Original Article

# Increasing BMI Correlates Directly with Higher Complication Rate in Breast Reduction Surgery

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## ABSTRACT

**Background:** Breast reduction improves quality of life for patients with breast hypertrophy in any Body Mass Index (BMI) category. We aimed to evaluate how BMI affected postoperative outcomes of breast reduction using a large nationwide database.

**Methods:** Using the American College of Surgeons National Surgery Quality Improvement Project (ACS-NSQIP) database, we examined patients undergoing breast reduction for hypertrophy from 2016 to 2020. Patients who had reductions for symmetry, oncoplastic reconstruction, or combined with panniculectomy were excluded.

**Results:** A total of 23,171 patients met inclusion criteria. Mean age was 40.7 years, and mean BMI was 31.0 +/- 6.8. Most patients (75%) had BMI<35. Mean operative time was 152 +/- 63 minutes. Overall complication rate was 5.0%, increasing from 2.4% in BMI<25 group to 11.4% in BMI>45. Many complications were related to the surgical site complications (4.4%), rising from 2.4% in BMI<25 to 10.2% in BMI>45. Rates of return to the operating room within 30 days (2.0%), venous thromboembolism (0.2%), urinary tract infection (0.2%), pneumonia (0.1%), and myocardial infarction (0.0%) did not differ significantly across BMI groups.

**Conclusion:** Higher BMI is associated with increased postoperative complications after breast reduction, primarily due to surgical-site events. However, BMI does not appear to affect rates of medical complications or unplanned returns to the operating room. Given the overall low risk and the benefits of surgery, obesity alone should not exclude patients from reduction mammaplasty. Patients should instead receive individualized risk counseling and assessment.

**KEYWORDS**
Body Mass Index; Breast Reductuion; Perioperative Complications

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## INTRODUCTION

Breast hypertrophy, also known as macromastia, is characterized by excessive enlargement of breast tissue that is disproportionate to normal body growth. It may occur unilaterally or bilaterally, develop gradually or rapidly, and present during adolescence or in adulthood[1–3]. Although its etiology is not fully understood, proposed contributing factors include

hormonal factors, stromal-epithelial interactions, and genetic predisposition[4–6]. Breast hypertrophy is associated with significant morbidity, including chronic neck, back, and shoulder pain, poor posture, exercise intolerance, and intertrigo, which restrict and interfere with daily activities[7,8]. The excessive breast volume may also negatively impact body image and contribute to psychological distress[7,9–11]. These combined physical and psychosocial burdens could profoundly reduce quality of life[9–11]. In symptomatic breast hypertrophy, surgical intervention, or reduction mammaplasty, remains the only definitive treatment and is associated with high patient satisfaction and durable symptom relief[2,7,12]. Non-surgical measures, such as support garments and physical therapy, offer limited and temporary relief[13].

Reduction mammaplasty reduction is one of the most frequently performed plastic surgery procedures, with over 75,000 performed annually in the United States[14]. Despite its documented improvements in quality of life,[15] insurance coverage remains inconsistent[16,17]. The American Society of Plastic Surgeons (ASPS) recommends medical necessity should be based on documentation of at least two symptoms of symptomatic breast hypertrophy, regardless of BMI or the weight of breast tissue removed[18]. Clinical evidence suggests that patients who completed a weight-loss program continued to experience symptomatic breast hypertrophy, therefore still requiring surgery[19]. Although some institutions and surgeons maintain their own BMI thresholds, existing evidence aligns with ASPS recommendations, indicating that obesity alone should not preclude reduction mammaplasty[20,21].

Yet, there is still inconclusive evidence whether postoperative complications increase with increasing BMI, with approximately half of existing studies reporting an association whereas the other half does not[22–25]. The conflicting findings in the literature may reflect heterogeneity in complication definitions, small sample sizes within specific obesity categories, variation in surgical techniques, and differences in patient comorbidity profiles. Although there are no national guidelines on BMI thresholds in breast reduction[7], individual surgeons and institutions apply varying BMI thresholds when determining candidacy for reduction mammaplasty. To further address whether BMI thresholds, we used a large, national, prospective database to stratify perioperative outcomes and associated risks across six BMI categories. We intend these findings to improve risk stratification, preoperative counseling, and surgical candidacy assessment for patients with higher BMIs considering reduction mammaplasty.

## METHODS AND MATERIALS

This was a retrospective cohort study analyzed the American College of Surgeons- National Surgical Quality Improvement Program (ACS-NSQIP) database to identify female patients who underwent breast reduction (reduction mammaplasty) between 2016 to 2020. ACS-NSQIP is a national, risk-adjusted database designed to measure and improve the quality of surgical care. Trained clinical reviewers prospectively collect validated data from medical records on preoperative risk factors, preoperative laboratory values, intraoperative variables, 30-day postoperative mortality, and 30-day morbidity for patients undergoing major surgery at participating institutions nationwide. In 2020, the ACS-NSQIP included 902,968 cases submitted from 706 NSQIP-participating sites, providing a large, diverse cohort suitable for evaluating important differences in patient risk[26].

Patients who underwent breast reduction were identified using Current Procedural Terminology (CPT) code 19318. All female patients who underwent reduction mammaplasty from 2016 to 2020, without age restrictions, were included. Patients were stratified into six groups based on the WHO BMI classes as follows:

Normal weight and below (<25 kg/m$^2$), overweight (25 kg/m$^2$-30 kg/m$^2$), Obesity class I (30 kg/m$^2$-35 kg/m$^2$), Obesity class II (35 kg/m$^2$-40 kg/m$^2$), and Obesity class III (40 kg/m$^2$-45 kg/m$^2$ and >45 kg/m$^2$) [27]. Collected demographics and clinical variables included age, race, American Society of Anesthesiologists (ASA) Physical Status Classification, comorbidities, operative time, and inpatient versus outpatient surgical setting. ASA Classifications includes Class I (a healthy patient), Class II (a patient with mild systemic disease), Class III (a patient with severe systemic disease), and Class IV (a patient with severe systemic disease that poses a constant threat to life) [28].

Perioperative outcomes assessed included wound complications (superficial surgical site infection (SSI), deep surgical site infection, organ space

surgical site infection, and wound dehiscence) as well as overall surgical site complication rate. Additional postoperative outcomes included pneumonia, venous thromboembolism (VTE), urinary tract infection (UTI), blood transfusion, and sepsis. VTE was defined as deep vein thrombosis (DVT) and/or pulmonary embolism (PE). Unplanned return to operating room (OR), and unplanned readmission within 30-day from durgery were also evaluated. All outcomes were measured within 30 days following surgery. Outcomes were compared across the six BMI categories and further stratified between BMI ≤35 kg/m² and >35 kg/m² cohorts.

### *Statistical Analysis*

Univariate and multivariate regression analyses were performed to identify the independent risk factors associated with a higher complications rate in patient who underwent breast reduction. The adjusted odds ratio (AOR) was calculated in multivariate regression analysis to determine the combined effect of various perioperative factors (age, patient comorbidities, smoking, BMI, length of surgery) on overall complication rate in patient who underwent breast reduction. All statistical analyses for the ACS-NSQIP were conducted using SPSS version 26 (IBM Corp., Armonk, NY, USA). Statistical significance was set at *P*-values <0.05 and odds ratio with the 95% confidence interval does not include the value of one. AOR>1 was considered the risk factor for overall complication rate.

## RESULTS

Overall, 23,171 patients underwent breast reduction between 2016 and 2020. Patients were stratified into six BMI categories. Most patients were overweight (33% in BMI of 25–30 kg/m²) or in Obesity Class I (30% with BMI 30–35 kg/m²), with a mean age of 40.7 ± 14.5 years. Most patients were white (40.5%) followed by African-American (21.7%). Higher BMI was associated with greater medical complexity, including higher ASA class and increased prevalence of hypertension, diabetes, severe chronic obstructive pulmonary disease (COPD), and congestive heart failure (CHF) (all *P*<0.05). Operative time increased modestly with BMI, with cases exceeding 4 hours rising from 5.9% to 14.9% (*P*<0.001). Inpatient surgery rates remained low overall (8.8%) (Table 1).

Postoperative complication rates generally increased with BMI, particularly wound complications, blood transfusion, sepsis, total complication rate, and unplanned readmissions. Rates of pneumonia, VTE, UTI, and unplanned return to the operating room remained low across BMI categories (Table 2).

Table 3 and 4 shows univariate and multivariate regression analyses evaluating the effect of BMI>35 versus BMI≤35 on perioperative outcomes. Multivariate regression analyses (Table 4), showed that BMI was an independent risk factor for overall postoperative complication predominantly increase surgical site complications. Although, several outcomes that appeared significant on univariate analysis, such as pneumonia, VTE, and sepsis, lose statistical significance after adjustment, suggesting that these risks may be largely mediated by underlying comorbidities rather than BMI alone.

Table 5 and 6 shows multivariate regression analyses evaluating the risk factors associated with overall complication rate (Table 5) and surgical site complication (Table 6) which is the most common postopetaive complications following breast reduction surgery. On multivariate regression analyses adjusting for age (>65 vs. ≤65), comorbidities (including hypertension, diabetes, smoking), BMI (>35 vs. ≤35) and operative time exceeding>4 hours, BMI >35 kg/m² emerged as the strongest independent predictor of overall complications (OR 1.71; *P*<0.010) (Table 5) and surgical site complications (OR 1.77; *P*<0.001) (Table 6). Current smoking was also independently associated with higher complication risk, whereas age >65, hypertension, diabetes, and prolonged operative time >4 hours were not significant predictors in these models.

## DISCUSSION

Breast reduction offers substantial quality-of-life improvements in patients with symptomatic macromastia, particularly for patients with obesity. In this large national cohort of patients undergoing reduction mammaplasty, a BMI > 35 kg/m² was strongly associated with increased perioperative complications. Our multivariate models demonstrated increased risk of overall complications. Predominantly, the complications

**Table 1.** Characteristics of patients who underwent breast reduction for breast hypertrophy

| Characteristics | BMI <25 | BMI 25-30 | BMI 30-35 | BMI 35-40 | BMI 40-45 | BMI >45 | P-value | Overall |
|---|---|---|---|---|---|---|---|---|
| Frequency (%) | 13.2 | 33.3 | 30.3 | 15.0 | 5.6 | 2.6 | | 100 |
| Age | | | | | | | | |
| >65 years old (%) | 5.4 | 5.3% | 5.6 | 4.8 | 4.7 | 4.2 | | 5.3 |
| Mean age | 38.77 +/- 15.49 | 40.68 +/- 14.77 | 40.14 +/- 14.30 | 41.09 +/- 13.86 | 41.29 +/- 13.59 | 41.33 +/- 13.68 | | 40.7 +/- 14.5 |
| Race (%) | | | | | | | <0.001 | |
| White | 43.6 | 42.6 | 39.4 | 37.7 | 35.8 | 36.6 | | 40.5 |
| African-American | 9.3 | 15.5 | 23.9 | 33.3 | 37.6 | 44.8 | | 21.7% |
| Asian | 1.2 | 0.9 | 0.6 | 0.1 | 0.2 | 0.3 | | 0.7% |
| Not reported and low frequency race | 45.9 | 41.0 | 36.1 | 28.9 | 26.4 | 18.3 | | 37.1% |
| ASA Classification (%) | | | | | | | <0.001 | |
| I- No disturbances | 47.0 | 36.9 | 19.9 | 9.0 | 4.9 | 3.9 | | 26.3 |
| II-Mild disturbances | 48.0 | 56.5 | 68.1 | 69.6 | 48.9 | 33.9 | | 59.8 |
| III-Severe disturbances | 4.8 | 6.4 | 11.8 | 21.0 | 45.3 | 58.9 | | 13.5 |
| IV- Life threatening | 0.1 | 0.1 | 0.2 | 0.3 | 0.9 | 3.2 | | 0.3 |
| Comorbidities (%) | | | | | | | | |
| Hypertension | 8.1 | 11.7 | 18.8 | 24.3 | 29.2 | 33.2 | <0.001 | 16.8 |
| Diabetes Mellitus | 1.6 | 2.7 | 4.6 | 6.4 | 9.5 | 14.4 | <0.001 | 4.4 |
| Smoker** | 5.3 | 6.6 | 7.8 | 9.9 | 9.3 | 4.5 | <0.001 | 7.6 |
| Severe COPD | 0.3 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5 | <0.001 | 0.6 |
| Chronic Steroid use | 1.3 | 1.3 | 1.5 | 1.5 | 2.2 | 2.1 | 0.173 | 1.5 |
| Operative Time (%) | | | | | | | | |
| > 4hours | 5.9 | 7.9 | 10.3 | 11.4 | 11.4 | 14.9 | <0.001 | |
| Inpatient Surgery (%) | 8.8 | 10.0 | 8.2 | 7.6 | 7.5 | 10.7 | <0.001 | 8.8% |

*ASA Classification = American Society of Anesthesiologists (ASA) Physical Status Classification System; COPD = chronic obstructive pulmonary disease **current smoker definition per database: within 3 months from surgery

**Table 2.** Outcomes in patients who underwent breast reduction for breast hypertrophy

| Outcomes | BMI <25 | BMI 25-30 | BMI 30-35 | BMI 35-40 | BMI 40-45 | BMI >45 | P-value |
|---|---|---|---|---|---|---|---|
| Postoperative complications (%) | | | | | | | |
| Wound complications | | | | | | | |
| I-Superficial surgical site infection | 2.0 | 2.5 | 3.7 | 4.2 | 5.4 | 7.2 | <0.001 |
| II-Deep surgical site infection | 0.1 | 0.1 | 0.3 | 0.5 | 0.4 | 1.2 | <0.001 |
| III-Organ space surgical site infection | 0.0 | 0.1 | 0.3 | 0.5 | 0.5 | 0.5 | <0.001 |
| IV-Wound dehiscence | 0.3 | 0.5 | 0.9 | 1.0 | 1.2 | 2.2 | <0.001 |
| Overall Surgical site complication rate | 2.4 | 3.1 | 4.9 | 5.9 | 7.0 | 10.2 | <0.001 |
| Pneumonia | 0.0 | 0.0 | 0.1 | 0.1 | 0.2 | 0.2 | 0.140 |
| Venous thromboembolism (VTE) | 0.1 | 0.1 | 0.2 | 0.2 | 0.3 | 0.0 | 0.461 |
| -Deep Vein Thrombosis (DVT) | 0.0 | 0.1 | 0.1 | 0.1 | 0.2 | 0.0 | 0.171 |
| -Pulmonary Embolism (PE) | 0.1 | 0.1 | 0.0 | 0.1 | 0.1 | 0.0 | 0.851 |
| Urinary tract infection (UTI) | 0.1 | 0.3 | 0.2 | 0.2 | 0.2 | 0.5 | 0.186 |
| Blood transfusion | 0.2 | 0.2 | 0.2 | 0.3 | 0.8 | 0.8 | <0.001 |
| Sepsis | 0.0 | 0.1 | 0.1 | 0.2 | 0.2 | 0.7 | <0.001 |
| Total complication rate | 2.8 | 3.7 | 5.6% | 6.6 | 8.1 | 11.4 | <0.001 |
| Unplanned return to OR | 2.2 | 1.9 | 1.8 | 2.3 | 1.7 | 2.9 | 0.231 |
| Unplanned readmission | 1.2 | 1.1 | 1.4 | 2.0 | 1.9 | 3.9 | <0.001 |

*Unplanned reintubation, occurrence of ventilator >48 hours, progressive renal insufficiency (0.0%), acute renal failure (0.0%), CVA (0.0%), cardiac arrest (0.0%), myocardial infarction (0.0%), septic shock (0.0%); C. difficile infection (0.0%)

**Table 3.** Univariate regression analysis evaluating the effect of BMI>35 versus BMI≤35 on perioperative outcomes in breast reduction

| Outcomes | Odds Ratio | 95% Confidence Interval | P-value |
|---|---|---|---|
| Postoperative complications | | | |
| Wound complications | | | |
| I-Superficial surgical site infection | 1.71 | 1.46 – 1.99 | <0.001 |
| II-Deep surgical site infection | 0.31 | 0.18 – 0.51 | <0.001 |
| III-Organ space surgical site infection | 2.42 | 1.46 4.01 | 0.001 |
| IV-Wound dehiscense | 1.96 | 1.43 – 2.66 | <0.001 |
| Overall Surgical site complication rate | 1.86 | 1.63 – 2.12 | <0.001 |
| Pneumonia | 3.34 | 1.17 – 9.54 | 0.024 |
| Venous thromboembolism (VTE) | 1.24 | 1.12 -1.37 | 0.004 |
| -Deep Vein Thrombosis (DVT) | 0.64 | 0.26 - 1.57 | 0.331 |
| -Pulmonary Embolism (PE) | 1.03 | 0.33 – 3.15 | 0.961 |
| Urinary tract infection (UTI) | 1.03 | 0.55 – 1.93 | 0.915 |
| Blood transfusion | 2.46 | 1.47 -4.13 | 0.001 |
| Sepsis | 3.35 | 1.55 – 7.22 | 0.002 |
| Overall complication rate | 1.81 | 1.60 – 2.05 | <0.001 |
| Unplanned return to operationg room | 1.18 | 0.95 – 1.46 | 0.124 |
| Operative time > 4 hours | 1.44 | 1.31 – 1.59 | <0.001 |

**Table 4.** Multivariate regression analysis evaluating the effect of BMI>35 versus BMI≤35 on perioperative outcomes in breast reduction

| Outcomes | Adjusted Odds Ratio | 95% Confidence Interval | P-value |
|---|---|---|---|
| Postoperative complications | | | |
| Wound complications | | | |
| I-Superficial surgical site infection | 1.66 | 1.42 – 1.94 | <0.001 |
| II-Deep surgical site infection | 0.35 | 0.21 – 0.59 | <0.001 |
| III-Organ space surgical site infection | 2.03 | 1.21 – 3.42 | 0.007 |
| IV-Wound dehiscense | 1.81 | 1.32 – 2.49 | <0.001 |
| Overall Surgical site complication rate | 1.77 | 1.55 – 2.03 | <0.001 |
| Pneumonia | 2.39 | 0.81 – 7.06 | 0.114 |
| Venous thromboembolism (VTE) | 1.31 | 0.64 – 2.70 | 0.461 |
| -Deep Vein Thrombosis (DVT) | 0.64 | 0.26 - 1.57 | 0.331 |
| -Pulmonary Embolism (PE) | 1.04 | 0.33 – 3.23 | 0.950 |
| Urinary tract infection (UTI) | 0.97 | 0.51 – 1.84 | 0.935 |
| Blood transfusion | 2.02 | 1.19 – 3.44 | 0.009 |
| Sepsis | 2.62 | 1.19 – 5.80 | 0.017 |
| Overall complication rate | 1.71 | 1.50 – 1.94 | <0.001 |
| Unplanned return to operating room | 1.09 | 0.88 – 1.35 | 0.446 |
| Operative time > 4 hours | 1.44 | 1.31 – 1.59 | <0.001 |

*Included factors were age, comorbidities (hypertension, diabetes mellitus and smoking) and operative time

were driven by surgical site complications, such as superficial surgical site infections, organ space surgical site infections, and wound dehiscence. These findings align with prior literature demonstrating a direct correlation between increasing BMI and postoperative complications[7,23,25,29]. A meta-analysis reported similar elevations in risk, with odds ratios of 1.71 for patients with BMI >35 kg/m² and 2.05 for those with BMI >40 kg/m².[30] Ran et al. observed increased complications at a lower BMI of 30 kg/m²

**Table 5.** Multivariate regression analysis evaluating the risk factors associated with overall complication rate in breast reduction

| Risk Factors | Adjusted Odds Ratio | 95% Confidence Interval | P-value |
|---|---|---|---|
| Age (yr) | | | |
| <65 years old | Reference | Reference | Reference |
| >65 years old | 1.06 | 0.82 – 1.37 | 0.662 |
| BMI | | | |
| <35 | Reference | Reference | Reference |
| >35 | 1.71 | 1.50 – 1.94 | <0.001 |
| Hypertension | 1.22 | 1.05 – 1.43 | 0.010 |
| Diabetes Mellitus | 1.33 | 1.04 -1.70 | 0.025 |
| Current Smoker* | 1.62 | 1.35 -1.95 | <0.001 |
| Operative time > 4 hours | 0.99 | 0.81 – 1.21 | 0.940 |

**current smoker definition per datebase: within 3 months from surgery

**Table 6.** Multivariate regression analysis evaluating the risk factors associated with overall surgical site complication rate in breast reduction

| Risk factors | Odds Ratio | 95% Confidence Interval | P-value |
|---|---|---|---|
| Age (yr) | | | |
| <65 years old | Reference | Reference | Reference |
| >65 years old | 1.0 | 0.75 – 1.33 | 0.990 |
| BMI | | | |
| <35 | Reference | Reference | Reference |
| >35 | 1.77 | 1.55 – 2.03 | <0.001 |
| Hypertension | 1.16 | 0.98 – 1.37 | 0.86 |
| Diabetes Mellitus | 1.26 | 0.96 – 1.65 | 0.091 |
| Current Smoker* | 1.62 | 1.34 – 1.98 | <0.001 |
| Operative time > 4 hours | 0.89 | 0.71 – 1.11 | 0.299 |

*current smoker definition per database: within 3 months from surgery

(OR 1.59, $P = 0.000$) [31] . The elevated risk in patients with higher BMI is likely multifactorial, reflecting impaired wound healing, increased tissue bulk, and altered immune and vascular function. Reduced tissue perfusion and oxygenation in adipose tissue can hinder healing and increase susceptibility to infection and fat necrosis, while larger resection volumes further elevate the risk of wound dehiscence and delayed recovery[7,30–32].

Smoking status was also a major contributor to adverse perioperative outcomes. Current smokers demonstrated significantly higher odds of both overall complications and surgical-site complications. These findings are consistent with prior work by Liu et al., who reported substantially elevated complication risks (OR 2.57, $P<0.01$), including higher risk of infection (OR = 2.03, $P < 0.01$) and wound dehiscence (OR 2.34, $P<0.01$) among smokers.[32] Ran et al. similarly observed that smoking increased the risk of wound infection and wound dehiscence by 1.86-fold[31]. As nicotine causes vasoconstriction and reduces tissue perfusion, smoking impairs oxygen delivery and wound healing, leading to increased rates of infection, dehiscence, delayed healing, and tissue necrosis[33–35]. The ASPS recommends preoperative counseling and smoking cessation due to increased risks[7].

Diabetes mellitus was associated with a modestly increased risk of overall complications in our cohort (OR 1.33, $P<0.025$), but interestingly not surgical site complications. The literature on diabetes as an independent risk factor in reduction mammaplasty is mixed[7]. Knoedler et al. found that when all diabetic patients were considered together, diabetes was not associated with increased complications. However, stratification by treatment type revealed that

insulin-dependent patients had significantly higher odds of overall adverse events (OR 1.9, *P*=0.001) and surgical complications (OR 1.6, *P*=0.04), whereas patients on oral agents did not (OR 1.1, *P*=0.6) [36]. This aligns with previous literature highlighting that diabetes, especially when insulin-dependent or poorly controlled, can increase complication risk, likely due to associated comorbidities and impaired wound healing mechanisms, including reduced leukocyte function, impaired collagen synthesis, and diminished microvascular perfusion[31,32,36,37]. Our study population is also noted to have low incidence of diabetes, with the highest rate of 14.4% in patients with BMI > 46 kg/m². The ASPS hypothesizes that low diabetes prevalence among reduction mammaplasty patient cohorts may reflect selection of medically optimized patients[7].

Similarly, hypertension mildly increased risk of overall complications (OR 1.22, *P*<0.010), but not surgical site complications. We hypothesize that hypertension increases perioperative bleeding and hematoma risk, leading to unplanned reoperations and wound complications. Its association with atherosclerosis and impaired microvascular perfusion, similar to diabetes, may further contribute to higher postoperative complication rates. The literature on hypertension as a risk predictor is mixed, with some studies suggesting little impact on wound healing, while others identify hypertension as associated with higher overall complications and unplanned readmission[32,38,39]. Perioperative and postoperative blood pressure peaks and variability have been specifically associated with a higher risk of hematoma formation, highlighting the importance of careful blood pressure management during and after surgery[40]. Currently, there is limited data regarding the impact of hypertension severity or specific antihypertensive medications on surgical outcomes, indicating a need for further research. Additionally, patient age at surgery was not associated with increased surgical site or overall complications in our cohort.

When stratifying our cohort by BMI>35 kg/m², operative time exceeding four hours was found to have a 1.44-fold higher risk of adverse perioperative outcomes. However, compared with other risk factors such as BMI, operative time (>4 hours) was not an independent predictor of overall or surgical site complications. This may be because extended operative time is often correlated with higher BMI, larger resection weights, and more complex procedures, all of which are independently associated with delayed healing and increased complications[29,41]. Consistent with this, we found 14.9% of patients with BMI>45 kg/m² have a operative times exceeding 4 hours, compared with only 5.9% of patients with BMI<25 kg/m². Simpson et al. similarly reported that prolonged operative time increases complication risk, even after adjusting for other factors[25,44,45].

Interestingly, increasing BMI was not associated with higher rates of venous thromboembolism such as deep vein thrombosis (OR 0.64, *P*=0.331) and pulmonary embolism (OR 1.04, *P*=0.950) nor with unplanned return to the operating room (OR 1.09, *P*=0.446). While higher BMI is generally expected to increase VTE risk,[42,43] our findings may reflect proactive prophylaxis measures in this population, including mechanical and chemical VTE prophylaxis and early ambulation in day-surgery protocols.

Many patients with breast hypertrophy are overweight and have higher BMI.[19,44] Prior studies demonstrate that complication rates, including wound healing problems, infection, fat necrosis, and seroma—rise with increasing BMI, especially above 35–40 kg/m².[30] Minor complications such as superficial wound issues are most common, while major complications and reoperation rates remain low and are not significantly affected by BMI.[29] Additionally, specimen weight, especially unilateral breast resection weight ≥1000 g, is associated with increased risk of complications such as fat necrosis and wound healing problems, but its effect is less pronounced than BMI[32]. However, most studies note that despite the increasing complications with increasing BMI and that BMI is an important consideration when determining operative candidacy, patients received the same symptom relief regardless of BMI or amount of breast tissue removed[7,29,30,45].

This study has several limitations. ACS-NSQIP is limited to data within the immediate 30-day postoperative period, potential omitting delayed complications. Unable to evaluate the effect of weight of resection, surgeon's experience which could be important factors in postoperative complications or performing breast reduction in teaching institutions has any impact on postoperative outcomes. Future research should focus on long-term outcomes regarding reduction mammaplasty. Additionally, as

reduction mammaplasty is primarily performed to alleviate symptoms, this analysis does not capture patient-reported outcomes and satisfaction, which may ultimately outweigh the perioperative risks identified.

## CONCLUSION

Increasing BMI correlates directly with higher complication rate in breast reduction surgery. In addition, patients with BMI >35 kg/m² face elevated risk for postoperative complications following reduction mammaplasty. Besides, BMI >35 kg/m² is the strongest predictor of complications following reduction mammaplasty. However, higher BMI was not an independent risk factor in increased rates of venous thromboembolism in these patients. These findings emphasize the impact of modifiable risk factors, particularly obesity and smoking, in shaping postoperative outcomes after breast reduction and support the need for future studies evaluating preoperative optimization, such as structured weight loss programs to reduce the possibility of postoperative complications (especially wound complications) as well as optimize long-term aesthetic outcomes. Also, patients should be counseled on timing weight management relative to surgery, especially given the increasing use of weight-loss medications. Patients with high BMIs will need thorough preoperative counseling and shared decision-making, particularly regarding wound-healing expectations, potential for prolonged postoperative care, and strategies to mitigate modifiable risks.

## ETHICAL APPROVAL

This study was presented in 73rd Annual Meeting, California Society of Plastic Surgeons, May 26-28, 2023 in San Francisco, California, United States.

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## CONFLICT OF INTEREST

The authors declare that there is no conflict of interests.

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