The relationship between preoperative nutritional state and adverse outcome following abdominal and thoracic surgery in children: Results from the NSQIP database

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ABSTRACT

Introduction: Anthropometric measurements can be used to define pediatric malnutrition. Our study aims to: (1) characterize the preoperative nutritional status of children undergoing abdominal or thoracic surgery, and (2) describe the associations between WHO-defined acute (stunting) and chronic (wasting) undernutrition (Z-scores < −2) and obesity (BMI Z-scores > + 2) with 30-day postoperative outcomes.
Methods: We queried the Pediatric NSQIP Participant Use File and extracted data on patients' age 29 days to 18 years who underwent abdominal or thoracic procedures. Normalized anthropometric measures were calculated, including weight-for-height for <2 years, BMI for ages ≥2 years, and height for age. Logistic regression models were developed to assess nutritional outlier status as an independent predictor of postoperative outcome.
Results: 23,714 children (88% ≥2y) were evaluated. 4272 (18%) were obese, while 2640 (11.1%) and 904 (3.8%) were stunted and wasted, respectively, after controlling for gender, ASA/procedure/wound classification, preoperative steroid use, need for preoperative nutritional support, and obese children had higher odds of SSIs (OR 1.29, 95% CI 1.1–1.5, p = 0.001), while stunted children were at increased risk of any 30-day postoperative complication (OR 1.16, 95% CI 1.0–1.3, p = 0.036).
Conclusion: Children who are stunted or obese are at increased risk of adverse outcome after abdominal or thoracic surgery.
Level of Evidence: III

Malnutrition is increasingly prevalent among hospitalized children [1,2]. Several anthropometric measurements have been used to objectively assess nutritional status in children. The World Health organization (WHO) classifies standardized anthropometric measurements (Z-scores) into "wasting" (low weight for height), "stunting" (low height for age), and "overweight/obese" (high weight for height or BMI) [3,4]. Despite evidence that nutritional state is a valid predictor of most child health outcomes, a paucity of evidence exists to characterize the relationship between preoperative nutritional state and postoperative outcomes in children undergoing surgery [5–7]. Several studies have shown a correlation between

malnutrition and increased postoperative morbidity and mortality in pediatric cardiac patients [8–14], and a predictive logistic regression model for 30 day mortality following pediatric cardiac surgery, which included weight as a covariate has been developed [15].

Among pediatric urology patients, weight less than fifth percentile was found to be independently predictive of postoperative complications [16]. A single institution study of children undergoing posterior spinal fusion identified BMI greater than 95th percentile as an independent predictor of surgical site infection [17]. A cohort study of children undergoing surgical procedures at participating American College of Surgeons' NSQIP Pediatric hospitals identified extremes of weight percentile (<5th, >95th) to be predictive of postoperative complications among non-cardiac pediatric surgery patients [18].

The purpose of our study is to: 1) characterize the preoperative nutritional states of children undergoing abdominal or thoracic surgery; and 2) describe the associations between WHO-defined acute and chronic undernutrition and obesity with 30-day postoperative outcomes.

1. Methods

1.1. Study design and data source

We queried the American College of Surgeons National Surgical Quality Improvement Program-Pediatric (ACS-NSQIP-P) Participant Use File (PUF) during the period from 2012 to 2014 and extracted data on patients 29 days to 18 years of age. This dataset includes high-quality clinical data collected by trained abstractors in participating hospitals worldwide. Patients were identified using the index procedure current procedural terminology (CPT) codes. Only patients who underwent general abdominal or thoracic procedures were included.

1.2. Clinical variables

We extracted data on demographics, preoperative comorbidities, need for preoperative nutritional support, and steroid use. Details on surgical procedures included case type, operative time, American Society of Anesthesiologists (ASA) risk class and wound classification. Standardized anthropometric measurements including height for age, weight-for-height (children <2 years), body mass index (BMI) (children ≥2 years) were generated using publicly available Centers for Disease Control and Prevention (CDC) and WHO algorithms. After excluding patients with missing anthropometric measurements, the cohort was divided into the following subgroups: 1) height for age: stunted (Z-score < −2), normal (−2 < Z-score < 2), and tall (Z-score > 2); and weight for height / BMI: wasted (Z-score < −2), normal (−2 < Z-score < 2), and obese (Z-score > 2).

1.3. Outcomes

We extracted 13 dichotomous post-operative occurrences, and length of stay (LOS) as outcomes of interest. The dichotomous outcomes were analyzed individually and as a component of "composite morbidity" which was defined as the occurrence of one or more of the following within 30 days of operation: superficial or deep surgical site infection (SSI), deep wound dehiscence, pneumonia, unplanned intubation, pulmonary embolism, renal insufficiency, renal failure, urinary tract infection, cardiac arrest, need for blood transfusion, venous thrombosis, sepsis, catheter associated infection and mortality.

1.4. Statistical analysis

Descriptive statistics were generated to characterize the cohort using mean and median for continuous data and frequency for categorical data. Two different analyses were performed according to the classification used to segregate the cohort: classification based in height for age Z-score or based on weight for height/BMI Z-scores. Baseline characteristics as well as outcomes were compared using Pearson's chi-squared and Analysis of variance (ANOVA) tests as appropriate.

Logistic regression models were developed to assess preoperative nutritional state as an independent predictor of SSI, deep wound dehiscence, and composite morbidity. Multivariate regression models included sex, ASA class, wound classification, case type (elective vs. emergency), preoperative nutritional support and steroid use.

Data processing and statistical analysis were conducted using IBM SPSS Statistics-version 20 (IBM, New York, USA). A p value of <0.05 is considered to be statistically significant.

2. Results

31,082 children were identified in the database, of which 7368 were excluded because of missing anthropometric data. Among 23,714 children analyzed, 20,956 (88.3%) were ≥2 years of age, and 9946 (41.9%) were female. 4272 (18%) were obese, while 2640 (11.1%) and 904 (3.8%) were stunted and wasted, respectively.
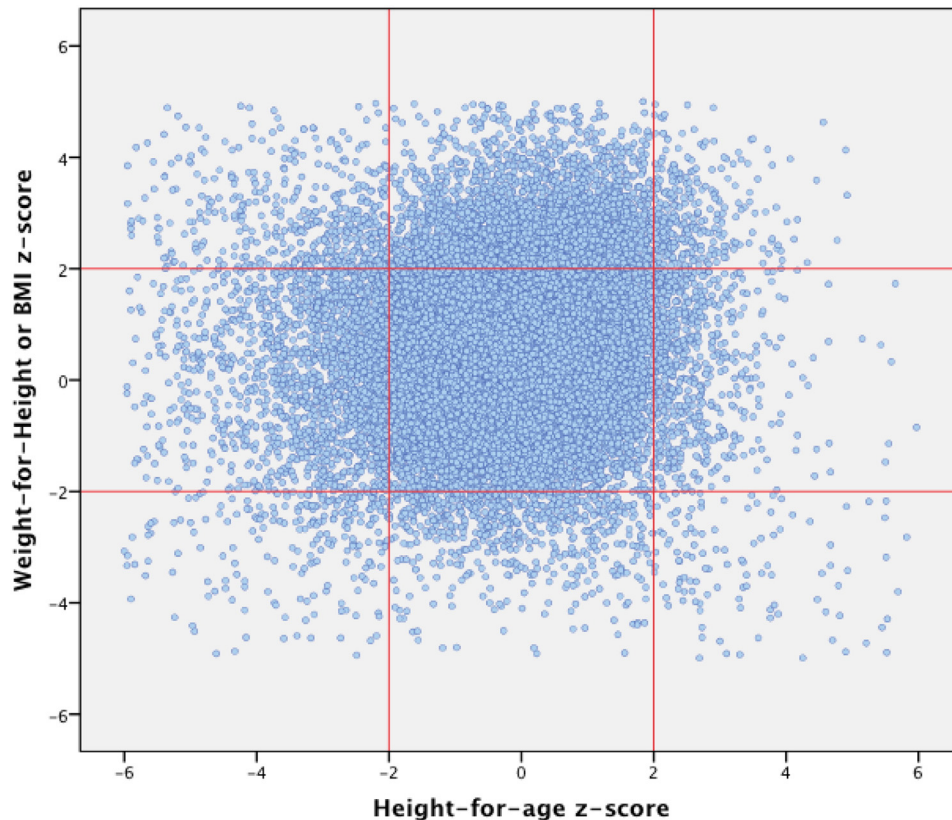
Fig. 1. Scatter plot showing the distribution of the entire cohort based on their height for age Z-score (X axis) and weight for height/BMI Z-scores (Y axis). Note skewness of population towards low height for age and higher weight for height/BMI.