Review Article

The Impact of Smoking on the Outcomes of Arthroplasty Surgeries: A Systematic Review

Bashah Almustanir[1], Saleh K. Aldhalai[2], Bader M. Al-Obayiah[2], Hussain M. Al Sulaiman [3], Muhannad A. Al Obaiyah[4], Yahya I. Al Ishaq [4], Ahmed M. Al-Obayiah[4], Ali H. Alsulaiman[4], Hamzah A. Alsharif[5], Saleh A. Alyami[6], Ahsan A. Almakrami[4]

[1]MBBS, Orthopedic Surgery Consultant, King Saud Medical City · Riyadh, KSA. [2]Medical Intern, Najran University, Najran, KSA. [3]Bachelor of Medicine and Surgery, Najran University, Najran, KSA. [4]Medical student, Najran University, Najran, KSA. [5]Orthopedic Resident, King Fahad Hospital, Albaha Health Cluster, Ministry of Health, Albaha, KSA. [6]Orthopedic Resident, King Khalid Hospital, Najran Health Cluster, Ministry of Health, Najran, KSA.

ABSTRACT

Total joint arthroplasty (TJA) is definitive for end-stage osteoarthritis. Tobacco use remains a leading preventable cause of postoperative complications, but its relationship with arthroplasty outcomes requires ongoing synthesis. This review followed Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. We searched PubMed/MEDLINE, Embase, Cochrane CENTRAL, and Web of Science for studies published from 2021- 2026. Eligible studies examined adults undergoing arthroplasty, compared outcomes by smoking status, and reported revision, mortality, infection, function, or complications. Thirteen studies comprising 411,008 patients were included. Smoking was associated with significantly increased risks of revision and mortality (adjusted hazard ratio [aHR] 1.4) within two years after hip and knee arthroplasty. Current smokers had inferior patient-reported outcomes, including Knee injury and Osteoarthritis Outcome Score for Joint Replacement (KOOS-JR), American Shoulder and Elbow Surgeons (ASES), Shoulder Pain and Disability Index (SPADI), Simple Shoulder Test (SST), University of California, Los Angeles (UCLA), and Constant scores. Smoking increased infection risk (odds ratio [OR] 1.31–1.84), wound complications (OR 1.77), 30-day readmission (OR 2.30), postoperative delirium (OR 4.02), myocardial infarction (MI) (OR 9.80), and deep vein thrombosis (DVT) (OR 20.05). Cessation programs achieved 62% preoperative quit rates; sustained abstinence was associated with fewer complications (5% vs. 27%, p=0.02) and better function. Passive smoking showed dose-dependent negative effects on pain, range of motion, and infection rate. Smoking profoundly impairs arthroplasty outcomes across revision, mortality, infection, functional recovery, and patient-reported outcomes. Perioperative.

Keyword: Smoking; Tobacco use; Total joint arthroplasty; Total knee arthroplasty; Total hip arthroplasty; Shoulder arthroplasty.

Introduction

Osteoarthritis (OA) is the most common arthritis and a leading cause of chronic pain and disability worldwide. For end-stage OA, total joint arthroplasty (TJA)—including total hip arthroplasty (THA), total knee arthroplasty (TKA), and shoulder replacement—remains the most effective surgical intervention, offering reliable pain relief and functional improvement. Demand has surged over the past two decades [1]. Primary THA is projected to rise 71% by 2030 and 659% by 2060, while primary TKA is expected to increase 85% by 2030 and 469% by 2060

Access this article online	
Quick Response Code:	Website: www.smh-j.com
	DOI: 10.54293/smhj.v6i3.213

Address for correspondence: Saleh Khalid M. Aldhalai, Medical Intern, Najran University, Najran, KSA.
E-mail: Dr.salehaldhalai@gmail.com

Received: 9 Jun 2026 **Accepted:** 17 Oct 2026

This is an open access article by SMHJ is licensed under Creative Commons Attribution 4.0 International License.
(https://creativecommons.org/licenses/by/4.0)

Please cite this article as: Bashah Almustanir, Aldhalai SKM, Al-Obayiah BMA, Al Sulaiman HMH, Al Obaiyah MAA, Al Ishaq YIB, Al-Obayiah AMA, Alsulaiman AH, Hamzah Abdullah M Alsharif, Saleh Ali M Alyami, Almakrami AAH. The Impact of Smoking on the Outcomes of Arthroplasty Surgeries: A Systematic Review. SMHJ [Internet]. 2026;6(3):414-426.

© Saudi Medical Horizons Journal

SMHJ
Saudi Medical Horizons Journal

[2,3]. Revision TKA volume is also predicted to grow substantially, from 53,446 in 2013 to 227,515 by 2040 [4]. Tobacco use remains a major preventable cause of morbidity and mortality. Despite a global decline in smoking prevalence from 22.3% (2007) to 16.4% (2023), approximately 1.25 billion people still smoke [5]. In surgical patients, smoking is associated with higher risks of wound infections, delayed healing, cardiovascular events, and respiratory failure, driven by carboxyhaemoglobin formation, nicotine-induced vasoconstriction, impaired collagen synthesis, and altered inflammation [6]. Recent evidence confirms smoking's negative impact on arthroplasty outcomes [7]. A meta-analysis of 40 studies (3,037,683 cases) found significantly elevated risks for total complications (odds ratio [OR] 1.41), wound complications (OR 1.77), prosthetic joint infection (OR 1.84), aseptic loosening (OR 1.62), revision surgery (OR 2.12), cardiac arrest (OR 4.90), pneumonia (OR 2.35), sepsis (OR 4.35), inpatient mortality (OR 12.37), and persistent opioid use (OR 1.64) [8]. Smoking cessation prior to elective surgery is increasingly advocated, with the perioperative period offering a "teachable moment" that can yield quit rates of 28–62% with structured programmes, versus 8% annually in the general population [9,10].

Despite growing evidence, key questions remain regarding comparative effects across joint types and primary versus revision settings. This systematic review aims to comprehensively synthesise the current literature on smoking's influence on clinical outcomes following arthroplasty.

Methods

This systematic review followed PRISMA guidelines. A comprehensive literature search was conducted across PubMed/MEDLINE, Embase, Web of Science, and Cochrane CENTRAL for studies published from 2021- 2026. The search strategy combined MeSH and free-text terms for (1) smoking/tobacco use, (2) arthroplasty/joint replacement, and (3) postoperative outcomes, using a structured PubMed template. Manual reference screening of included studies and reviews supplemented the electronic search, with only English abstracts considered for initial screening.

Eligibility Criteria (PICOS):

• Population: Adults (≥18 years) undergoing any arthroplasty (THA, TKA, UKA, shoulder, or revision).

• Intervention/Exposure: Current/former smoking, pack-years, passive exposure, or preoperative cessation programmes.

• Comparison: Non-smokers, or former vs. current smokers, or quitters vs. continuers.

• Outcomes: Revision, mortality, PJI, SSI, wound complications, readmission, PROMs (e.g., KOOS JR, ASES, SST, SPADI, UCLA, Constant score), ROM, strength, delirium, thromboembolic events, MI, and in-hospital complications.

• Study design: Prospective/retrospective cohorts, case-control, or registry-based studies. Excluded: editorials, conference abstracts, case reports/series <10, animal/cadaveric studies, and studies without smoking-stratified quantitative outcomes.

Study Selection: Records were managed in Rayyan. Two independent reviewers screened titles/abstracts, with disagreements resolved by consensus or a third reviewer. Full texts of eligible studies were assessed, with exclusion reasons recorded, and a PRISMA flow diagram was generated. Data Extraction: A standardised Excel form was used. Two reviewers independently extracted: author, year, country, design, sample size, demographics, arthroplasty type, smoking definition, follow-up duration, outcomes, and effect estimates (OR, HR, RR, p-values, CIs). Discrepancies were discussed; missing data were sought from authors via email (twice) or marked as "not mentioned". Quality Assessment: Two reviewers used the Newcastle-Ottawa Scale (NOS) for cohort studies, assessing three domains (selection, comparability, outcome) for a 0–9 score. Scores 7–9 = good (low bias), 5–6 = moderate, ≤4 = poor (high bias). Disagreements were resolved by consensus or third reviewer. No study was excluded based solely on quality, though a sensitivity analysis excluding poor-quality studies was planned. Data Synthesis: Due to substantial heterogeneity across joint types, smoking definitions, outcome measures, follow-up durations, and effect estimates, a meta-analysis was not feasible. A narrative synthesis was performed, grouping studies into six outcome domains: (1) revision and mortality, (2) infection and wound complications, (3) functional and PROMs, (4) readmission and other complications (delirium, thromboembolic events, MI), (5) smoking cessation effects, and (6) passive smoking. Findings were summarised descriptively, considering study quality, consistency, and effect direction/strength.

Results

PRISMA flow diagram in (Figure 1) outlines the systematic review's study selection process, beginning with 213 records identified from databases, of which 100 duplicates were removed, leaving 113 records for screening. After excluding 61 records, 52 reports were sought for retrieval, but 7 were not retrieved, resulting in 45 reports assessed for eligibility. Of these, 32 were excluded due to wrong outcome (n=14), wrong

population (n=10), or abstract format (n=8). Ultimately, 13 studies were included in the final review. (Table 1) summarises the characteristics of the 13 included studies. In sequential order, Couture et al. [11] was a retrospective cohort from the USA including 200 preoperative smokers and nonsmokers undergoing total knee arthroplasty (TKA); the overall mean age was 65.2 years, with nonsmokers older than smokers (67.6 vs. 62.8 years). Tirumala et al. [12] was a retrospective matched cohort from the USA including 1,924 patients after matching from 4,302, comparing nonusers (808), smokers (421), drinkers (483), and concurrent users (212) in revision total joint arthroplasty of the hip/knee, with in-hospital and 90-day post-discharge follow-up. Amador et al. [13] was a retrospective cohort from the USA of 428 patients (nonsmokers 251, former smokers 138, current smokers 39) undergoing anatomical total shoulder arthroplasty, with a mean follow-up of 2.4 ± 0.6 years. Bongers et al. [14] was a prospective registry-based cohort from the Netherlands including 272,640 patients (THA 140,336; TKA 117,497; UKA 14,807), comparing active smokers with nonsmokers and reporting 2-year outcomes. Gonzalez-Parreño et al. [15] was a prospective registry-based cohort from Spain of 4,591 patients (nonsmokers 3,031, ex-smokers 688, smokers 872) undergoing primary TKA (3,076) or THA (1,515), with 4-year follow-up. Heckmann et al. [16] was a retrospective matched cohort from the USA using the NSQIP database, including 2,088 patients (1,044 smokers matched to 1,044 nonsmokers from 143,641), with 30-day follow-up after primary THA and TKA. Chen et al. [17] was a prospective cohort from China of 188 patients from 254 enrolled, comparing smokers with nonsmokers until discharge after unilateral TKA. Ling et al. [18] was a retrospective cohort from the USA using NSQIP, including 22,817 outpatients (2,367 current/recent smokers vs. 20,450 nonsmokers) undergoing total shoulder arthroplasty, with 30-day follow-up. Koschmeder et al. [19] was a retrospective survey from the USA of 101 respondents out of 210 (48% response rate) who were asked to quit smoking before total joint arthroplasty, with 6-month postoperative self-reported follow-up. Damrow et al. [20] was a retrospective cohort from the USA of 676 patients (nonsmokers 544, former smokers 84, current smokers 38) undergoing reverse total shoulder arthroplasty, with 2–4-year follow-up. Kim et al. [21] was a retrospective cohort with phone survey from the USA of 37 patients from 88 eligible self-reported tobacco users who quit within 3 months pre-TJA, with a mean age of 61 ± NM years, 60% female, and mean follow-up of 2.9 ± 1.9 years. An et al. [22] was a prospective cohort from China of 216 female nonsmokers classified by passive smoking severity (none, mild, heavy), with 100% female participants and 3-month follow-up after primary TKA. Tanaka et al. [23] was a retrospective cohort from Japan using the DPC database of 105,102 patients after propensity matching (52,551 per group), comparing smokers with nonsmokers, with in-hospital follow-up after elective primary THA; smoking status was identified by administrative codes, and heavy smoking was defined as Brinkman Index ≥600. Revision and Mortality: (Table 2) shows that, Bongers et al. [14] reported that smokers had higher risks of revision and mortality within two years after primary hip or knee arthroplasty. For THA, the adjusted hazard ratio (aHR) for revision was 1.3 (95% CI 1.1–1.4) and for mortality 1.4 (95% CI 1.3–1.6). For TKA, the aHR for revision was 1.4 (95% CI 1.3–1.6) and for mortality 1.4 (95% CI 1.2–1.6). For unicompartmental knee arthroplasty (UKA), mortality aHR was 1.7 (95% CI 1.0–2.8), while revision risk was not significant. Infection and Wound Complications: Infection risk was elevated among smokers. Gonzalez-Parreño et al. [15] found no significant association between smoking and periprosthetic joint infection (PJI) (nonsmokers 1.6%, ex-smokers 1.7%, smokers 1.9%; P=0.413; OR 1.1, P=0.052), but wound complications were higher in smokers (1.9% vs. 0.7%, P=0.045). Tanaka et al. [23] reported higher early postoperative infection after elective THA (OR 1.31, 95% CI 1.15–1.49, P<0.001). In revision arthroplasty, Tirumala et al. [12] found higher in-hospital complications among smokers (OR 2.40, P<0.01). Functional Outcomes and Patient-Reported Outcomes: Couture et al. [11] reported that nonsmokers had significantly better Knee injury and Osteoarthritis Outcome Score for Joint Replacement (KOOS-JR) scores after TKA (P=0.016). Amador et al. [13] found that current smokers had worse American Shoulder and Elbow Surgeons (ASES), Shoulder Pain and Disability Index (SPADI), Simple Shoulder Test (SST), University of California, Los Angeles (UCLA), and Constant scores, as well as worse forward elevation, abduction, and external rotation strength compared with nonsmokers. Former smokers also had worse SPADI, SST, and forward elevation strength than nonsmokers. Damrow et al. [20] similarly reported worse functional scores in current smokers after reverse total shoulder arthroplasty. Readmission and Other Complications Heckmann et al. [16] found that smoking increased 30-

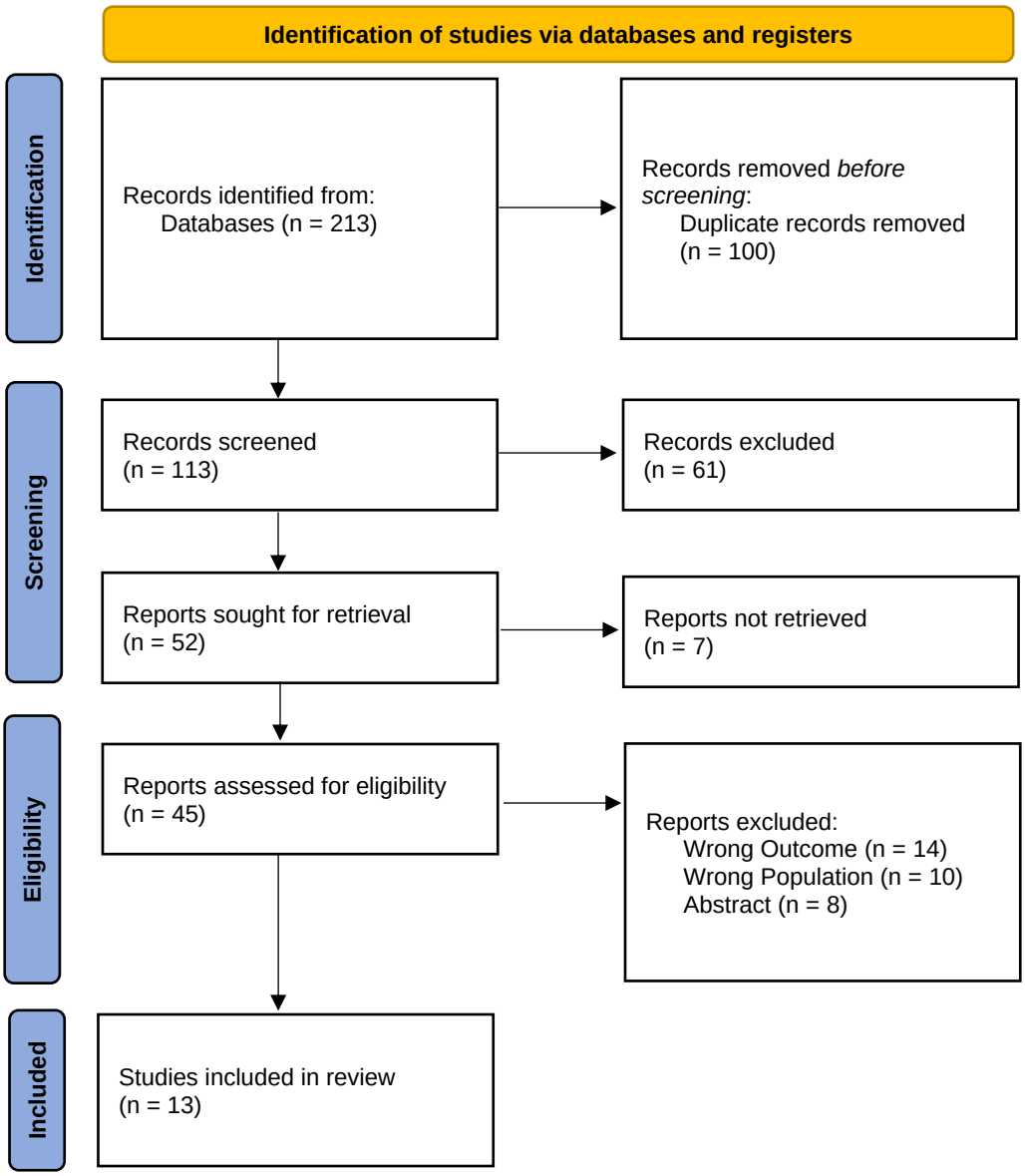

Figure 1: PRISMA Flow Diagram of the Study Selection Process.

Table 1: Study Characteristics and Demographic Data.

Study (Author, year) [Ref]	Location	Study Design	Sample Size (N)	Sample Type	Age (mean ± SD or range)	Gender (% female)	Follow-up Duration	Joint Type	Smoking Definition
Couture *et al.* (2025) [11]	USA	Retrospective cohort	200	Preoperative smokers (100) and nonsmokers (100)	Overall mean 65.2 (28-86); Nonsmokers 67.6 vs Smokers 62.8	NM	NM	Total knee arthroplasty (TKA)	Preoperative smoker vs nonsmoker
Tirumala *et al.* (2021) [12]	NM (USA likely)	Retrospective matched cohort	1,924 (after matching; from 4,302)	Nonusers (808), smokers (421), drinkers (483), concurrent users (212)	NM	NM	In-hospital and 90-day post-discharge	Revision total joint arthroplasty (hip/knee)	Smoker (active), drinker, concurrent
Amador *et al.* (2024) [13]	USA	Retrospective cohort	428	Non-smokers (251), former smokers (138), current smokers (39)	NM (former smokers quit mean 21 years prior; pack-years: former 25±22, current 23±20)	NM	Mean 2.4 ± 0.6 years	Anatomical total shoulder arthroplasty (aTSA)	Current, former (quit ≥1 year? NM), non-smoker
Bongers *et al.* (2024) [14]	Netherlands	Prospective cohort (registry)	272,640 (THA 140,336; TKA 117,497; UKA 14,807)	Smokers vs non-smokers	NM	NM	2 years	Primary THA, TKA, UKA	Smoker (active at time of surgery) vs non-smoker
Gonzalez-Parreño *et al.* (2024) [15]	Spain	Prospective registry-based cohort	4,591	Nonsmokers (3,031), ex-smokers (688), smokers (872)	NM	NM (but female gender was predictor in multivariate)	4 years	Primary TKA (3,076) and THA (1,515)	Current smoker, ex-smoker, nonsmoker

Heckmann *et al.* (2021) [16]	USA (NSQIP database)	Retrospective matched cohort	2,088 (1,044 smokers matched to 1,044 nonsmokers from 143,641)	Smokers vs nonsmokers	NM	NM (matched for age/sex)	30 days	Primary THA and TKA	Smoker (any, pack-year as continuous)
Chen *et al.* (2023) [17]	China	Prospective cohort	188 (from 254 enrolled)	Smokers vs nonsmokers (POD: 41, non-POD: 147)	NM	NM	Until discharge (postoperative hospital stay)	Unilateral TKA	Preoperative smoking (any)
Ling *et al.* (2023) [18]	USA (NSQIP)	Retrospective cohort	22,817 (outpatient cohort: 2,428)	Current/recent smokers (2,367) vs nonsmokers (20,450)	NM	NM	30 days	Outpatient total shoulder arthroplasty (TSA)	Current or recent smoking within 12 months prior to surgery
Koschmeder *et al.* (2023) [19]	USA	Retrospective survey	101 (survey responders out of 210? response rate 48%)	Patients asked to quit smoking before TJA	NM	NM	6 months postoperatively (self-reported)	Primary total joint arthroplasty (TJA)	Documented smoking history
Damrow *et al.* (2025) [20]	USA	Retrospective cohort	676	Nonsmokers (544), former smokers (84), current smokers (38)	Current smokers: 44±47 pack-years; former: quit 20±14 years prior (38±32 pack-years)	NM	2-4 years	Reverse total shoulder arthroplasty (rTSA)	Current, former, nonsmoker
Kim *et al.* (2024) [21]	USA	Retrospective cohort with phone survey	37 (from 88 eligible)	Self-reported tobacco users who quit within 3	Mean 61 ± NM	60%	Mean 2.9 ± 1.9 years	Total joint arthroplasty (TJA)	Self-reported tobacco user with cessation date ≤3

				months pre-TJA					months preop
An *et al.* (2021) [22]	China	Prospective cohort	216	Female nonsmokers classified by passive smoking severity (none, mild, heavy)	NM	100%	3 months	Primary TKA	Passive smoking exposure (environmental tobacco smoke)
Tanaka *et al.* (2026) [23]	Japan	Retrospective cohort (DPC database)	105,102 (after propensity matching: 52,551 each group)	Smokers vs non-smokers	NM	NM	In-hospital (early postoperative)	Elective primary THA	Smoking status identified by administrative codes; heavy smoking: Brinkman Index ≥600

NM = Not mentioned; THA = total hip arthroplasty; TKA = total knee arthroplasty; UKA = unicompartmental knee arthroplasty; TSA = total shoulder arthroplasty; aTSA = anatomical total shoulder arthroplasty; NSQIP = National Surgical Quality Improvement Program; DPC = Diagnosis Procedure Combination; PJI = periprosthetic joint infection; SSI = surgical site infection; POD = postoperative delirium.

Table 2: Main Outcomes and Key Findings by Study Objective.

Study (Author, year) [Ref]	**Smoking Comparison Groups**	**Primary Outcomes**	**Secondary/Other Outcomes**	**Key Findings (Effect sizes, p-values, OR/HR)**
Couture *et al.* (2025) [11]	Preoperative nonsmokers vs smokers	Patient-reported outcomes (KOOS-JR)	Knee health, functional movements, pain from movement	Nonsmokers had significantly better KOOS-JR scores (P=0.016); better overall knee health and functional performance
Tirumala *et al.* (2021) [12]	Nonusers vs smokers vs drinkers vs concurrent users	In-hospital complications	90-day post-discharge complications	Smokers (OR 2.40), drinkers (OR 1.55), concurrent users (OR 5.13) had higher odds of in-hospital complications (P<0.01); concurrent users highest odds for 90-day complications (OR 1.64, P=0.02)
Amador *et al.* (2024) [13]	Nonsmokers vs former smokers vs current smokers	Functional outcomes (ASES, SPADI, SST, UCLA, Constant), ROM, strength	Revision-free survival	Current smokers had worse SPADI, SST, ASES, UCLA, Constant, FE, abduction, ER strength vs

				nonsmokers; former smokers had worse SPADI, SST, FE strength vs nonsmokers; nonsmokers had higher revision-free survival at 2,5,8,10 years
Bongers *et al.* (2024) [14]	Smokers vs nonsmokers	Risk of revision within 2 years	Risk of mortality within 2 years; revision for infection	THA: aHR for revision 1.3 (CI 1.1-1.4), mortality 1.4 (CI 1.3-1.6); TKA: revision aHR 1.4 (CI 1.3-1.6), mortality 1.4 (CI 1.2-1.6); UKA: mortality aHR 1.7 (CI 1.0-2.8), revision NS
Gonzalez-Parreño *et al.* (2024) [15]	Nonsmokers vs ex-smokers vs smokers	Periprosthetic joint infection (PJI) rate	Wound complications, 4-year arthroplasty survival	PJI: nonsmokers 1.6%, ex-smokers 1.7%, smokers 1.9% (P=0.413); smoking not significant predictor (OR 1.1, P=0.052); wound complications higher in smokers (1.9% vs 0.7%, P=0.045); female gender was significant PJI predictor (OR 1.3, P=0.039)
Heckmann *et al.* (2021) [16]	Smokers vs nonsmokers (matched)	30-day readmission	Wound complications, thrombotic events, total complications	Smokers had increased 30-day readmission (OR 2.30, CI 1.45-3.65, P<0.001) regardless of pack-years; no relationship between pack-years and wound complications or thrombotic events
Chen *et al.* (2023) [17]	Preoperative smokers vs nonsmokers	Postoperative delirium (POD) incidence	Length of hospital stay	POD in 21.8% overall; smoking higher in POD group (54% vs 32%, P<0.05); smoking was risk factor (OR 4.018, CI 1.158-13.947, P=0.028); longer hospital stay correlated with POD
Ling *et al.* (2023) [18]	Current/recent smokers vs nonsmokers (outpatient TSA)	Myocardial infarction (MI), deep vein thrombosis (DVT), readmission	Pulmonary complications	Smokers had higher MI (OR 9.80, CI 1.48-64.96, P=0.018), DVT (OR 20.05, CI 1.63-247.38, P=0.019), readmission (OR 2.82, CI 1.19-6.67, P=0.018); readmission most often due to pulmonary complication (22.7%)
Koschmeder *et al.* (2023) [19]	Patients who quit smoking vs those who did	Wound complication/infection rate	Smoking cessation success rate	62% quit before surgery; 51% remained smoke-free at 6 months; wound complication/infection rate

	not (required to quit)			significantly higher for those who did not quit (4/16, 27%) vs those who quit (3/63, 5%; P=0.02)
Damrow *et al.* (2025) [20]	Nonsmokers vs former smokers vs current smokers	Functional outcomes (SPADI, SST, ASES, UCLA, Constant)	Complications, revision-free survivorship	Current smokers had worse all functional scores vs former and nonsmokers (multivariable analysis); no significant differences in complications or revision-free survivorship between cohorts
Kim *et al.* (2024) [21]	Patients who maintained cessation vs those who relapsed postoperatively	Tobacco abstinence rate at final follow-up	PROMIS-10 mental health scores, HOOS.JR scores	73% abstinent preop; 43.2% complete abstinence at mean 2.9 years; maintainers had better PROMIS-10 mental (58 vs 49, P=0.01) and HOOS. JR (82 vs 63, P=0.02); no PJI or revision
An *et al.* (2021) [22]	No passive smoking vs mild vs heavy passive smoking (female only)	VAS pain, ROM, HSS knee score	HADS (anxiety/depression), SF-36, SSI rate	Heavy passive smoking group had higher VAS, lower ROM at discharge, 1,3 months (P<0.01); higher SSI rate (8.51% vs 1.82% vs 0.88%, P=0.02); worse HADS and SF-36
Tanaka *et al.* (2026) [23]	Smokers vs nonsmokers (propensity-matched)	Postoperative infection	Dislocation, periprosthetic fracture, wound dehiscence, reoperation, major medical complications, in-hospital mortality, blood transfusion	Smoking associated with higher infection risk (OR 1.31, CI 1.15-1.49, P<0.001); lower likelihood of blood transfusion (OR 0.83, CI 0.80-0.85); no significant association with other complications; heavy smoking (Brinkman ≥600) not associated

Abbreviations: KOOS-JR = Knee injury and Osteoarthritis Outcome Score for Joint Replacement; ASES = American Shoulder and Elbow Surgeons; SPADI = Shoulder Pain and Disability Index; SST = Simple Shoulder Test; UCLA = University of California, Los Angeles; ROM = range of motion; FE = forward elevation; ER = external rotation; aHR = adjusted hazard ratio; CI = confidence interval; THA = total hip arthroplasty; TKA = total knee arthroplasty; UKA = unicompartmental knee arthroplasty; NS = not significant; PJI = periprosthetic joint infection; POD = postoperative delirium; MI = myocardial infarction; DVT = deep vein thrombosis; TSA = total shoulder arthroplasty; PROMIS-10 = Patient-Reported Outcomes Measurement Information System 10; HOOS.JR = Hip disability and Osteoarthritis Outcome Score for Joint Replacement; VAS = visual analogue scale; HSS = Hospital for Special Surgery; HADS = Hospital Anxiety and Depression Scale; SF-36 = Short Form-36; SSI = surgical site infection.

Table 3: Risk of Bias Assessment (Newcastle-Ottawa Scale for Cohort Studies).

Study [Ref]	**Selection (Max 4)**	**Comparability (Max 2)**	**Outcome (Max 3)**	**Total Score (Max 9)**	**Quality Rating**
Couture *et al.* (2025) [11]	3	1	2	6	Moderate

Tirumala *et al.* (2021) [12]	3	2	2	7	Good
Amador *et al.* (2024) [13]	3	2	3	8	Good
Bongers *et al.* (2024) [14]	4	2	3	9	Good
Gonzalez-Parreño *et al.* (2024) [15]	4	2	3	9	Good
Heckmann *et al.* (2021) [16]	3	2	2	7	Good
Chen *et al.* (2023) [17]	3	1	2	6	Moderate
Ling *et al.* (2023) [18]	3	2	2	7	Good
Koschmeder *et al.* (2023) [19]	2	1	1	4	Poor
Damrow *et al.* (2025) [20]	3	2	3	8	Good
Kim *et al.* (2024) [21]	2	1	2	5	Moderate
An *et al.* (2021) [22]	3	1	2	6	Moderate
Tanaka *et al.* (2026) [23]	4	2	2	8	Good

Quality rating: 7–9 = Good, 5–6 = Moderate, ≤4 = Poor.

day readmission (OR 2.30). Ling et al. [18] reported that current or recent smokers undergoing outpatient total shoulder arthroplasty had higher risks of myocardial infarction (MI) (OR 9.80, 95% CI 1.48–64.96, P=0.018), deep vein thrombosis (DVT) (OR 20.05, 95% CI 1.63–247.38, P=0.019), and readmission (OR 2.82, 95% CI 1.19–6.67, P=0.018). Chen et al. [17] found that preoperative smoking increased postoperative delirium after TKA (OR 4.02). Smoking Cessation: Koschmeder et al. [19] reported that 62% of patients quit smoking when required before surgery, and those who failed to quit had higher wound complications (27% vs. 5%, P=0.02). Kim et al. [21] found that 43.2% of patients maintained complete abstinence at a mean of 2.9 years; maintainers had better PROMIS-10 mental health scores (58 vs. 49, P=0.01) and HOOS.JR scores (82 vs. 63, P=0.02), with no PJI or revision. Passive Smoking: An et al. [22] reported that heavy passive smoking in female nonsmokers was associated with higher visual analogue scale (VAS) pain scores, lower range of motion (ROM) at discharge and 1.3 months (P<0.01), higher surgical site infection (SSI) rate (8.51% vs. 1.82% vs. 0.88%, P=0.02), and worse Hospital Anxiety and Depression Scale (HADS) and Short Form-36 (SF-36) scores. (Table 3) presents the Newcastle-Ottawa Scale (NOS) quality assessments. Most studies were of good to moderate quality, supporting the findings. One study was rated poor quality [19] and warrants caution.

Discussion

Active smoking is associated with increased revision and mortality risks within two years after primary hip or knee replacement. In a Dutch registry study (n > 272,000), smokers had 30–40% higher risks for death (adjusted hazard ratio [aHR] 1.4) and revision (total hip arthroplasty [THA] aHR 1.3, total knee arthroplasty [TKA] aHR 1.4) [14]. Mayo Clinic data showed revision hazard ratio (HR) 1.78 and deep infection HR 2.37 for current smokers [24]. Meta-analyses confirmed higher total complications, medical complications, and mortality [25], and surgical site wound problems (odds ratio [OR] 1.53–1.59) [26]. Functional recovery is also impaired: nonsmokers had better Knee injury and Osteoarthritis Outcome Score for Joint Replacement (KOOS-JR) scores after TKA [11]; current smokers had lower American Shoulder and Elbow Surgeons (ASES), Simple Shoulder Test (SST), Shoulder Pain and Disability Index (SPADI), and Constant scores after shoulder arthroplasty, with former smokers (quit ~21 years prior) still showing inferior results [13,20]. A systematic review of 338,117 shoulder cases confirmed worse patient-reported outcome measures (PROMs) and higher reoperation rates [27]. Infection risk is elevated: current smokers had more wound issues (OR 1.59 vs. non-smokers, 1.42 vs. former

smokers) [26]; smokers had higher revision-for-infection risk after TKA (aHR 1.3) [14], greater deep surgical site infection (SSI) (1.1% vs. 0.2%) [28], and early infection after THA (OR 1.31) [23]. One study found no significant periprosthetic joint infection (PJI) association but higher wound complications (1.9% vs. 0.7%) [15]. A meta-analysis of 406,553 TKA patients showed higher surface and deep SSI in smokers [29].

Other complications: smoking increased 30-day readmission (OR 2.30) [16], with smokers having 4.8% vs. 3.2% readmission [28]; outpatient shoulder arthroplasty smokers had elevated myocardial infarction (MI) (OR 9.80), deep vein thrombosis (DVT) (OR 20.05), and readmission (OR 2.82) [18]; and preoperative smoking raised postoperative delirium risk after TKA (OR 4.02) [17]. Encouragingly, cessation is achievable: 62% quit when required, with failures having higher wound complications (27% vs. 5%) [19]; 43% remained abstinent at ~3 years, with better Patient-Reported Outcomes Measurement Information System 10 (PROMIS-10) and Hip disability and Osteoarthritis Outcome Score for Joint Replacement (HOOS.JR) scores [21]; self-reported quitters had lower infection rates (3.7% vs. 12.5%) [30]. Former smokers had no significant difference in wound issues versus never smokers (OR 1.11) [26], suggesting reversibility. In revision arthroplasty, smokers had higher in-hospital complications (OR 2.40) [12], and smoking was linked to higher revision risk after revision TKA [31]. Passive smoking in female non-smokers was associated with worse pain, range of motion (ROM), higher infection (8.51% vs. 0.88%), and lower quality of life [22]. Dose-response evidence is mixed [16,23,26]. These findings align with orthopaedic literature outside arthroplasty (e.g., fracture non-union, rotator cuff repair) [32,33], with potentially greater impact in arthroplasty due to prosthetic biofilm risk; mechanisms include impaired oxygenation, reduced collagen synthesis, and altered inflammation [34]. Limitations: Heterogeneity in smoking definitions, follow-up, and outcomes; retrospective designs; incomplete demographic reporting; possible publication bias; limited generalisability beyond Western populations; only one study each on passive smoking and revision arthroplasty; and one poor-quality study [19].

Conclusion

Smoking negatively affects arthroplasty outcomes across multiple domains. Preoperative cessation is achievable, reduces complications, and improves function, with effects potentially reversible. Passive smoking is an underappreciated risk factor. We recommend integrating cessation into preoperative optimisation. Future research should standardise definitions, determine optimal cessation duration, evaluate cost-effectiveness, and conduct prospective studies on passive smoking and revision arthroplasty.

Conflict of Interest

None

Funding

None

References

1. Steinmetz JD, Culbreth GT, Haile LM, Rafferty Q, Lo J, Fukutaki KG, *et al.* Global, regional, and national burden of osteoarthritis, 1990–2020 and projections to 2050: A systematic analysis for the Global Burden of Disease Study 2021. Lancet Rheumatol. 2023; 5(9):e508-22.
2. Quicke JG, Conaghan PG, Corp N, Peat G. Osteoarthritis year in review 2021: epidemiology & therapy. Osteoarthritis Cartilage. 2022; 30(2):196-206.
3. Singh JA, Yu S, Chen L, Cleveland JD. Rates of total joint replacement in the United States: Future projections to 2020–2040 using the national inpatient sample. J Rheumatol. 2019; 46(9):1134-40.
4. Schwartz AM, Farley KX, Guild GN, Bradbury TL Jr. Projections and epidemiology of revision hip and knee arthroplasty in the United States to 2030. J Arthroplasty. 2020; 35(6):S79-85.
5. World Health Organization. WHO report on the global tobacco epidemic, 2023: Protect people from tobacco smoke. Geneva: World Health Organization; 2023.
6. Lassig AA, Bechtold JE, Lindgren BR, Pisansky A, Itabiyi A, Yueh B, *et al.* Tobacco exposure and wound healing in head and neck surgical wounds. Laryngoscope. 2018; 128(3):618-25.
7. Singh JA. Smoking and outcomes after knee and hip arthroplasty: A systematic review. J Rheumatol. 2011; 38(9):1824-34.
8. Bedard NA, DeMik DE, Owens JM, Glass NA, DeBerg J, Callaghan JJ. Tobacco use and risk of wound complications and periprosthetic joint infection: Asystematic review and meta-analysis of primary total joint arthroplasty procedures. J Arthroplasty. 2019; 34(2):385-96.
9. Farley KX, Schwartz AM, Boden S, Daly CA, Gottschalk MB, Wagner ER. The effect of tobacco smoking on short-term outcomes in the shoulder arthroplasty patient. JSES Open Access. 2019; 3(4):243-4.
10. Alhabdan S, Alashjaai A, Adebisi YA. Preoperative smoking cessation interventions and their effects on smoking abstinence and

postoperative outcomes: A systematic review and meta-analysis. Updates Surg. 2025; 15:1-5.
11. Couture A, Derefinko KJ, Ford MC, Crockarell JR, Guyton JL, Harkess JW, *et al.* Smoking cessation and relapse effects on patient-reported outcomes after total knee arthroplasty. J Long Term Eff Med Implants. 2025;35(3).
12. Tirumala V, Bounajem G, Klemt C, Barghi A, Kwon YM. Impact of smoking and drinking on complications after revision total joint arthroplasty: A matched cohort analysis. J Am Acad Orthop Surg. 2021; 29(15):e769-81.
13. Amador IE, Hao KA, Buchanan TR, Damrow DS, Hones KM, Simcox T, *et al.* The effect of smoking on functional outcomes and implant survival of anatomical total shoulder arthroplasty. Bone Joint J. 2024; 106(11):1263-72.
14. Bongers J, Maartje BE, Spekenbrink-Spooren A, Smulders K, Schreurs BW, Koeter S. Smoking is associated with higher short-term risk of revision and mortality following primary hip or knee arthroplasty: A cohort study of 272,640 patients from the Dutch Arthroplasty Registry. Acta Orthop. 2024; 95:114.
15. Gonzalez-Parreño S, Miralles-Muñoz FA, Martinez-Mendez D, Perez-Aznar A, Gonzalez-Navarro B, Lizaur-Utrilla A, *et al.* Smoking is not closely related to revision for periprosthetic joint infection after primary total knee and hip arthroplasty. Orthop Traumatol Surg Res. 2024; 110(5):103876.
16. Heckmann ND, Katebian B, Chung BC, Lieberman JR. Smoking as a risk factor for complications following total joint arthroplasty. Orthopedics. 2021 ;44(5):e639-44.
17. Chen JR, Chen JQ, Hu JC, Huang RS, Shen L, Gu H, *et al.* Cigarette smoking is linked to an increased risk of delirium following arthroplasty in patients suffering from osteoarthritic pain. CNS Neurosci Ther. 2023; 29(12):3854-62.
18. Ling K, Smolev E, Tantone RP, Komatsu DE, Wang ED. Smoking is an independent risk factor for complications in outpatient total shoulder arthroplasty. JSES Int. 2023; 7(6):2461-6.
19. Koschmeder KT, Carender CN, Noiseux NO, Elkins JM, Brown TS, Bedard NA. What is the fate of total joint arthroplasty patients who are asked to quit smoking prior to surgery? Arthroplast Today. 2023; 19:101087.
20. Damrow DS, Buchanan TR, Hao KA, Amador IE, Hones KM, Simcox T, *et al.* The effect of smoking on outcomes of reverse total shoulder arthroplasty. J Shoulder Elbow Surg. 2025; 34(4):987-96.
21. Kim BI, O'Donnell J, Wixted CM, Seyler TM, Jiranek WA, Bolognesi MP, *et al.* Smoking cessation prior to elective total joint arthroplasty results in sustained abstinence postoperatively. World J Orthop. 2024; 15(7):627.
22. An X, Wang J, Shi W, Ma R, Li Z, Lei M, *et al.* The effect of passive smoking on early clinical outcomes after total knee arthroplasty among female patients. Risk Manag Healthc Policy. 2021; 14:2407-19.
23. Tanaka H, Tarasawa K, Mori Y, Fukuchi H, Fushimi K, Aizawa T, *et al* Smoking increases the risk of early postoperative infection after elective total hip arthroplasty: Evidence from a Nationwide Japanese database. Int Orthop. 2026; 11:1-9.
24. Singh JA, Schleck C, Harmsen WS, Jacob AK, Warner DO, Lewallen DG. Current tobacco use is associated with higher rates of implant revision and deep infection after total hip or knee arthroplasty: A prospective cohort study. BMC Med. 2015; 13(1):283.
25. Yue C, Cui G, Ma M, Tang Y, Li H, Liu Y, *et al.* Associations between smoking and clinical outcomes after total hip and knee arthroplasty: A systematic review and meta-analysis. Front Surg. 2022; 9:970537.
26. Zhu J, Si M, Huang Z. Effect of tobacco usage on surgical site wound problems after primary total hip and total knee arthroplasty: A meta-analysis. Int Wound J. 2024; 21(1):e14375.
27. Bryan MR, White AE, King AH, Healy RJ, Brusalis CM, Taylor SA. Primary shoulder arthroplasty in tobacco users: A systematic review of patient-reported outcomes and complications in 338,117 cases. Semin Arthroplasty. 2024; 34(2):514-23.
28. Sahota S, Lovecchio F, Harold RE, Beal MD, Manning DW. The effect of smoking on thirty-day postoperative complications after total joint arthroplasty: A propensity score-matched analysis. J Arthroplasty. 2018; 33(1):30-5.
29. Simmons HL, Grits D, Orr M, Murray T, Klika AK, Piuzzi NS. Trends in the prevalence and postoperative surgical complications for smokers who underwent a total knee arthroplasty from 2011 to 2019: An analysis of 406,553 patients. J Knee Surg. 2023; 36(9):957-64.
30. Herrero C, Tang A, Wasterlain A, Sherman S, Bosco J, Lajam C, *et al.* Smoking cessation correlates with a decrease in infection rates following total joint arthroplasty. J Orthop. 2020; 21:390-4.
31. Bedard NA, Dowdle SB, Owens JM, Duchman KR, Gao Y, Callaghan JJ. What is the impact of smoking on revision total hip arthroplasty? J Arthroplasty. 2018; 33(7):S182-5.

32. Scolaro JA, Schenker ML, Yannascoli S, Baldwin K, Mehta S, Ahn J. Cigarette smoking increases complications following fracture: A systematic review. J Bone Joint Surg Am. 2014; 96(8):674-81.
33. Mall NA, Tanaka MJ, Choi LS, Paletta GA Jr. Factors affecting rotator cuff healing. J Bone Joint Surg Am. 2014; 96(9):778-88.
34. Sørensen LT. Wound healing and infection in surgery: The pathophysiological impact of smoking, smoking cessation, and nicotine replacement therapy: A systematic review. Ann Surg. 2012; 255(6):1069-79.