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# Increased complications in pediatric surgery are associated with comorbidities and not with Down syndrome itself



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### ABSTRACT

**Background:** Down syndrome (DS) is a genetic condition associated with multiple comorbidities. While physicians may perceive that DS patients have more postoperative complications, the literature remains unclear. This study compared postoperative complications for children with and without DS who underwent abdominal and thoracic procedures.

**Methods:** The National Surgical Quality Improvement Program Pediatric was queried for patients aged <18 years, who underwent abdominal and noncardiac thoracic operations (by Current Procedural Terminology codes) from 2012 to 2015. The analysis compared patients based on the presence or absence of DS. The primary outcome was a composite of all postoperative complications as defined by the National Surgical Quality Improvement Program Pediatric. The analysis utilized chi-square, Student's *t*-test, and univariate and multiple logistic regression.

**Results:** There were 91,478 patients included, of which 1476 (1.6%) had a diagnosis of DS. Patients with DS had higher rates of preoperative nutritional support (38.8% versus 15.0%), developmental delay (61.9% versus 10.4%), and cardiac risk factors (76.5% versus 13.8%). The overall rate of postoperative complications was 11.1%, with a greater proportion in DS patients (16.2% versus 10.8%,  $P < 0.001$ ). On univariate analysis, DS was associated with increased odds of postoperative complications (odds ratio 1.6 95% confidence interval 1.4–1.9) compared with the non-DS group; however, DS was not a risk factor after adjusting for other covariates (adjusted odds ratio 0.86 95% confidence interval 0.7–1.1).

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**Conclusions:** A higher proportion of postoperative complications were observed in patients with DS. However, after adjusting for other risk factors, DS was not an independent risk factor. The increased rate of complications is likely related to the presence of multiple comorbidities in DS.

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## Introduction

Down syndrome (DS) is a genetic condition caused by a trisomy of chromosome 21. This syndrome is associated with multiple comorbidities, such as respiratory and seizure disorders, congenital heart disease, hematologic and endocrine disorders, intellectual disability, and intestinal atresias.<sup>1,2</sup> Literature has shown that patients with DS have a shorter average life expectancy than patients without DS.<sup>3</sup> In addition, there is a perception among surgeons that patients with DS have a higher risk of postoperative complications; however, the existing literature demonstrates mixed results.<sup>4–10</sup>

Although DS is the most common chromosomal abnormality, it is still relatively infrequent with an incidence of 1 per 1,000 live births worldwide. Thus, it remains a challenge to accumulate large cohorts of patients to evaluate risks associated with DS. The American College of Surgeons National Surgical Quality Improvement Program Pediatric (NSQIP-P) is a clinical registry that collects perioperative variables and 30-day postoperative outcomes.<sup>11–13</sup> Data registries, such as NSQIP-P, allow for larger sample sizes that may facilitate analyses of patients with relatively rare medical conditions. Use of standardized variable definitions and data collection methods allows for comparison across multiple hospitals.

It remains unclear whether children with DS who undergo gastrointestinal and noncardiac thoracic procedures are at increased risk for postoperative complications. The aim of this study was to investigate whether DS is a risk factor for postoperative complications and to determine what specific factors are associated with complications in this population. We hypothesized that patients with DS would have a higher incidence of postoperative complications than children without the condition.

## Methods

### Data source and patients

A retrospective review of the NSQIP-P data was performed using Participant Use Files from 2012 to 2015. All patients aged <18 y who underwent gastrointestinal or thoracic surgery based on Current Procedural Terminology (CPT) codes were included. Diagnosis codes were utilized to determine which patients carried a diagnosis of DS or trisomy 21.

Trained surgical clinical reviewers abstract patient-level clinical data for the NSQIP-P program. Over 200 perioperative variables, including demographics, comorbidities, laboratory values, case type (by surgical specialty and CPT codes), and 30-day outcomes, are provided. The NSQIP-P uses rigorous variable definitions and random audits to optimize reliability, data validity, and definition compliance. Systematic sampling of nonconsecutive cases is performed across all pediatric

surgical specialties at each participating institution per a specified protocol to limit bias and ensure capture of a variety of procedures.<sup>13,14</sup>

### Outcomes

The primary outcome was a composite binary variable of any postoperative complication within 30 d of surgery. This included all types of surgical site infection, wound dehiscence, pneumonia, urinary tract infection, central line-associated blood stream infection, acute renal failure, postoperative sepsis, reintubation, pulmonary embolism, venous thromboembolism, cardiac arrest, cerebral intraventricular hemorrhage, stroke, seizure, peripheral nerve injury, coma >24 h, reoperation, bleeding requiring transfusion, graft/prosthesis/flap failure, and death. Mortality was included in the composite outcome because it was a rare occurrence in this cohort and a competing outcome with the other postoperative complications. Each variable included in the composite outcome was based on the American College of Surgeons NSQIP-P User Guide for the 2015 Participant Use File.

### Statistical analysis

Stata 14 (College Station, TX) statistical software was utilized for descriptive statistics, as well as chi-square, Student's *t*-test, and logistic regression analysis. A *P*-value of <0.05 was significant for any inferential testing regarding baseline characteristics and outcomes. Univariate logistic regression was used to evaluate whether an association between each variable and any postoperative complication existed. A multiple logistic regression model was developed utilizing variables with a *P*-value of <0.20 on univariate analysis. The number of comorbidities associated with postoperative complications was determined for each patient. Logistic regression was utilized to evaluate the association between the presence of postoperative complications, DS, and the number of comorbidities. This model was then used to predict the probability of complications in patients with and without DS given the number of comorbidities present.

## Results

A total of 91,478 patients under age 18 underwent gastrointestinal or noncardiac thoracic surgery during the study period (2012–2015) with a mean age of  $7.2 \pm 6.1$  y. Of those patients, 57.8% were male, and most were Caucasians (70.9%). Intestinal surgery was the most common (53.5%), followed by gastric surgery (18.9%). A diagnosis of DS was present in 1476 (1.6%) patients.

When comparing patients with and without DS, no significant differences were observed in gender, race, ethnicity, or preterm birth (Table 1). Patients with DS were younger and

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