

# Postoperative Complication Rates in the “Super-Obese” Hip and Knee Arthroplasty Population

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**Abstract:** The effect of obesity on the outcomes of total joint arthroplasties is an ongoing concern. As obesity becomes more endemic, new categories emerge, such as the “super-obese.” We conducted a retrospective study to determine the difference in outcomes among the super-obese. When categorized according to body mass index (BMI), the overall rate of complications was higher for patients with BMI of 45 or higher. Super-obese patients had an odds ratio (OR) of 8.44 for developing in-hospital complications. Most importantly, each incremental 5-U increase in BMI above 45 was associated with an increased risk of in-hospital (OR, 1.69) and outpatient complications (OR, 2.71), and readmission (OR, 2.0), compared with patients with BMI of 45 to 50. Length of stay was increased by 13.8% for each 5-U increase in BMI above 45. There is a significant increased risk for complications in the super-obese population, and this continues to increase with BMI increases above 45. These data are important when counseling super-obese patients and should be accounted for in reporting quality outcome measures in this population.

**Keywords:** total joint arthroplasty, postoperative complications, obesity, morbid obesity.  
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The obesity epidemic continues to increase [1-5]. A substantial population of patients who are candidates for hip and knee arthroplasties can be classified as morbidly obese. More recently, a new classification of “super-obese” has been discussed in the literature [6]. The term *super-obese* was first used in the literature in 1987 to describe a category of patients with body mass index (BMI) of 50 or higher [7,8]. Although these patients experience an improvement in quality of life, mobility, and pain resolution, their positive results are often compromised by postoperative complications [9-18].

In general, *super-obesity* refers to extremely overweight individuals with a body mass index (BMI) of 45 to 60. Patients with BMI of 60 or higher have been classified as super-super obese [19-21]. The ideal body weight in this

population is exceeded by 225%. According to the National Institutes of Health, increases in 20% or more above the ideal body weight are associated with weight-related health dangers. This includes an increased risk of dying of 5 to 10 times greater than individuals of normal weight [1].

Obesity as a risk factor for postoperative complications after total joint arthroplasty has been studied in the immediate and late postoperative period [9-18]. In addition, it is established that a higher BMI increases the relative risk for requiring a total hip and knee arthroplasty [22]. However, there are little data that further stratify the risks associated with total joint arthroplasty for patients within the super-obese category.

In this study, we were interested in evaluating the super-obese population and their outcomes in the 90-day postoperative period after total hip and knee arthroplasty. This information will assist physicians when counseling their patients regarding the risk of surgery according to their BMI level.

## Materials and Methods

### Study Design and Selection Criteria

This retrospective observational study was performed after institutional review board approval. Using the New York University Hospital for Joint Diseases Arthroplasty

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Registry, the authors reviewed the charts of all patients who had undergone primary total joint arthroplasty at a single institution between 1996 and 2004. All patients who underwent hip or knee arthroplasty and had a BMI of 45 or higher, in this 9-year period, were identified from patient records, and they were compared first with a group of patients whose BMI was normal,  $25 \leq \text{BMI} < 30$ , and underwent total joint arthroplasty during the same period. A scored comparison was done of only the patients with BMI of 45 or higher, looking at outcomes between each group within the super-obese cohort, when divided into 5-U increments of BMI compared with patients with BMI between 45 and 50, thus allowing us to quantify the association of increased BMI within the super-obese group and outcomes after total joint surgery.

Of 10 500 hip and knee arthroplasties done in our institution during this 9-year period, 137 patients with a BMI of 45 or higher were identified and included in this study. These 137 patients were matched with 63 patients with a  $25 \leq \text{BMI} < 30$ . Controls were chosen by a randomizing computer algorithm and were matched for year of surgery, age, and sex.

### Data Collection

All hip and knee arthroplasties were performed in one institution, using both cemented and noncemented implants. All patients were evaluated for complications during the hospital stay and for up to 1 year post surgery. Complications occurring during the hospital course included deep vein thrombosis, pulmonary embolism, unexpected return to the operating room, intraoperative complications, decompensation requiring intensive care unit transfer, urinary tract infection, and pneumonia. Postoperative complications included deep vein thrombosis, pulmonary embolism, fracture, myocardial infarction, surgical site infection, revision for any reason, and dislocation (Table 1). Operative data were collected, including tourniquet time, surgical time, and blood loss. Information regarding length of hospital stay, rehabilitation location, and readmission rates were collected for both cohorts. Demographic and patient data were collected for both cases and controls.

### Data Analysis

Associations between the patient's BMI and operative and hospital course, postoperative complications, and readmission rates were analyzed. To address the first item of interest, we conducted both preliminary 1-way analysis followed by multivariate logistic regression analysis to account for all covariates simultaneously. For the preliminary analysis, the differences in complication rates between categorical groups were determined using Fisher exact test. The Mantel-Haenszel test was used to conduct the Fisher exact test, blocking for a demographic variable. Continuous data were analyzed using the Mann-Whitney and the Kruskal-Wallis one-

**Table 1.** Complications in the Super-Obese Patient Group

	Complications While Hospitalized (n = 137)	Complications Within 1 y (n = 137)
Urinary tract infection	4 (2.92%)	
Continued drainage requiring return to the OR	2 (1.46%)	
Acute renal failure	2 (1.46%)	
Acute respiratory failure	2 (1.46%)	1 (0.73%)
Postoperative ileus	1 (0.73%)	
Metabolic alkalosis	1 (0.73%)	
Severe hypovolemia	1 (0.73%)	
Acute infection	1 (0.73%)	
Pulmonary embolism	1 (0.73%)	1 (0.73%)
Deep vein thrombosis	1 (0.73%)	3 (2.19%)
Anemia requiring intensive care unit transfer	1 (0.73%)	
Return to the OR for knee manipulation		4 (2.92%)
Wound dehiscence		2 (1.46%)
Hip dislocation		1 (0.73%)
Myocardial infarction		1 (0.73%)

way analysis of variance on ranks. Only the adjusted odds ratios from the full models are presented below.  $P < .05$  was chosen as an indicator of a high association between 2 covariates.

Statistical analysis was conducted using the software package R (version 2.8.1; Free Software Foundation Inc, Boston, Mass).

### Results

When separated by BMI, the proportion of complications during hospitalization was higher for patients with BMI of 45 or higher than for patients with BMI of 25 or lower ( $P = .0144$ ). No specific demographic or surgical procedure factors were found to be significant (Table 2). After controlling for patient characteristics, the odds ratio of complications was found to be higher for patients with BMI of 45 or higher ( $P = .02$ ) (Table 3). This is similar to the  $P$  value of the Fisher exact test without blocking, hence confirming the result that different patient characteristics are not significant.

Having high BMI (with all other covariates fixed) is associated with the increase in odds of having complications within 1 year by 1.61 (95% CI, 0.44-5.88). No significant association between BMI grouping and readmission counts was found ( $P = .13$ ). Patients undergoing bilateral surgery had significantly higher readmission rates than patients undergoing unilateral surgery ( $P = .04$ ).

After taking into account all available covariates, being in the high BMI group had the largest effect on the risk of developing complications after the surgery. Given all other variables fixed (ie, for patients with the same age, sex, surgery type, presence/absence of diabetes, and

**Table 2.** Characteristics of Patients With and Without Complications While Hospitalized

Variable	Complications While Hospitalized	No complications While Hospitalized	P
Age			.99
Median age (y)	61	62	
BMI			.01
≥45	17	120	
≤25	1	62	
Procedure			.20
Hip	4	74	
Knee	14	108	
Sex			.77
Male	3	43	
Female	15	139	
Diabetes			.51
Male	4	29	
Female	14	153	
Rehab			.67
Discharged home	3	48	
Inhospital rehabilitation	15	128	
Other rehabilitation center	0	6	
Bilateral/unilateral			.29
Bilateral	4	24	
Unilateral	14	158	

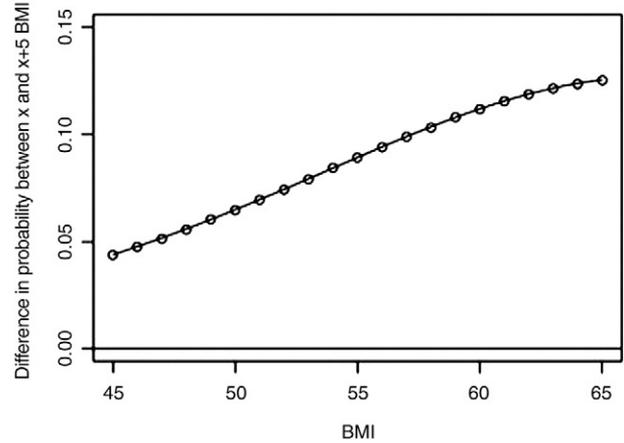
rehabilitation), having a BMI of 45 or higher is associated with an 8.44 times increase in odds of developing complications while hospitalized (95% CI, 0.97-73.5) (Table 3). The average predictive difference in the probability of having complications after surgery for high-BMI patients vs low-BMI patients is estimated to be 10.6%. When all covariates highly associated with the independent variable are excluded from the model (sex, surgery type, diabetes, rehabilitation), the effect of high BMI on the likelihood of complications becomes significant.

When we analyze a subset of patients, the super-obese cohort, with BMI ranging from 45 to 70, all outcomes showed statistically significant association with the BMI covariate. Our patient cohort breakdown was as follows: 88 patients, BMI 45-49; 20 patients, BMI 50-54; 16 patients, BMI 55-59; 7 patients, BMI 60-64; 6 patients, BMI >65. Holding all other variables fixed, the effect of a 5-point increase in BMI above 45 is associated with a 69% increase in the odds of having complications while

**Table 3.** Estimated Odds Ratio for Complications While Hospitalized Associated With Each Covariate and Corresponding P values (Multivariate Logistic Regression)

Covariate	Odds Ratio	P
Age	1	.88
Male	1.24	.76
Hip	0.54	.32
High BMI	8.44	.05
Diabetes	0.88	.84
Hospital rehabilitation	1.13	.86

**Complications after surgery**



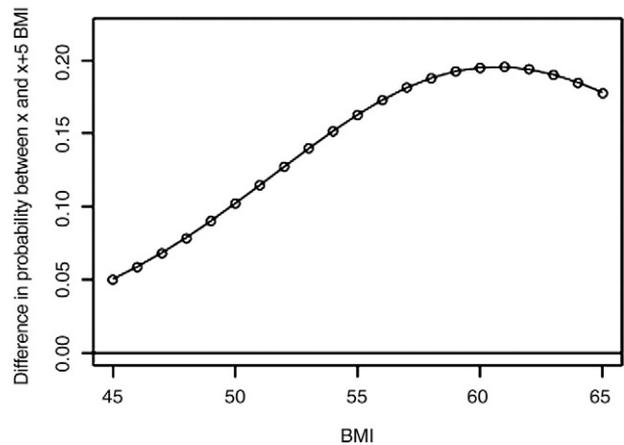
**Fig. 1.** The probability of in hospital complications after surgery as BMI increases above 45.

hospitalized compared with patients with BMI between 45 and 50 (Fig. 1). It is also associated with a 171% increase in odds of having complications within 1 year (Fig. 2). Finally, the odds of getting readmitted are increased by 100% with a 5-unit change in BMI (Fig. 3). Length of stay is estimated to increase on average by 13.8% with each 5-unit increase in BMI above 45 (Table 4). Body mass index was the only significant variable found in the model.

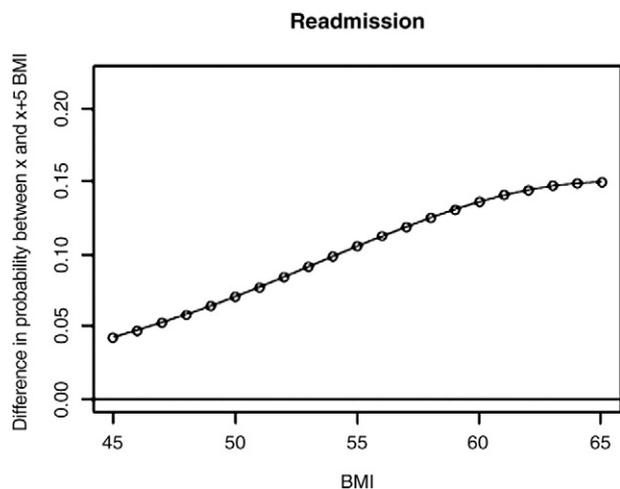
**Discussion**

Obesity is emerging as one of the greatest health risk to the modern-day population in this country as well as worldwide. Being overweight or obese is a major risk factor for the development of osteoarthritis [22]. The

**Complications in 1 year**



**Fig. 2.** The probability of complications with in 1 year after surgery as BMI increases above 45.



**Fig. 3.** The probability of readmission after surgery as BMI increases above 45.

effects of obesity on the outcomes of patients undergoing total joint arthroplasty have been an ongoing concern of orthopedic surgeons [9-18]. Not only has implant longevity been in question in this population, but also the risk of postoperative complications as influenced by BMI category is of increasing concern [18,23-25]. As a greater percentage of the population is defined as obese, there are new categories emerging within the definition of obesity, such as the super-obese [19-21].

Multiple studies have shown that obesity increases peri- and postoperative risk in total joint arthroplasty. In a study by Vasquez-Vela et al, 562 total knee arthroplasty (TKA) cases were reviewed, and it has been shown that obese individuals younger than 60 years at the time they underwent TKA had a 10-year survival rate of 35.7% compared to 96.8% survival rate of the non-obese group [26]. Miric et al looked at 512 TKA patients with a BMI above 35 and showed that among obese TKA patients, there was a statistically significant increase in total complication rates, 38% compared with 25% for patients with BMI of 35 or lower ( $P = .002$ ). They also found that 9.3% of patients among the obese group had multiple complications compared with 6.2%

**Table 4.** Estimated odds ratio of complications and readmissions per 5-U increase in BMI

Outcome	Estimated Odds		Significant Effect?
	Ratio	95% CI	
Complications while hospitalized	1.69	1.02-2.80	Yes
Complications within 1 y	2.71	1.48-4.97	Yes
Readmission	2.00	1.17-3.38	Yes
Length of stay	1.14	1.06-1.22	Yes

of the non-obese group ( $P = .03$ ) [17]. A prospective study of 1214 TKA patients by Dowsey et al found that the odds of surgical site infection among obese patients (BMI >30) was higher than the non-obese group (OR-8.96, 95% CI 1.59-50.63). However, despite the attempt to establish various threshold levels for obesity, little information is available regarding the risks for patients who exceed these thresholds.

We have shown in our study that overall, after controlling for the available demographic variables (sex, diabetes, age, type of the surgery, and rehabilitation indicator), the association between BMI grouping and complication rates while hospitalized continues to increase in a statistically significant way as BMI increases above 45. Analysis of the subset of patients with BMI between 45 and 70 showed that BMI value is highly associated with the likelihood of each outcome in this subgroup. In fact, among the super-obese patients, each incremental 5-U increase in BMI above 45 was associated with a statistically significant increased risk of having an in-hospital (OR 1.69) or postoperative outpatient complication (OR 2.71) and readmission (OR 2.0) ( $P < .05$ ). Length of stay was found to increase by 13.8% for each 5-U increase in BMI above 45 as well ( $P < .05$ ) (Table 4). This suggests that the impact of obesity continues to become more significant as patients' BMI increases above 45, which is the current threshold used for describing the super-obese population. This is important for clinicians and patients to understand when considering total joint arthroplasty with a BMI above 50. In addition, this may need to be accounted for when conducting studies and reporting results for patients after total joint arthroplasty with BMI greater than 45.

Our study had several limitations. It was a retrospective study looking at a mixed group of hip and knee patients treated by multiple surgeons in our institution. Therefore, surgical technique, implant type, and postoperative management varied for the patients in the study.

There is a significant increased risk for postoperative complications in the super-obese population, and this risk continues to increase significantly with every 5-U increase in BMI above 45, suggesting sustained increased risk as BMI increases above a 45 threshold. These data are important for orthopedic surgeons to understand when counseling super-obese patients and should be accounted for in reporting outcome and quality measures in this population.

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