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Childhood Obesity as a Risk Factor for Postoperative Complications: A Review

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Abstract

Background: childhood obesity is an increasingly common challenge in pediatric surgery and may increase perioperative and postoperative risk because of physiological and metabolic alterations. The clinical impact depends on age, obesity severity, associated comorbidities, and the type of surgical procedure.

Aim: to review current evidence on the relationship between childhood obesity and postoperative complications and summarize practical strategies for perioperative risk assessment and management in pediatric surgical patients.

Material and methods: a review of peer-reviewed studies evaluating postoperative outcomes in obese children undergoing surgery was conducted. Evidence on respiratory complications, wound healing, surgical-site infections, thromboembolic events, operative characteristics, and perioperative management was analyzed.

Results: childhood obesity is associated with an increased risk of perioperative respiratory complications, difficult airway management, surgical-site infections, wound complications, and longer operative time. However, obesity alone is not a consistent predictor of adverse outcomes, as risk is also influenced by obesity severity, comorbidities, surgical complexity, and perioperative care. Individualized perioperative management, including BMI assessment, screening for sleep-disordered breathing, optimized drug dosing, lung-protective ventilation, weight-adjusted antimicrobial prophylaxis, multimodal analgesia, and early mobilization, may reduce complications.

Conclusions: childhood obesity should be regarded as an important modifier of perioperative risk rather than an independent predictor of postoperative complications. Multidisciplinary assessment and individualized perioperative management are essential to optimize outcomes. Further prospective studies using standardized pediatric outcome measures are needed.

Keywords: childhood obesity; pediatric surgery; postoperative complications; surgical-site infection; anesthesia; respiratory adverse events; wound healing; risk stratification

1. Introduction

Childhood obesity has become a common chronic disease rather than an unusual comorbidity. The World Health Organization estimates that more than 390 million children and adolescents aged 5–19 years were overweight in 2022, including a large and growing population living with obesity [1]. In clinical practice, this epidemiologic shift means that children with excess adiposity now present for the full spectrum of operations: emergency appendectomy, fracture fixation, spinal fusion, adenotonsillectomy, vascular access, abdominal and thoracic surgery, plastic and reconstructive procedures, and metabolic surgery. Pediatric operating rooms therefore increasingly encounter physiologic and logistical problems that were previously concentrated in adult surgical populations.

Obesity in a growing child is not defined by the adult threshold of body mass index (BMI) greater than or equal to 30 kg/m². For children and adolescents, BMI must be interpreted relative to age and sex. In the commonly used US Centers for Disease Control and Prevention framework, obesity is defined as BMI at or above the 95th percentile, while severe obesity is often defined using an extended metric such as at least 120% of the 95th percentile or an absolute BMI threshold, whichever is lower [2]. The American Academy of Pediatrics emphasizes that obesity is a complex chronic disease requiring active evaluation for associated medical, behavioral, and social complications [3]. These definitions matter in perioperative research because a child at the 96th percentile and an adolescent with extreme obesity may have very different airway anatomy, cardiometabolic burden, mobility, and drug-distribution characteristics.

The phrase “obesity is a risk factor” can be misleading if it is interpreted as a uniform, procedure-independent effect. A broad 2024 systematic review and meta-analysis found higher pooled risks of surgical-site infection and wound dehiscence and longer operative times among pediatric patients with obesity, but the included studies varied substantially in design, operation type, obesity definition, and adjustment for confounding [5]. Large database studies likewise show that obesity is linked to selected 30-day complications, especially wound events, but not consistently to every measured outcome [6]. The central clinical question is therefore not whether obesity is universally harmful, but which complications become more likely, in which patients and procedures, through what mechanisms, and which elements of risk are modifiable.

2. Research materials and methods

This article integrates publicly accessible institutional guidance, open-access reviews, meta-analyses, and representative pediatric cohort studies. The discussion focuses on non-bariatric surgery, because the presence of obesity as a comorbidity is conceptually different from surgery performed specifically to treat severe obesity. Evidence from adolescent metabolic surgery is used only where it clarifies pharmacology, respiratory monitoring, or thromboprophylaxis.

3. Research results

3.1. Biological and Clinical Pathways Linking Obesity to Surgical Risk

Excess adipose tissue is metabolically active. In children with obesity, adipocyte hypertrophy and altered adipokine signaling may promote chronic low-grade inflammation, endothelial dysfunction, insulin resistance, and abnormal immune responses [30]. These changes do not create a single predictable postoperative syndrome, but they can reduce physiologic reserve during surgical stress. The inflammatory response to tissue injury must be sufficiently strong to control contamination and initiate repair, yet sufficiently regulated to avoid excessive edema, impaired microcirculation, and metabolic instability. Obesity may shift this balance through altered cytokine production, oxidative stress, and adipose-tissue hypoxia.

Wound healing can be impaired through several converging mechanisms. Adipose tissue has lower vascular density than well-perfused muscle, and thick subcutaneous layers increase the distance over which oxygen and antimicrobial agents must diffuse. Greater wound tension, larger dead space, moisture retention in skin folds, and tissue trauma from retraction may contribute to seroma, superficial dehiscence, and infection. These biological factors interact with technical factors: thicker abdominal or extremity walls can prolong access and closure, reduce visualization, and increase instrument torque. Longer operations in turn increase exposure time, tissue handling, heat loss, and the probability that antimicrobial concentrations fall below effective levels.

Respiratory physiology is another major pathway. Obesity reduces chest-wall compliance and functional residual capacity, particularly in the supine and anesthetized state. Oxygen consumption is often increased, while the oxygen reserve available during apnea is reduced. Fat deposition around the upper airway, adenotonsillar hypertrophy, and a high prevalence of sleep-disordered breathing increase the likelihood of airway obstruction during induction, emergence, and early recovery. These changes help explain why respiratory events are among the most reproducible perioperative associations in pediatric obesity [7-14].

Obesity-related comorbidities may be more important than BMI alone. Obstructive sleep apnea can increase sensitivity to sedatives and opioids; asthma and recent respiratory infection may add bronchial hyperreactivity; hypertension and left-ventricular remodeling reduce cardiovascular reserve; insulin resistance and type 2 diabetes impair immune function and glycemic control; metabolic dysfunction-associated steatotic liver disease may alter drug metabolism; and orthopedic pain or limited mobility may increase venous stasis. Consequently, two children with the same BMI percentile can have very different postoperative risk.

Drug dosing introduces an additional layer of uncertainty. Total body weight, ideal body weight, lean body weight, and adjusted body weight are not interchangeable. Lipophilic and hydrophilic drugs distribute differently, and maturation-dependent clearance changes across childhood. Reviews of pediatric obesity pharmacology conclude that there is no universal dosing rule and that both underdosing and toxicity are plausible when standard milligram-per-kilogram calculations are applied without a drug-specific rationale [11,29]. In the perioperative setting, this issue affects induction agents, neuromuscular blockers, opioids, acetaminophen, antibiotics, and anticoagulants.

3.2. Overall Evidence for Postoperative Complications

The most comprehensive recent pediatric synthesis concluded that obesity was associated with an approximately 1.6-fold pooled risk of surgical-site infection and with an increased risk of wound dehiscence, while operative time was also prolonged [5]. These findings are clinically plausible and consistent with multiple specialty-specific cohorts. Nevertheless, pooled estimates should be interpreted cautiously. Many studies use retrospective databases, capture only 30-day outcomes, and classify obesity from a single preoperative height and weight. Important confounders such as pubertal stage, fat distribution, glycemic status, socioeconomic disadvantage, operative complexity, and local infection-prevention protocols are inconsistently recorded.

A large pediatric surgical analysis by Train and colleagues found that obesity altered the pattern of 30-day morbidity, with an increased risk of wound complications in some specialties rather than a uniform increase in all complications [6]. A separate assessment of children undergoing surgical procedures found that obesity was associated with certain procedural patterns and that wound dehiscence was the complication most clearly linked with BMI category [31]. These studies reinforce a selective-risk model: obesity appears to amplify complications for which tissue perfusion, wound mechanics, respiratory physiology, or prolonged immobilization are biologically relevant.

The severity of obesity is also important. Studies that combine overweight, class I obesity, and severe obesity into a single group may dilute associations. Severe obesity is more likely to coexist with obstructive sleep apnea, hypertension, dyslipidemia, insulin resistance, and mobility limitations. Conversely, some database studies report little or no increase in overall morbidity among children with moderately elevated BMI. The apparent contradiction is partly methodological: a composite outcome may conceal an increase in wound infection if other events are rare or unaffected.

The evidence should therefore be presented to families without determinism. Obesity does not mean that a postoperative complication will occur, and the absolute rate of serious events remains low for many common pediatric procedures. At the same time, relative increases in uncommon events can be important when surgery is prolonged, contaminated, or associated with implants.

Counseling should include the specific complication profile of the planned operation rather than a generic statement that the child is “high risk.”

3.3. Respiratory and Anesthetic Complications

Prospective and retrospective pediatric anesthesia studies consistently identify obesity as a marker for respiratory difficulty. In a prospective study of more than 2,000 children, Tait and colleagues reported that children with obesity had more difficult mask ventilation, airway obstruction, major oxygen desaturation, and overall critical respiratory adverse events than normal-weight peers [7]. El-Metainy and colleagues similarly observed an increased incidence of perioperative adverse respiratory events in children with obesity undergoing elective general surgery, with particularly important associations in younger patients and in those with asthma or sleep apnea [14].

Severe obesity appears to carry greater risk than modest obesity. In children undergoing tonsillectomy, Gleich and colleagues found perioperative airway complications in 15% of severely obese children compared with 2% of matched normal-weight controls [8]. The association remained after adjustment for severe systemic disease and preoperative respiratory disorders. Earlier work by Setzer and Saade also found a modest increase in minor respiratory complications among anesthetized children with obesity [13]. The differences among studies likely reflect obesity severity, procedure type, age, airway instrumentation, and the prevalence of sleep-disordered breathing.

Adenotonsillectomy illustrates the interaction between obesity and the underlying indication for surgery. Children with obesity are more likely to have obstructive sleep apnea, but obesity is not always the best single predictor of postoperative deterioration. Nafiu and colleagues reported more perioperative complications and greater likelihood of admission among overweight and obese children presenting for adenotonsillectomy [15]. In a more recent cohort of obese children with obstructive sleep apnea, Lee and colleagues found that the oxygen saturation nadir and time spent below 90% saturation on preoperative polysomnography were stronger predictors of overnight postoperative respiratory complications than BMI percentile alone [16]. This distinction is clinically useful: obesity should trigger screening, but physiologic severity should guide monitoring intensity.

Abdominal fat distribution may provide information beyond BMI percentile. Nafiu and Onyewuche found that abdominal obesity, measured by waist circumference, independently predicted perioperative respiratory adverse events and was associated with prolonged post-anesthesia care unit stay [12]. This supports the concept that body habitus and fat distribution influence lung mechanics and airway risk, although waist measurements are not routinely incorporated into pediatric surgical pathways.

Perioperative management should reduce avoidable respiratory stress. Preoperative evaluation should ask directly about habitual snoring, witnessed apnea, restless sleep, morning headache, daytime somnolence, school difficulties, prior airway events, asthma control, and recent respiratory infection. Equipment should be selected for the child's actual size, including blood-pressure cuffs, operating tables, transfer devices, masks, oral airways, and appropriately long intravenous or regional-anesthesia needles. Preoxygenation in a head-up or ramped position, availability of video laryngoscopy, careful neuromuscular monitoring, complete reversal, and fully planned extubation are especially important in severe obesity [9-11].

Postoperatively, supplemental oxygen may conceal hypoventilation if monitoring relies on pulse oximetry alone. Children with severe obstructive sleep apnea, repeated airway obstruction, high opioid requirement, prolonged surgery, residual sedation, or significant desaturation may require extended observation or overnight admission. Opioid-sparing multimodal analgesia is attractive because obesity and sleep apnea can increase vulnerability to opioid-related respiratory depression. However, non-opioid drugs also require attention to dose ceilings and organ function. The goal is not to withhold analgesia but to use the lowest effective opioid exposure within a broader analgesic plan.

3.4. Surgical-Site Infection, Wound Dehiscence, and Healing

Surgical-site infection (SSI) is the postoperative domain in which obesity has shown one of the most consistent associations. The 2024 meta-analysis found a higher pooled SSI risk in pediatric patients with obesity [5]. Blackwood and colleagues, using a pediatric surgical cohort, reported an increased risk of SSI among overweight and obese children [18]. Earlier pediatric infection research also identified obesity as an independent risk factor alongside higher American Society of Anesthesiologists classification and selected antibiotic-prophylaxis patterns. These studies support the need for procedure-specific infection prevention rather than the assumption that pediatric patients are uniformly protected by young age.

Orthopedic and spinal procedures are particularly important because deep infection can require repeated debridement, prolonged antimicrobial therapy, or implant management. In adolescents undergoing posterior spinal fusion for idiopathic scoliosis, Katyal and colleagues reported infection rates of 11% in the obese group and 12% in the overweight group compared with 3% in the normal-weight group [19]. Other multicenter analyses have identified obesity as a significant predictor of infection after pediatric spinal deformity surgery [20,21]. The absolute risk remains influenced by diagnosis, number of fused levels, operative time, blood loss, neuromuscular disease, nutritional status, and institutional prevention bundles.

Foot surgery provides another specialty-specific example. A national pediatric database analysis found higher overall complications, wound complications, and SSI among children with obesity undergoing foot surgery [17]. The likely mechanisms include thicker soft-tissue envelopes, higher mechanical load across the incision, edema, reduced mobility, and difficulty maintaining dressings. These findings should inform wound surveillance and counseling, particularly when osteotomy, hardware, or prolonged non-weight-bearing is planned.

Plastic surgery data also demonstrate a dose-response pattern. In pediatric reduction mammaplasty, Fairchild and colleagues found obesity to be associated with a higher likelihood of postoperative adverse events and readmission [32]. A later national analysis reported increasing superficial SSI rates with increasing BMI and identified BMI and ASA class as important correlates [33]. These procedures involve long incisions, broad undermined surfaces, skin-fold moisture, and substantial wound tension, making them biologically sensitive to adiposity.

Prevention begins before incision. Height and weight should be measured rather than estimated. The antimicrobial agent, dose, infusion timing, need for redosing, and maximum dose should be checked against pediatric and institutional guidance. Because pediatric pharmacokinetic evidence is incomplete, weight-based dosing should be reconciled with adult maximum doses and procedure-specific recommendations rather than applied mechanically [29]. Intraoperative normothermia, careful tissue handling, hemostasis, appropriate oxygenation and perfusion, and reduction of unnecessary operative delay remain fundamental.

After surgery, clinicians should distinguish routine inflammatory change from early infection while maintaining a lower threshold for direct wound assessment when visualization is difficult. Families need clear instructions about spreading erythema, drainage, fever, wound separation, increasing pain, malodor, and dressing failure. Follow-up systems should account for the fact that deep skin folds or limited mobility may make self-inspection difficult. Wound risk should also be framed respectfully; stigmatizing language can impair communication and delay care.

3.5. Abdominal Surgery and Appendectomy: Why the Evidence Is Mixed

Appendectomy is the most frequently studied pediatric abdominal operation in relation to obesity, yet the literature remains inconsistent. The systematic review by Zavras and colleagues concluded that most included studies did not show statistically significant differences in overall complications between normal-weight and overweight or obese children, although some studies reported longer operative time, longer length of stay, or more SSI [22]. This heterogeneity is not surprising because appendicitis severity, perforation, timing of antibiotics, operative approach, and institutional discharge pathways strongly influence outcomes.

Several large analyses have nevertheless found clinically relevant associations. Delgado-Miguel and colleagues reported that overweight and obesity were associated with a higher risk of postoperative wound infection and dehiscence in children with acute appendicitis [23]. Michailidou and colleagues, using the ACS NSQIP Pediatric database, examined laparoscopic appendectomy and found obesity-related differences in operative metrics and selected outcomes [24]. Witt and colleagues reported that increasing BMI percentile was associated with greater complication risk and longer operative duration in pediatric gastrointestinal surgery, particularly appendectomy [34].

The signal is stronger in some cohorts of perforated appendicitis. Garey and colleagues found that children with obesity and perforated appendicitis had longer mean hospital stays and longer operations than non-obese children [25]. These results are biologically plausible because severe intra-abdominal infection magnifies the importance of ventilation, source control, antibiotic exposure, and wound mechanics. However, other studies found no significant effect of obesity on perforation, infectious complications, readmission, or length of stay [26].

The correct interpretation is not that one group of studies is necessarily wrong. Differences in BMI definitions, sample size, open versus laparoscopic surgery, severity adjustment, enhanced-recovery protocols, and thresholds for discharge can change results. Laparoscopy may reduce wound burden compared with open surgery, but increased abdominal wall thickness can make access and visualization more difficult. A recent open-access narrative review of pediatric abdominal surgery similarly concluded that obesity increases technical complexity and may increase selected complications while emphasizing the need for individualized perioperative pathways [35].

In practical terms, obesity should not delay urgent appendectomy. Instead, the team should anticipate difficult intravenous access, optimize positioning and ventilation, confirm antimicrobial dosing, use experienced laparoscopic technique, and plan postoperative respiratory and wound observation according to the child's comorbidities and disease severity. Perforation, sepsis, delayed presentation, and physiologic instability usually carry more immediate risk than BMI alone.

3.6. Orthopedic, Spine, and Mobility-Related Complications

Orthopedic surgery exposes several obesity-related vulnerabilities simultaneously: long procedures, prone or lateral positioning, pressure load, implants, reduced postoperative mobility, and mechanical stress on the operative site. In posterior spinal fusion, higher BMI has been linked with longer anesthesia, wound complications, infection, and greater resource use in several cohorts [19-21]. Neuromuscular scoliosis may carry additional risk because respiratory muscle weakness, impaired cough, nutritional abnormalities, and dependence for mobility coexist with obesity.

Positioning deserves explicit attention. Standard operating tables, frames, padding, and transfer devices have weight limits. Excess pressure over the face, abdomen, peripheral nerves, and bony prominences can cause skin injury, neuropraxia, ocular pressure concerns, or rhabdomyolysis during prolonged procedures. In the prone position, abdominal compression worsens venous pressure and ventilation; therefore, the abdomen should be allowed to hang freely when the surgical system permits. Team-based transfer planning protects both the patient and staff.

Venous thromboembolism (VTE) is rare in children but is not negligible in adolescents with multiple risk factors. In a large study of adolescent idiopathic scoliosis fusion, clinically significant VTE occurred in approximately 0.3% of patients, and obesity was associated with higher risk, although the absolute incidence remained low [28]. Other recognized contributors include older adolescent age, extensive fusion, thrombophilia, central venous catheters, trauma, malignancy, estrogen-containing medication, prolonged immobilization, and prior VTE.

Routine chemoprophylaxis for every child with obesity is not supported. Instead, institutions should use a pediatric VTE risk-assessment process that considers age, pubertal status, procedure duration, mobility, comorbidities, bleeding risk, and cumulative factors. Mechanical prophylaxis and early mobilization are low-risk strategies when feasible. Pharmacologic prophylaxis may be appropriate for selected high-risk adolescents, but dosing and monitoring require pediatric expertise, particularly in severe obesity.

3.7. Readmission, Length of Stay, and Health-Care Utilization

Postoperative harm is not limited to classic complications. Longer post-anesthesia care, unplanned admission, prolonged hospitalization, emergency-department visits, and readmission affect children and families even when no major morbidity occurs. Respiratory obstruction, nausea, pain-control difficulties, wound concerns, and limited mobility can delay discharge. Studies of adenotonsillectomy have found higher admission rates and longer stays among children with obesity [8,15], while abdominal studies report variable effects depending on disease severity and surgical approach [22-26].

In children with Crohn disease undergoing intestinal resection, Egberg and colleagues found that obesity was associated with an approximately twofold adjusted risk of 30-day readmission compared with average BMI [27]. This finding may reflect the interaction of obesity with chronic inflammation, immunosuppressive therapy, nutritional status, surgical complexity, and postoperative recovery rather than adiposity alone. It nevertheless highlights the importance of discharge readiness and early follow-up in medically complex children.

Resource utilization can also increase because standard equipment or ambulatory pathways are not designed for severe obesity. Additional staff may be needed for transfer; ultrasound may be required for vascular access; imaging can be technically limited; and postoperative beds must accommodate safe mobilization. These are not minor operational issues. Inadequate preparation can produce delays, repeated procedures, or unsafe workarounds.

Discharge planning should therefore begin before surgery. Families should receive realistic expectations regarding mobility, wound care, respiratory symptoms, medication dosing, and return precautions. For children with obstructive sleep apnea who use positive airway pressure, the plan should specify whether and when home equipment will be used. For orthopedic procedures, home access, bathroom safety, wheelchair dimensions, and caregiver lifting capacity may determine whether discharge is feasible.

3.8. Preoperative Risk Assessment and Optimization

The first preoperative task is accurate anthropometry. Measured height and weight should be plotted using an age- and sex-appropriate system, and severe obesity should be identified rather than hidden within a broad "obese" category. BMI is a screening metric, not a direct measurement of adiposity, and it may misclassify very muscular adolescents or fail to describe central fat distribution. Nonetheless, standardized BMI classification is essential for communication, equipment planning, and drug review [2-4].

History and examination should focus on conditions that change perioperative management. Respiratory questions should cover snoring, apnea, positive-airway-pressure use, exercise tolerance, asthma control, prior intubation, and previous postoperative desaturation. Cardiometabolic assessment should consider blood pressure, type 2 diabetes, symptoms of hypertension, dyslipidemia, fatty liver disease, and relevant laboratory results. The AAP guideline recommends systematic evaluation of obesity-related comorbidity rather than waiting for symptoms to become severe [3].

Elective surgery creates an opportunity for optimization, but unrealistic weight-loss requirements can delay beneficial treatment and reinforce stigma. There is little pediatric evidence that short-term preoperative weight reduction alone lowers postoperative complication rates. The more defensible approach is to optimize active disease: improve asthma control, initiate or reinforce sleep-apnea treatment, manage hypertension and glucose abnormalities, treat skin infection, correct relevant micronutrient deficiency, and encourage feasible physical conditioning and nutrition.

The decision to obtain polysomnography should follow the planned procedure and local guidelines. In children with obesity undergoing adenotonsillectomy for suspected obstructive sleep apnea, objective sleep testing can clarify disease severity and help plan postoperative admission [16]. For other procedures, a formal sleep study may not be practical, but a strong history of apnea or severe daytime symptoms should influence anesthetic strategy and postoperative monitoring.

Medication reconciliation must include stimulants, antihypertensives, insulin or other glucose-lowering therapies, corticosteroids, anticoagulants, and estrogen-containing contraceptives in adolescents. Drug dosing should be reviewed individually, with explicit documentation of the weight scalar and maximum dose when relevant [29]. Preoperative fasting instructions should be standard unless another indication exists; obesity alone does not justify prolonged fasting, which can worsen discomfort, dehydration, and insulin resistance.

Equally important is communication. Weight bias can cause families to avoid care and can lead clinicians to attribute every symptom to obesity. Neutral, person-first language—"a child with obesity" rather than "an obese child"—supports accurate history taking and shared decision-making. The purpose of discussing weight is to make surgery safer, not to assign blame.

3.9. Intraoperative Management Principles

Intraoperative preparation begins with a team briefing. The plan should address table capacity, transfer method, positioning, pressure protection, airway equipment, vascular access, antimicrobial prophylaxis, thromboembolism prevention, and postoperative destination. For severe obesity or complex surgery, the presence of experienced anesthesia, surgical, nursing, respiratory, and pharmacy staff may prevent delays and dosing errors.

Airway management should maximize oxygen reserve and first-pass success. Head-up preoxygenation, a ramped position, continuous capnography, appropriately sized masks and oral airways, and ready availability of video laryngoscopy are reasonable. Because children desaturate more rapidly than adults, repeated unsuccessful attempts are particularly hazardous. An explicit difficult-airway rescue plan is preferable to relying on BMI as a vague warning.

Ventilation should account for reduced functional residual capacity and the effects of pneumoperitoneum or prone positioning. Tidal volumes should be based on an appropriate size scalar rather than total body weight, with individualized positive end-expiratory pressure and recruitment when indicated. Excessive airway pressures, inadequate PEEP, and unnecessary high oxygen concentrations should be avoided. Hemodynamic monitoring and cuff selection must be accurate; a cuff that is too small can overestimate blood pressure and lead to inappropriate treatment.

Drug dosing requires the greatest caution at transitions—induction, neuromuscular blockade, reversal, analgesia, and antibiotic redosing. The pharmacokinetic literature repeatedly emphasizes that no single body-size descriptor is correct for all drugs [11,29]. Local dosing references and pharmacist support are valuable. Neuromuscular monitoring is especially important because residual blockade and upper-airway collapsibility are a dangerous combination.

Surgical technique should minimize tissue trauma and unnecessary operative duration. Minimally invasive surgery can reduce incision size and wound burden, but only when exposure and instrument length are adequate. Trocar placement may require modification, and the team should anticipate thicker abdominal walls. In open surgery, careful retraction, dead-space management, layered closure, and protection of skin folds are important.

Temperature, perfusion, and glucose should be managed without assuming that obesity protects against heat loss or metabolic instability. Long operations can still produce hypothermia, while insulin resistance may contribute to hyperglycemia during stress. Glucose monitoring should be individualized according to diabetes status, surgery duration, and clinical condition rather than performed reflexively in every child.

3.10. Postoperative Management and Surveillance

The early postoperative period is dominated by airway, ventilation, pain, nausea, and hemodynamic stability. Children with obesity should recover in a position that supports airway patency, often head-up or lateral when appropriate. Recurrent obstruction, apnea, rising carbon dioxide, excessive sedation, or persistent oxygen requirement should prompt reassessment rather than automatic discharge. Pulse oximetry is useful but should be interpreted with respiratory rate, work of breathing, mental status, and, when available, capnography.

Analgesia should be multimodal and individualized. Acetaminophen, nonsteroidal anti-inflammatory drugs when not contraindicated, local or regional anesthesia, dexmedetomidine, and other adjuncts can reduce opioid exposure. Weight-based calculations must respect maximum doses and organ function. In children with severe obstructive sleep apnea, opioid titration should be cautious, but undertreated pain is also harmful because it impairs breathing, mobilization, sleep, and cooperation.

Wound surveillance should be adapted to the procedure and body habitus. Dressings must remain secure in areas exposed to moisture or friction. Skin-fold hygiene, pressure-area checks, and caregiver education are essential. After orthopedic procedures, casts and braces should be checked for fit and pressure because soft-tissue compression can change as swelling evolves.

Mobilization and VTE prevention should be planned rather than left to chance. Adequate analgesia, physical therapy, properly sized mobility devices, and early removal of unnecessary lines all support ambulation. Adolescents with multiple VTE risk factors require reassessment when postoperative complications prolong immobilization, because the risk profile can change after surgery.

Discharge criteria should be physiologic and functional. A child should demonstrate stable ventilation, acceptable pain and nausea control, safe mobility or transfer, medication tolerance, and a feasible home-care plan. Same-day discharge may still be appropriate for many children with obesity, but severe sleep apnea, repeated respiratory events, complex comorbidity, prolonged surgery, or unreliable home observation may justify admission.

3.11. Research Limitations and Future Directions

Current evidence is limited by retrospective design, inconsistent definitions, and low event rates. BMI percentile is often the only obesity measure, although central adiposity, body composition, and metabolic health may better predict respiratory or wound risk. Studies also differ in whether they adjust for surgery type, ASA classification, comorbidities, urgency, and operative duration. As a result, obesity may appear to be an independent risk factor in one model and a proxy for procedure complexity or comorbidity in another.

Composite outcomes are especially problematic. A combined endpoint of "any complication" can obscure a clinically important rise in SSI if other complications are unchanged or less frequent. Future studies should report respiratory events, superficial and deep SSI, dehiscence, thromboembolism, readmission, reoperation, and length of stay separately. Severity of obesity should be stratified using contemporary extended BMI metrics.

Prospective multicenter research should evaluate practical interventions: standardized sleep-apnea screening, weight-appropriate antimicrobial protocols, pharmacy-supported dosing, enhanced positioning pathways, opioid-sparing analgesia, remote wound follow-up, and targeted VTE assessment. The key question is not merely whether obesity predicts risk, but whether a defined perioperative pathway reduces that risk.

Research should also address equity. Obesity prevalence and surgical access are shaped by socioeconomic conditions, food environment, chronic stress, disability, and unequal access to specialist care. A child should not be denied timely surgery because a health system lacks suitable equipment or because weight-management resources are unavailable. Risk reduction must be paired with respectful, equitable access.

4. Conclusion

Childhood obesity is a clinically meaningful modifier of perioperative risk, but it is not a universal predictor of poor outcome. The strongest pediatric evidence supports increased vulnerability to respiratory adverse events, airway obstruction, surgical-site infection, wound dehiscence, and prolonged operative time in selected procedures. Risk is greatest when severe obesity coexists with obstructive sleep apnea, asthma, metabolic disease, long or contaminated surgery, implants, and reduced mobility.

The evidence is procedure-specific and sometimes contradictory. Appendectomy studies demonstrate why BMI should not replace clinical judgment: some cohorts report longer operations, infections, and length of stay, while others find no significant difference after accounting for disease severity and surgical approach. Therefore, necessary surgery should not be postponed solely because a child has obesity.

A structured perioperative pathway is more useful than a risk label. Accurate anthropometry, comorbidity screening, individualized drug dosing, appropriate equipment, planned airway management, lung-protective ventilation, infection prevention, opioid-sparing analgesia, mobilization, and selective postoperative monitoring can address the mechanisms most likely to cause harm. Pediatric obesity should trigger preparation, not stigma.

Disclosure

Author's contribution

Conceptualization JS and ZO; methodology KK; software MGS; check KW, ND and YL; formal analysis HK; investigation KJ; resources JS; data curation ZO; writing -rough preparation JS; writing -review and editing JS; visualization KK2; supervision MGS; project administration JS. All authors have read and agreed with the published version of the manuscript

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Conflicts of Interest

The authors declare no conflict of interest.

Declaration on the Use of Artificial Intelligence

AI-assisted tools were used exclusively for linguistic refinement. The authors take full responsibility for the scientific content, interpretation of the data, and final version of the manuscript

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