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Research Article

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The Role of Body Mass Index in Perioperative Complications Among Patients Undergoing Total Hip Arthroplasty

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ABSTRACT

Introduction: Osteoarthritis is a degenerative joint disease characterized by the breakdown of cartilage and underlying bone, often resulting in significant pain and disability, particularly in weight-bearing joints such as the hips, knees and spine. Obesity is a well-established risk factor for osteoarthritis, as it increases mechanical stress on the joints and contributes to systemic inflammation. While total hip arthroplasty (THA) is an effective treatment for end-stage osteoarthritis, the impact of body mass index (BMI) on perioperative and postoperative outcomes remains a topic of debate, with some studies suggesting increased complications in obese patients, with other studies reporting no significant difference. This variability highlights the need for more research in understanding this relationship. This paper aims to evaluate the effect of BMI on perioperative outcomes in THA.

Methods: A retrospective cohort study of the TriNetX US Collaborative Network, an electronic health record repository of United States healthcare organizations including over 117 million patients, was conducted. Current Procedural Terminology codes were used to identify a cohort of patients who received THA between January 1, 2020 and January 1, 2025. Patients were stratified into five BMI categories: underweight (< 18.5 kg/m^2), normal (18.5–24.9 kg/m^2), overweight (25–29.9 kg/m^2), Obesity Class I (30–34.9 kg/m^2), Obesity Class II (35 - 39.9 kg/m^2) and Obesity Class III (> 40 kg/m^2). Outcomes were compared between each BMI group to normal weight and post-operative outcomes and BMI were evaluated for clinical significance.

Cohorts underwent 1:1 propensity score matching based on sex, BMI, and medical comorbidities. Postoperative medical and surgical complications were assessed between 0-30 days. Differences between groups were assessed by Student's t-test. Odds ratios (OR) were calculated. Significance was defined as $p < 0.05$. Postoperative outcomes examined in this study included: acute myocardial infarction, acute kidney failure, pneumonia, acute embolism, anemia, sepsis, pulmonary embolism and cerebral infarction.

Results: During the study period 110,282 patients underwent a total hip arthroplasty. After 1:1 propensity score matching, patients with Class II to were less likely to develop acute kidney failure (5.2% vs 7.8%, OR 0.641, p= 0.000) and more likely to develop cerebral infarction (16.1% vs 59.26%, OR 3.089, p = 0.000) and anemia (10.6% vs 13.56%, OR 1.203, p= 0.003). For Class III obesity, there was a statistically significant difference in developing acute kidney failure (3.3% vs 5.6%, OR 0.436, p=0.025) and acute embolism (4.3% vs 9.8%, OR 0.645, p=0.037).

Discussion/Conclusion: Our study focuses on total hip arthroplasty in osteoarthritis and the relationship between a patient's BMI and postoperative outcome. Obesity is known to be associated with increased surgical risks; our study indicates a nuanced relationship between BMI and specific postoperative outcomes. We found higher BMI categories demonstrated a lower incidence of acute kidney failure but had a greater likelihood of anemia and cerebral infarction. Limitations of the study included the inability to perform a multivariate analysis with the data set. Further research is needed to develop preoperative management strategies and guidelines to reduce patient morbidity.

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Introduction

Osteoarthritis is a degenerative joint disease characterized by the breakdown of cartilage and underlying bone, often resulting in significant pain and disability, particularly in weight-bearing joints such as the hips, knees and spine. The prevalence of osteoarthritis has increased by 132.2% over the last 30 years and is projected to rise by 60-100% by 2050 [1]. Many studies have shown that women experience a more severe form than men, with increased pain and a greater impact on their quality of life.1 While osteoarthritis incidence continues to rise worldwide, the burden is seen more significantly in African Americans and Hispanics compared to non-Hispanic whites [2]. Conservative management includes exercise, weight loss, and NSAIDs. Additionally, intra-articular steroid injections are options that provide short-term pain relief in patients who have failed to benefit from conservative measures. For patients with significant structural damage and symptoms not relieved by conservative management, total hip replacement is utilized for end-stage osteoarthritis of the hip [3].

The complex pathogenesis of osteoarthritis involves both genetic and environmental components. This disease involves degeneration of not only articular cartilage, but also the synovium, subchondral bone, ligaments, and surrounding muscles. The pathogenesis of osteoarthritis is multifactorial including, history of joint trauma, female sex, and age greater than 40. Obesity remains as the leading modifiable risk factor.

Over the past several decades, obesity has been identified as a growing epidemic within the United States, affecting one-third of the adult population [4]. Obesity increases mechanical stresses on the joints and contributes to systemic inflammation. Obesity and other metabolic syndromes are associated with higher levels of pro-inflammatory cytokines and increased production of adipokines, proteolytic enzymes, and reactive oxygen species which ultimately contribute to increased inflammation of the joints [5]. The presence of these immune mediators may present challenges to patients undergoing THA, including increased risk of postoperative infection, dislocation, and need for revisions [6]

While total hip arthroplasty (THA) is an effective treatment for end-stage OA, the impact of body mass index (BMI) on perioperative and post-operative outcomes remains a topic of debate.

While total hip arthroplasty (THA) is an effective treatment for end-stage osteoarthritis, the impact of body mass index (BMI) on perioperative and post-operative outcomes remains a topic of debate. Although obese patients have reported significant improvements in pain, function, and activity levels following THA, literature has also shown THA in obese patients have more perioperative complication rates [7]. However, other studies report that revision rates and prosthetic joint infection rates in patients with BMI >40 kg/m^2) undergoing THA were not inferior to those classified as normal weight, overweight, or class I or II obesity (BMI <40 kg/m^2) [8]. This contrast highlights the need for more research to understand the relationship between BMI and THA outcomes.

In this study, we investigate the impact of BMI on THA outcomes and complications utilizing a national database with patient BMI data. Demographic characteristics and the baseline health status of patients were analyzed to observe the effect on patient perioperative outcomes. We hypothesize that as the prevalence of obesity rises, complication rates would increase in obese and morbidly obese patients in comparison to non-obese patients

Methods

We conducted a retrospective cohort study utilizing data from TriNetX US Collaborative Network, which aggregates electronic health records from United States healthcare organizations across 117 million patients. This dataset identified patients who underwent THA between January 1, 2020, and January 1, 2025, using Current Procedural Terminology (CPT) codes. This study analyzed BMI relationships with postoperative results by dividing patients into six BMI categories which included underweight (<18.5 kg/m²), normal weight (18.5–24.9 kg/m²), overweight (25–29.9 kg/m²), Obesity Class I (30–34.9 kg/m²), Obesity Class II (35–39.9 kg/m²), and Obesity Class III (>40 kg/m²). This research evaluated postoperative complications by comparing clinical results between different BMI groups to normal-weight patients.

The cohorts in each BMI category underwent 1:1 propensity score matching that included sex and BMI with prevalent medical comorbidities. The matching process generated equivalent groups in order to reduce selection bias when evaluating postoperative surgical complications during a 30-day period following THA. The analysis uses student t-tests to evaluate continuous variable differences between groups, and odds ratios (OR) were calculated with for the various outcome measures.

This study analyzed eight postoperative complications after THA including acute myocardial infarction, acute kidney failure, pneumonia, acute embolism, anemia, sepsis, pulmonary embolism, and cerebral infarction. The research investigates how different BMI levels impact surgical dangers after THA by dividing patients into BMI groups to evaluate multiple severe postoperative complications.

Results

A total of 110,282 individuals who underwent THA were identified during the study period. After applying 1:1 propensity score matching based on baseline characteristics, cohorts were well balanced and yielded a sample size of 74,987 (Figure 1). Postoperative outcomes within 30 days of the index procedure were analyzed. Of the patients that met the inclusion criteria for the study, 62.5% of patients were female and 37.5% of patients were male (Figure 2).

Amongst individuals classified as Obesity Class II (BMI 35 - 39.9 kg/m2), the incidence of acute kidney failure was significantly lower compared to normal weight individuals (5.2% vs 7.8%, OR 0.641, p=0.000). However, Obesity Class II individuals demonstrated a significantly higher likelihood of developing cerebral infarction (16.1% vs 59.26%, OR 3.089, p = 0.000) and anemia (10.6% vs 13.56%, OR 1.203, p= 0.003). In individuals classified as Obesity Class III (BMI > 40 kg/m2), the incidence of acute kidney failure (3.3% vs 5.6%, OR 0.436, p=0.025) and acute embolism (4.3% vs 9.8%, OR 0.645, p=0.037) was similarly lower compared to normal weight individuals. There were no statistically significant differences observed between groups regarding the incidence of acute myocardial infarction, pneumonia, sepsis, or pulmonary embolism.

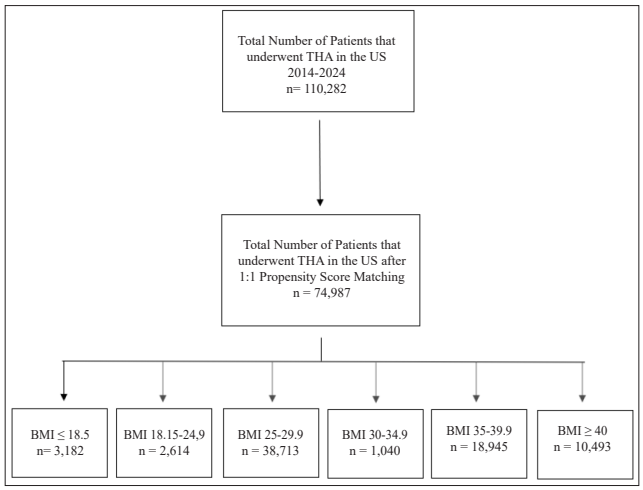

Figure 1: Patients who underwent THA between 2014-2024, separated by BMI class.

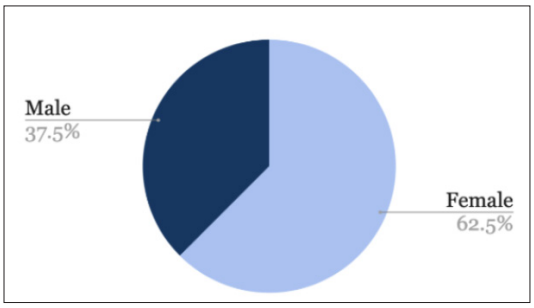

Figure 2: Gender Demographics in Patients undergoing THA in the United States 2014-2024

Table 1: Postoperative complications stratified into six BMI categories: underweight (<18.5 kg/m²), normal weight (18.5–24.9 kg/m²), overweight (25–29.9 kg/m²), Obesity Class I (30–34.9 kg/m²), Obesity Class II (35–39.9 kg/m²), and Obesity Class III (≥40 kg/m²).

Postoperative Complications	<18.5 (%)	p value	25-29.9 (%)	p value	30-34.9 (%)	p value	35-39.9 (%)	p value	≥ 40kg	p value
Pneumonia unspecified organism	2.0	.463	.6	.157	-	-	0.3	.127	0.6	.157
Acute kidney failure	3.6	.935	1.5	.896	1.9	.865	1.6	.798	1.5	.896
Acute embolism and thrombosis of deep veins of lower extremity	0.7	.413	0.7	.569	1.1	1	0.1	.330	0.7	.569
Acute myocardial infarction	0.8	.869	0.7	.087	1.1	1	0.4	.935	0.7	.087
Pulmonary embolism	0.6	.669	0.5	.816	1.1	1	0.5	0.342	0.7	.816
Cerebral infarction	1.1	.646	0.8	.458	1.1	1	0.4	.873	0.8	.458
Sepsis, unspecified organism	1.3	.130	0.3	.450	1.1	1	0.2	.686	0.3	.450
Other specified organisms	0.5	.002	0.0	.827	0.0	.002	0.1	1	0.0	.827
Other Anemias	-	-	-	-	7.4	.930	-	-	-	-

Discussion/Conclusion

Osteoarthritis remains one of the leading causes of disability worldwide, with THA serving as an effective surgical intervention for end-stage disease. Given the rising prevalence of obesity and the increasing demand for THA in an aging population, understanding the relationship between BMI and perioperative surgical risk is critical. Current literature identifies obesity as a risk factor for perioperative complications, largely due to its association with atherosclerosis, arterial stiffness, endothelial dysfunction, hypertension, peripheral artery disease, vascular inflammation, and venous thromboembolism [9-11]. However, our findings suggest a more nuanced relationship between BMI and specific postoperative outcomes..

In our retrospective cohort study, patients in higher BMI categories (Class II and Class III) exhibited a higher incidence of cerebral infarction and anemia but a lower incidence of acute kidney failure compared to those with normal BMI. This finding differs from previous studies that report that higher BMI is correlated to increased risk of acute kidney failure [12,13] Other studies report that risk of anemia may stem from chronic low-grade inflammation associated with obesity, which can contribute to anemia of chronic disease [14]. This study also demonstrated that there was no statistically significant difference between groups in the rates of acute myocardial infarction, pneumonia, sepsis, or pulmonary embolism.

Our study has several limitations. Although propensity score matching was employed to mitigate bias, we were unable to perform multivariate analysis. Because this was a retrospective cohort study, while we were able to report correlation between BMI and postoperative complications, we were unable to

determine causation with this study design. Further research is needed to elucidate the mechanisms underlying cerebral infarction, anemia, and acute kidney injury in relation to elevated BMI. Additionally, with the rise of the use of GLP-1 agonists in weight loss, it would be valuable to investigate the role of GLP-1 agonists in the THA outcomes.

These findings underscore the need for tailored preoperative optimization protocols, particularly focusing on cardiovascular evaluation and anemia management, to improve patient outcomes. While obesity remains a well-established surgical risk factor, its impact on postoperative outcomes after THA is yet to be fully elucidated.

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