokers, former smokers, and history of tobacco cigarette use.
Comparison (C)	Individuals who have never smoked (non-smokers).
Outcome (O)	1. Incidence of osteoarthritis (clinical and/or radiological diagnosis). 2. Progression of osteoarthritis, including worsening radiological grade, increasing pain, decreased joint function, or the need for surgical intervention.
Study Design (S)	Observational studies (cohort, case-control, and cross-sectional) analyzed through systematic review.

Keywords

The literature search strategy was developed based on the PICOS framework using a combination of keywords and Medical Subject Headings (MeSH) terms. Keywords used included "smoking," "cigarette smoking," and "tobacco use" to describe smoking exposure, and "osteoarthritis" for the disease condition. In addition, the keywords "incidence," "risk,"

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"progression," and "disease progression" were used to describe the study outcomes. The literature search strategy was conducted systematically by combining keywords using Boolean operators to increase the sensitivity and specificity of the search. The search strategy used was as follows: ("osteoarthritis" OR "degenerative joint disease") AND ("smoking" OR "cigarette smoking" OR "tobacco use") AND ("incidence" OR "risk" OR "progression" OR "disease progression"). The literature search was limited to research articles in adult humans and publications in both English and Indonesian. The final search process was conducted in March 2025.

Article Sorting

Articles were systematically screened in accordance with the Preferred Reporting Items for Systematic Reviews (PRISMA) 2020 guidelines. The screening process began with article identification through searches across multiple electronic databases. The identified articles were then screened to eliminate duplication. The screening process continued with an assessment of titles and abstracts to determine their relevance to the research topic. Articles meeting the initial criteria were then assessed for eligibility through full-text review. Articles meeting all inclusion criteria were included in the systematic review.

The literature search for this study was conducted using the Google Scholar database. This database was chosen because of its ability to index a wide range of international and national journals, including open-access articles and gray literature relevant to the research topic. However, the limitations of using a single database can affect the completeness of the identified literature and potentially lead to the exclusion of some relevant studies from other databases. This limitation has been taken into account in the interpretation of the research results.

Inclusion and Exclusion Criteria

Inclusion Criteria

Inclusion criteria were established to ensure that included studies were directly relevant to the study's objective, which was to evaluate the association between smoking exposure and the risk of osteoarthritis and its progression. Studies meeting the inclusion criteria were expected to have adequate methodological quality and provide data that could be analyzed quantitatively. Studies were included in this study if they met the following criteria; (1) Observational studies, including cohort, case-control, or cross-sectional studies; (2) Involve adult human subjects aged ≥18 years; (3) Evaluate smoking exposure (current smokers, former smokers, or history of smoking); (4) Assess outcomes in the form of osteoarthritis incidence and/or osteoarthritis progression; (5) Report effect sizes as Odds Ratio (OR), Risk Ratio (RR), or Hazard Ratio (HR) as part of the study results; (6) Articles are available in full-text form; (7) Articles are published in English or Indonesian

Exclusion Criteria

Exclusion criteria were established to avoid including studies that were irrelevant, of low methodological quality, or potentially biased in the systematic review results. Studies that did not specifically address the relationship between smoking and osteoarthritis or did not provide sufficient data were excluded from the analysis. Studies were excluded from this study if they met any of the following criteria; (1) Articles in the form of literature reviews, editorials, letters to the editor, or case reports; (2) Experimental animal or in vitro studies; (3) Studies that did not report outcomes such as osteoarthritis incidence or progression; (4) Studies with incomplete or unextractable data; (5) Multiple publications from the same dataset (only the most complete publication was included); (6) Articles not available in full text.

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Data Extraction Process

The collected data included author information and year of publication, country and study design, sample size, and subject characteristics. Data were also extracted regarding the definition and classification of smoking exposure, location of osteoarthritis, outcomes assessed in terms of osteoarthritis incidence and/or progression, and effect sizes reported in each study, such as odds ratio (OR), risk ratio (RR), or hazard ratio (HR), along with 95% confidence intervals (CIs) as part of the study results. The extracted data were used for narrative synthesis without quantitative statistical analysis.

Research Ethics

This study is a secondary study using data from openly available scientific publications and therefore does not require ethics approval. All stages of the study were conducted in accordance with research ethics principles, including transparency, academic honesty, and respect for the intellectual property rights of original authors.

Flowchart (PRISMA 2020)

The study selection process is presented in the form of a PRISMA 2020 flowchart, which illustrates the number of articles at each stage, from initial identification, screening, full-text eligibility assessment, to the final number of studies included in this systematic review of the relationship between smoking and the incidence and progression of osteoarthritis.

Study Quality Assessment

The methodological quality assessment of the studies was conducted descriptively, taking into account the study design, clarity of the definition of smoking exposure, osteoarthritis assessment methods, and potential bias reported by each study. This approach was chosen due to the limited availability of uniform quantitative reporting data across the included studies.

Data Analysis

Data analysis in this study was conducted using a narrative synthesis approach. Data from each study are presented and compared based on study characteristics, direction of association, and consistency of results. Effect sizes such as odds ratio (OR), relative risk (RR), and hazard ratio (HR) reported in the studies are used as supporting information without quantitative statistical analysis. This study did not conduct a meta-analysis due to study heterogeneity.

Risk of Bias Assessment in Observational Studies Using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist

Methodological quality assessment was conducted using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist, tailored to the design of the included observational studies. Aspects assessed included the clarity of the study population, validity of exposure measurements, validity of outcome measurements, identification of confounding factors, strategies for controlling confounding, and the appropriateness of statistical analyses. The assessment results were used to support the interpretation of the quality of evidence synthesized narratively.

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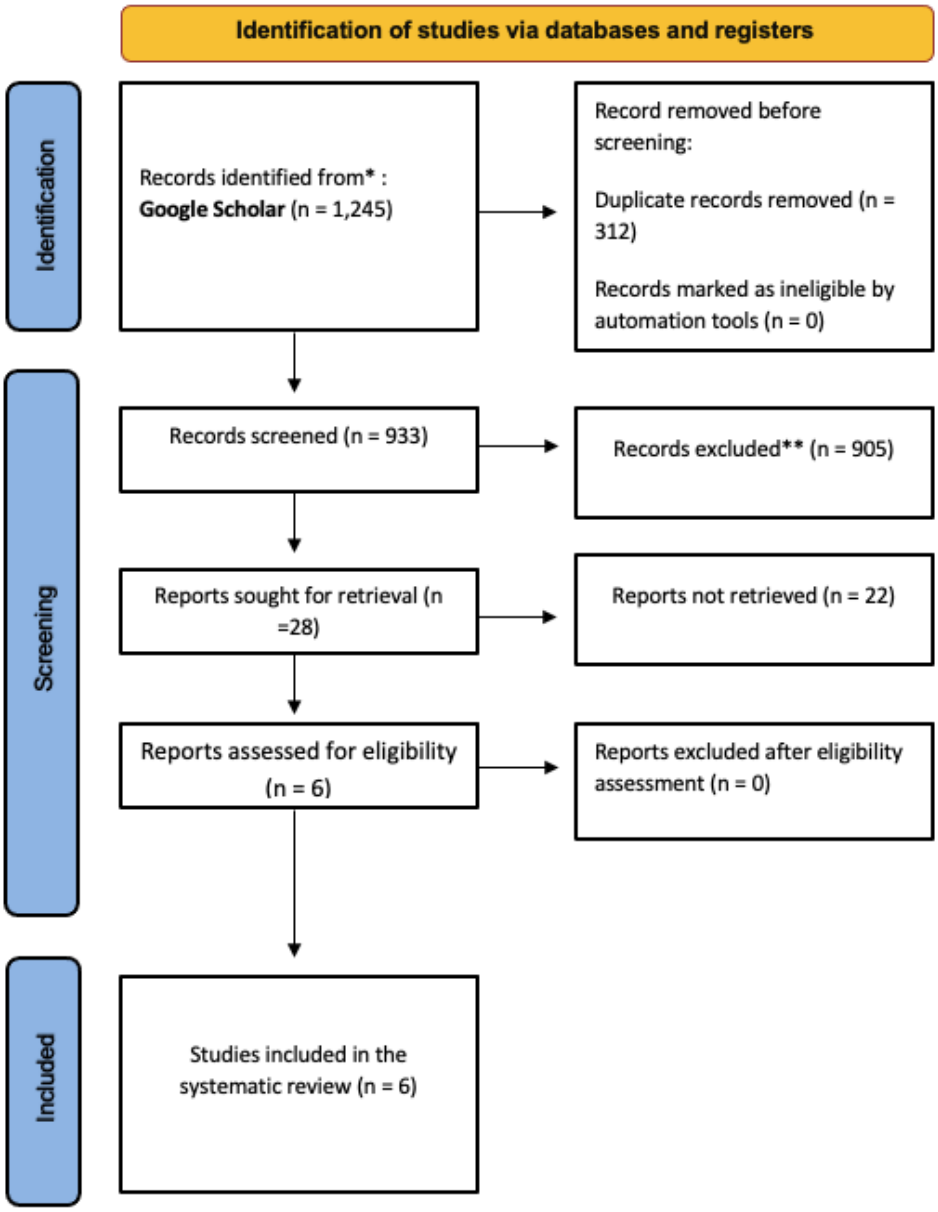

The study identification and selection process followed the PRISMA 2020 guidelines. A literature search through the Google Scholar database yielded 1,245 records. After deduplication, 312 duplicate records were removed, leaving 933 records for the title and abstract screening stage. During this screening stage, 905 records were excluded due to their irrelevance to the research topic, resulting in 28 reports that proceeded to the full-text search stage.

28 reports selected for the full-text search and assessment stage, 22 were not retrieved and could not be further assessed for eligibility (reports not retrieved). Therefore, only six reports were available in full text and were subsequently assessed based on the established inclusion and exclusion criteria. All reports met the inclusion criteria, despite variations in study design and outcome measurement methods. Therefore, six studies were included in the systematic review and subsequently analyzed in this study.

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Results and Discussion

The characteristics of the six studies included in this systematic review demonstrate a variety of study designs, populations, and measurement methods for smoking exposure and osteoarthritis outcomes. Most studies used a longitudinal cohort design, followed by population-based studies and causal analyses using a Mendelian randomization approach. The study populations generally involved adult subjects at risk for or diagnosed with osteoarthritis, with the knee and hip being the most frequently studied joint sites.

The qualitative synthesis results indicate that smoking is associated as a relevant risk factor for the development and clinical course of osteoarthritis, while evidence regarding progression varies between studies. Some studies report an increased risk of osteoarthritis in active smokers compared with nonsmokers, while others demonstrate accelerated joint structural progression, such as decreased cartilage volume and increased radiographic damage. Furthermore, some studies also report an association between smoking and worsening clinical symptoms of osteoarthritis, including joint pain and functional limitations.

The findings from the six included studies suggest a trend toward an association between smoking exposure and an increased risk of osteoarthritis. However, evidence regarding the association between smoking and osteoarthritis progression remains variable across studies. Although there is variation in results between studies, particularly regarding joint location and outcome assessment methods, the available evidence supports the role of smoking as a relevant risk factor in the development and clinical course of osteoarthritis.

Table 1. Quality Assessment of Observational Studies Using the JBI Critical Appraisal Checklist

No	Author (Year)	Study Design	Clear Population & Setting	Valid Exposure Measurement	Valid Outcome Measurement	Confounding Factors Identified	Strategies for Overcoming Confounding	Accurate Statistical Analysis	Study Quality
1	Salis et al. (2024)	IPD meta-analysis	Yes	Yes	Yes	Yes	Yes	Yes	High
2	Shen et al. (2023)	Kohort longitudinal	Yes	Yes	Yes	Yes	Yes	Yes	High
3	Xiao et al. (2025)	Mendelian randomization	Yes	Yes	Yes	Yes	Yes	Yes	High
4	Yanchao Li et al. (2025)	Cross-sectional	Yes	Yes	Yes	Yes	Yes	Yes	High
5	Beini Mao et al. (2025)	Mendelian randomization	Yes	Yes	Yes	Yes	Yes	Yes	High
6	Park et al. (2023)	Kohort restrospektif 10 year	Yes	Yes	Yes	Yes	Yes	Yes	High

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Based on the results of a quality assessment using the JBI Critical Appraisal Checklist, tailored to each study's design, all included studies met adequate methodological quality criteria and were therefore suitable for inclusion in the systematic synthesis. The assessment results indicated that each study clearly defined the study population and setting, measured exposure and outcomes validly, and used appropriate statistical analyses. However, some studies had potential limitations related to the control of confounding factors, which varied according to the characteristics of their study designs.

Quantitative assessment of publication bias was not performed because this study did not conduct statistical pooling across studies (meta-analysis). Furthermore, the number of included studies was only six, so the use of funnel plots is not recommended as it can lead to less reliable interpretations. Therefore, potential publication bias was evaluated qualitatively through an assessment of the study design, methodological quality, and consistency of findings across the studies analyzed in this systematic review.

Table 2. Characteristics of Studies Included in the Systematic Review

No	Author (Year)	Country / Data Source	Study Design	Population and Sample Size	Exposure	Assessed Outcomes	Key Findings
1	Salis et al. (2024)	Multinasional (OAI, MOST, CHECK)	IPD meta-analysis	Knee OA patients from three large cohorts (n = 8,824 participants)	Smoking status	Structural Damage and Symptoms of Knee OA	No significant association was found between smoking status and structural damage or symptoms of knee OA.
2	Shen et al. (2023)	Australia & Belanda	Kohort longitudinal	Knee OA patients from two cohorts (n = 987; OAI = 593, TASOAC = 394)	Smoking status	Knee Cartilage Loss	Smokers showed a tendency to lose cartilage volume more rapidly than nonsmokers.
3	Xiao et al. (2025)	Eropa	Mendelian Randomization	Adult population genetic data from	Smoking behavior	Risk of OA Incidence	The analysis suggests a possible causal

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				large-scale GWAS (n = following GWAS dataset)			relationship between smoking behavior and increased OA risk.
4	Yanchao Li et al. (2025)	Amerika Serikat	Cross-sectional	Adult participants from NHANES (n = as per article)	Tobacco smoke exposure	Early-Onset OA	Tobacco smoke exposure is associated with an increased likelihood of early-onset OA.
5	Beini Mao et al. (2025)	Eropa	Mendelian Randomization	Genetic data of European women from GWAS (n follows GWAS dataset)	Smoking behavior	Risk of OA	Smoking is associated with an increased risk of OA in European women.
6	Park et al. (2023)	Korea Selatan	Kohort retrospektif 10 tahun	Adult population (n = according to article)	Smoking status	Incidence and Progression of Knee OA	Smoking has been associated with the incidence of knee OA, but results regarding progression are variable.

Study Heterogeneity

The studies included in this systematic review exhibited clinical and methodological heterogeneity. These differences included variations in study design, population characteristics, joint locations studied, and definitions and classifications of smoking exposure. Furthermore, differences in the methods used to assess osteoarthritis outcomes, both clinically and radiologically, contributed to the variation in results between studies. This heterogeneity was a key consideration in interpreting the systematic review results and formed the basis for the use of narrative synthesis. However, the results between studies still showed heterogeneity, requiring careful interpretation.

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Based on the results of the systematic review analyzed, it can be concluded that the relationship between smoking and osteoarthritis shows an increasingly clear trend in recent studies. Although previous observational studies have shown varying results, the six studies included in this systematic review generally indicate a trend toward an association between smoking exposure and an increased risk of osteoarthritis incidence. However, the magnitude of the association varies across studies depending on study design, population characteristics, and analytical methods used. This synthesis of results indicates that the relationship is likely supported by biological mechanisms described in the literature. However, the studies reviewed in this thesis primarily demonstrate an association, rather than directly proving a biological mechanism. Conversely, evidence regarding the relationship between smoking and osteoarthritis progression is still limited and inconsistent (Xiao et al., 2025; Courties & Sellam, 2023).

Several longitudinal studies have found no significant association between smoking status and clinical or radiographic worsening of OA over a specific follow-up period, suggesting that the impact of smoking is more pronounced in the early stages of the disease than in subsequent progression. Findings from modern studies support the view that smoking is a modifiable risk factor for the prevention of osteoarthritis, although longer-term studies using more comprehensive methods are needed to clarify the relationship between smoking and the overall course of the disease (Courties et al., 2024; Mao et al. 2025; Shen et al. (2023). The evidence is more consistent in linking smoking with an increased incidence of osteoarthritis than with disease progression.

Biological Mechanisms of the Relationship Between Smoking and Osteoarthritis

Smoking exposure is suspected to be associated with processes that can accelerate joint tissue damage through increased oxidative stress. Exposure to toxic substances in cigarette smoke causes excessive production of reactive oxygen species unbalanced by the endogenous antioxidant system, thus triggering cellular damage to chondrocytes and the cartilage extracellular matrix (Fernández-Torres et al., 2023).

In addition to the oxidative pathway, smoking is suspected to be associated with worsening osteoarthritis through the direct effects of nicotine on chondrocytes, impaired joint tissue vascularization, and an intensification of the chronic inflammatory response. Inhibition of chondrocyte proliferation and function, accompanied by decreased synthesis of cartilage structural components, further limits the tissue's ability to repair. Furthermore, local vasoconstriction and hypoxia inhibit nutrient supply, while increased proinflammatory cytokines and activation of matrix-degrading enzymes accelerate cartilage degradation. This combination of mechanisms confirms that, theoretically, cigarette smoke exposure can increase oxidative stress, chronic inflammation, and impaired chondrocyte function, potentially impacting joint tissue health. This mechanism is suspected to be one biological explanation for the association between smoking and osteoarthritis found in several studies. However, based on the results of the synthesis of six studies in this study, evidence regarding the effect of smoking on osteoarthritis progression remains inconsistent, requiring further research (Kong et al., 2017; Xie et al., 2024).

Differences in the Impact of Smoking on the Incidence and Progression of OA

In general, scientific evidence indicates that smoking has a more consistent impact on increasing the risk of osteoarthritis than on accelerating disease progression once OA develops. One study using a Mendelian randomization approach in this review indicated a possible causal relationship between smoking behavior and an increased risk of osteoarthritis. However,

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overall, the results of this systematic review suggest an association between smoking and osteoarthritis rather than proving a causal relationship. The synthesis results indicate that the relationship between smoking and osteoarthritis incidence is more consistent than its relationship with disease progression. Mendelian randomization-based and cohort studies indicate a trend toward an increased risk of osteoarthritis incidence in individuals exposed to smoking. In contrast, studies on progression have yielded mixed findings, so a consistent association cannot yet be concluded (Xiao et al., 2025; Shen et al. 2023).

Conversely, evidence regarding the association of smoking with osteoarthritis progression remains inconsistent. Several large-scale longitudinal studies have reported that smoking status, in both current and former smokers, was not significantly associated with the rate of cartilage loss or radiographic worsening after adjustment for major confounding factors. This variation in results between studies is likely related to differences in exposure assessment methods, the lack of quantitative measures of smoking intensity and duration, and interactions with other risk factors such as obesity and joint biomechanical load. Therefore, although long-term smoking exposure contributes to the increased incidence of OA, its role in accelerating disease progression requires further research with more comprehensive exposure designs and measurements (Xiao et al., 2025; Shen et al. 2023).

Differences Based on Joint Location

Current evidence suggests that smoking is associated with an increased risk of osteoarthritis in both the knee and hip joints, but the strength and consistency of this association vary across joint locations. Based on the results of a synthesis of six articles, the studies were conducted at different joint locations, particularly the knee and hip. Differences in joint locations studied may contribute to variation in results between studies, so interpretation of the relationship between smoking and osteoarthritis needs to consider the characteristics of the joint sites evaluated. Differences in joint locations studied may contribute to variation in results between studies, so interpretation of the relationship between smoking and osteoarthritis needs to consider the characteristics of the joint sites evaluated (Xiao et al., 2025; Salis et al. (2024).

Comparison with Previous Research

Historically, research on the relationship between smoking and osteoarthritis prior to 2020 has yielded mixed and often conflicting results. Several early observational studies and meta-analyses reported a negative association between smoking and OA, particularly in the knee, which led to the suggestion of a protective effect. However, the interpretation of these findings is limited by various methodological weaknesses, including the predominance of observational designs, the presence of confounding factors such as lower body mass index in smokers, and differences in outcome definitions and population characteristics. These conditions make the observed associations difficult to interpret as causal and potentially reflect selection bias or inadequately controlled confounding (Joanna Briggs Institute. 2024; Courties et al., 2024; Xiao et al., 2025).

In contrast, the growth of scientific evidence in recent years through the use of large-scale cohorts and Mendelian randomization approaches provides a more consistent picture of the role of smoking as a risk factor for osteoarthritis. Genetic evidence from Mendelian randomization studies included in this review indicates a possible causal relationship between predisposition to smoking and an increased risk of OA. However, overall, the results of this systematic review suggest a trend toward an association between smoking and osteoarthritis. This approach significantly reduces the confounding and reverse causation biases common in observational studies, clarifying the direction of the association between smoking and OA.

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Compared with previous studies that showed mixed results, the more recent studies included in this systematic review tend to show an association between smoking exposure and an increased risk of osteoarthritis. However, results between studies still show variation, necessitating further research using more homogenous methodology to strengthen the existing evidence (Mao et al., 2025; Joanna Briggs Institute, 2024).

Strengths of the Study

This study boasts significant methodological strength through the implementation of a systematic review that strictly adheres to the PRISMA 2020 guidelines. The use of the PRISMA framework enhances transparency in the literature search and selection process and ensures that each stage of the review is traceable and replicable. Clearly defining inclusion and exclusion criteria, along with visualization of the study selection process, contributes to reducing potential selection bias and strengthening the internal validity of the study results. This approach provides a strong foundation for synthesizing the resulting scientific evidence (Kong et al., 2017; Ni et al., 2022). Furthermore, the study's strengths are enhanced by the inclusion of longitudinal studies and modern causal analyses such as Mendelian randomization, which allow for the assessment of temporal and causal relationships between smoking and osteoarthritis. Methodological quality evaluation used internationally standardized instruments appropriate to the study designs analyzed. One of the main strengths of this study is the systematic review approach, which utilizes a structured synthesis of research findings. Although not all data could be statistically combined due to methodological heterogeneity, this study conducted a structured narrative synthesis of the effect sizes reported in each study without statistically combining them across studies due to methodological heterogeneity. This approach allows for a more comprehensive interpretation of the association between smoking exposure and osteoarthritis incidence than a narrative review alone and aligns with the PRISMA 2020 reporting principles.

In general, the main limitation of this study lies in the relatively small number of studies, which limits the robustness of the evidence synthesis and the breadth of generalizability of the findings. Despite a comprehensive systematic review, only six studies met the inclusion criteria, potentially impacting the stability of the conclusions. This situation suggests that findings indicating an association between smoking and osteoarthritis should be interpreted with caution, as the available evidence is not yet strong enough to broadly represent the entire clinical population (Xiao et al., 2025). Furthermore, the predominance of observational designs in the included studies limits the ability to draw definitive causal conclusions Salis et al. (2024).

The main limitation of this study is the limited ability to conduct a comprehensive quantitative meta-analysis. This is due to the variation in population characteristics, differences in definitions of smoking exposure, and variations in osteoarthritis assessment methods across the included studies. These conditions limit the possibility of validly combining numerical data and may affect the strength of statistical inferences from the results.

Nevertheless, only studies with relevant data and adequate methodological quality were included in the narrative synthesis to maintain the validity of the conclusions and minimize the risk of bias. This approach was taken to maintain the validity of the conclusions and minimize the risk of bias due to the use of incomplete or non-standardized data. Furthermore, this study did not conduct a quantitative meta-analysis, thus unable to provide statistical estimates of effect sizes.

Furthermore, the literature search in this study was limited by the number of databases used, so it is possible that some relevant articles were not identified. Therefore, the results of this

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study should be interpreted taking into account the possibility of additional evidence not captured in the literature search process.

Clinical Implications

Smoking cessation education is a crucial aspect of osteoarthritis prevention and management, particularly in high-risk individuals. Epidemiological and genetic evidence suggests that smoking potentially contributes to an increased risk of OA through systemic inflammatory mechanisms and impaired joint tissue metabolism. Therefore, educational interventions that encourage smoking cessation could be an effective strategy to reduce exposure to modifiable risk factors, potentially lowering the risk of osteoarthritis in the early stages of the disease (Xiao et al., 2025). From a healthcare practice perspective, recognizing smoking as a modifiable risk factor provides an important opportunity for healthcare professionals to implement meaningful preventive interventions. Physicians, nurses, and public health workers have a strategic role in integrating smoking cessation counseling into clinical services and promotive-preventive programs. A multidisciplinary, community-based approach is expected to not only foster individual behavior change but also contribute to a broader reduction in smoking prevalence and the burden of osteoarthritis at the population level (GBD 2021 Osteoarthritis Collaborators, 2023).

Public Health Implications

In general, tobacco control is a critical component in preventing non-communicable diseases, including musculoskeletal disorders such as osteoarthritis. Cigarette exposure adversely affects joint and bone tissue through various biological mechanisms that contribute to an increased risk of degenerative diseases. Therefore, population-level tobacco control strategies, such as advertising restrictions, fiscal policies, and strengthening smoking cessation services, have the potential to reduce smoking prevalence while reducing the risk of osteoarthritis and other musculoskeletal disorders in the community (Mobasheri et al., 2023; Hayashi, et al. (2025).

Recommendations for Further Research

Future research should focus on long-term prospective cohort designs with more comprehensive and standardized measurements of smoking exposure. Detailed recording of the duration, intensity, and accumulation of smoking exposure allows for a more accurate evaluation of the dose-response relationship between smoking and the incidence and progression of osteoarthritis. Longitudinal designs also offer the advantage of assessing the temporal relationship between exposure and outcome, thereby increasing the strength of causal inferences and reducing the potential for bias often present in retrospective or cross-sectional studies (Wang et al., 2023; Courties et al., 2024; Salis et al., 2024).

Furthermore, the development of experimental research and advanced methodological approaches is essential to strengthen the existing causal evidence. Intervention studies, including randomized clinical trials of smoking cessation programs, have the potential to provide a direct picture of the impact of smoking cessation on the clinical and structural outcomes of osteoarthritis. The integration of more sensitive biological biomarkers and imaging technologies, along with meta-analyses using more homogeneous and sophisticated methods, is expected to clarify the biological mechanisms underlying the relationship between smoking and OA and produce more reliable risk estimates for the development of future disease prevention and management strategies (Hayashi 2025; Li et al., 2025).

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Conclusion

This systematic review suggests that smoking is associated with an increased risk of osteoarthritis. The synthesis of six studies analyzed suggests a trend toward an association between smoking exposure and an increased risk of osteoarthritis. However, the strength and consistency of this association vary across studies. Nevertheless, evidence regarding the relationship between smoking and osteoarthritis progression remains mixed. Some studies report an association with structural deterioration or clinical symptoms, while others find no significant association after accounting for confounding factors. Overall, these results support the belief that smoking is associated with an increased risk of osteoarthritis and is a modifiable risk factor. However, evidence regarding the relationship between smoking and osteoarthritis progression remains inconsistent, with some longitudinal studies showing differences in structural progression, while others have found no significant association with symptoms, function, or radiological changes.

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