General

Impact of Obesity on Postoperative Complications After Total Hip Arthroplasty: A Systematic Review and Meta-Analysis

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Background

Total hip arthroplasty (THA) is an effective treatment for degenerative hip disease. However Obesity may increase preoperative risk and postoperative complications this study aimed to evaluate association between preoperative obesity and post operative complication following THA.

Questions/Purposes

This study aimed to determine whether preoperative obesity is associated with postoperative complication after THA and whether complication rates vary according to BMI category.

Methods

A systematic review and meta-analysis were conducted according to PRISMA guidelines. PubMed/MEDLINE, the Cochrane Library and Google Scholar were searched for study published between 2015 and 2025 adult patient undergoing primary THA were included. Study quality was assessed using the Newcastle-Ottawa Scale, and pooled odds ratios (OR) were collected using a random-effect model.
Thirteen studies with sample size ranging from 39 to 131,576 THA patient were included.

Results

Obese patient had higher rates of post-operative complication compared with non-obese patient. Meta-analysis showed increased risk of infection (OR 0.39), dislocation (OR 0.63), and revision surgery (OR 0.60). No significant difference was observed in postoperative mortality (OR 0.58) or thromboembolic events (OR 0.69).

Conclusion

Obesity is associated with increased risk of several postoperative complication following THA, particularly infection, dislocation, and revision surgery. However, mortality and thromboembolic event do not appear to be significantly affected.

1. INTRODUCTION

1.1. LONG-TERM OUTCOMES AND INCREASING DEMAND FOR THA

Total hip arthroplasty (THA) has demonstrated outstanding long-term survivorship and therapeutic benefit.[1]

Projections indicate that the annual demand for THA in the United States will exceed 500,000 procedures by the year 2030, with revision arthroplasty rates anticipated to surpass 95,000 cases per annum.[2] Although major and minor complications after primary THA are relatively rare, such events may be catastrophic and result in substantial morbidity. Revision hip arthroplasty is associated with increased mortality and a higher incidence of surgical and medical complications compared to primary procedures.[3] Furthermore, the prevalence of obesity has escalated significantly, particularly in developed nations.[4]

1.2. TRENDS IN OBESITY AND IMPLICATIONS FOR THA

The proportion of patients presenting with a body mass index (BMI) ⩾ 40 kg/m^2 has increased by 50% per year, indicating rapid growth within the most obese subgroups.[5,6] Presently, it is estimated that 40.3% of Americans are classified as obese.[7] Obesity is positively correlated with elevated risk of osteoarthritis and increased utilization of total joint replacement procedures.[8]

A substantial body of literature has identified higher rates of serious complications, component malposition, prolonged operative times, postoperative infections, inferior component survival, and diminished clinical outcome scores among patients with elevated BMI undergoing THA.[9,10] Additionally, obese individuals experience increased frequency of revision surgeries and perioperative complications following total joint arthroplasty.[11,12]

1.3. COMPLICATION PROFILE AND LIMITATIONS IN PRIOR REVIEWS

Several systematic reviews have shown that obesity is associated with a heightened risk of postoperative complications after THA. Ponnusamy et al. reported that patients categorized as severely, morbidly, and super-obese faced substantially increased risks of all-cause and septic revision, even as their functional outcomes were comparable to those of non-obese patients.[13] Onggo et al., in a meta-analysis including more than two million individuals, observed higher incidences of postoperative infection, dislocation, revision, and hospital readmission among obese and morbidly obese cohorts.[14] Liu et al. noted more severe overall complications, increased risk of dislocation, reduced functional scores, and extended operative times among obese individuals.[15] Furthermore, Bialaszewski et al. underscored elevated risks of venous thromboembolism and earlier need for THA in this population.[16]

Nevertheless, these reviews are subject to several methodological limitations. Many failed to uniformly stratify patients by BMI, often grouping disparate obesity typologies. Direct comparison between narrative and quantitative findings was infrequent, revision-specific analyses were sometimes omitted, and the inclusion of contemporary data was lacking, thereby limiting the representativeness of recent clinical practice.

1.4. OBJECTIVES OF THE PRESENT STUDY

To address existing gaps, this study endeavors to provide a modern, comprehensive, and well-delineated synthesis of postoperative complication rates following THA. This will be achieved by incorporating both narrative interpretation and meta-analytical methodologies to elucidate the impact of obesity on THA outcomes.

1.4.1. *INFECTION RATE*

In total hip arthroplasty, patients with BMI >30 had a significantly higher risk of postoperative infection than those with BMI <30. Across seven studies, the random-effects meta-analysis showed an OR of 0.39 (95% CI 0.26–0.58), indicating 61% lower odds of infection in patients with BMI <30. Despite high heterogeneity (I^2 = 98%) from differences in infection definitions and populations, the effect direction was consistent across studies (Figure 2).

1.4.2. *DISLOCATION*

In total hip arthroplasty, patients with BMI <30 had significantly lower odds of postoperative dislocation than those with BMI >30. The random-effects meta-analysis showed a 37% reduction in dislocation risk (OR 0.63, 95% CI 0.52–0.76, P < 0.00001). Despite moderate heterogeneity (I^2 = 59%), the effect consistently favored the non-obese group, indicating that obesity substantially increases dislocation risk (Supplementary Figure 3).

1.4.3. *THROMBOEMBOLIC EVENTS*

In the pooled analysis of thromboembolic events after total hip arthroplasty, no significant difference was observed between patients with BMI <30 and >30 (OR 0.69, 95% CI 0.41–1.16; P = 0.16). Across six studies, substantial heterogeneity was present (I^2 = 97%), likely due to differences in study size, populations, and thromboprophylaxis, with inconsistent effect directions with some studies showing a slight protective effect and others showing a modestly increased risk in obese patients. (Supplementary Figure 4).

1.4.4. *POSTOPERATIVE MORTALITY*

In the pooled analysis of five large cohort studies, obesity did not demonstrate a significant association with postoperative mortality following total hip arthroplasty. The combined odds ratio comparing patients with BMI >30 kg/m² to those with BMI <30 kg/m² was 0.58 (95% CI: 0.08–4.11; p = 0.59), indicating no statistically meaningful difference in mortality risk between obese and nonobese groups. While individual studies showed wide variability in effect estimates, the extremely high heterogeneity (I^2 = 100%) reflects substantial differences in study population size, event rates, and methodology (Supplementary Figure 5).

1.4.5. *REVISION*

In total hip arthroplasty, patients with BMI <30 had a significantly lower risk of revision than those with BMI >30. Across all studies, individual ORs favored the non-obese group, and the random-effects meta-analysis showed an OR of 0.60 (95% CI 0.56–0.64), indicating a 40% lower revision risk. Heterogeneity was low (I^2 = 41%), suggesting a stable effect across studies (Figure 3).

1.5. NARRATIVE SYNTHESIS

1.5.1. *TRENDS IN THE ASSOCIATION BETWEEN OBESITY AND POSTOPERATIVE THA OUTCOMES*

Across the included studies, obesity consistently emerged as a significant predictor of postoperative complications following total hip arthroplasty (THA). Multiple large database analyses demonstrated a clear dose–response relationship, with complication rates escalating progressively with higher BMI categories.[2,17] The strength of this association intensified particularly among morbidly obese (⩾40 kg/m^2) and super-obese (⩾50 kg/m^2) patients, who showed markedly elevated risks of wound complications, prosthetic joint infection (PJI), revision, and readmission.[18-20]

1.5.2. SURGICAL AND WOUND COMPLICATIONS

A clear pattern emerged showing that surgical complications increased with rising BMI. Matar et al. found significantly higher rates of major surgical complications (3.6% vs 1.5%) and deep infection (2.8% vs 0.7%) among morbidly obese patients, with hazard ratios exceeding 2.5 for infection and revision.[18] In large NSQIP datasets, obese and morbidly obese groups had markedly higher wound complication rates, demonstrating a graded increase from non-obese to obese to morbidly obese categories.[21] Fu et al. similarly showed that wound complications rose from 0.8% in non-obese patients to 3.2% in obese class III.[22]

Studies focusing on extreme obesity showed disproportionate increases in early complications. Luger et al. reported extraordinarily high odds of periprosthetic joint infection (OR 21.7 for BMI ⩾35 and OR 57.7 for BMI ⩾40), identifying BMI ⩾35 as a threshold for substantially higher surgical risk.[23] Werner et al. also confirmed that super-obese patients (BMI >50) had significantly higher risks of infection, transfusion, and medical complications compared to all lower BMI groups.[19]

1.5.3. RISK OF REVISION SURGERY

Most studies consistently found higher revision rates in obese patients. Matar et al. reported a 2.6-fold increased risk of revision in morbid obesity.[18] Jeschke et al. demonstrated a dose–response pattern: patients with BMI ⩾40 had a more than twofold increase in 1-year revision risk compared with BMI <30.[17] Luger et al. noted particularly high early revision odds at BMI ⩾35 and ⩾40 (OR 8.8 and 20.7, respectively).[23] Long-term functional studies further support this trend. Issa et al. found that super-obese patients (BMI ⩾50) had lower implant survivorship (89.6% vs 97.8%) and increased need for revision.[20]

1.5.4. INFECTIOUS COMPLICATIONS AND PERIPROSTHETIC JOINT INFECTION (PJI)

Obesity was a strong and consistent risk factor for PJI. Luger et al. reported some of the highest PJI odds in the literature, with risk increasing over 20-fold at BMI ⩾35 and more than 50-fold at BMI ⩾40.[23] Jeschke et al. also showed a progressive increase in early surgical infections across BMI categories, with the highest risk observed in patients with BMI ⩾40.[17] DeMik et al. and Fu et al. reinforced this pattern, demonstrating increasing deep infection rates across obesity categories in large national datasets.[21,22]

1.5.5. MEDICAL COMPLICATIONS AND READMISSIONS

Higher BMI was associated not only with surgical problems but also with increased medical complications and hospital readmissions. Super-obese patients had significantly higher rates of venous thromboembolism, medical complications, and readmissions compared to non-obese and obese counterparts.[19] Hanly et al. found markedly higher 30-day readmission rates in morbidly obese patients (12.8% vs 2.7%) and greater inpatient bed-days.[24]

Scully et al. identified a J-shaped relationship between BMI and complications such as reoperation, infection, and sepsis, with risk rising at both low and high extremes of BMI. Mortality also displayed a reverse J-shaped association, lowest among overweight patients and higher in both underweight and morbidly obese individuals.[25]

1.5.6. THRESHOLD EFFECTS AND NONLINEAR ASSOCIATIONS

Several studies identified critical BMI thresholds beyond which complications increased sharply. Adhikary et al. showed that complication rates rose exponentially in THA patients with BMI ⩾45, indicating a nonlinear effect rather than a gradual progression.[26] Luger et al. similarly proposed BMI ⩾35 as a practical cutoff for predicting markedly elevated risks.[23] J-shaped association in which complication risk was lowest at BMI ~28 and increased at both low and high extremes.[25] Gurunathan et al. uniquely found a U-shaped pattern, with overweight and moderate obesity associated with lower odds of perioperative complications, but BMI ⩾40 significantly increasing infectious risk and operative time.[27] This nuance suggests that mild-to-moderate obesity may not always worsen outcomes, but severe obesity consistently does.

2. METHODOLOGY

2.1. STUDY DESIGN

This systematic review and meta-analysis evaluated the impact of preoperative obesity on postoperative complications following total hip arthroplasty (THA). The study adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure methodological transparency and reproducibility.

2.2. SEARCH STRATEGY

A comprehensive literature search was conducted across PubMed/MEDLINE, the Cochrane Library, and Google Scholar for studies published between 2015 and 2025. Search terms included "obesity," "BMI," "total hip arthroplasty (THA)," and "postoperative complications," combined using Boolean operators to maximize sensitivity. The main search string was: (obesity OR obese OR body mass index OR BMI) AND (total hip arthroplasty OR hip replacement OR hip prosthesis) AND (postoperative complication OR infection OR revision OR dislocation OR thromboembolism OR wound complication OR mortality). For Google

Scholar, the first 400 results were screened using these terms, followed by title, abstract, and full-text filtering where available. Reference lists of included articles and relevant reviews were manually checked to identify additional eligible studies. Multi-database searches and manual cross-checks are essential to minimize publication bias and ensure exhaustive coverage and are recommended for future systematic reviews in this field.

2.3. ELIGIBILITY CRITERIA

Eligible studies included adult patients undergoing primary THA with postoperative complications reported by BMI or obesity status. Appropriate study designs were cohort studies, case-control studies, and registry analyses. Exclusion criteria comprised case reports, editorials, conference abstracts, and studies lacking relevant outcome data.

2.4. STUDY SELECTION

All identified records were imported into a reference management system, and duplicates were removed. Study selection followed a two-step process: first, two reviewers independently screened titles and abstracts to exclude irrelevant studies; second, full texts of potentially eligible articles were reviewed using predefined inclusion and exclusion criteria. Discrepancies were resolved by consensus or consultation with a third reviewer. Independent screening by multiple reviewers enhances objectivity and reduces the risk of selection bias.

2.5. DATA EXTRACTION

A standardized data extraction form was used. Two reviewers independently collected information on: study characteristics (author, year, country, design, sample size); patient demographics (age, gender, BMI); BMI details (means, groupings, thresholds); surgical factors (approach, prosthesis type); and comorbidities (e.g., diabetes, hypertension, cardiovascular disease). Outcomes extracted included wound complications, superficial/deep infections, dislocations, thromboembolic events (DVT/PE), reoperation/revision, mortality, and other medical/surgical complications. Effect measures (adjusted/unadjusted OR, RR, HR with 95% CIs) and follow-up duration were recorded. For studies with multiple BMI thresholds, data were collected separately for standard obesity (BMI ⩾30 kg/m^2) and severe/morbid obesity (BMI ⩾35 or ⩾40 kg/m^2).

2.6. QUALITY ASSESSMENT

The methodological quality of included studies was assessed using the Newcastle–Ottawa Scale (NOS) for cohort studies. The NOS evaluates three domains: selection of study groups, comparability of groups, and ascertainment of outcomes, including adequacy of follow-up. Studies scoring 7 or higher were deemed high quality, 5–6 moderate quality, and 4 or lower low quality. The choice of the NOS is justified by its widespread acceptance and its structured approach to evaluating observational studies. Two reviewers independently performed quality assessments to ensure rigor and reduce subjective bias.

2.7. DATA SYNTHESIS AND STATISTICAL ANALYSIS

Quantitative findings were synthesized using meta-analytic techniques designed to accommodate clinical and methodological heterogeneity. Effect sizes were calculated as odds ratios (ORs) with 95% confidence intervals (CIs). A random-effects model was selected for meta-analysis due to anticipated variability in study designs, BMI classifications, outcome definitions, and follow-up durations. The random-effects model provides more conservative and generalizable estimates when heterogeneity is present. Heterogeneity was quantified using the I^2 statistic, and potential sources of substantial heterogeneity (I^2 >75%) were explored, such as differences in population characteristics, BMI cut-offs, and outcome definitions.

3. RESULTS

The sequence of study selection is presented in the PRISMA flow diagram (Supplementary Figure 1).

We initially identified 2,725 records from PubMed (n=2,128), Google Scholar (n=400), and the Cochrane Library (n=197). After removing 541 duplicates, 2,184 studies remained for screening by title and abstract. Of these, 2,021 were excluded based on relevance. The remaining 163 articles underwent full-text assessment, resulting in 150 exclusions according to our criteria. Ultimately, 13 studies met all inclusion criteria and were included in the qualitative and quantitative synthesis. The exclusion criteria included studies lacking original data, those not addressing the research question, and articles with insufficient methodological quality.

STUDY CHARACTERISTICS

Thirteen primarily retrospective cohort studies were reviewed, with sample sizes ranging from 180 to 131,576 total hip arthroplasties. Most involved adults undergoing primary hip replacement for osteoarthritis; some compared hip to knee procedures. Obesity classifications varied (BMI ⩾30, ⩾40, ⩾50 kg/m^2). Follow-up ranged from 30 days to several years. Data included demographics, BMI, comorbidities, surgical approaches, prosthesis types, and postoperative outcomes. Table 1 and Supplementary Table 2.

QUALITY ASSESSMENT

Most studies used retrospective designs or national databases. Seven were high-quality, showing strong selection and outcome assessment, three were moderate-to-high, and three moderate-quality had some comparability or assessment limitations. Refer to Supplementary Table 2 for full details.

META-ANALYSIS

TOTAL COMPLICATIONS IN PATIENTS WITH BMI < VS. BMI 30–40

Patients with BMI 30–40 undergoing hip arthroplasty faced a higher postoperative complication risk than those with BMI <30 (OR 0.67, 95% CI 0.52–0.87). Despite notable heterogeneity (I^2 = 99%), the direction of effect was consistent across eight studies (Figure 1).

TOTAL COMPLICATIONS OF PATIENTS WITH BMI < VERSUS BMI >40

Patients with BMI >40 had significantly higher postoperative complication rates after total hip arthroplasty compared to those with BMI <30. Meta-analysis across eight studies found an OR of 0.39 (95% CI 0.27–0.57), indicating a 61% lower risk in patients with BMI <30 compared to those with BMI >40. Despite high heterogeneity (I^2 = 99%), the direction of effect was consistent across studies (Figure 1).

4. DISCUSSION

This review highlights the significant and progressive impact of obesity on total hip arthroplasty (THA), revealing a dose-dependent increase in risk associated with higher body mass index (BMI). While THA remains an effective procedure across all BMI categories, patients classified as obese, particularly those with a BMI of 40 or greater, face higher perioperative and postoperative morbidity. Specifically, the risk of major surgical complications, infections, revisions, and readmissions is markedly elevated in morbidly and super-obese patients, with hazard ratios ranging from 2.4 to 7.7 across various cohorts.[18-20] These findings are consistent with earlier systematic reviews and meta-analyses.

For instance, Onggo et al. analyzed 67 studies involving over 2 million patients and found that obese and morbidly obese individuals exhibited significantly higher rates of major complications, infections, dislocations, reoperations, revisions, and readmissions.[2] Similarly, Liu et al. pooled data from 15 prospective cohort studies, revealing the negative impact of obesity on overall complications, dislocation rates, functional outcomes, and operative times, although both obese and non-obese groups had comparable lengths of hospital stay.[15] Kuroda et al. further demonstrated that obesity was linked to poorer patient-reported outcome scores, a higher likelihood of conversion to THA, and an increased risk of postoperative complications in hip arthroscopy patients, suggesting that the adverse effects of obesity extend across different types of hip surgeries.[28]

These previous reviews support the dose-response and threshold effects observed in our analysis. A key finding among the prospective studies included in this review is that obesity presents a stepwise, non-linear association with surgical risk rather than a simple binary relationship. Notably, complication rates begin to rise in individuals with a BMI of 30–35,[17,23,26] and this trend continues to worsen for those with a BMI of 40 or higher. This threshold effect illustrates that beyond a certain BMI, physiological reserves, soft tissue integrity, and immune function decline, adversely affecting surgical outcomes.

Significant increases in adverse events—such as venous thromboembolism, dislocation, infection, and early revision THA—are noted in both registry-based and single-center cohorts among patients with the highest BMI. While obesity correlates with an overall increase in risk, it is important to recognize that not all outcome domains are equally impacted. For instance, while surgical-site and mechanical complications are consistently prevalent in obese patients, outcomes like mortality and thromboembolic events appear to be comparable to those in non-obese cohorts. This discrepancy may be attributed to advancements in perioperative protocols, such as standardized thromboprophylaxis and enhanced recovery pathways, which help mitigate the systemic complications associated with obesity.

The modest relationship between BMI and mortality observed in most databases suggests that contemporary perioperative interventions are effective in addressing acute complications at the systemic level.[22,24,25] Moreover, the interplay between U- and J-shaped relationships in other analyses underscores the complexity of interpreting BMI in the context of surgical risk assessment. Some literature indicates that moderately high BMI may not be associated with increased risk,[25] and paradoxically, certain complications were found to occur less frequently in individuals with elevated BMI who followed similar trends.[22,27] However, these protective signals diminish as BMI rises, emphasizing the detrimental impact of obesity on soft-tissue management, immune sensitivity, surgical exposure, and implant biomechanics.[19,22,23]

Several limitations must be acknowledged in this review. Most included studies were retrospective, posing potential selection bias and limiting causal inferences. Additionally, significant variations in BMI classification, outcome definitions, follow-up durations, and surgical procedures were present. Differences in perioperative care and complication reporting may also have affected pooled estimates. Furthermore, the lack of direct assessment for publication bias through funnel plots, along with a limited number of publications per outcome and the exclusion of non-English articles from the past decade, may have restricted the inclusion of relevant studies and introduced language and temporal biases.

Future research should focus on conducting large, multicenter prospective studies with predefined BMI categories and standardized definitions for postoperative complications. Such studies could clarify the relationship between obesity and THA outcomes, ultimately guiding the perioperative optimization of obese and morbidly obese patients.

5. CONCLUSION

Obesity is associated with a significantly higher risk of postoperative complications following total hip arthroplasty, including increased rates of infection, dislocation, and revision surgery. While overall mortality and thromboembolic events do not appear significantly affected by BMI, patients with severe and morbid obesity experience greater surgical challenges, longer operative times, and lower functional outcomes. These findings highlight the importance of preoperative risk assessment, careful surgical planning, and targeted perioperative optimization for obese patients to improve outcomes and reduce complication rates after THA.

DECLARATION OF CONFLICTING INTERESTS

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

HUMAN/ANIMAL RIGHTS

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration.

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INFORMED CONSENT

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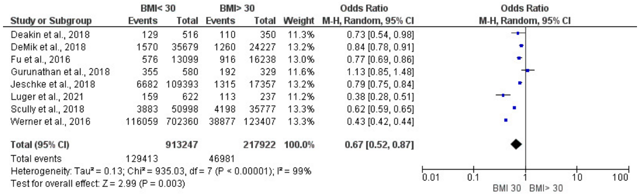
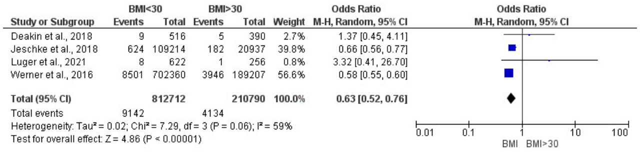
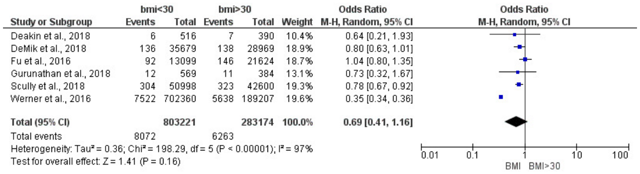
6. FIGURES AND TABLES



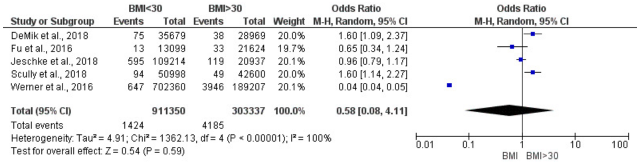
Supplementary Figure 1. Forest plot of total complications of patients with BMI <30 versus those with BMI>40.



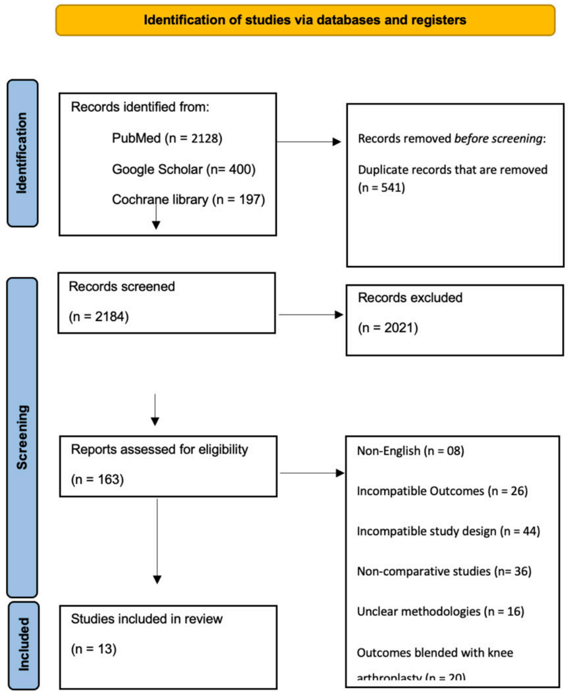
Supplementary Figure 2. Forest plot of dislocation between BMI<30 vs BMI>30.



Supplementary Figure 3. Forest plot of thromboembolic events between BMI<30 vs BMI>30.



Supplementary Figure 4. Forest plot of mortality rate between BMI<30 vs BMI>30.



Supplementary Figure 5. PRISMA flow diagram.

Supplementary Table 1. Characteristics and results of the studies included.

Author, Year	Study Design	Population (Type & Size)	BMI Categories	Follow-up Duration	Postoperative Complications (With Statistics)	Other Relevant Findings (With Statistics)	Association Between Obesity & Complications
Matar et al., 2020[18]	Population-based retrospective cohort; propensity-matched	3683 morbidly obese THA patients, matched with non-obese controls; Adults with primary THA for OA.	Morbid obesity: BMI ≥ 40 kg/m²	1 year	Obese patients had higher major surgical complications (3.6% vs 1.5%, HR 2.54), more deep infections requiring surgery (2.8% vs 0.7%, HR 3.85), and increased revision surgery rates (2.4% vs 0.9%, HR 2.61) compared with non-obese patients.	Operative time: Median 116 vs 102 min (longer in obese) No difference in: hospital stay, medical complications, acute care cost	Strong independent association of morbid obesity with major surgical complications, infection, and revision
DeMik et al., 2018[21]	Retrospective database study (NSQIP)	64,648 THA patients (comparative by BMI)	Non-obese vs obese vs morbidly obese (BMI categories per NSQIP definitions)	30 days	Obesity increased postoperative risks after THA, with higher wound complications (1.53% vs 0.96%), deep infection (0.31% vs 0.17%), reoperation (2.11% vs 1.02%), and overall complications (5.22% vs 4.63%), which were all further elevated in morbidly obese patients.	THA has higher obesity-related complication rates compared to TKA. Higher odds of each complication with increasing BMI (multivariate regression)	Clear graded increase in complications as BMI increases; stronger effect for THA than TKA
Luger et al., 2021[23]	Single-center retrospective cohort	878 THA procedures in 808 adult patients (MIS anterolateral short stem THA; OA patients, 2014–2019)	Stratified: BMI <35, BMI ≥35, BMI ≥40	90 days	Higher BMI greatly amplified risk: BMI ≥35 sharply increased general complications (OR 4.37), PJI (OR 21.69), and revision (OR 8.79), and these rose even further at BMI ≥40 (OR 4.99, 57.65, and 20.71).	Operative time: Significantly longer in BMI ≥35 & ≥40 (p < 0.001). MIS approach remains technically feasible even in obese patients	Very high risk of early PJI and revision in BMI ≥35; BMI ≥35 identified as a “threshold” for increased complications
Adhikary et al., 2016[26]	Retrospective NSQIP database study (2006–2013)	49,475 primary THA patients	Seven BMI groups: 18.5–24.9, 25–29.9, 30–34.9, 35–39.9, 40–44.9, 45–49.9, >50 kg/m²	30 days	Complication rates rose markedly at BMI ≥45 kg/m², with steep increases in overall and major complications as well as infectious events, demonstrating a clear exponential risk threshold.	Propensity matching confirmed exponential increase when BMI ≥45. Strong nonlinear (threshold) effect	Identified BMI ≥45 kg/m² as critical threshold where odds of complications increase dramatically in THA
Scully et al., 2018[25]	Retrospective NSQIP cohort	93,598 primary THA patients	Continuous BMI model + categorical groups (normal, overweight, obese, morbidly obese)	30 days	A J-shaped pattern was observed, with higher BMI associated with increased risks of readmission (p<0.001), reoperation (p=0.007), superficial infection (p=0.003), periprosthetic joint infection (p<0.001), and sepsis (p=0.026).	Mortality (p=0.007) & transfusion (p<0.001): reverse J-shaped (lowest in normal/overweight)	BMI as continuous variable: risk lowest around BMI ≈28, increases at low & high extremes (J-shaped)
Werner et al., 2016[19]	Retrospective cohort study using national insurance database	Super-obese THA patients: n = 3,244. Comparators: non-obese, obese, morbidly obese, and revision THA patients	Focus: Super-obese (BMI >50 kg/m²) vs. obese & non-obese BMI categories	Not reported	Super obese patients had the highest complications: VTE 5.8%, infection 12.4%, transfusion 37.2%, medical 28.6%, dislocation 3.3%, revision THA 8.8%, and 90-day readmission 18.7% (all significant).	None specifically outside complication rates	Super obesity was an *independent* risk factor for: VTE, infection, transfusion, readmission, dislocation, medical complications, and early revision THA
Jeschke et al., 2018[17]	Nationwide retrospective cohort using German insurance billing data	131,576 THAs in 124,368 patients (2012–2014)	BMI categories: <30 (reference), 30–34, 35–39, ≥40 kg/m²	• 90-day mortality • 90-day complications • 1-year revision rates	Complications increased with BMI (OR 1.1, 1.5, and 2.1 for BMI 30–34, 35–39, and ≥40). Surgical risks rose across all BMI groups, and mortality increased only in the BMI ≥40.	One-year revision risk rose with BMI: OR 1.2 for BMI 30–34, 1.6 for BMI 35–39, and 2.4 for BMI ≥40. Femoral fractures increased only in BMI ≥40.	Higher BMI resulted in a higher risk of overall complications, surgical complications, and revision rates. BMI ≥40 is especially high-risk.
Gurunathan et al., 2018[27]	Retrospective single-center study (tertiary hospital)	964 THA patients, Brisbane, Australia (2006–2010)	BMI categories: normal weight, overweight (25–29.9), obese class II (35–39.9), BMI ≥40	In-hospital postoperative period	Overweight and class II obese patients had lower perioperative risk (OR 0.62, CI 0.43–0.92; p=0.016 and OR 0.60, CI 0.36–0.99; p=0.047). Infectious complications increased in BMI ≥40 (OR 2.68, CI 1.08–6.65; p<0.05).	Cardiac complications: Lower odds in BMI ≤40 (p=0.02) Operating time: increases with rising BMI (p<0.001)	Shows a U-shaped effect: Mild-moderate obesity protective for some complications; severe obesity (≥40) increases infectious risk and operative time
Fu et al., 2016[22]	Retrospective cohort (NSQIP, propensity-adjusted)	Elective primary THA patients, 40,653 cases (postoperative outcomes N=33,400)	Non-obese (18.5–29.9), Obese I (30–34.9), Obese II (35–39.9), Obese III (≥40)	30-day postoperative outcomes	Higher BMI increased overall complications (4.4%→7.8%, p<.001), major complications (3.1% to 5.0%, p<.001), wound issues (0.8%to 3.2%, p<.001), septic events (p=.009), return-to-OR (1.6% to 3.4%, p<.001), and hospital stay (p=.002). Cardiopulmonary events, DVT/PE, and mortality were not significant.	Transfusion rates decreased with rising BMI (p<.001), while obesity was linked to higher comorbidities, including increased diabetes (7.5% to 25.8%, p<.001) and hypertension (52.6% to 75.6%, p<.001).	Obesity increased overall complications (OR 1.19–1.54), wound complications (OR 1.80–3.23, all p<.001), return to the OR (OR 1.59–1.80), and extended LOS (OR 1.22), while major and respiratory complications were not significant.
Issa et al., 2016[20]	Retrospective matched cohort	Super-obese primary THA: 48 hips in 45 patients; matched non-obese group: 135 patients	Super-obese ≥50 kg/m² vs <30 kg/m²	Mean 6 years (range 4–12)	Super-obese patients had significantly higher complications (OR 7.7, p=0.017) and an elevated revision risk (OR 4.5, p=0.06), with lower implant survivorship at 89.6% compared with 97.8% in matched controls.	Lower functional outcomes: HHS 82 vs 91 (p=0.002), SF-36 Physical 39 vs 49 (p=0.001), SF-36 Mental 46 vs 58 (p=0.001), UCLA activity 3.9 vs 6.2 (p=0.001); Super-obese patients needed more surgeons to find treatment	Super-obesity associated with higher complication rate, lower functional outcomes, increased revision risk
Alvi et al., 2015[29]	Retrospective cohort (ACS-NSQIP database)	Primary THA and TKA: 13,250 patients	Stratified into 5 BMI groups	30-day postoperative outcomes	Higher BMI was linked to increased overall (p<0.001), medical (p=0.005), and surgical complications (p<0.001), higher superficial and deep infections (p=0.019; p=0.040), more returns to the OR (p=0.016), and longer discharge time (p=0.003).	Stratified analysis adjusting for demographics and comorbidities; obesity independently increases LOS and complications	Elevated BMI significantly increases the risk of medical and surgical complications after arthroplasty
Deakin et al., 2018[30]	Retrospective audit	Primary THA: 906 patients; TKA: 1014 patients	Non-obese <30, Obese 30–40, Morbidly obese >40	Up to 2 years	THA: Postoperative problems increased with BMI: 25% non-obese, 31% obese, 38% morbidly obese.	OHS after THA declined by about 2 points with each higher BMI category.	Morbid obesity is associated with higher complication rates and lower functional scores
Hanly et al., 2016[24]	Retrospective cohort	39 morbidly obese vs 186 normal weight THA patients	Morbidly obese ≥40, Normal 18.5–<25	Short-term (30 days for complications/ readmission)	30-day readmission: 12.8% vs 2.7% (P=0.005); longer operative time and readmission bed-days	Operative time increased (122 vs 100 min, P=0.002); readmission bed-days were higher (1.64 vs 0.32, P=0.026)	Morbid obesity is associated with higher readmission and resource use

Supplementary Table 2. Quality assessment of studies by the Newcastle–Ottawa Scale.

Author, Year	Selection (0–4)	Comparability (0–2)	Outcome (0–3)	Total Score (0–9)	Quality Rating
Matar et al., 2020[18]	4	2	3	9	High
DeMik et al., 2018[21]	4	1	3	8	High
Luger et al., 2021[23]	3	1	3	7	Moderate–High
Adhikary et al., 2016[26]	4	1	3	8	High
Scully et al., 2018[25]	4	1	3	8	High
Werner et al., 2016[19]	4	1	2	7	Moderate–High
Jeschke et al., 2018[17]	4	2	3	9	High
Gurunathan et al., 2018[27]	3	1	2	6	Moderate
Fu et al., 2016[22]	4	2	3	9	High
Issa et al., 2016[20]	4	2	2	8	High
Alvi et al., 2015[29]	4	1	3	8	High
Deakin et al., 2018[30]	3	1	2	6	Moderate
Hanly et al., 2016[24]	3	1	2	6	Moderate