

# Body Mass Index (BMI) Impact on Anesthetic Safety among Adolescents Undergoing Bilateral Reduction Mammoplasty

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**Introduction:** Obesity is common in adolescents with macromastia seeking surgery, prompting concerns over anesthesia-related complications due to obesity. This may lead to weight-based surgical policies, despite limited research. This study's purpose is to examine the impact of obesity status on perioperative anesthetic-related adverse events/surgical complications in adolescents/young adults undergoing bilateral reduction mammoplasty.

**Methods:** A medical record query was performed to retrospectively identify patients who underwent bilateral reduction mammoplasty at our institution between January 2021 and December 2021. Patient demographics and clinical/surgical data were obtained from medical records. Pearson's chi-square, Fisher exact, and Median tests were used to examine associations between body mass index (BMI) category and clinical/demographic data.

**Results:** Two hundred patients were included in analyses, with a median age at surgery of 18.0 years. The majority of patients were obese (63.5%, n = 127), and none were underweight. The most common comorbidity was asthma (27.0%, n = 54). There were no anesthetic-related intraoperative complications or delayed waking. The following did not significantly differ by BMI category: proportion of patients who experienced oxygen desaturation (pre-, intra-, or postoperatively), frequency of postoperative complications, and length of postanesthesia care unit and total hospital stays ( $P > 0.05$ , all).

**Conclusions:** While institutions may implement weight-based surgical policies due to anesthesia-related complication concerns in patients with obesity, our study showed that BMI category did not significantly impact anesthetic-related adverse events/surgical complications in our sample. This suggests that such policies are not warranted in all situations, and that decisions regarding their necessity be data-driven. (*Plast Reconstr Surg Glob Open* 2022;10:e4641; doi: 10.1097/GOX.0000000000004641; Published online 3 November 2022.)

## INTRODUCTION

As pediatric obesity rates climb nationally, so does the frequency of obese pediatric and adolescent patients presenting for elective surgery.<sup>1</sup> In addition to medical

conditions such as sleep apnea and type II diabetes, obese pediatric patients are at increased risk for a variety of surgical conditions as well. Symptomatic macromastia has been strongly associated with obesity, with roughly two-thirds of breast patients presenting for consultation being overweight or obese.<sup>2-7</sup> In addition, obesity increases the risk of macromastia severity in the adolescent and young adult populations.<sup>5-7</sup> The reasons for presentation, and the patient-reported outcomes following reduction mammoplasty, are similar in obese and healthy-weighted adolescents and young adults.<sup>3</sup> Unlike findings in the adult population,

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Received for publication July 13, 2022; accepted September 13, 2022.

IRB Statement: This study was approved by the Boston Children's Hospital Committee on Clinical Investigation. Protocol number: X08-10-0492.

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DOI: 10.1097/GOX.0000000000004641

**Disclosure:** The authors have no financial interest to declare in relation to the content of this article. This work was supported in part by the Plastic Surgery Foundation (grant number 192776; July 2011). The Plastic Surgery Foundation had no involvement in the study design; collection, analysis, and interpretation of data; the writing of this article; or the decision to submit this article for publication.

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surgical complications following breast reduction in adolescence and young adulthood seem independent of body mass index (BMI) category as well.<sup>4</sup> A remaining area of concern in the perioperative management of obese breast surgery patients is the potential for perioperative anesthesia-related complications such as oxygen desaturation events, delayed awakening, or more severe adverse outcomes.

A number of studies in the anesthesia literature suggest that children with obesity are more likely to experience intraoperative adverse events, including airway obstruction and oxygen desaturations, than their healthy-weighted peers.<sup>8–15</sup> It remains unclear whether these observations extend to all surgical interventions, or whether there are specific BMI limits above which standard pediatric anesthesia protocols should be adapted. In contrast, there are several recent studies that suggest the majority of children with obesity complete surgical treatment without experiencing adverse events.<sup>9,12,13</sup>

The purpose of this single-center retrospective cohort study is to compare the frequency of perioperative anesthesia-related adverse events and surgical complications in obese and nonobese adolescents and young adults undergoing bilateral reduction mammoplasty.

## METHODS

This is a retrospective review of patients undergoing bilateral reduction mammoplasty at our institution between January 2021 and December 2021. (See **appendix, Supplemental Digital Content 1**, which displays the STROBE checklist, <http://links.lww.com/PRSGO/C248>.) All research activities were conducted with a waiver of informed consent in accordance with the Boston Children's Hospital Committee on Clinical Investigation and with the Declaration of Helsinki.

### Patient Population

Patients were included if they underwent bilateral reduction mammoplasty at our institution. Patients were identified through a query of the electronic medical record. BMI category was determined for participants aged 20 years and older via the Centers for Disease Control (CDC) and Prevention adult BMI calculator, and for those younger than 20 years via the CDC child and teen BMI calculator.<sup>16,17</sup> For all analyses, adult patients were stratified into the following BMI categories: underweight (BMI, <18.5 kg/m<sup>2</sup>), healthy-weighted (BMI, 18.5–24.9 kg/m<sup>2</sup>), overweight (BMI, 25–29.9 kg/m<sup>2</sup>), and obese (BMI, >30 kg/m<sup>2</sup>). For patients younger than 20 years old, BMI-for-age percentiles were also tabulated, accounting for both age and gender. Patients were deemed underweight

## Takeaways

**Question:** Does obesity status in adolescents/young adults undergoing bilateral reduction mammoplasty impact the frequency of perioperative anesthesia-related adverse events and surgical complications?

**Findings:** This retrospective study included 200 patients who had undergone bilateral reduction mammoplasty. Despite 63.5% of the cohort being obese, there were no instances of anesthesia-related intraoperative complications or delayed waking. Additionally, BMI category did not significantly impact oxygen desaturation events, postoperative complication frequency, or length of stay (hospital and PACU).

**Meaning:** The necessity of weight-based surgical policies should be evidence-based, and evaluated on a procedure/population-specific basis.

when their BMI resided below the fifth percentile, healthy-weighted if between the fifth and 84th percentiles, overweight if between the 85th and 94th percentiles, and obese if their BMI was greater than the 95th percentile.<sup>17</sup>

### Variables

Patient demographics and medical history, including comorbidities and drug use at the time of procedure, were recorded. Preoperative, intraoperative, and postoperative oxygen saturation levels were documented, as were the frequency of oxygen desaturation occurrences (SPO<sub>2</sub> level <95%) and other notable intraoperative adverse events. Postoperatively, time (minutes) spent in the postanesthesia care unit (PACU) and total length of stay (hours) were recorded. Any notable postoperative adverse events occurring in the first 6 weeks following the operation were also noted.

### Statistical Analysis

All statistical analyses were performed using IBM SPSS Version 24 (IBM Corp., Armonk, N.Y.) Demographics and clinical information were compared across BMI category groups using Pearson's chi-square, Fisher exact, and Median tests, as appropriate. Results from all analyses were considered statistically significant at a *P* value less than 0.05.

## RESULTS

### Patient Demographics

Two hundred patients were identified and included for analysis (Table 1). Of these patients, 63.5% (n = 127) were obese, 16.5% (n = 33) were overweight, and 20.0% (n =

**Table 1. Patient Demographics and Medical History (n = 200 Patients)**

Demographics	Healthy-weighted	Overweight	Obese	<i>P</i>
n (%)	40 (20.0)	33 (16.5)	127 (63.5)	
Median age (IQR), y	18.9 (3.7)	17.6 (3.6)	18.1 (3.5)	0.131
Any comorbidity, n (%)	15 (37.5)	9 (27.3)	53 (41.7)	0.311
Any drug use, n (%)	14 (35.0)	11 (33.3)	26 (20.5)	0.097

IQR, interquartile range.

40) were healthy-weighted; no patients were underweight. Age at time of reduction ranged from 13.0 to 30.2 years [median [interquartile range (IQR)] = 18.0 [3.5] years], and did not vary across BMI category ( $P = 0.131$ ).

#### Preoperative Characteristics

Medical comorbidities were reported in all BMI categories, including in 41.7% ( $n = 53$ ) of obese patients, 27.3% ( $n = 9$ ) of overweight patients, and 37.5% ( $n = 15$ ) of healthy-weighted patients ( $P = 0.311$ ). The most common comorbidities documented in the sample included asthma (27.0%,  $n = 54$ ), hematologic malignancies (6.0%,  $n = 12$ ), obstructive sleep apnea (5.5%,  $n = 11$ ), cardiovascular disease (4.5%,  $n = 9$ ), hypertension (4.0%,  $n = 8$ ), polycystic ovary syndrome (PCOS) (3.5%,  $n = 7$ ), and diabetes (2.5%,  $n = 5$ ) (Fig. 1). Subgroup analysis revealed that a significantly higher proportion of patients with a BMI more than 40 kg/m<sup>2</sup> ( $n = 15$ ) had a formal diagnosis of PCOS compared with all other patients ( $P = 0.010$ ). For all other comorbidities, there were no significant differences between patients with BMI more than 40 kg/m<sup>2</sup> and BMI less than 40 kg/m<sup>2</sup> ( $P > 0.05$ , all).

Drug use, including the use of tobacco products, marijuana, and vaporizers, was also documented across all BMI groups. Drugs were used by 20.5% ( $n = 26$ ) of obese patients, 33.3% ( $n = 11$ ) of overweight patients, and 35.0% ( $n = 14$ ) of healthy-weighted patients, and did not vary significantly across BMI categories ( $P = 0.097$ ).

#### Anesthetic and Operative Details, and PACU Protocol

All patients received general anesthesia with either an endotracheal tube or laryngeal mask airway. They were induced with a variation of fentanyl, propofol ± rocuronium (for intubation), and maintained either on a total intravenous anesthetic technique of propofol and remifentanyl, or sevoflurane and fentanyl anesthetic. All patients also received dexamethasone, ondansetron, and a scopolamine patch to prevent postoperative nausea and vomiting. Analgesia was provided primarily with hydromorphone. Inferior pedicle and Wise pattern skin excisions were used on all patients.

All patients arriving in the PACU were signed out to the nursing staff where they had vital signs checked, and focused physical examination performed. Patients were discharged from the PACU when they met the following criteria: hemodynamically stable, awake or easily arousable, pain well-controlled, and capable of tolerating sips of clear liquids. Compression bras were worn by patients for 7 days postoperatively.

#### Intraoperative and Postoperative Events

There were no reports of anesthetic-related intraoperative complications or delayed waking experienced by patients. The percentage of patients with at least one oxygen desaturation did not vary across BMI categories preoperatively, intraoperatively, or postoperatively ( $P > 0.05$ , all; Table 2). Similarly, neither length of PACU stay nor total length of hospital stay differed significantly across

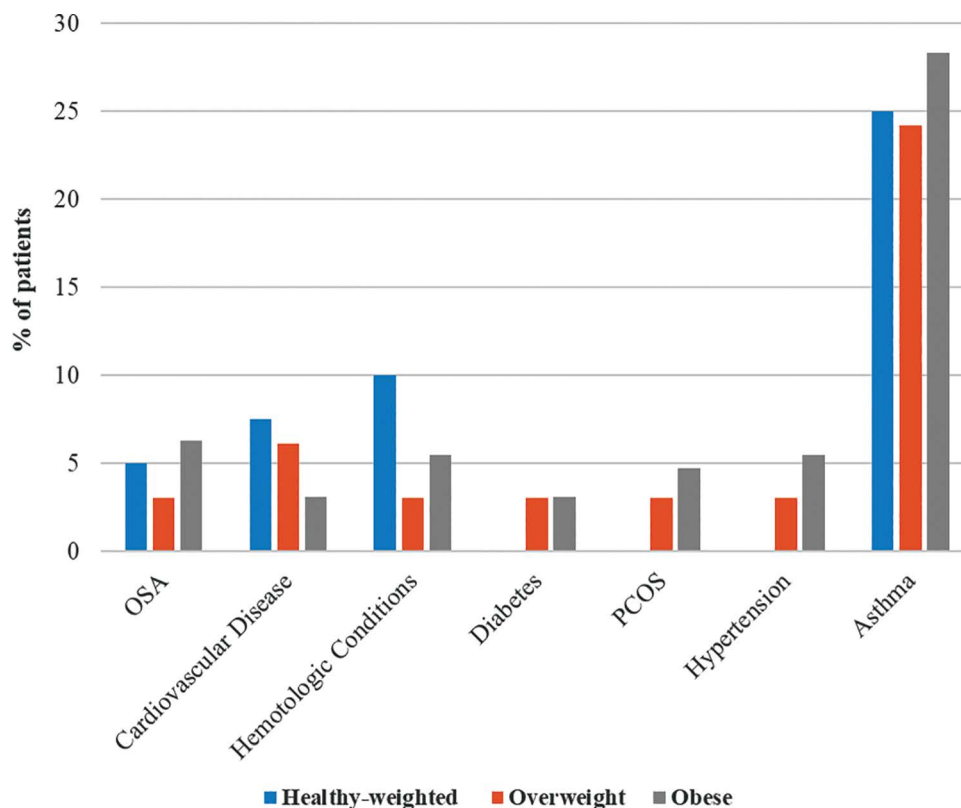


Fig. 1. Incidence of medical comorbidities by BMI category.

**Table 2. Frequency of Patients Experiencing at Least One Oxygen Desaturation (SpO<sub>2</sub> <95%); n = 200 Patients**

Time Point	Healthy-weighted, n = 40	Overweight, n = 33	Obese, n = 127	P
Preoperative, n (%)	0 (0.0)	3 (9.1)	9 (7.1)	0.139
Intraoperative, n (%)	2 (5.0)	4 (12.1)	15 (11.8)	0.474
Postoperative, n (%)	0 (0.0)	0 (0.0)	1 (0.8)	>0.999

BMI categories ( $P > 0.05$ , both; Table 3). Postoperative complications were reported in all categories, including in 6.3% (n = 8) of obese patients, 12.1% (n = 4) of overweight patients, and 10.0% (n = 4) of healthy-weighted patients (Table 4). However, there was no significant difference in the frequency of reported postoperative complications across BMI categories ( $P = 0.445$ ). Among all patients, postoperative complications included hematoma requiring evacuation (n = 13), notable inflammation (n = 1), formation of a granulomatous foreign body (n = 1), and diet-related anaphylaxis (n = 1).

Additional subgroup analyses were performed on patients who had higher BMIs [grouped as: 30.00–35.00 kg/m<sup>2</sup> (n = 68), 35.01–40.00 kg/m<sup>2</sup> (n = 34), and ≥40.01 kg/m<sup>2</sup> (n = 15)]. Similar to the above analyses, we found that oxygen desaturation events did not vary across groups pre-, intra-, or postoperatively ( $P > 0.05$ , all). Furthermore, neither length of hospital and PACU stays nor postoperative complication frequency varied across these high BMI groups ( $P > 0.05$ , all).

### DISCUSSION

This single-center retrospective cohort study was performed to compare the frequency of anesthetic-related adverse events and surgical complications across BMI categories for adolescents and young adults undergoing bilateral reduction mammoplasty. Patients’ medical history, height, weight, and perioperative and early postoperative records were used to assess the safety of performing bilateral reduction mammoplasty on adolescent and young adult patients across BMI categories.

The majority of patients included in this study were classified as obese (63.5%, n = 127), echoing previous studies and national trends indicating that the prevalence of obesity is increasing in adolescents with macromastia and

in general, respectively.<sup>18,19</sup> Presently, 17.4% of the United States’ pediatric population meets CDC criteria for obesity.<sup>20</sup> Women of reproductive age are similarly affected, with 23% of this population now classified as obese.<sup>21</sup> The impact that obesity has on affected individuals, as well as the healthcare system in general, is difficult to overstate. Specialized equipment and treatment protocols have been utilized to improve perioperative safety for this growing population, and these alterations in care have added considerably to healthcare costs. Given the numbers involved, it is important to determine when and for whom specialized treatment models are required for obese surgical patients. For example, at our institution, all obese patients requiring a general anesthetic must be treated at the main hospital, and not at lower cost community satellite facilities. It remains unclear whether such broad policies are warranted.

In our cohort, obese and nonobese patients experienced similar positive perioperative outcomes. There were no major anesthetic complications or sequela in either group. BMI category did not affect the number of postoperative oxygen desaturation events ( $P > 0.999$ ) or length of PACU and hospital stays ( $P > 0.05$ , both). This result differs from studies in the pediatric literature that have reported increased adverse events in obese patients, including a greater incidence of pneumonia and desaturation requiring reintubation within a 7-day postoperative window.<sup>22–24</sup> Although there is no conclusive explanation for this discrepancy, it should be noted that the studies showing increased risk in obese pediatric patients included patients undergoing longer and more invasive procedures as compared with reduction mammoplasty. It is highly plausible that the nature of the operation is an important consideration in estimating risk for adverse perioperative anesthesia events.

Surgical complications occurred in 16 patients (n 8.0%). This overall complication rate is lower than many published studies.<sup>25–27</sup> This is likely due to the limited follow-up time precluding late complications, such as asymmetry, hypertrophic scarring, or sensory differences. In addition, there were no observed differences in the frequency of complications across BMI categories in our study ( $P = 0.445$ ). This observation is similar to a previous report by our group.<sup>4</sup> Furthermore, while obese surgical

**Table 3. Hospital and PACU Length of Stay (n = 200 Patients)**

Stay Type	Healthy-weighted, n = 40	Overweight, n = 33	Obese, n = 127	P
Median (IQR) length of PACU stay, min	72.5 (68.3)	72.0 (45.0)	75.0 (45.0)	0.752
Median (IQR) length of hospital stay, h	10.0 (18.0)	21.0 (18.0)	23.0 (16.0)	0.139

IQR, interquartile range; PACU, post anesthesia care unit.

**Table 4. Postoperative Complications (n = 200 Patients)**

Complication	Healthy-weighted, n = 40	Overweight, n = 33	Obese, n = 127	P
Any Complication	4 (10.0%)	4 (12.1%)	8 (6.3%)	0.445
Hematoma	3	3	7	
Diet-related anaphylaxis	0	1	0	
Notable inflammation	1	0	0	
Granulomatous foreign body	0	0	1	

patients have been reported to be at an elevated risk of postoperative infection, there were no similar complications in this series.<sup>28–30</sup> It is also important to note that postoperative complication frequency, desaturation events, and PACU and total hospital stays similarly did not vary across patients in high BMI groups (30.00–35.00 kg/m<sup>2</sup>, 35.01–40.00 kg/m<sup>2</sup>, and ≥40.01 kg/m<sup>2</sup>). Although the small sample sizes should be acknowledged, these data still support the perioperative safety of surgery on patients with obesity in our sample.

The association of obesity with a host of medical comorbidities is clearly established.<sup>31–34</sup> Although pediatric and young adult patients are not immune to these comorbidities, they are less prevalent in younger populations. A number of medical comorbidities commonly associated with obesity were observed in our patient population, although the prevalence did not differ by BMI category ( $P = 0.311$ ). Specifically, children with obesity are four times as likely to develop type II diabetes compared with healthy-weighted children.<sup>35</sup> However, the prevalence of diabetes across all patients in our study was low ( $n = 5$ , 2.5%). Similarly, the prevalence of obstructive sleep apnea and hypertension in our patient sample were below national rates (60% and 25% of obese children, respectively).<sup>36,37</sup> Asthma, observed in 10.1% of the national pediatric population, was well documented in our series (27.0% of all patients and 28.3% of obese patients).<sup>38</sup> PCOS was observed in 3.5% of all patients and in 4.7% of obese patients in our cohort. Moreover, when patients were further stratified, there was a higher frequency of patients with PCOS with a BMI more than 40 kg/m<sup>2</sup>. This association has been reported by others.<sup>39</sup> These differences in comorbidity rates in our cohort may reflect regional, socioeconomic, or ethnic selection biases. In addition, the limited size of our study is likely to affect the accuracy of prevalence numbers for these conditions.

The presence of medical comorbidities did not translate into increased intraoperative anesthetic risk across BMI category. Within this series, there were no reports of anesthetic-related intraoperative adverse events or delayed waking, and the frequency of preoperative and intraoperative oxygen desaturations was similar across BMI categories ( $P > 0.05$ , both). Some studies within the anesthesia literature have suggested that obesity poses considerable risk in the occurrence of adverse anesthetic-related events.<sup>40,41</sup> This association was not observed in our cohort, echoing emerging studies suggesting that pediatric patients respond well to general anesthesia, regardless of BMI.<sup>42</sup>

### Limitations

The present study was limited in design, using a retrospective approach and a small sample size. Subgroup analyses using high BMI groups may also be underpowered. In addition, our cohort was selected from a single, tertiary care institution with demographic features that may not be generalizable to all patients undergoing bilateral reduction mammoplasty. Moreover, all patients in this study were treated by specialized, pediatric anesthetic and nursing staff, which may not be translatable to all locations performing this operation. It should also be emphasized

that the anesthetic risks and surgical complications reported were for a single operation type. The length of operative time for bilateral reduction mammoplasty is relatively short with limited metabolic or hemodynamic perturbations compared with many operations. Longer, more invasive operations might impact the effects that obesity has on anesthetic risk or the frequency of surgical and anesthesia-related adverse events.

## CONCLUSIONS

Obesity and obese surgical patients are becoming more common in this country. This is also true for adolescents and young adults. Comorbidities, such as insulin resistance, type II diabetes, hypertension, and sleep apnea, are strongly associated with this rise in average BMI.<sup>1</sup> In addition, surgical conditions, such as macromastia, are similarly associated.<sup>2–7</sup> However, obese adolescent and young adult patients undergoing reduction mammoplasty are not at significantly greater risk for anesthesia-related or perioperative adverse events as compared with healthy-weighted individuals. As such, weight-based policies for some operations and procedures requiring general anesthesia may be arbitrary and unnecessary.

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