Independent Review Article

Review of nutritional assessment and clinical outcomes in pediatric surgical patients: Does preoperative nutritional assessment impact clinical outcomes?

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A B S T R A C T

Introduction: Malnourished adult patients who undergo surgical procedures tend to have worse clinical outcomes compared to well-nourished patients. In the pediatric surgical patient, nutritional assessment is considered a critical aspect of the initial evaluation, but a correlation between preoperative malnutrition and poor surgical outcomes is not clear. We hypothesized that an evidence-based review would reveal that measures of nutritional assessment in children would not correlate pre-operative malnutrition with poor surgical outcomes.

Materials and Methods: A search of major English language medical databases (Medline, Cochrane, SCOPUS) was conducted for the key words nutritional assessment, pediatric, children, surgery, and outcomes. All methods of nutritional assessment in pediatric surgery were evaluated for their relevance and relation to outcomes after surgery. The Oxford Center for Evidence Based Medicine (CEBM) classification for levels of evidence was used to develop grades of clinical recommendation for each variable studied.

Results: 35 articles were evaluated after an exhaustive literature search, of which six met inclusion criteria for this review. There is a paucity of high quality evidence correlating preoperative malnutrition in pediatric surgical patients with clinical outcomes. Factors contributing to the low level of evidence include a lack of high quality randomized controlled trials, a lack of consensus in study design and methods, and utilization of incongruous methods of nutritional assessment, including methods that may be unproven in the study population.

Conclusion: Larger multi center randomized studies are needed to offer higher level of evidence to support nutritional intervention prior to major elective pediatric surgery.

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Maldnourished adult patients who undergo surgical procedures tend to have worse clinical outcomes compared to well-nourished patients [1]. Preoperative malnutrition is associated with longer hospital length of stays, worse clinical condition, and increased healthcare related costs [2]. Numerous studies during the last 30 years have clearly demonstrated that malnutrition is a risk factor for postoperative complications in patients undergoing major abdominal surgery [3]. Preoperative nutritional assessment should theoretically help predict clinical outcomes, but it is problematic since some markers of malnutrition may be multifactorial in etiology, especially in the chronically ill patient.

In the pediatric surgical patient, nutritional assessment is considered a critical aspect of the initial evaluation, but a correlation between preoperative malnutrition and poor surgical outcomes is not clear. In 1981, Cooper demonstrated that there was a remarkably high prevalence of acute protein calorie malnutrition among hospitalized pediatric and pediatric surgical patients, but speculated as to whether perioperative nutritional support would influence morbidity and mortality [4]. Recent literature reinforces the concept that adequate nutritional support in critically ill children on mechanical ventilation improved 60-day mortality [5].

The metabolic response of the child or infant to operative stress is physiologically similar to the stress response in adults although it is altered in degree by the type of insult, its magnitude and duration, the metabolic reserve, and the capacity to mobilize reserves. In adults, major surgery or trauma causes a brief period of depressed metabolic rate followed by a phase of increased energy expenditure [6]. In newborn infants, major abdominal surgery causes a moderate and immediate elevation of oxygen consumption and resting energy expenditure, but a rapid return to baseline after 12–24 h, with no further increase in energy expenditure in the first 5–7 days. The response in children and infants may be due to a diversion of energy...
from growth to repair of tissues and recovery [7,2]. However the latter statement must be tempered by the fact that post-operative care strategies in this population such as mechanical ventilation (that decrease work of breathing), incubators (that reduce energy required to replace insensible energy losses), and use of sedation/opiates (that reduce activity associated daily energy requirements) significantly reduce energy requirements and may be responsible for the lower energy expenditure noted.

Several barriers exist to evaluating the effect of preoperative malnutrition on surgical outcomes in infants and children. This includes a lack of consensus for nutrition assessment techniques, and a paucity of high quality, randomized, controlled trials correlating a statistically significant relationship between preoperative malnutrition and outcomes. We hypothesized that an evidence-based review would reveal that measures of nutritional assessment in children would not correlate pre-operatively with poor surgical outcomes.

1. Materials and methods

A search of major English language medical databases (PUBMED, MEDLINE, Cochrane) was conducted for articles that preoperatively assessed the nutritional status of pediatric surgical patients and correlated them with clinical outcomes. Key words included nutritional assessment, malnutrition, preoperative assessment, pediatric, children, surgery, and outcomes. The only filters set were for age group, which included children from newborn to 18 years of age. All articles including randomized controlled trials (RCT), cohort studies, case-control studies, case reports, literature reviews, and meta-analyses were considered. These articles were critically evaluated to determine the level of evidence.

To meet inclusion criteria, the article must have measured the nutritional status of the patient in the perioperative period, by any means, and correlated that data with clinical outcomes in the perioperative period (Table 1). Articles were excluded if they contained adult data, did not measure nutritional parameters preoperatively, were informative articles without new data, did not isolate data for surgical patients, did not include clinical outcomes data, or focused only on metabolic or biochemical changes in the post-operative period.

The Oxford Center for Evidence Based Medicine (CEBM) classifications for levels of evidence was used to develop grades of clinical recommendation for each variable studied and its rationale addressed in the ‘review of scientific evidence’ that follows a brief summary of each article reviewed (Table 2). A grade A recommendation was used for consistent level 1 studies, Grade B for consistent level 2 or 3 studies or extrapolations from level 1 studies, Grade C for level 4 studies or extrapolations from level 2 or 3 studies, and Grade D representing level 5 evidence or inconclusive studies of any level. Only studies involving pediatric surgical patients were reviewed.

2. Results

35 articles were evaluated in detail after an exhaustive literature search, of which six [10,12,13,22,23,25,29] met inclusion criteria for this review. Three articles were retrospective chart reviews [22,25,29], two articles were prospective controlled cohort studies [10,12], and one article was a 2-center cohort study [13]. The two-center prospective study took place in California and Guatemala [13], while the other two prospective studies were conducted in Canada [12] and Brazil [10]. The retrospective studies were conducted in the USA [29], Japan [25], and Mexico [22].

2.1. Patient demographics

The prospective study by Secker et al. [12] utilized a heterogeneous cohort of pediatric general and non-cardiac thoracic surgery patients of various ages, from 31 days to 17.9 years of age, undergoing surgery on a non-emergent basis [12]. Five articles [10,13,22,25,26] meeting inclusion criteria studied infants and toddlers undergoing surgical repair of congenital heart defects (Table 1).

2.2. Clinical outcome measures

The clinical outcome measures among the five articles studying infants undergoing congenital heart defect repair were similar [10,13,22,25,29]. They favored measures of mortality, hospital and ICU length of stay, and duration of mechanical ventilation in relation to the nutritional status of the patient at the time of operation (Table 2).

The article by Secker et al. [12] measured nutrition associated complications and classified them as major or minor. These included unplanned reoperation, readmission, infectious and non-infectious complications, and non-prophylactic use of antibiotics, in addition to hospital length of stay. Patients were followed for 30 days postoperatively for nutrition-associated complications [12].

2.3. Modalities of nutritional assessment

2.3.1. Overview

Numerous options are available to assess the nutritional status of pediatric surgical patients, broadly classified into objective and subjective modalities. There are two general classes of objective assessment (1), anthropometric measurements of body composition and (2) measurement of serum protein levels. Subjective assessments include questionnaires, which incorporate both subjective data from the patient history, and anthropometric body composition measurements. These include the Subjective Global Nutritional Assessment (SGNA), utilized by Secker et al. [12] and the Mini Nutrition Assessment (MNA), which was not utilized in the reviewed articles and thus will not be further discussed. Both general classes of nutritional assessment are subject to observer error or are influenced by changes in body composition induced by non-nutritional factors [9].

2.3.2. Anthropometric nutritional assessment modalities

2.3.2.1. Background. Anthropometric assessment of nutritional status is an objective assessment tool involving measurement of body dimensions and composition to evaluate nutritional status and growth. The most basic are age, height, weight, and head circumference. This is a common and inexpensive method to assess growth and nutritional status, which can also be charted on a standardized growth curve for comparison with normative data. Other measurements can also be utilized, such as skin fold thickness, mid-arm circumference, and handgrip strength. Once patients are over 2 years of age, weight to length ratio can best be reflected using body mass index (BMI), or expression of BMI as a Z-score [14,20,21].

Waterlow’s criterion is an objective method of assessing the patient for both acute and chronic malnutrition. Weight for height as an indicator of the present state of nutrition (stunting), and height for age as an indicator of past nutrition (wasting) [30,31]. Acute changes in nutritional status should have a more immediate effect on weight than length or height, and chronic malnutrition usually impacts both the height and weight of the child [14,21].

2.3.2.2. Review of scientific evidence. There was a statistically significant correlation between anthropometric measures of nutritional assessment and clinical outcomes in four articles included in this review (Table 1). The anthropometric modalities that each of the authors found to be significant were incongruent, as was the statistically significant nutrition associated clinical outcome. There
were no consistent findings among the articles that would upgrade their level of recommendation (Table 2).

Among the five articles studying congenital heart defect patients, four anthropometric parameters show a statistically significant correlation with post-operative clinical outcomes. These included weight for age (W/A) at birth, Body Mass Index (BMI) Z-Score, Triceps Skin Fold Thickness (TSFT), and length for age (L/A) or height for age (H/A). Secker et al. [12] found a statistically significant association between height for age and prolonged length of stay among their heterogeneous study population of pediatric patients undergoing both abdominal and non-cardiac thoracic surgical procedures on a non-emergent basis. Height for age is generally considered an indicator of the patient’s long-term or previous nutritional status [20]. Thus, these results suggest that patients with chronic malnutrition had increased length of stays. H/A was also utilized for assessment in Toole et al. [29], whereby a statistically significant correlation was made among some study groups.

Toole et al. [29] conducted a retrospective study utilizing Waterlow’s criteria to assess preoperative nutritional status and cardiovascular risk of infants and children undergoing surgical repair of congenital heart defects. The authors stratified their study cohorts as not malnourished, acute malnourishment, and chronic malnourishment. Then, they further subdivided those groups into mildly, moderately, and severely malnourished (Table 1). They found no statistically significant correlation with acute malnutrition (defined using weight for length), but did discover statistically significant correlations with chronic malnutrition (Length for age). They found that Length for age that is 90%–95% of median values, defined as “mild chronic malnutrition”, was associated with longer hospital length of stay compared to patients without malnutrition. In severe chronically-malnourished children, length for age that is 85% or less of median values, was associated with longer hospital length of stay and longer cardiovascular intensive care unit length of stay, but only when compared to the moderate chronically malnourished group. And paradoxically, moderate chronically-malnourished children had fewer days of mechanical ventilation, shorter hospital length of stay, and shorter cardiovascular ICU length of stay when compared to all groups, including the group that was not malnourished [29]. The findings in the Toole et al. [29] article were not replicated by two other articles that also utilized length for age [10,25].

W/A at birth < 90% showed a correlation with hospital length of stay in the article by Vivanco-Munoz et al. [22], but this finding was not reproduced by two other articles that also included W/A in their assessments [10,25]. Similarly, Vivanco-Munoz et al. found a correlation between BMI Z-score > −2 (The negative Z-score implies the number of standard deviations the data is below the mean) and mortality, but BMI was not utilized by any of the other congenital heart defect articles. Secker and colleagues assessed BMI in non-cardiac patients, but no correlation with clinical outcomes was found [12].

The prospective study by Radman et al. [13] found a correlation between preoperative TSFT and Intensive Care Unit (ICU) length of stay, duration of mechanical ventilation, and duration of continuous inotropic infusion. This was a 2-center prospective cohort study that utilized a resource abundant facility in California, and a resource deficient facility in Guatemala. The statistically significant findings were only at the resource abundant arm, they were not reproduced in the resource deficient facility. Secker et al. [12], found no correlation with TSFT and postoperative clinical outcomes in their study of non-cardiac surgery patients. TSFT was not utilized as an assessment modality by the authors of the other articles included in this review.

2.3.3. Biochemical nutritional assessment modalities

2.3.3.1. Background. Serum levels of albumin, prealbumin, transferrin, and retinol-binding protein have been utilized in adults to assess protein calorie malnutrition. The half-life of albumin is longer than prealbumin, 18–20 days versus 2 days, this fact was used by some authors to assess acute versus chronic malnutrition [14,15]. The application of this nutritional assessment modality in young children and infants is controversial. A multitude of non-nutritional variables impacts the predictive value of serum protein levels [14,15,21]. They lack specificity under conditions of acute metabolic stress and inflammation secondary to increased catabolism, cytokine induced endothelial permeability, fluid changes, and hepatic reprioritization of acute phase protein synthesis [15]. They are likely more predictive of inflammation and morbidity rather than nutritional status [1,16–19]. Additionally, there are no established normal ranges for prealbumin and retinol-binding proteins in young children [10,14,15,21]. Therefore, these levels must be interpreted in the context of the patient’s nutritional and medical history.

2.3.3.2. Review of scientific evidence. In 1993, Chwals et al. [11], found that infants with lower prealbumin levels prior to surgery had a higher risk of mortality within 30 days of surgery, and, that infants with persistently low prealbumin levels beyond postoperative day 4 had the highest mortality risk. However, prealbumin was not thought to be an indicator of malnutrition in these patients, but rather a marker of the metabolic stress changes due to disease induced injury [11].

Preoperative serum albumin levels were found to have a statistically significant correlation with clinical outcomes in all three articles that included this assessment in their study [10,12,13]. In the study by Leite et al. [10], 30 consecutive high-risk surgical patients, median age 12 months, were compared with 30 healthy pediatric patients undergoing hernia repairs. Preoperative albumin levels less than 3.0 g/dl were associated with increased postsurgical infections and increased mortality [10].

In the prospective review by Secker et al. [12], preoperative albumin levels were associated with increased infectious complications, minor complications, length of stay, and non-prophylactic antibiotic use. The author emphasizes that mean serum albumin concentrations among the 3 study groups (well-nourished, moderately malnourished, and severely malnourished) were all within normal limits. The level that was associated with increased infectious complications was in the range of 4.0 g/dl [12].

Radman et al. [13] utilized serum albumin and prealbumin to evaluate preoperative nutritional status of Children admitted to the pediatric ICU after surgical repair of congenital heart defects (median age 10.2 months). Low serum albumin levels were classified as representing chronic malnutrition, and low serum prealbumin was acute malnutrition. Serum albumin levels less than 3.2 g/dl and serum prealbumin levels less than 12.1 mg/dl were associated with a statistically significant increase in duration of continuous inotropic support postoperatively, and increased length of mechanical ventilation. These data were only statistically significant after the authors made adjustments to the age, gender, and Risk Adjustment for Surgery for Congenital Heart Disease Score (RACHS) scores of the cohort, and were only significant at one of the two study sites. In this high-risk group, it may be difficult to isolate nutritional deficits alone as the factor responsible for altered serum protein levels as a multitude of factors other than nutritional status may have been contributory.

2.3.4. Other objective nutritional assessment modalities

2.3.4.1. Prognostic nutritional index

2.3.4.1.1. Background. The Prognostic Nutritional Index (PNI) is a nutritional assessment tool described by Mullen et al. [32] in 1979. It was designed to predict malnutrition associated morbidity and mortality in adult surgical patients. The authors discovered that three factors measured in the preoperative period, serum albumin less than 3.0 g/dl, transferrin less than 220 mg/dl, and delayed hypersensitivity reactions in anergic patients, identified a group of patients at
<table>
<thead>
<tr>
<th>Study</th>
<th>Year</th>
<th>Hypothesis/Aim</th>
<th>Study Classification</th>
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<th>Primary Outcomes</th>
<th>Statistically significant clinical outcomes/method of nutrition assessment</th>
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<tr>
<td>Leite, Brazil</td>
<td>2005</td>
<td>Quantify serum albumin concentrations in children who have congenital heart defects, to evaluate its behavior in response to surgical metabolic stress that is associated with elective cardiac surgery, and to verify that these concentrations can be predictors of postoperative outcome.</td>
<td>Prospective, controlled cohort study</td>
<td>n = 30 Infants aged 3 months to 134 months admitted after repair of congenital heart defect</td>
<td>1. Serum Albumin 2. Weight for age 3. Height for age 4. Weight for height</td>
<td>1. 30 day postoperative mortality 2. Postoperative length of hospital stay 3. Postoperative infection.</td>
<td>Preoperative serum albumin: 1. Postoperative infection 2. Mortality</td>
</tr>
<tr>
<td>Vivanco-Munoz, Mexico</td>
<td>2010</td>
<td>Assess the impact of malnutrition and nutritional support on the length of hospitalization and mortality in the pediatric ICU in children with congenital heart defects after undergoing surgery.</td>
<td>Retrospective chart review</td>
<td>n = 289 age: median age 10.6 months (range 0.1–36 months) Children &lt; 3 years old who underwent their first surgical corrective intervention for congenital heart defect with extracorporeal circulation</td>
<td>1. Weight for age at birth 2. BMI Z-score</td>
<td>1. Long stay (&gt;6 days) 2. Death (before and after 72 hours at the PICU)</td>
<td>Weight for age at birth ≥ 90%: 1. Long-term stays BMI Z-score &lt; -2. 2. Mortality</td>
</tr>
</tbody>
</table>
Radman, USA and Gueta 2013 Poor nutritional status is associated with worse postoperative outcomes in children with congenital heart defects.

Prospective 2-center cohort study
UCSF n = 41
UNICAR n = 30
Children admitted to PICU after surgical repair of congenital heart disease.
Median age 10.2 months
1. Triceps skin fold thickness
2. Serum albumin
3. Serum prealbumin
4. Serum BNP

1. 30 day mortality
2. ICU length of stay
3. Duration of mechanical ventilation
4. Duration of continuous inotropic infusions

UCSF cohort:
Preoperative Triceps skin fold thickness (TSFT) Z-scores:
1. ICU length of stay
2. Duration of postoperative mechanical ventilation
3. Duration of continuous inotropic infusion postoperatively
4. Preoperative BNP levels

Albumin < 3.2, prealbumin < 12.1
1. Duration of any continuous inotropic infusions
2. Preoperative serum BNP

UNICAR: No statistically significant findings

Toole, Texas 2013 The aim of this study was to correlate nutritional status and cardiovascular risk as they relate to hospital outcomes in infants and children undergoing surgical repair of congenital heart defects.

Retrospective chart review
n = 121
Children younger than 24 months of age with a gestational age greater than 36 weeks admitted postoperatively to the Cardiovascular intensive care unit for longer than 48 h following surgery

Waterlow criteria for acute and chronic malnutrition
1. Weight for length (acute malnutrition)
2. Length for age (Chronic malnutrition)

1. Hospital length of stay
2. Cardiovascular Intensive care unit length of stay
3. Duration of mechanical ventilation

Length for age 90%–95% of median values (mild chronic malnutrition)
1. Longer hospital length of stay
2. Longer cardiovascular intensive care unit length of stay

* only significant when compared to moderate chronic malnutrition group.

Length for age 85% or less of median values (severe chronic malnutrition)
1. Longer hospital length of stay
2. Longer cardiovascular intensive care unit length of stay

** When compared to cohorts with none, mild, or severe chronic malnutrition.

** Length for age 85%–90% of median values (moderate chronic malnutrition)
1. Fewer days of mechanical ventilation
2. Shorter Hospital length of stay
3. Shorter Cardiovascular ICU length of stay
high risk for post-operative morbidity and mortality secondary to malnutrition [32].

Onodera’s PNI was described by Onodera et al. [26] in 1984 to identify malnourished patients at higher operative risk for gastrointestinal resection and anastomosis. The authors studied a cohort of adult patients with gastrointestinal cancer who were malnourished and treated with total parenteral nutrition preoperatively. They concluded that patients with a score less than 40 were at greater risk of poor outcomes when undergoing resection and anastomosis of the gastrointestinal tract. They also asserted that the score provided prognostic information for patients with terminal cancer.

This assessment of nutritional status should not be applied during times of acute metabolic stress or inflammation. The components of PNI, namely albumin and total lymphocyte count, change drastically during acute stress, inflammation, and tissue destruction. Albumin will decrease secondary to counter regulatory hormone induced catabolism, and total lymphocyte count will increase due to inflammation associated marrow stimulation. Therefore, there is no utility of these factors to assess nutritional status in the metabolically stressed patients [11,14,35,36].

2.3.4.1.2. Review of scientific evidence. In the article by Wakita et al. [25], the authors conducted a retrospective study of congenital heart defect patients under the age of 18 months undergoing surgical correction at one facility. They utilized Onodera’s PNI, W/A, H/A, and W/H as preoperative nutritional assessment parameters, hypothesizing that these parameters may predict clinical outcomes in infants undergoing cardiac surgery. No correlations were found with the anthropometric parameters, but with Onodera’s PNI, they found a score less than 55 was correlated with increased length of stay in the ICU and increased total length of hospital stay in infants with congenital cardiac anomalies.

Onodera’s PNI has been applied to adult patients with end-stage liver disease, tuberculosis, and gastrointestinal malignancy [24]. This modality is not validated for use in the pediatric population, as there are no standard reference scores for this age group [25]. The study by Wakita et al. [25] appears to be the first to apply Onodera’s PNI to the pediatric surgical patient. The evidence to support PNI as a nutritional assessment tool capable of predicting clinical outcomes in pediatric surgical patients is weak.

2.3.5. Subjective nutritional assessment modalities

2.3.5.1. Subjective global nutritional assessment (SGNA)

2.3.5.1.1. Background. Subjective Global Assessment (SGNA) evaluates the nutritional status of the patient utilizing history, physical examination, and anthropometric measurements. This assessment tool is validated for use in adults, and has been adapted for the pediatric population and renamed (SGNA) Subjective Global Nutritional Assessment. The focus of this assessment tool is to identify evidence of loss of subcutaneous fat, muscle wasting, or edema. It also incorporates a questionnaire, which identifies other factors associated with malnutrition, such as rate of growth, dietary intake, gastrointestinal symptoms, functional capacity, and metabolic stress. A rating form is used, which takes into account the variables from the history and physical exam, and assigns a rating of normal/well nourished, moderate malnutrition, and severe malnutrition [9,12,16,21].

Subjective methods, such as the Subjective Global Nutritional Assessment (SGNA) and Mini Nutrition Assessment, have been shown to be equal to or better predictors of nutritional status than objective methods in pediatric patients [2,9,12,16].

2.3.5.1.2. Review of Scientific Evidence. SGNA has been shown to be a valid and reliable tool for identifying malnourished adults [27], and has also been proven for use in predicting clinical outcomes in adult patients undergoing gastrointestinal surgery [28].

The prospective cohort study by Secker et al. [12] examined the correlation of malnutrition via SGNA with postsurgical clinical outcomes in a heterogeneous cohort of pediatric patients. The study incorporated SGNA assessment, anthropometrics, and biochemical
predictors to evaluate the predictive capability of each method for comparison. Malnutrition in pediatric surgical patients by SGNA standards correlated with a statistically significant increase in postoperative infectious complications, minor infectious complications, increased length of hospital stay, and increased minor complications when compared to well nourished patients.

3. Discussion

30% of children admitted to the ICU are likely malnourished, and there is convincing evidence that malnutrition during their length of stay has a significant impact on mortality [5]. The goal of this study was to examine whether preoperative malnutrition affects clinical outcomes in pediatric surgical patients. The amount of data was minimal and variable in quality. We identified six reports that specifically examined the impact of preoperative nutritional assessment on clinical outcomes in pediatric surgical patients. Only one study examined a cohort of heterogeneous pediatric surgical patients, all other studies focused specifically on congenital heart defect patients. There are an overall lack of high-quality data, many variations in study design and methodology, and of particular interest, the variability among authors' choice of nutritional assessment and interpretation.

The congenital heart defect (CHD) patients are a high-risk population with an incidence of acute and chronic malnutrition up to 50%, and associated increases in infectious complications and poor wound healing [29]. Common anthropometric measurements of nutrition, such as weight for length, length for age, and BMI, tend to be inaccurate in this cohort. The distribution of major components of body weight in CHD patients is impacted by muscle mass loss, cachexia, and edema, thus anthropometric measures tend to underestimate body fat in this population [13].

In the article by Radman et al. [13], the authors claim that Triceps-skin fold thickness Z-score (TSFZ) is a more accurate measure of nutritional status in CHD patients because it eliminates the influence of fluid body weight abnormalities [13]. This is a controversial assumption, as there are no high-quality data to indicate the reproducibility of measurements of skin-fold thickness as a means of nutritional assessment in the edematous child. While edema would certainly contribute to increasing the circumference of the arm, the extent to which the caliper would squeeze edema fluid from the tissues is unknown, and well-documented corrective factors are not available [34].

In the article by Secker et al. [12], children classified as malnourished by SGNA standards had a statistically significant increase in postoperative length of stay, infectious complications, and minor complications. This relationship was not apparent utilizing other assessments of nutritional status except height for age Z-score and serum albumin levels. This was the only study in our review that evaluated a heterogeneous group of elective pediatric surgical patients and incorporated the SGNA assessment. While the level of evidence remains low due to this being the first study to test SGNA for clinical outcomes in pediatric surgery, it introduces SGNA as a nutritional assessment with potential to predict clinical outcomes that impact health related costs and morbidity. SGNA shows promise as a predictor of malnutrition in the pediatric surgical patient, therefore future studies should incorporate this modality in their nutritional assessment algorithm as it may provide valuable clinical predictability.

The findings in this review emphasize the need for prospective controlled trials that utilize appropriate and varied methods of nutritional assessment for the studied population. The complexity of isolating malnutrition as the causal factor impacting outcomes in pediatric surgical patients, especially those with medical comorbidities, is something that must be taken into consideration for planning future studies. For example, the use of serum protein levels to estimate a pediatric patient's nutritional status is controversial, and as some authors noted, these levels cannot be correlated exclusively with nutritional status since a multitude of factors other than nutrition may impact these levels [14]. A consensus on defining standard nutritional assessments in pediatric surgical patients is ideal, but until that consensus is made, authors should incorporate all relevant and practical nutritional assessment tools in future studies. This will strengthen our database of information on this topic to incorporate it into perioperative guidelines that improve patient care.

4. Conclusion

There is a paucity of high quality evidence correlating preoperative malnutrition in pediatric surgical patients with clinical outcomes. Factors contributing to the low level of evidence include a lack of high quality randomized controlled trials, a lack of consensus in study design and methods, and utilization of incongruous methods of nutritional assessment, including methods that may be unequal in the study population. While the data are weak, there is promising evidence in some studies that preoperative nutritional assessment is predictive of clinical outcomes. These outcomes should serve as pilot studies for future high quality, randomized, controlled trials. This review has exposed some of the limitations to attaining higher quality evidence on this topic, which if taken into consideration, should improve the quality of future trials.

References


