Relationship between preoperative nutritional status and postoperative complications categorized according to the Clavien-Dindo classification in Paediatric Surgical patients

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DECLARATION

I hereby declare that **the 'Relationship between preoperative nutritional status and postoperative complications categorized according to the Clavien-Dindo classification in Paediatric Surgical patients'** embodies the original work carried out by the undersigned in All India Institute of Medical Sciences Jodhpur.

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CERTIFICATE

This is to certify that the thesis titled **'Relationship between preoperative nutritional status and postoperative complications categorized according to the Clavien-Dindo classification in Paediatric Surgical patients'** is the bonafide work of Dr Tripti Agrawal, carried out under our guidance and supervision, in the Department of Paediatric Surgery, All India Institute of Medical Sciences, Jodhpur.

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INDEX

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

WHO	World Health Organisation
BMI	Body mass index
SGA	Subjective global assessment
MNA	Mini nutritional assessment
PNI	Prognostic nutritional index
NRI	Nutritional risk index
MI	Maastricht index
TIBC	Total iron binding capacity
SFT	Skin fold thickness
MAC	Mid arm circumference
PCM	Protein calorie malnutrition
LOS	Length of stay
CHD	Congenital Heart Disease
ICU	Intensive care unit

SUMMARY

INTRODUCTION:

Nutrition is crucial for a child's healthy development, physiologic balance, and robust infection resistance. Theoretically, preoperative nutritional assessment should aid in predicting clinical outcomes, but this presents a challenge because several indicators of malnutrition may have multiple aetiologies, particularly in the chronically ill patient. Several methods have been developed to assess nutritional status. These can be loosely divided into objective and subjective modalities. There are two primary types of objective assessment: anthropometric measurements of the body and measurements of serum protein levels. Subjective assessment includes Surveys that integrate anthropometric body composition measurements and subjective information from the patient's medical history. Malnutrition's impact on postoperative outcomes in adults has been studied in numerous research. Adult patients who are undernourished and have surgery often have worse clinical outcomes than well-nourished ones. Numerous studies have been conducted on children to determine the influence of nutritional status on postoperative outcomes utilizing various nutritional status assessment techniques. However, there is conflicting evidence regarding the relationship between nutritional status and postoperative outcomes in children.

AIMS & OBJECTIVES:

The study aims to find out the relationship between preoperative nutritional status with the postoperative complications categorized according to Clavien-Dindo classification in paediatric surgical patients. The study's objectives are to assess the nutritional status of the paediatric surgical patients preoperatively, categorising the postoperative complications according to the Clavien-Dindo classification and find out the relation of the preoperative nutritional status with the postoperative complications.

METHODOLOGY:

After approval of the IEC, from March 12th, 2021, to August 2022, the study was conducted in the Department of Paediatric Surgery, All India Institute of Medical Science, Jodhpur. Patients meeting the inclusion criteria were included in the study. Anthropometry measurement was done to assess nutritional status. Patients were

followed up to 1 month after surgery to observe any complications and need for readmission. Statistical analysis was done to find out the relationship between nutritional status and postoperative complications. The relation between the duration of surgery with postoperative outcomes was also measured.

RESULTS:

During the study period, 627 patients were included; 350 patients were in Group 1, i.e., had an age between 6 months to 5 years, while 277 patients were in Group 2, i.e., had an age between 5 years to 18 years. The complication rate was 39.14 % in group 1 and 38.99% in group 2. None of the parameters of nutritional status was related to postoperative complications in the groups. In Group 1, 185 patients had surgery in less than 2 hours, and 165 patients had surgery in more than 2 hours. In group 2, 179 patients had surgery in less than 2 hours, and 98 patients had surgery in more than 2 hours. Complications were found to be higher in patients who had prolonged surgery. In group 1, out of 185 patients who had surgery in less than 2 hours, 159 developed no complications, while 26 had complications (17 %). Out of 165 patients who had surgery for more than 2 hours, 111 patients developed complications(67 %), and 54 patients did not develop any complications. In group 2, out of 179 patients who had surgery in less than 2 hours, 151 had no complications, while 28 had complications (15.6 %). Out of 98 patients who had surgery for more than 2 hours, 81 developed complications (82 %), and 17 did not have a complication. None of the nutritional status parameters was related to the length of hospital stay and readmission rates in both group. Patients with complications had longer hospital stay (> 7 days) and higher readmission rates in both groups. Haemoglobin levels were comparatively low in patients with complications.

CONCLUSION:

There is no current recommendation or consensus for nutritional assessment in preoperative paediatric patients. Our study showed a high prevalence of malnutrition in paediatric surgical patients. Using a single screening anthropometric evaluation tool, we found no significant relation between z scores of nutritional parameters and postoperative complications. However, factors like prolonged duration of surgery and preoperative haemoglobin values were significantly associated with postoperative complications.

INTRODUCTION

For healthy development, physiologic equilibrium, and strong infection resistance, nutrition is essential(1). Children who require surgical treatments are vulnerable to physiologic stress, necessitating a period of recuperation. Although it is physiologically similar to the stress response in adults, the metabolic response of children to operative stress is affected to varying degrees by the type of insult, its severity and duration, the metabolic reserve, and the capacity to mobilize reserves. Depletion of bodily reserves, a decline in immunocompetence, and an increase in morbidity and death are all effects of hypermetabolic conditions.

POSTOPERATIVE COMPLICATIONS:

Postoperative problems may be generic or unique to the type of surgery performed, and they should be addressed with consideration for the patient's medical history. Postoperative fever, wound infection, embolism, and Deep vein thrombosis are common general postoperative problems.

Between one and three days following the procedure, postoperative problems are most common. However, specific complications have different temporal patterns of occurrence: early postoperative, several days after the operation, throughout the postoperative period, and in the late postoperative period(2). Immediate postoperative complications occur within 48 hours of the procedure; early complications occur between 2-21 days, and late complications occur after 21 days of the procedure.

GENERAL POSTOPERATIVE COMPLICATIONS

IMMEDIATE - Primary haemorrhage (starting during surgery) or reactionary haemorrhage (following a postoperative increase in blood pressure), basal atelectasis, shock, and low urine output.

EARLY – Pain, nausea and vomiting, paralytic ileus, fever, secondary haemorrhage, pneumonia, wound or anastomosis dehiscence, acute urinary retention, urinary tract infection (UTI), postoperative wound infection, pressure sores, bowel obstruction due to fibrinous adhesions, paralytic ileus.

LATE - Bowel obstruction due to fibrous adhesions, incisional hernia, persistent sinus, recurrence of the reason for surgery - e.g., malignancy, keloid formation, cosmetic appearance - depends on many factors.

It is unknown what percentage of children have postoperative complications. The most frequent one is postoperative nausea and vomiting, which is followed by respiratory issues that result in hypoxia. Cardiac problems are usually seen in patients with pre-existing cardiac malformations.

FACTORS AFFECTING POSTOPERATIVE RECOVERY

Postoperative recovery depends on various factors, including the type and extent of the surgical operation, the immunological and nutritional status of the patient, the baseline psychological profile, as well as the associated medical comorbidities.

Nutrition and normal protein metabolism are essential for optimal wound healing. A total body protein deficiency or an imbalance of specific amino acids has adverse effects on almost all aspects of wound healing, including neovascularization, lymphatic formation, fibroblast proliferation, collagen synthesis and wound remodelling. In the presence of prolonged protein deficiency or impaired liver function, local wound oedema secondary to hypoalbuminemia may develop and further impair fibroplasia, especially of a healing intestinal or colonic anastomosis(3). Nutritional deficiency increases the risk of infection. The association of malnutrition with infection has been well recognized through clinical observations and epidemiologic studies(4,5). Rhoads and Alexander demonstrated the association of postoperative infections with poor nutritional status in 1955 (6).

According to research by Cooper and colleagues, malnutrition affects 18% to 40% of paediatric surgery patients(7). Even though the prevalence of undernutrition is declining worldwide, 13% of people living in the world today are undernourished(8). Children are particularly vulnerable, and over 50% of all infant fatalities are attributable to undernutrition. Malnutrition is more common in developing nations. Fourteen per cent of Indians are undernourished, according to the "The State of Food Security and Nutrition in the World, 2020" report(8). According to findings of the 2019-21 National Family Health Survey (NFHS-5), nutrition indicators for children under 5 showed the prevalence of being underweight at 32.1 %, stunting - at 35.5% and wasting at 19.3%.

MODALITIES OF NUTRITIONAL ASSESSMENT

The nutritional examination is a crucial component of the first assessment for paediatric surgery patients. Numerous approaches, roughly categorized into objective and subjective modalities, are available to evaluate the nutritional condition of paediatric surgery patients. There are two main categories of objective evaluation: first-measurements of serum protein levels: second - anthropometric assessments of body composition. Subjective assessment includes Surveys that integrate both anthropometric body composition measurements and subjective information from the patient's medical history. These include the Mini Nutrition Assessment (MNA) and the Subjective Global Nutritional Assessment (SGNA) (9). Observer error or changes in body composition brought on by non-nutritional factors can affect either general class of nutritional evaluation.

ANTHROPOMETRIC NUTRITIONAL ASSESSMENT MODALITIES

An objective assessment method involves measuring body measurements and composition to estimate nutritional status and growth. Age, height, weight, and head circumference are the most fundamental. The growth and nutritional status can also be charted on a standardized growth curve for comparison with normative data. This is a typical and affordable way to assess growth and nutritional status. In addition, metrics such as handgrip strength, mid-arm circumference, and skin fold thickness can be used. When patients are older than 2 years, body mass index (BMI), or BMI expressed as a Z-score, provides the best indication of weight-to-length ratio (10).

The anthropometric indices can screen populations for nutritional status with the required simplicity and speed. The World Health Organization (WHO) defines malnutrition as "the imbalance between the supply of nutrients and energy and the body's demand for them to ensure growth, maintenance, and specific functions". The WHO divides paediatric malnutrition into underweight, stunting (low height for age), wasting (low weight for height), and severe protein-calorie malnutrition using standardized anthropometric measures (z-scores) (11). Weight is primarily affected during periods of acute undernutrition, whereas chronic undernutrition typically manifests as stunting. Z-scores for weight for age and height for the age that is less than −2 SD of the median of the WHO international reference indicate severe malnutrition (12,13).

IMPACT OF NUTRITIONAL STATUS ON POSTOPERATIVE OUTCOMES

Theoretically, preoperative nutritional assessment should aid in predicting clinical outcomes, but this presents a challenge because several indicators of malnutrition may have multiple aetiologies, particularly in chronically ill patients.

Various studies have been done depicting the effect of malnutrition on postoperative outcomes in adults. Compared to well-nourished individuals, adult patients who are malnourished and undergo surgery typically experience inferior clinical outcomes (14). Preoperative malnutrition is related to longer hospital stays, worse clinical conditions, and higher healthcare-related costs(15).

Numerous studies have been conducted on children to determine the influence of nutritional status on postoperative outcomes utilizing various nutritional status assessment techniques. For instance, being stunted was linked to a higher risk of 30-day postoperative problems in children who had abdominal or thoracic surgery, while wasting was not (16). Low preoperative albumin was also linked to a longer hospital stay after surgery in a study of young patients with heart disease at high surgical risk (17). However, due in part to different preoperative nutritional assessment methods, a systematic review identified a lack of evidence supporting the association between preoperative nutritional status and postoperative clinical outcomes(18).

Thus, there is conflicting evidence regarding the relationship between nutritional status and postoperative outcomes in children. Little is known about the impact of undernutrition on outcomes following elective and emergency paediatric surgery, as well as the relative frequency of postoperative complications in undernourished children.

The purpose of the current research is to determine the preoperative nutritional status and its impact on postoperative complications categorized according to the Clavien-Dindo classification in Paediatric Surgical patients.

The Clavien-Dindo classification system is the simplest form of classification of surgical complications. It is easily understood by medical as well as paramedical staff. It provides a gross structural idea of the nature of surgical complications and helps in better assessment of postoperative complications.

AIMS AND OBJECTIVES

AIM: To find out the relationship between preoperative nutritional status with the postoperative complications categorized according to Clavien-Dindo classification in paediatric surgical patients.

OBJECTIVES:

- Assessment of the nutritional status of the paediatric surgical patients preoperatively
- Categorization of the postoperative complications according to the Clavien-Dindo classification
- Relation of the preoperative nutritional status with the postoperative complications

REVIEW OF LITERATURE

Mullen et al. in 1979 studied the implications of malnutrition in surgical patients. The preoperative nutritional and immunological assessment was performed prospectively, on admission, in 64 consecutive surgical patients. Prospective immunological factors were neutrophil migration, IgG, IgM, IgA, C3, C4, rosette formation, delayed hypersensitivity, and total lymphocyte count (peripheral venous). Prospective nutritional factors were weight loss/time, triceps skinfold, midarm muscle circumference, creatinine-height index, serum total protein level, serum albumin level, and serum transferrin level (from total iron-binding capacity [TIBC]). The authors identified serum transferrin, serum albumin levels and delayed hypersensitivity reactivity as three nutritional markers that prospectively identify a subgroup of patients in whom there is a substantial increase in operative morbidity and mortality. Patients with a serum albumin level of less than three g/dl had a two and half-fold increase in the complication rate compared to those patients with a serum albumin level greater than 3 g/dl. Serum transferrin levels below 220 mg/dl accurately denoted a patient population with a five-fold increase in complications. Anergic patients had a 33% complication rate, a two-and-one-half-fold increase over patients who were reactive to at least one of three skin test antigens (19).

In 1984, Onodera et al. first described Onodera's Prognostic Nutritional Index (PNI), relating the risk of postoperative complications to baseline nutritional status in cancer patients of digestive organs. The linear predictive model relating the risk of operative complication, mortality or both to nutritional status is given by the relation: prognostic nutritional index (PNI) = 10 Alb. + 0.005 Lymph. C., where Alb. was serum albumin level (g/100 ml) and Lymph. C. was total lymphocyte count/mm3 peripheral blood. They concluded that resection and anastomosis of the gastrointestinal tract could be safely practised when the index was over 45. The same procedure might be dangerous between 45 and 40. In below 40, this kind of operation might be contraindicated. The prognostic nutritional index was also useful for knowing the prognosis of patients with terminal cancer. They found that the patient had a high possibility of dying within the next two months if the PNI remained below 40 and the total lymphocyte count remained below 1,000/mm3(20).

In a prospective cross-sectional study by Pham et al., subjective global assessment (SGA) was used as a tool to assess the nutritional status of surgical patients. They determined the incidence of malnutrition according to SGA and an association between SGA class and infectious complications. Patients were rated as well nourished (A), moderately malnourished (B), or severely malnourished (C). Infectious complications (wound infection, intra-abdominal abscesses, anastomotic leakage) were recorded. It was concluded that malnutrition was associated with an increase in infectious complications. Weight loss and per cent weight loss, muscle wasting, loss of subcutaneous fat, functional capacity, and significant gastrointestinal symptoms correlated significantly with the severity of the SGA class ($P<0.001$). The rate of postoperative infectious complications was higher in patients classified as SGA class C (33.6%) than as class A (6%) and B (11%)(21).

Kuzu et al. in 2006 performed a prospective study to determine the best possible nutrition screening system and its role in predicting postoperative outcomes in patients undergoing major surgery. Nutritional status was assessed using the Nutritional Risk Index (NRI), Maastricht Index (MI), Subjective Global Assessment (SGA), and Mini Nutritional Assessment (MNA). Postoperative complications were classified as infectious and non-infectious. It was found that all nutritional assessment techniques can be safely applied to the clinical setting with no significant difference in predictive value, and morbidity rates were significantly higher in malnourished patients across all nutritional indices. The odds ratio for morbidity between the well-nourished and malnourished patients was 3.09 [95% confidence interval (CI), 1.96–4.88], 3.47 (95% CI, 2.12–5.68), 2.30 (95% CI, 1.43–3.71), and 2.81 (95% CI, 0.79–9.95) for the SGA, NRI, MI, and MNA, respectively. All indices except the MNA were significantly predictive of morbidity(15).

A study from Canada by Sungurtakin et al. in 2013 studied the influence of nutritional status on complications in 100 patients undergoing major intraabdominal surgery. Patients were assessed for - Subjective Global Assessment(SGA), Nutritional Risk Index(NRI), anthropometric measurements, total serum protein, serum albumin, lymphocyte count, and total serum cholesterol. In their cohort, at admission, 44% of the patients were malnourished, according to the SGA, and 61% of the patients, according to the NRI. A significantly higher number of complications were seen in the malnourished groups than in the well-nourished group. Also, the mean number of complications was significantly lower in the well-nourished group. The risk of complication was increased in malnourished patients with both assessment techniques. The odds ratios for the association between malnutrition and complications varied between 1.926 and 9.854 with both assessments. In their study, the presence of cancer in the patient was predictive of complications. Hospital stay was also found to be longer in the malnourished groups but was not statistically significant(14).

Cooper et al., in 1981, first demonstrated the prevalence of acute protein-calorie malnutrition in paediatric surgical patients. They performed comprehensive nutritional assessments on the entire inpatient population of the Children's Hospital of Philadelphia in the United States. A total of 198 inpatients ranging in age from 0 to 22 years were surveyed. Primary diagnosis, developmental age, weight, height, head circumference, skin fold thickness (SFT), and mid-arm circumference (MAC) were obtained in every case, from which were calculated the weight/height ratio and arm muscle circumference (AMC). Authors found that the overall prevalence of acute protein-calorie malnutrition (PCM) was 54%: but if premature and term infants less than three months of age were selected, the prevalence of acute PCM was a striking 63%. If only surgical patients were considered, the prevalence of acute PCM among patients hospitalized for trauma or burns was 31%. for elective operation, 39%. and for acute but complex operative procedures, 64%. These data demonstrate that a remarkably high prevalence of acute PCM exists among hospitalized paediatric and paediatric surgical patients, and comprehensive nutritional assessment should be an essential part of the preoperative evaluation of all paediatric surgical patients(7).

Leite et al., in 1995, studied the nutritional status of children with heart diseases and evaluated nutritional parameters for predicting postoperative complications. Fifty children undergoing cardiac surgery were studied and classified in high and low surgical risk prospectively. Assessment parameters included anthropometry and plasma proteins albumin, transferrin, and prealbumin. The nutritional classification according to Waterlow's modified criteria showed a high prevalence of malnutrition (78 %) in the population studied. The measures of arm circumference, when located below the 5th percentile, showed a significant association with general postoperative complications in the high-risk group (arm circumference, $p = 0,0019$; arm muscle circumference, $p = 0,0419$). The percentage of weight per height, serum albumin, and transferrin have not played a prognostic role concerning postoperative morbidity. The mean value of prealbumin was significantly lower in high-risk group patients developing postoperative infections (p < 0,01) compared to those who did not. The nutritional risk classification seems to be a good way to identify the subgroups of children with additional postoperative surgical risk(22)

Secker et al. used SGA to identify presurgical malnutrition and studied its use to predict postsurgical nutrition-associated morbidities that lead to a prolonged hospital stay in paediatric patients. They prospectively evaluated the preoperative nutritional status of 175 children (aged 31 d to 17.9 y) having major thoracic or abdominal surgery with the use of SGNA and commonly used objective measurements- length or height; weight; percentage of ideal body weight for height; body mass index-for-age; midarm circumference; triceps skinfold thickness; midarm muscle area; handgrip strength; concentrations of serum albumin, transferrin, haemoglobin; and total lymphocyte count. SGA successfully divided children into 3 groups (well-nourished, moderately malnourished, and severely malnourished) with different mean values for various anthropometric and biochemical measures (P <0.05). Malnourished children had higher rates of infectious complications than well-nourished children (P 0.042). Postoperative length of stay was longer for malnourished children than for well-nourished children (P <0.002). No objective nutritional measures showed an association with outcomes, except serum albumin. However, serum albumin was not clinically predictive because mean concentrations were in the normal range irrespective of the presence or absence of complications (9).

A retrospective study conducted by Wakita et al. in 2011 used the prognostic nutritional index as a nutritional assessment tool to predict clinical outcomes (COs) in an infant undergoing cardiac surgery. The nutrition parameters assessed include Onodera's prognostic nutritional index (PNI), height for age, weight for height, and weight for age. COs included mortality rate during hospitalization, length of stay in the intensive care unit (LOS-1), length of stay in the Hospital after surgery (LOS-2), and duration of mechanical ventilation support. It appeared that preoperative PNI was the most influential factor on LOS-1 for infants undergoing cardiac surgery. The PNI cut-off point 55 in infants who underwent cardiac surgery seemed to be the good predictor of COs(23)

Toole et al., in their retrospective study, assessed the effect of nutritional status and cardiovascular risk on hospital outcomes after congenital heart surgery in infants and children. One hundred twenty-one patients less than 24 months of age were enrolled. The degree of malnutrition was classified as mild, moderate, or severe according to Waterlow criteria for acute and chronic malnutrition. The prevalence of acute protein-energy malnutrition and chronic protein-energy malnutrition was 51.2% and 40.5%. The outcomes studied were mortality, length of cardiovascular intensive care unit (CVICU), length of hospital stays (LOS), and days of mechanical ventilation. Although they did not find any statistically significant links between acute malnutrition (defined as using weight for length) and outcomes, they did find correlations with chronic malnutrition (Length for age). The median hospital stay for mild, moderate, and severe chronic protein-energy malnutrition was 31, 10, and 22.5 days, respectively, vs normal 15 days (Kruskal–Wallis, $P < .005$). The authors concluded that care should be taken to optimize the nutritional condition of infants and children prior to and to follow surgical correction of congenital heart disease to improve hospital outcomes(24).

In a prospective cohort study done by Radman et al. in 2014, an association between preoperative nutritional status and postoperative outcomes was determined in children undergoing surgery for congenital heart defects (CHD). They recorded preoperative anthropometric measures of nutritional status - triceps skin fold, a direct measure of peripheral fat mass and an indirect measure of total body fat mass and laboratory measures of nutritional status, including serum prealbumin, a marker of acute malnourishment, and serum albumin, a marker of chronic malnourishment. Postoperative outcomes measured were 30-day mortality, ICU stay, length of hospital stay (LOS), duration of mechanical ventilation, and duration of continuous inotropic infusions. The authors concluded that lower total body fat mass and acute and chronic malnourishment are associated with worse clinical outcomes in children undergoing surgery for CHD(25).

Wessner et al. 2014 performed a review study to evaluate the impact of preoperative nutritional status on clinical outcomes in paediatric surgical patients. Thirty-five articles were evaluated. All methods of nutritional assessment in paediatric surgery were evaluated for their relevance and their relation to outcomes after surgery. It was hypothesized that measures of nutritional assessment in children would not correlate preoperative malnutrition with poor surgical outcomes. Authors concluded that there is a paucity of high-quality evidence correlating preoperative malnutrition in paediatric surgical patients with clinical outcomes; hence larger multi-centre randomized studies are needed to offer a higher level of evidence to support nutritional intervention prior to major elective paediatric surgery(18).

A retrospective analysis by Ross et al. in 2017 evaluated the impact of preoperative malnutrition on outcomes after paediatric cardiac surgery. Patients between 0 to 5 years who underwent cardiac surgery were included. Preoperative anthropometric indices, including height-for-age, weight-for-age, and weight-for-height z-scores, were calculated for each patient. Secondary outcomes measured included length of ICU stay, length of hospital stay, the incidence of cardiac arrest, duration of mechanical ventilation, and postoperative infection. The authors demonstrated a significant association between malnutrition and 30-day mortality and other adverse outcomes after paediatric cardiac surgery. In the range of z-score less than or equal to − 2, each unit decrease in height-for-age z-score is associated with a 2.9% increased risk for mortality, and each unit decrease in weight-for-age z-score is associated with a 2.1% increased risk for mortality. Each unit decrease in height-for-age z-score and weight-for-age z-score was associated with a 1.1 and 0.8% increased risk for infection, respectively(17).

Alshehri et al. in 2018 studied the Relationship between Preoperative Nutritional State and Adverse Outcomes following Abdominal and Thoracic Surgery in Children. Data were extracted from patients aged 29 days to 18 years who underwent abdominal or thoracic procedures. Standardized anthropometric measurements, including height for age, weight-for-height (children < 2 years), and body mass index (BMI) (children > 2 years), were generated. The cohort was divided into subgroups: 1) height for age: stunted (Z-score <-2), normal (-2< Z-score 2); and weight for height / BMI: wasted (Z-score <-2), normal (-2< Z-score 2). Postoperative outcomes studied were the length of hospital stay and 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. The analysis demonstrated that stunted children had higher odds of composite morbidity (OR 1.2, 95% CI 1.0–1.3, p = 0.04), while obese children had higher odds of SSI (OR 1.3, 95% CI 1.1–1.5, p = 0.001). It was concluded that Children who are stunted or obese are at increased risk of adverse outcomes after abdominal or thoracic surgery(16)

In a prospective study by Majumder et al., preoperative nutritional status was correlated with postoperative wound infection in Children. Nutritional status was assessed by measuring BMI, serum albumin, haemoglobin and total lymphocyte count, and thus children were categorized preoperatively. The children were assessed during the first 30 postoperative days for evidence of wound infection that were confirmed by culture and sensitivity. The authors found that most of the wound infections developed among malnourished children with low BMI (93.8%, p = 0.006) and low serum albumin(87.5%, p = 0.01) (26).

Bergkvist et al., 2020 studied the relationship between nutritional status and outcomes of surgery in paediatric surgical patients. Nutritional status was standardized using Z-scores for BMI, length, weight, and middle-upper arm circumference. Primary outcomes after 30 days included mortality, surgical site infection, reoperation, and readmission. The secondary outcome was the length of stay. A positive correlation was found between undernourishment and increased postoperative complications. Authors identified a seven-fold increased risk of postoperative complications among undernourished children (OR 7.3 [2.3-22.8], p=0.001), (27)

In 2021, Koofy et al. conducted a prospective study to study to evaluate the impact of preoperative nutritional status on surgical outcomes in patients with paediatric gastrointestinal surgery. They found that Nutritional assessment is a crucial component of paediatric surgical patient management. Postoperative complications and a long hospital stay were more common among stunted patients. They included 75 patients with ages ranging from 1 to 60 months. The nutritional assessment tools were divided into objective and subjective. The objective parameters included: measurements of weight, length, mid-arm circumference (MAC), triceps skin fold thickness (TSF), mid-arm muscle circumference (MAMC), as well as 2 biochemical markers; albumin and haemoglobin levels. The subjective methods were based on history and clinical judgment, and they included subjective global nutritional assessment (SGNA) and STRONGKIDS score. Postoperative outcomes studied were complications featured using Clavien-Dindo classification and length of hospital stay. It was found that postoperative complications and a long hospital stay were more common among stunted patients. Out of 17 patients who were stunted, 76.4 % developed complications ($p = 0.003$), and 58.8 % of patients had Hospital stay longer than 7 days ($p = 0.037$) (28).

Most of these studies have been done for the western population in the age group of 1 to 5 years. There is limited evidence for older children. Our aim of this study is to evaluate the relationship between nutritional status and surgical outcomes in paediatric surgical patients the age ranging from 6 months to 18 years. This might be helpful in avoiding postoperative complications and morbidity by tackling pre-existing nutritional deficiencies.

MATERIALS AND METHODS

Study setting: This study was carried out at the Department of Paediatric Surgery, All India Institute of Medical Sciences, Jodhpur.

Study design: This is a prospective Observational cohort study in a tertiary hospital.

Study duration: 12th March 2021 to 31st December 2022

Sample size: All the patients fulfilling inclusion criteria during the study period were included.

INCLUSION EXCLUSION CRITERIA:

Inclusion criteria:

All children between the age group of 6 months to 18 years were admitted to the Department of Paediatric Surgery, All India Institute of Medical Sciences Jodhpur, for undergoing surgeries.

Exclusion criteria:

1. Patients of age less than 6 months
2. Patients of age more than 18 years
3. Patients with congenital heart disease, metabolic syndromes, endocrinopathies, malignancies and other syndromic patients
4. The parent/legal guardian of the patient is not willing to consent to participate in the study

Method of collection of data

A prospective descriptive study will be done. Parents/legal guardians of the patient who are admitted under the Department of Paediatric Surgery, All India Institute of Medical Sciences Jodhpur, for undergoing surgery for the conditions mentioned in the inclusion criteria would be informed regarding the study and voluntary informed written consent would be taken from the parents/legal guardian for participation

Preoperative nutritional assessment:

Patients will be divided into 2 groups ;

1. Children of age group 6 months to 5 years
2. Children of age group more than 5 years to 18 years

In the first group, the nutritional status will be assessed by using the following parameters

- Weight for age - z scores
- Height for age - z scores
- Weight for height - z scores

In the 2nd group, the nutritional status will be assessed using the following parameters –

- Weight for age - z scores
- Height for age - z scores
- BMI for age - z scores

Preoperative anthropometric indices, including height-for-age, weight-for-age, and weight-for-height, BMI for age z-scores, were calculated for each patient using World Health Organisation (WHO) Anthro (version 3.2.2, 2011)and AnthroPlus software (version 1.0.4, 2014)

Nutritional status was standardized using cut-off values of Z-scores for weight, length/height and BMI based on WHO's growth reference data (Table 1.)

Table 1. - Nutritional status classification using Z scores for weight for age, length or height for age, weight for height and BMI for age.

Cut off Values	Terms of status
Weight for Age Z -scores	
< -3.00	Severe underweight
-3.00 to -2.01	Moderate underweight
-2.00 to 1.01	Mild underweight
± 1.00	Normal
Height for Age Z -scores	
< -3.00	Severe stunting
-3.00 to -2.01	Moderate stunting
-2.00 to 1.01	Mild stunting
± 1.00	Normal
Weight for height Z- scores	
< -3.00	Severe wasting
-3.00 to -2.01	Moderate wasting
-2.00 to 1.01	Mild wasting
± 1.00	Normal
+ 2.01 to +3.00	Overweight
>3.00	Obesity
BMI Z scores	
< -3.00	Severe thinness
-3.00 to -2.01	Thinness
-2.00 to + 1.00	Normal
+ 1.01 to 2.00	Overweight
≥ 2.01	Obesity

Along with the nutritional status, two more parameters were also considered in the assessment.

1. Type of wound – surgical wounds are classified into the following 4 categories -

  a. clean
  b. clean contaminated
  c. contaminated
  d. dirty

2. Duration of surgery - it had 2 categories

  a) less than 2 hours
  b) more than 2 hours

The standard guideline for Anthropometric assessment -

1. **Weight –**Tared electronic weighing machine was used for all the children.

Children >2 years of age:

- If a child is 2 years or older and can stand still, the child was weighed alone. Shoes and outer clothing were removed. The child was asked to stand in the middle of the scale, feet slightly apart, and to remain still until the weight appeared on display. The child's weight was recorded to the nearest 0.1 kg. If the child jumped on the scale or was not standing still, the tared weighing procedure was used instead.

Child less than 2 years old or was unable to stand:

- The guardian was made to stand on the scale to be weighed alone first. After the guardian's weight appeared on display, the reading was reset to zero. The child was then given to the guardian to hold. The child's weight would appear on the scale which was recorded. The weighing machine was calibrated frequently.

2. **Height/length-** Height or length is a measure of the chronic nutritional status of the child. Up to 2 years of age, recumbent length was measured with the help of an Infantometer. In older children, standing height or stature was recorded.

Measure length: in age group less than 2 year

- The child was laid on his back with his head against the fixed headboard, compressing the hair. The head was positioned so that an imaginary vertical line from the ear canal to the lower border of the eye socket was perpendicular to the board. The child was laid straight along the board while the shoulders' were touching the board, and the spine was not arched. The child's legs were held down with one hand, and the mobile footboard was moved with another. Gentle pressure was applied to the knees to straighten the legs without causing injury. While holding the knees, the footboard was pulled against the child's feet. The soles of the feet were flat against the footboard, toes pointing upwards. The child's length was recorded in centimetres to the last completed 0.1 cm.

Measure height: for age groups more than 2 year

- Stadiometer was fixed on level ground. Shoes, socks and hair ornaments were removed. The child was held standing on the ground with feet slightly apart. The back of the head, shoulder blades, buttocks, calves, and heels would be in contact with the vertical board. The trunk was balanced over the waist, i.e., not leaning back or forward. The child's head was positioned so that a horizontal line from the ear canal to the lower border of the eye socket ran parallel to the baseboard. With the head in position, the headboard was pulled down to rest firmly on top of the head while compressing the hair. Measurement was read and recorded in centimetres to the last completed 0.1 cm

POSTOPERATIVE OUTCOMES: These were categorized into the followings-

PRIMARY – Grading of postoperative complications according to the Clavien –Dindo classification system

Table 2. The Clavien-Dindo classification for postoperative complication.

Grades	Definition
Grade I	Any deviation from the normal postoperative course without the need for pharmacological treatment or surgical, endoscopic and radiological interventions. Allowed therapeutic regimens are drugs such as antiemetics, antipyretics, analgesics, diuretics and electrolytes and physiotherapy. This grade also includes wound infections opened at the bedside.
Grade II	Requiring pharmacological treatment with drugs other than such allowed for grade I complications. Blood transfusions and total parenteral nutrition are also included.
Grade III	Requiring surgical, endoscopic or radiological intervention
- III a	Intervention not under general anaesthesia
- III b	Intervention under general anaesthesia
Grade IV	Life-threatening complications (including central nervous system complications) requiring intensive care unit (ICU) management
- IV a	single organ dysfunction (including dialysis)
- IV b	Multiorgan dysfunction
Grade V	Death of a patient

SECONDARY OUTCOMES-

1. Length of hospital stay after surgery
2. Readmission within 30 days after discharge

RELATIONSHIP BETWEEN PREOPERATIVE NUTRITIONAL STATUS WITH POSTOPERATIVE OUTCOMES

All the above-mentioned parameters were assessed, and a comparison was made between the preoperative nutritional status of the child and postoperative outcomes. Duration of surgery and modes of procedure were also compared with postoperative outcomes. Length of hospital stay and readmission rates were also assessed between patients with complications and without complications.

DATA COLLECTION:

Patients admitted under the Department of Paediatric Surgery, All India Institute of Medical Sciences Jodhpur fulfilling the inclusion criteria undergoing surgery were included.

Demographic details-

Name

Age

Gender

Place of residence

Weight

Height

Routine blood investigations:

Complete hemogram

Kidney function test

Liver function test

Serum electrolytes

Viral markers (HBsAg/HCV/HIV)

Details of surgery-

Date of surgery

Procedure performed

Mode of surgery (open/ laparoscopic/Laparoscopic assisted/ Cystoscopic /robotic)

Duration of surgery

Type of surgical wound

Postoperative complications

Fever

Nausea & vomiting

Dehydration

Electrolyte imbalance

Shock

Metabolic abnormalities

Lung atelectasis/ Pneumonia

Acute urinary retention

Urinary tract infection

Surgical site infection

Bloodstream infection

Wound dehiscence

Prolonged ileus

STATISTICAL ANALYSIS:

- All data were entered in Microsoft Excel and analysed using statistics analysing software (IBM SPSS for windows version 23.0, 2017, Armonk, NY: IBM corp.)
- Normally distributed continuous variables were expressed as mean and standard deviations. Nonnormally distributed data were expressed by the median and interquartile range (IQR).

- A comparison of numerical variables was made using the Student t-test for independent samples in comparing 2 groups of normally distributed data, and the Mann-Whitney U test was used for nonnormal data.
- Nominal data were described using counts and percentages and compared using the Chi-Square test.
- A p-value of less than 0.05 was considered significant.

ETHICAL CONSIDERATION:

- Ethical clearance was obtained from the Institutional Ethics Committee (IEC). Patients were enrolled after taking informed consent. Patient details were kept confidential.

RESULTS

From March 2021 to August 2022, 627 patients who underwent elective surgery in the department of paediatric surgery, All India Institute of Medical Sciences, Jodhpur were recruited in the study. Three hundred fifty patients were in Group 1 i.e., had age between 6 months to 5 years while 277 patients were in Group 2 i.e., had age between 5 years to 18 years. The mean age of patients with age between 6 months to 5 years was 24.52 $\pm$ 0.73 months while of those between 5 years to 18 years was 9.52 $\pm$ 0.22 years. In group 1, 60 patients were female (17.1 %) and 290 patients were male(82.9%). In Group 2, 60 patients were female (21.7 %) and 217 patients were male (78.3%). The distribution of patients according to the age and gender is shown in Figure 1 and Figure 2.

Figure 1. Distribution of patients according to age:

Age wise distribution of all patients

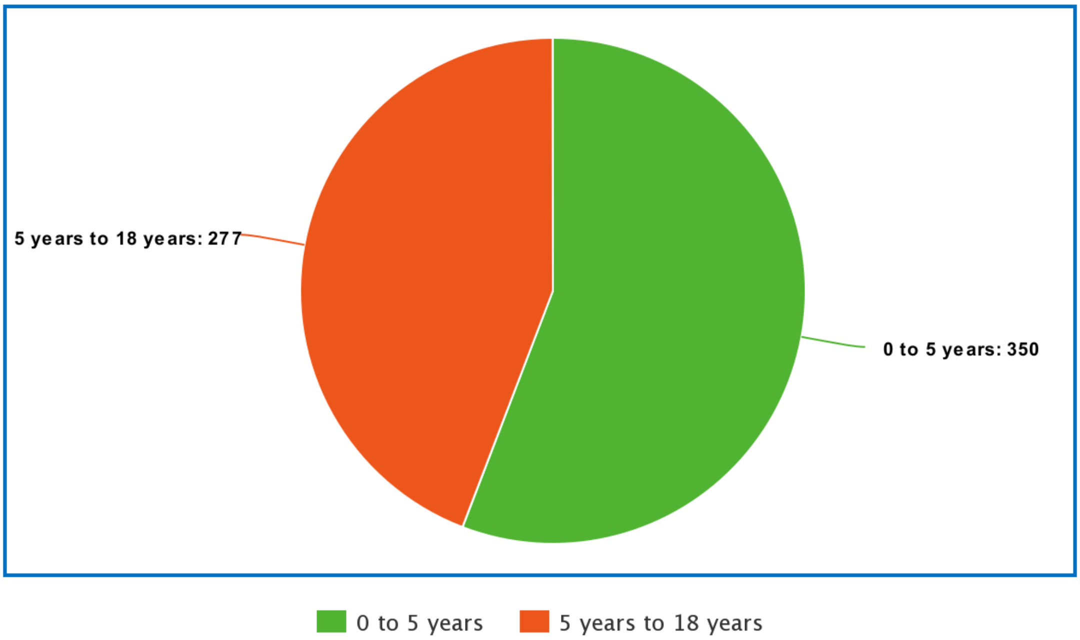
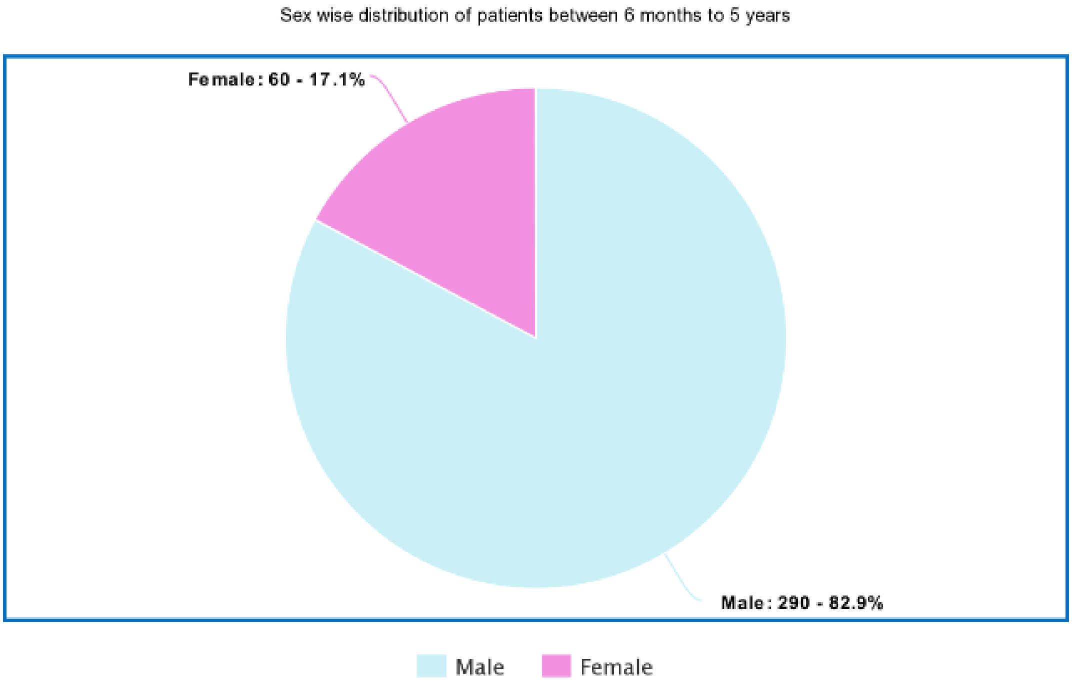
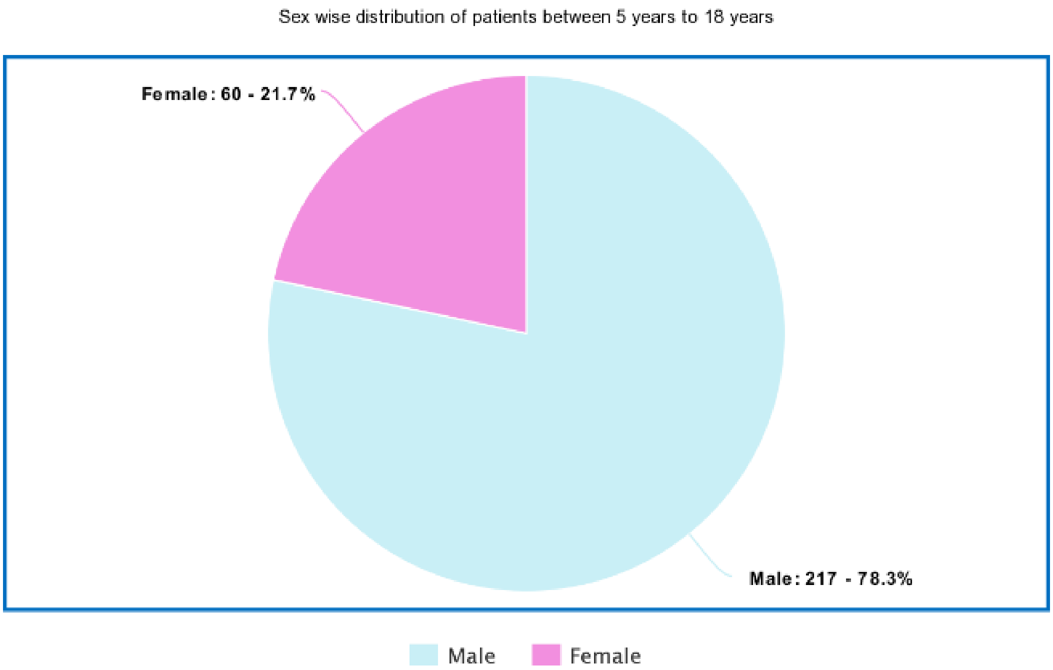


Figure 2. Distribution of patients according to gender in the two groups:





Patient preoperative nutritional assessment:

In Group 1, the weight for age Z score was in the normal range for 150/350 (42.86%) patients, while 200/350 (57.14%) patients were underweight (Figure 3). Among 200 patients, 143 patients had mild, 40 patients had moderate, and 7 patients had severe grades of underweight. The height for age Z scores was in the normal range for 210/350 (60.00%) patients, while 140/350 (40.00%) patients had stunting (Figure 4). Among 140 patients, 116 patients had mild, 19 patients had moderate, and 5 patients had severe stunting. The weight for height Z score was in the normal range for 175/350 (50.00%) patients, while 167/350 (47.71%) patients had wasting, 6/350 (1.71%) were overweight, and 2 (0.57%) were obese (Figure 5). Among 167 patients, 92 patients had mild, 50 patients had moderate, and 25 patients had severe wasting.

In group 2, height for age Z scores were in the normal range for 45/277 (16.25%) patients, while 232/277 (83.75%) patients had stunting. Among 232 patients, 197 had mild, 28 patients had moderate, and 7 patients had severe stunting. The BMI Z scores were normal for 157/277 (56.68%), 115/277 (41.52%) patients were thin, 2 (0.72%) patients were overweight, and 3 (1.08%) were obese. Among 115 patients, 90 patients had moderate, and 25 patients had severe wasting.

Figure 3. Nutritional status of patients according to weight for age z score in Group 1

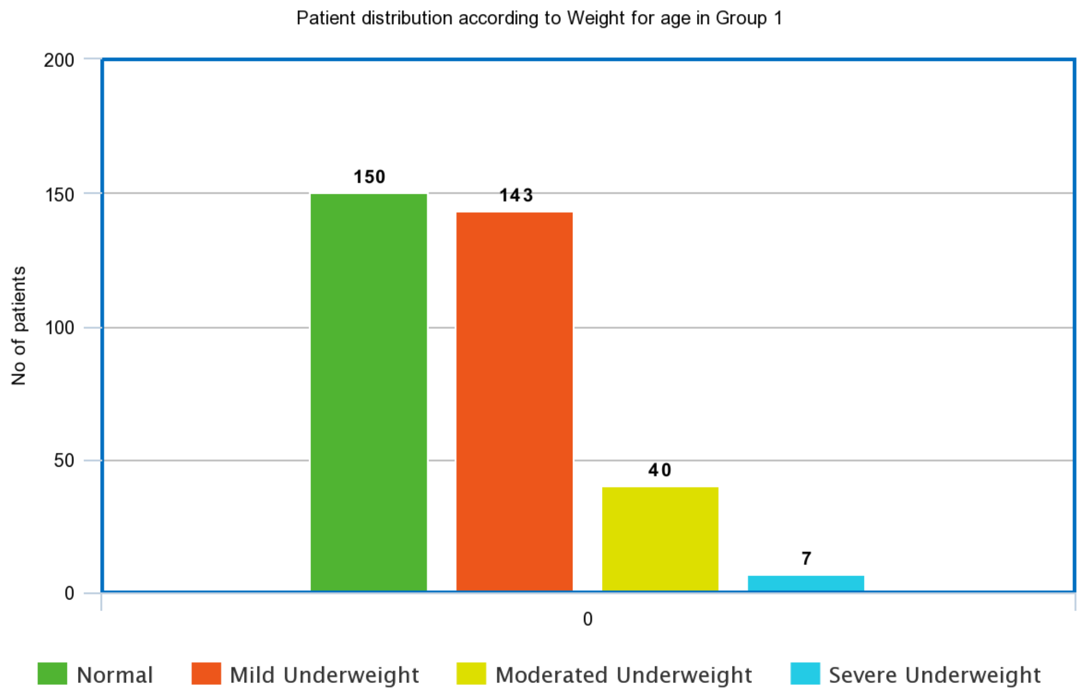


Figure 4. Nutritional status of patients according to height for age in Group 1

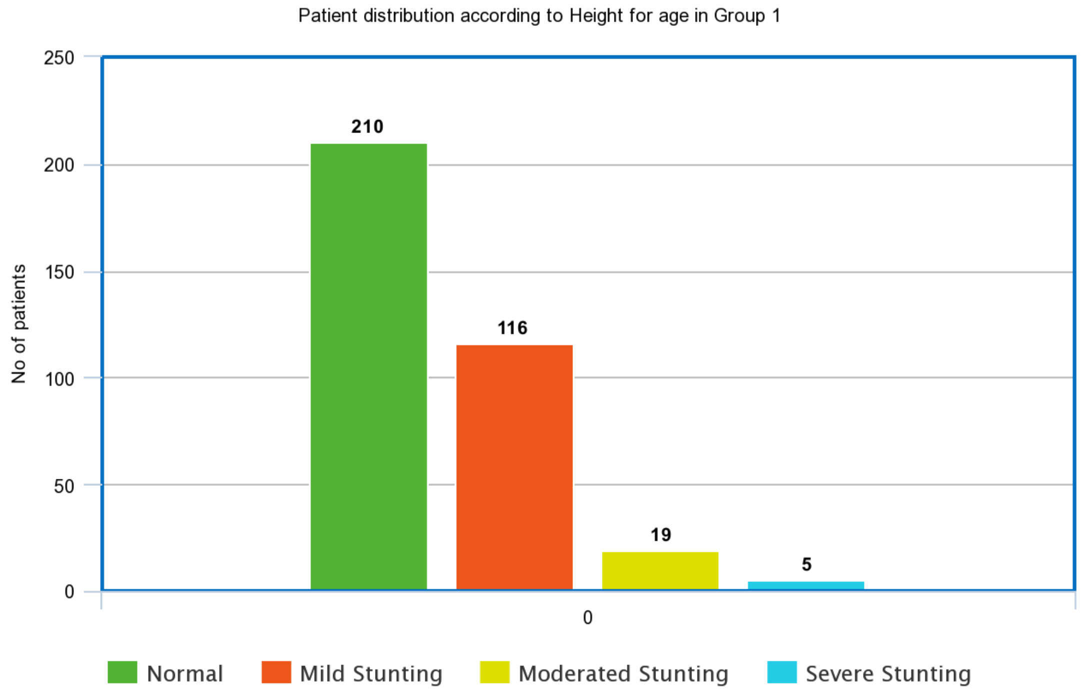


Figure 5. Nutritional status of the patients according to weight for height in Group 1

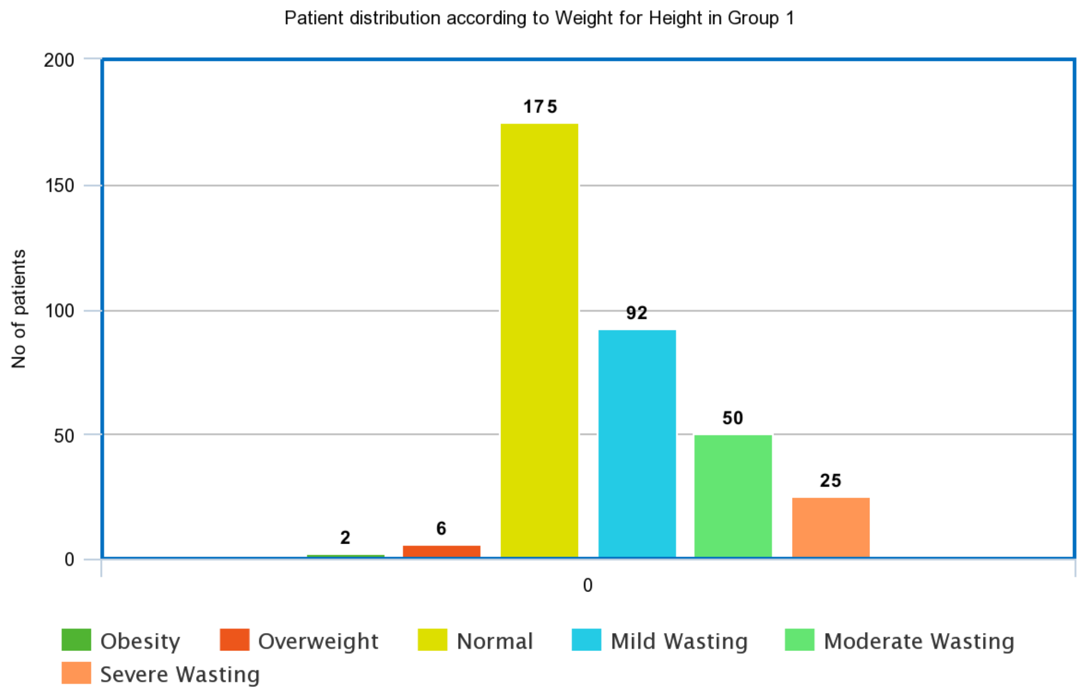


Figure 6. Nutritional status of the patients according to height for age in Group 2

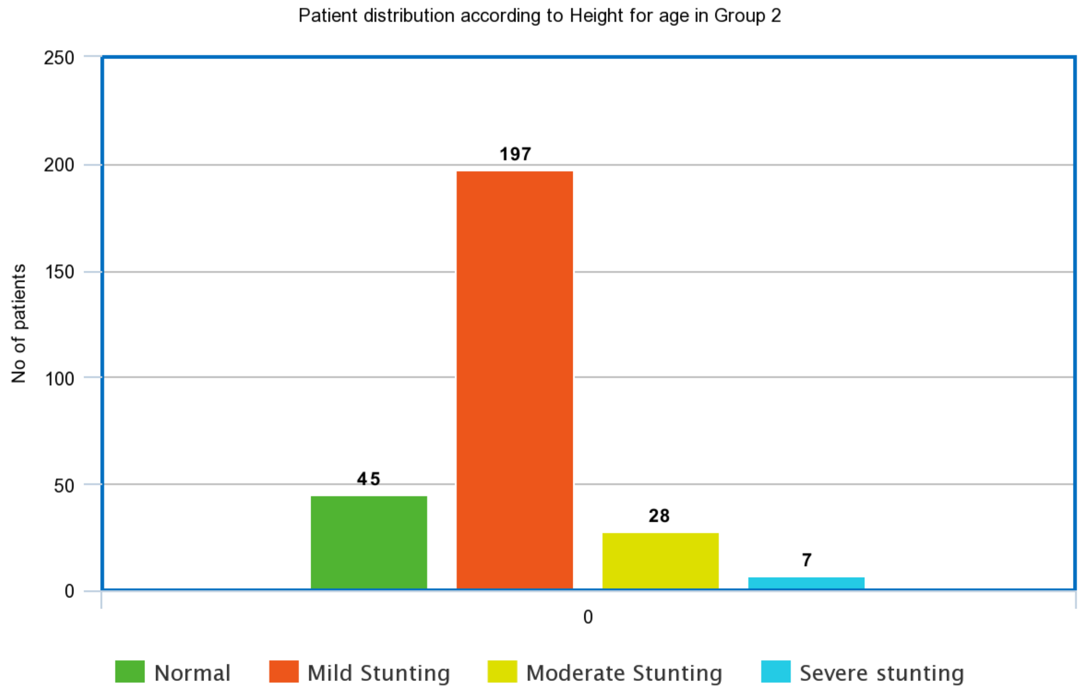
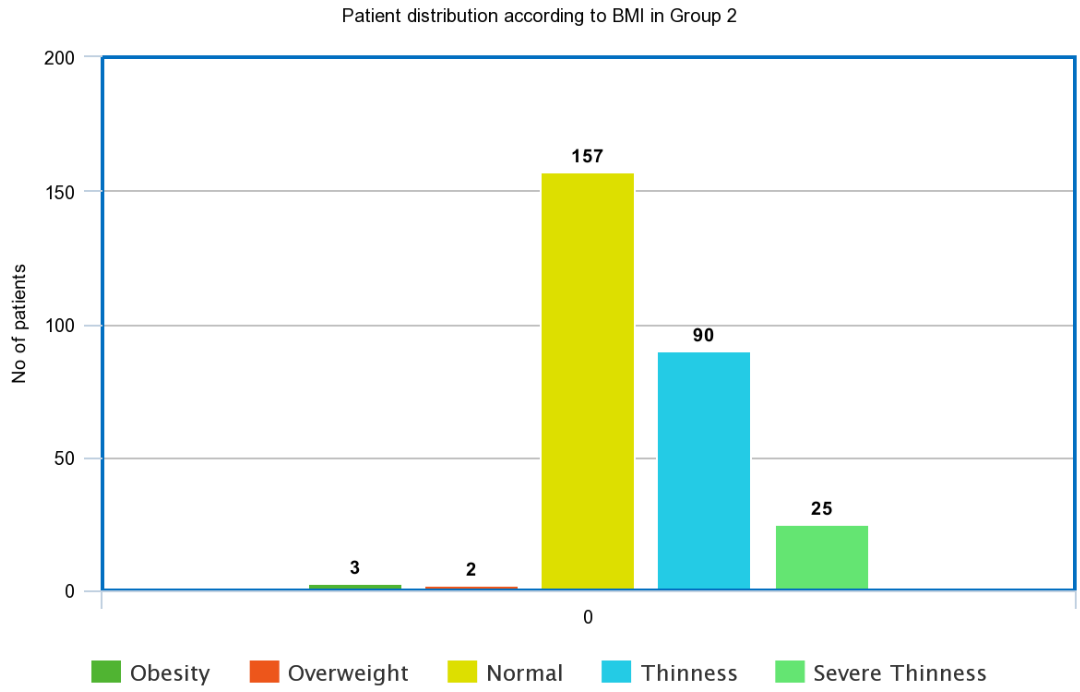


Figure 7. Nutritional status of the patients according to BMI z score in Group 2



Postoperative clinical outcomes in patients:

The commonly seen complication in both groups was wound oedema, wound erythema, fever, vomiting, abdominal pain, abdominal distention, urinary tract infection and anaemia. The postoperative complications were graded between 1 to 5 according to the Clavien-Dindo classification.

In Group 1, 137/350 (39.14%) had postoperative complications. Among 137 patients, 87 (63.50%) patients in group 1 had grade 1 complications which mainly include surgical site infection (SSI). Grade 1 also included minor risk events not requiring therapy with exceptions of analgesic, antipyretic, antiemetic, diuretics, electrolytes and physiotherapy. Grade 2 complications which represent patients requiring blood transfusion, total parenteral nutrition and additional medications, were present in 26/137 (18.98 %) patients. Grade 3 complications were present in 23/137 (16.79%), which represents patients requiring surgical/endoscopic/radiological intervention. One child had a grade 4 complication which represents life-threatening complications requiring ICU management. None of the patients had grade 5 complications, i.e. death. (Figure 8)

In group 2, 108/277 (38.99%) patients had postoperative complications. Ninety were grade 1, 6/108 (5.56%) were grade 2, and 12/108 (11.11%) were grade 3. None of the patients had grade 4 or grade 5 complications.

Figure 8. Postoperative complications according to Clavien-Dindo Classification in Group 1

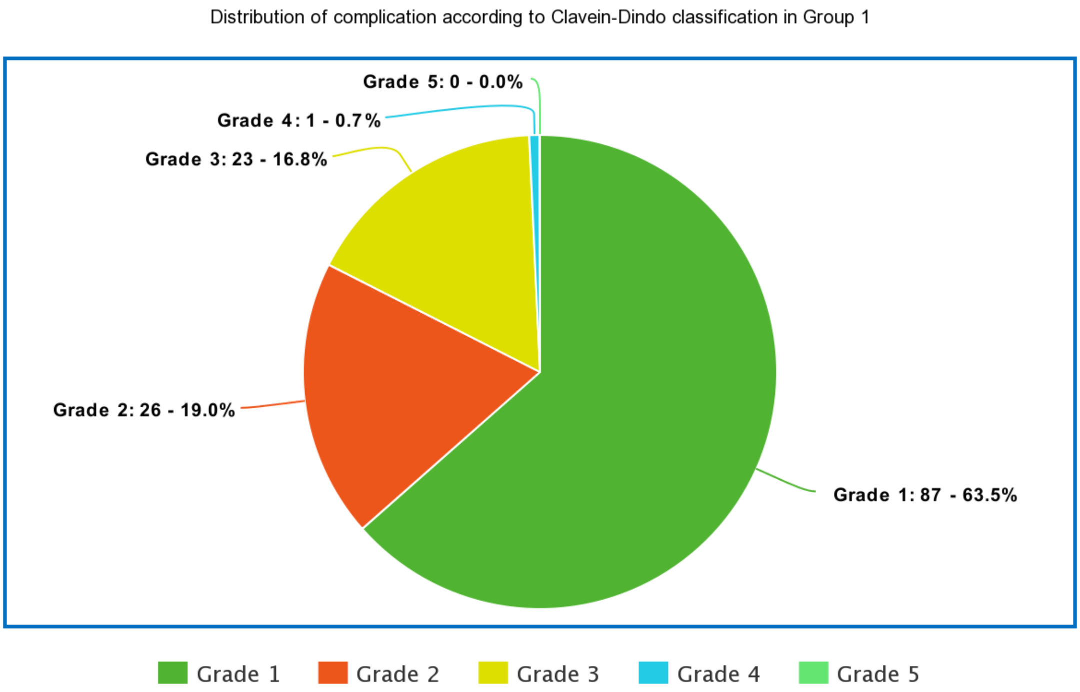
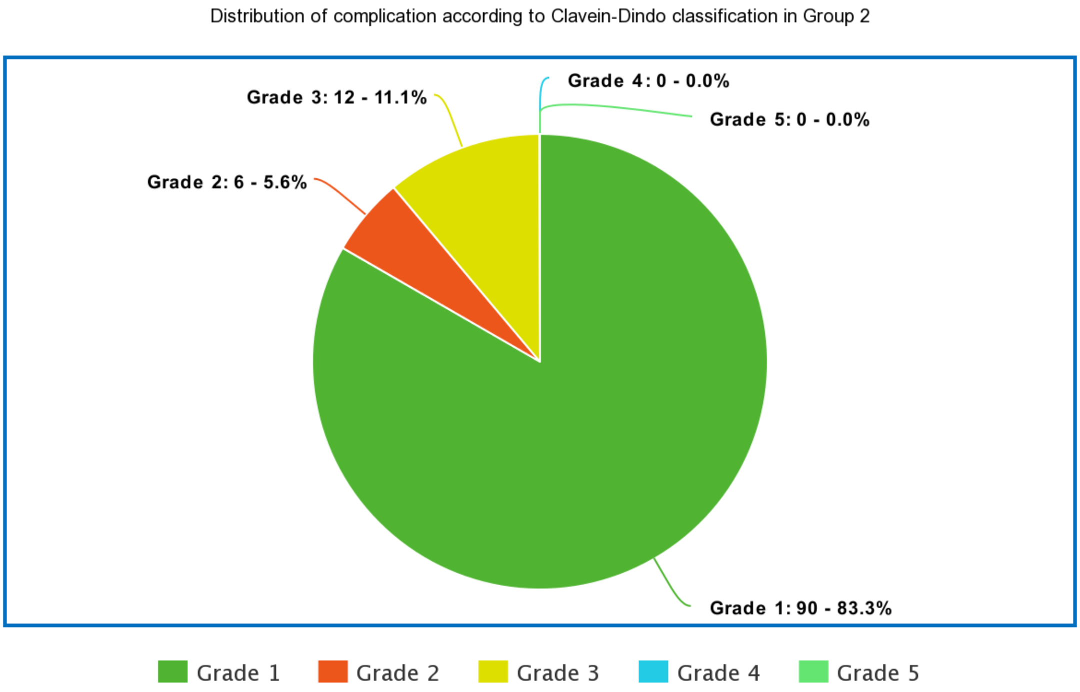


Figure. 9. Postoperative complications according to Clavien- Dindo classification in Group 2



RELATIONSHIP BETWEEN PREOPERATIVE NUTRITIONAL STATUS AND POSTOPERATIVE OUTCOMES:

For group 1:

In group 1, 137 patients had complications out of 350, while 213 did not have complications. The median (IQR) weight for age Z score for patients with complications was -1.07 (IQR= 1.30), while it was -1.13 (IQR = 1.02) for patients without complications. The median (IQR) height for age Z score for patients with complications was -0.72 (IQR =1.12), while it was -0.89 (IQR = 0.89) for patients without complications. The median (IQR) weight for height Z score for patients with complications was -1.11 (IQR=2.08), while it was -0.90 (IQR= 1.63) for patients without complications. There was no statistically significant difference in the medians between the patients with and without complication in any of the categories assessing nutrition. (Table 3.)

Table 3. - Comparison of anthropometric measurements of the included patients with postoperative complication status in Group 1.

Variable	Complicated (n=141)	Non-complicated (n=209)	P value
Weight for age Z score, Median $\pm$ IQR	-1.07 $\pm$ 1.30	-1.13 $\pm$ 1.02	0.66
Underweight, n(%)	74 (52.5%)	126 (60.3%)	0.14
Height for age Z score Median $\pm$ IQR	-0.72 $\pm$ 1.12	-0.89 $\pm$ 0.89	0.33
Stunted, n(%)	53 (37.6%)	87 (41.6%)	0.44
Weight for height Z score Median $\pm$ IQR	-1.11 $\pm$ 2.085	-0.90 $\pm$ 1.63	0.38
Wasted, n(%)	72 (51.1%)	95 (45.5%)	0.30

Mann-Whitney U test and chi- square test was applied, no statistically significant p values were obtained.

The complications were graded according to the Clavien-Dindo classification of complications for each of the nutritional assessment parameters. (Table 4-6).

Table 4. Nutritional status defined by weight for age Z score and Grades of Complications in each in Group 1

Weight for age Z score	Total	Clavien-Dindo grade of complications			
		Grade 1	Grade 2	Grade 3	Grade 4
Severe underweight	2	1	0	1	0
Moderate	19	12	3	3	1
Mild	53	35	10	8	0
Normal	63	39	13	11	0
Total	137	87	26	23	1

Table 5. Nutritional status defined by height for age Z score with Grades of Complications in each in Group 1

Height for age Z score	Total	Clavien-Dindo grade of complications			
		Grade 1	Grade 2	Grade 3	Grade 4
Severe stunting	4	2	1	1	0
Moderate stunting	5	2	2	1	0
Mild stunting	44	28	7	9	0
Normal	84	55	16	12	1
Total	137	87	26	23	1

Table 6. Nutritional status defined by weight for age Z score with Grades of Complications in each in Group 1

Weight for height Z score	Total	Clavien-Dindo grade of complications			
		Grade 1	Grade 2	Grade 3	Grade 4
Severe wasting	11	6	2	3	0
Moderate wasting	25	16	4	4	1
Mild wasting	36	25	7	4	0
Normal	62	39	12	11	0
Overweight	2	1	1	0	0
Obesity	1	0	0	1	0
Total	137	87	26	23	1

For Group 2:

In group 2, 108 patients had complications out of 277, while 169 did not have complications. The median (IQR) height for age Z score for patients with complications was -1.59 (IQR= 0.48), while it was -1.62 (IQR = 0.48) for patients without complications; the difference between the medians was not statistically significant, p= 0.15. The median (IQR) BMI Z score for patients with complications was -1.40 (IQR = 1.59), while it was -1.38 (IQR=1.13) for patients without complications, with no statistically significant difference between them. (Table 7.)

Table. 7. Comparison of anthropometric measurements of the included patients with postoperative complication status in Group 2.

Variable	Complicated (n=109)	Non-complicated (n=166)	P value
Height for age Z score Median ± IQR	-1.59 ± 0.48	-1.62 ± 0.48	**0.15**
Stunted, n(%)	91 (83.5%)	141 (84.9%)	0.57
BMI Z score Median ± IQR	-1.40 ± 1.59	-1.38 ± 1.13	0.28
Thin, n(%)	51 (46.8%)	64 (38.5%)	0.27

Mann-Whitney U test and chi- square test was applied to get p values.

The complications were graded according to the Clavien-Dindo classification of complications for both the nutritional assessment parameters (Table 8, 9).

Table 8. Nutritional status defined by height for age z score with Grades of Complications in each in Group 2

Height for age Z score	Total	Clavien-Dindo grade of complications		
		Grade 1	Grade 2	Grade 3
Severe stunting	5	5	0	0
Moderate stunting	16	12	1	3
Mild stunting	70	58	4	8
Normal stunting	17	15	1	1
Total	108	90	6	12

Table 9. Nutritional status defined by BMI z score with Grades of Complications in each in Group 2

BMI Z score	Total	Clavien-Dindo grade of complications		
		Grade 1	Grade 2	Grade 3
Normal	53	44	2	7
Overweight	2	2	0	0
Obesity	2	2	0	0
Thinness	42	35	3	4
Severe thinness	9	7	1	1
Total	108	90	6	12

ASSOCIATION OF COMPLICATIONS WITH DURATION OF SURGERY:

In both groups, patients were divided into 2 categories based on the duration of surgery – less than 2 hours and more than 2 hours. In Group 1, 185 patients had surgery in less than 2 hours, and 165 patients had surgery in more than 2 hours. In group 2, 179 patients had surgery in less than 2 hours, and 98 patients had surgery in more than 2 hours. Complications were assessed in both categories. In group 1, out of 185 patients who had surgery in less than 2 hours, 159 developed no complications, while 26 had complications. Out of 165 patients who had surgery for more than 2 hours, 111 patients developed complications, and 54 patients did not develop any complications. In group 2, out of 179 patients who had surgery in less than 2 hours, 151 had no complications, while 28 had complications. Out of 98 patients who had surgery more than 2 hours, 81 developed complications and 17 did not have a complication. It was found that complications were higher with a longer duration of surgery in both groups, and this was statistically significant (Table 10, 11)

Table 10. Comparison of Duration of surgery with postoperative complications in Group 1

	< 2 hours	> 2 hours	Total
No complication	159	54	213
Complications	26	111	137
Total	185	165	350

Chi – Square test was applied and significant P value 0.0001 was obtained.

Table 11. Comparison of Duration of surgery with postoperative complications in Group 2

	< 2 hours	> 2 hours	Total
No complication	151	17	168
Complications	28	81	109
Total	179	98	277

Chi – Square test was applied and significant P value 0.0001 was obtained

ASSOCIATION OF NUTRITIONAL STATUS WITH LENGTH OF HOSPITAL STAY POST-SURGERY:

The patients were divided on the basis of hospital stay as those getting discharged within 7 days of operation and those requiring 7 or more days of hospital admission post-surgery.

In group 1, the median (IQR) weight for age Z score of patients requiring less than 7 days of hospital stay post-surgery was -1.12 (IQR= 1.08), and those requiring 7 days or more were -1.08 (IQR= 1.33). The median (IQR) height for age Z score of patients requiring less than 7 days of hospital stay post-surgery was -0.89 (IQR = 0.97), and those requiring 7 days or more were -0.67 (IQR= 0.93). The median (IQR) weight for height Z score of patients requiring less than 7 days of hospital stay post-surgery was -0.91 (IQR =1.65), and for those requiring 7 days or more was -1.10 (2.12). There was no statistically significant difference between them. (Table 12)

Table 12. Comparison of Nutritional status parameters with the length of hospital stay in Group 1

Variable	< 7 days (277 patients)	≥ 7 days (73 patients)	p-value
Weight for age Z score, Median ± IQR	-1.12 ± 1.08	-1.08 ± 1.33	0.554
Height for age Z score, Median ± IQR	-0.89 ± 0.97	-0.67 ± 0.93	0.111
Weight for height Z score, Median ± IQR	-0.91 ± 1.65	-1.10 ± 2.12	0.250

Mann-Whitney U test was applied, no statistically significant result found.

In group 1, more patients who developed complications (66/137) (48.2 %) had a longer duration of hospital stay, i.e. more than 7 days, compared to patients who did not have complications (7/213)(3.2%), p < 0.001. (Table 13)

Table 13. Comparison of postoperative complication status with the length of hospital stay in group 1

	< 7 days	> 7 days	Total
No complication	206	7	213
Complications	71	66	137
Total	277	73	350

Chi – square test was applied and statistically significant p value 0.001was obtained.

In group 2, the median (IQR) height for age Z score of patients requiring less than 7 days of hospital stay post-surgery was -1.61(0.54), and those requiring 7 days or more were -1.62 (IQR=0.30). The median BMI Z score of patients requiring less than 7 days of hospital stay post-surgery was -1.39 (IQR= 1.33), and those requiring 7 days or more were -1.62 (IQR=1.90). There was no statistically significant difference between them. (Table 14)

Table 14. Comparison of Nutritional status parameters with the length of hospital stay in Group 2

Variable	< 7 days (226 patients)	> 7 days (51 patients)	p-value
Height for age Z score, Median ± IQR	-1.61 ± 0.54	-1.62 ± 0.30	0.56
BMI Z score, Median ± IQR	-1.39 ± 1.33	-1.62 ± 1.90	0.19

Mann-Whitney U test was applied, no statistically significant result found.

In group 2, more patients who developed complications (47/108) (43.5 %) had a longer duration of hospital stay, i.e. more than 7 days, compared to patients who did not have complications (4/169)(2.3%), p = 0.001. (Table 15)

Table 15. Comparison of postoperative complication status with the length of hospital stay in group 2

	< 7 days	≥ 7 days	Total
No complication	165	4	169
Complications	61	47	108
Total	226	51	277

Chi – square test was applied and statistically significant p value 0.001was obtained.

ASSOCIATION OF NUTRITIONAL STATUS PARAMETERS WITH READMISSION RATES:

In group 1, 10/350 patients required readmission within 30 days of discharge. The median (IQR) weight for the age Z score of patients requiring readmission was -1.11 (IQR=1.79), and for those not requiring readmission was -1.11 (IQR= 1.16). The median (IQR) height for age Z score of patients requiring readmission was -0.51(IQR=0.82), and for those not requiring was -0.84(IQR=0.97). The median (IQR) weight for height Z score of patients requiring readmission was -1.58 (IQR=2.06), and for those not requiring was -0.93 (IQR=1.65). There was no statistically significant difference between them (Table 16).

Table 16. Comparison of anthropometric measurements of the included patients with Readmission status in Group 1

Variable	Yes (n=10)	No (n=340)	P value
Weight for age Z score, Median ± IQR	-1.11 ± 1.79	-1.11 ± 1.16	0.73
Height for age Z score Median ± IQR	-0.51 ± 0.82	-0.84 ± 0.97	0.21
Weight for height Z score Median ± IQR	-1.58 ± 2.06	-0.93± 1.65	0.16

Mann-Whitney U test was applied, no statistically significant result found.

In group 2, 11/277 patients required readmission within 30 days of discharge. The median (IQR) height for age Z score of patients requiring readmission was -1.44 (IQR=0.36), and for those not requiring was -1.61 (IQR=0.50). The median (IQR) BMI for age Z score of patients requiring readmission was – 0.77 (IQR=1.21), and for those not requiring was -1.39 (IQR=1.27). There was no statistically significant difference between them. (Table 17).

Table 17. Comparison of anthropometric measurements of the included patients with Readmission status in Group 2

Variable	Yes (n=11)	No (n=266)	P value
Height for age Z score Median ± IQR	-1.44 ± 0.36	-1.61 ± 0.50	0.77
BMI Z score Median ± IQR	-0.77 ± 1.21	-1.39 ± 1.27	0.22

Mann-Whitney U test was applied, no statistically significant result found.

In both groups, readmission rates were higher in patients with complications than in patients without complications, and this was statistically significant (Table 18, 19)

Table 18. Readmission status in patients with complications and without complications in Group 1

Variable	Complicated (n=137)	Non-complicated (n=213)	Total
Readmission - Yes	8	2	10
Readmission – No	129	211	340
Total	137	213	350

Chi – square test was applied and statistically significant p value **0.016** was obtained**.**

Table 19**.** Readmission status in patients with complications and without complications in Group 2

Variable	Complicated (n=109)	Non-complicated (n=168)	Total
Readmission - Yes	9	2	11
Readmission – No	100	166	266
Total	109	168	277

Chi – square test was applied and statistically significant p value **0.008** was obtained**.**

Association of baseline Haemoglobin with Complications:

In Group 1, the mean Hb of patients who developed complications was 10.5 $\pm$ 1.2, and those who did not have any complications were 10.6$\pm$1.3. There was no statistically significant difference in haemoglobin levels between the complicated and non-complicated groups (Table 20)

In Group 2, the mean Hb of patients who developed complications was 11.8 $\pm$ 1.8, and those who did not have any complications were 12.2$\pm$1.5. There was a statistically significant difference in haemoglobin levels between the complicated and non-complicated groups (Table 21)

Table 20. Comparison of Haemoglobin levels and postoperative complication status in group 1

Variable	Complicated (n=137)	Non-complicated (n=213)	P value
Hb Mean ±SD	10.5 ± 1.2	10.6 ± 1.3	**0.32**

Student t-test was applied, no statistically significant result obtained p value = 0.32

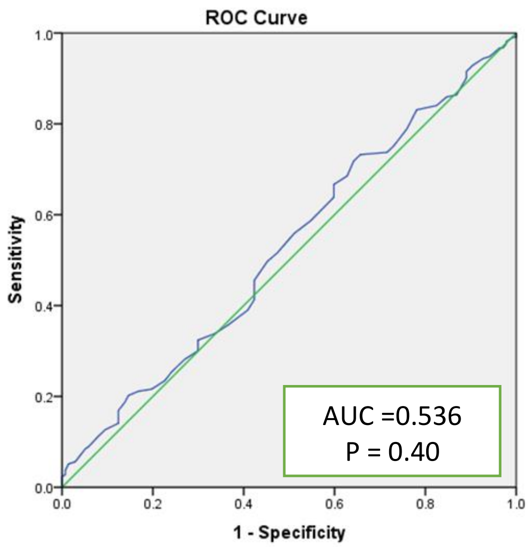
Table 21. Comparison of Haemoglobin levels and postoperative complication status in group 2

Variable	Complicated (n=109)	Non-complicated (n=168)	P value
Hb Mean ±SD	11.8 ± 1.8	12.2 ± 1.5	**0.046**

Student t-test was applied, statistically significant result obtained with p value = 0.046

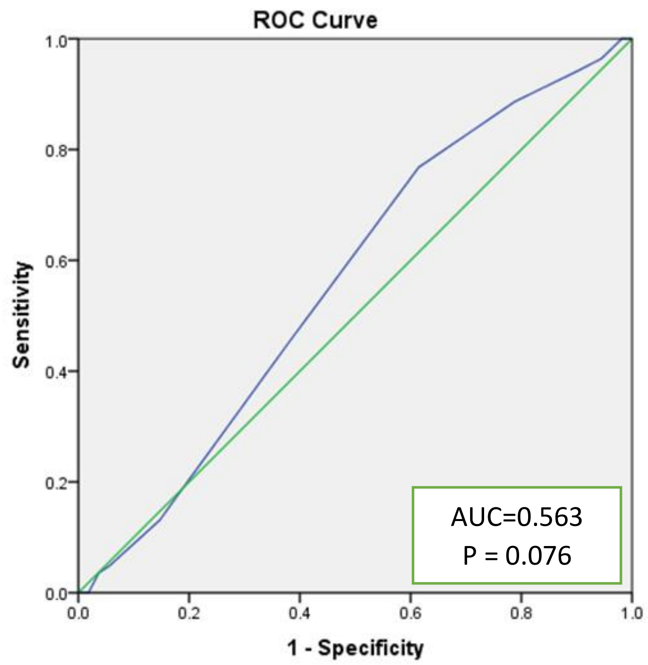
To obtain a cut-off value of hemoglobin for discrimination of complications, a receiver operating characteristic (ROC) curve was obtained for both the groups. However, Area under the curve (AUC) was 0.526 for group 1 and 0.563 for group 2 which were not statistically significant**.** Hence, no cut-off value of hemoglobin could be obtained below which complications can be expected.

Figure 10. Evaluation of the cut-off value of the hemoglobin in group 1 patients using the receiver operating characteristic curve.



Area under the curve - 0.526 (95% CI 0.464- 0.588)

Figure 11. Evaluation of the cut-off value of the hemoglobin in group 2 patients using the receiver operating characteristic curve. Area under the curve Z 0.526**.**



Area under the curve - 0.563 (95% CI 0.492- 0.634)

SUMMARY OF RESULTS:

- There is no statistically significant relation between anthropometric nutritional parameters defined by z scores with postoperative complications.
- There is no statistically significant relation between anthropometric nutritional parameters with length of hospital stay.
- Prolonged duration of surgery (more than 2 hours) is associated with increased postoperative complications and it is statistically significant.
- Patients with complications have longer duration of hospital stay (more than 7 days) and higher readmission rates within 30 days of follow up period.
- Patients with complications have lower levels of hemoglobin compared to patients without complications.

DISCUSSION

The optimal method for identifying and categorizing malnutrition in paediatric patients is still up for debate in the literature. Numerous studies have assessed malnutrition using objective metrics like weight-for-height scores, Z-scores, BMI, growth velocity, weight loss, and mid-upper arm circumference, in addition to subjective assessment scoring systems like the subjective global assessment(12). These scoring systems weren't as well researched for use with children because they were originally designed to evaluate the nutritional status of adults. Developing a standard analysis for children has been challenging because of the significant variances across different populations and age groups. Consequently, most research claims that it is possible to accurately forecast a patient's nutritional status by combining subjective and objective data.

A unified approach to define paediatric malnutrition in hospitalized children is required and must be based on clinical and/or laboratory data that can be easily measured during hospital admission. Due to their increased metabolic rate and postoperative energy needs as compared to adult patients, this assessment is particularly crucial for paediatric surgical patients. Children's reactions to surgery, anaesthesia, and recuperation are thereby significantly impacted(29).

Recently, a new paradigm for defining and quantitating malnutrition was proposed by the American Society for Parenteral and Enteral Nutrition (ASPEN) taskforce (and endorsed by the American Academy of Paediatrics)(13). This combines anthropometry further with the aetiology and duration of malnutrition, the presence or absence of an inflammatory state and the physiologic mechanism of nutrient imbalance.

Accurate anthropometric measurements have formed the basis of traditional nutritional assessment in children using calculated weight for age, height for age, weight for height and body mass index (BMI) to define the nutritional state of an individual relative to a reference population. Since these classification schemes were originally developed for global populations, they may be less applicable to hospitalized children, whose nutritional derangement may be nonconforming to the classic categories of "wasting" (low weight for height), "stunting" (low height for age) and "overweight/obese (high weight for height or BMI) (30). Despite these limitations, anthropometric classification likely represents the best available option for characterizing nutritionally at-risk populations, who might selectively benefit from risk-mitigating strategies, such as preoperative nutritional rehabilitation.

In this study, we have used anthropometric measures to assess the nutritional status of patients. Malnourished patients were divided into mild, moderate and severe categories based on World Health Organisation-defined z scores for weight for age, Height for age, Weight for height and BMI for age(31,32). We found that in group 1, 57.14 % of our cohort was underweight, 40 % were stunted, and 47.71 % were wasted. According to findings of the 2019-21 National Family Health Survey (NFHS-5), nutrition indicators for children under 5 showed the prevalence of being underweight at 32.1 %, stunting - at 35.5% and wasting at 19.3%. In group 2, stunting was present in 83.7% of patients, wasting was present in 41.5 %, and obesity was present in 1 % of patients. This suggests that our cohort had a slightly higher rate of malnutrition than the general population. Despite an increased rate of malnutrition, these children in our study did not experience a statistically significant increase in surgical complications. In one observational study of children with congenital heart malformations, there was an increased risk of 30-day mortality, length of hospital stay, and need for longer mechanical ventilation in patients with Z-score less than – 2(33). This study included 302 patients, out of which 88 patients were malnourished with a BMI less than − 2 SD, which likely powered their study to observe differences between the malnourished and properly nourished cohorts

In our study, we could not find any statistically significant correlation between stunting, i.e., height for age z scores and postoperative complications. This could be attributed to the higher number of stunted patients compared to patients with normal height for age z scores, limiting the ability to perform meaningful analysis. Alsheri et al. conducted a similar study in which they assessed the nutritional status of 23,714 paediatric patients undergoing abdominal and thoracic surgery and found out its relation with postoperative outcomes, including length of hospital stay. The stunted group had higher rates of deep wound dehiscence, urinary tract infection, need for blood transfusion and 30-day mortality, as well as a higher rate of composite morbidity(OR 1.2, 95% CI 1.0–1.3, $p = 0.04$). These patients also experienced longer average LOS (mean = 9.8 days, $p < 0.05$). They concluded that stunted or obese patients are at increased risk of adverse outcomes after abdominal or thoracic surgery(13). Toole et al. reported similar results in their study of the effect of nutritional status and cardiovascular risk on hospital outcomes after congenital heart surgery in infants and children. He defined acute and chronic malnutrition in 121 patients less than 24 months of age according to Waterlow criteria. They did not find any statistically significant links between acute malnutrition (defined as using weight for length) and outcomes, but they did find correlations with chronic malnutrition (Length for age). Forty-nine patients with Chronic protein energy malnutrition had a longer hospital LOS when compared with patients without chronic malnutrition ($P < .005$) (21).

In our study, we did not find any correlation between preoperative nutritional status and length of hospital stay in the groups. None of the indicators of nutritional status was related to the length of hospital stay. This finding is similar to a previous study done by Secker et al. in which no objective nutritional measures showed an association with outcomes (6). However, subjective global assessment (SGA) showed a significant association with postoperative outcomes. SGA successfully divided children into 3 groups - well-nourished, moderately malnourished, and severely malnourished. Postoperative length of stay was longer for malnourished children than for well-nourished children ($P < 0.002$). Goofy et al., in their study on the impact of preoperative nutritional status on surgical outcomes in patients with paediatric gastrointestinal surgery, found that 28 patients with a prolonged hospital stay had significantly lower preoperative length-for-age z score (-1.06 ± 1.75, $p = 0.022$)(25). The variance in observations between the studies might have resulted from differences in the study populations and the analysis undertaken.

Our study observations revealed that postoperative complications were significantly associated with prolonged length of hospital stay. In Group 1, 48.2% of patients who developed complications required a prolonged hospital stay, i.e., more than 7 days, and in Group 2, 43.5% of patients who developed complications required a prolonged hospital stay. A general tendency exists to optimize the patient’s vital parameters and ensure multiorgan system stability before discharge. Thus, the presence of any postoperative complication would delay optimizing the general status of the patient. Our results are partly in agreement with those from paediatric and adult cardiac surgery studies that have reported that postoperative complications were significantly associated with a prolonged hospital stay(34–36)

The duration of surgery has a significant impact on postoperative outcomes. In our study, we found that the duration of surgery extending beyond 2 hours had a higher risk of developing postoperative complications, and it was statistically significant in both groups ($p<0.001$). A systematic review and meta-analysis performed by Cheng et al. concluded a similar finding that prolonged operative time is associated with an increase in the risk of complications. A total of 66 retrospective studies were included in the systematic review. Pooled analyses showed that the likelihood of complications increased significantly with prolonged operative duration, approximately doubling with operative time thresholds exceeding 2 hours or more. The meta-analyses also demonstrated a 14% increase in the likelihood of complications for every 30 min of additional operating time (37).

In our study, 2.8 % of patients in Group 1 and 3.9 % of patients in Group 2 required readmission within 30 day follow-up period. Readmission rates were not related to any of the nutritional parameters which were studied. However, it was found that readmission rates were higher in patients who developed postoperative complications compared to patients who did not develop complications, and it was statistically significant (Group 1 - $p < 0.016$, Group 2 – $p < 0.008$). Readmissions after surgery are considered multifactorial. Factors associated with readmission depend on the patient's condition and surgery type. Earlier studies demonstrated that postoperative complications are the most notable independent risk factor for surgical readmission(38). Another study from the United States investigated the underlying reasons for readmission following surgery and reported the highest rate of postoperative complications, particularly SSI(39).

Haemoglobin levels were also assessed in our patients as markers for nutrition. It was found that patients who developed complications had lower levels of haemoglobin compared to patients who did not develop complications in both groups. However, it was statistically significant only in group 2**.** Anaemia can be considered both a marker for an adverse outcome as well as a marker for undernutrition. Several previous studies have correlated low levels of haemoglobin with an increased risk of postoperative complications (13, 24, 25).

Surgical site infection (SSI) is considered one of the most common complications following major surgery. We found that 28.2% of our patients experienced infectious complications postoperatively. The effects of SSI can be life-threatening. It is reported SSI accounts for 20 % of all hospital-acquired infections and is associated with a 2 to 11- fold increase in the risk of mortality, with 75 % of SSI-associated deaths directly attributable to the SSI (40,41). The association of malnutrition with infection has been well recognized through clinical observations and epidemiologic studies(4,5). Majumder demonstrated the association of postoperative wound infection with poor nutritional status in 2019(26). Neumann et al. identified severe degrees of weight loss and serum albumin level depression as being associated with increased rates of clinical sepsis(42). Most other clinical studies have been accomplished in the paediatric population, particularly those with kwashiorkor. The most common complication that occurred in the current series of patients among those who were malnourished was the occurrence of septic complications. Though in our study, no significant association was found between malnourishment and postoperative infections, earlier studies confirm the common occurrence of sepsis in the malnourished individual(4–6,26,42–44).

There are some limitations of this study that should be noted. Sample size was small as compared to previous studies because of time constraints. There were very small numbers of patients with z scores within the normal range for weight for age, height for age, weight for height and BMI for age, thus limiting our ability to perform meaningful analysis to assess the outcomes. We have used anthropometric measurements to assess the presence of malnutrition in our study; other studies have used different criteria and biochemical/hematologic markers to classify malnutrition. Biochemical markers that may correlate with nutritional statuses, such as albumin and prealbumin, were not ordered routinely in our patient population. We did not assess whether the postoperative complications were a complication of a specific surgical intervention. We have included all the elective procedures which covered day care procedures also; hence our results are affected because such procedures tend to have a lesser complication rate. It would also have been interesting to assess the impact of nutritional status on long-term outcomes. However, we were unable to collect such data due to limited follow-up and a varied heterogeneous population. One of the strengths of this study is the use of the WHO references for deriving z scores for Weight for age, height for age, weight for height and BMI for age. This increases the generalizability of this study, as the WHO references were derived from an international cohort of children.

CONCLUSION

The prevalence of malnourishment is high in paediatric surgery patients. Using a single screening tool of anthropometric assessment, we found that there was no significant relation between z scores of nutritional parameters and postoperative complications. However, factors like prolonged duration of surgery and preoperative haemoglobin values were significantly associated with postoperative complications. In our study, patients with complications had prolonged hospital stay and an increased rate of readmissions which added to their morbidity. In our study preoperative nutritional parameters were not associated with postoperative complications in paediatric surgical patients; to attain higher quality evidence on this topic randomised control trials are required correlating preoperative malnutrition with clinical outcomes in paediatric surgical patients.

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ANNEXURE I: ETHICAL CLEARANCE CERTIFICATE

अखिल भारतीय आयुर्विज्ञान संस्थान, जोधपुर

All India Institute of Medical Sciences, Jodhpur

संस्थागत नैतिकता समिति

Institutional Ethics Committee

No. AIIMS/IEC/2021/ 3547 **Date: 12/03/2021**

ETHICAL CLEARANCE CERTIFICATE

Certificate Reference Number: **AIIMS/IEC/2021/3382**

Project title: **"Relationship between preoperative nutritional status and postoperative complications categorized according to the clavein dindo classification in pediatric surgical patients"**

Nature of Project:	**Research Project Submitted for Expedited Review**
Submitted as:	**M.Ch. Dissertation**
Student Name:	**Dr. Tripti Agrawal**
Guide:	**Dr. Rahul Saxena**
Co-Guide:	**Dr. Arvind Sinha, Dr. Manish Pathak, Dr. Kirtikumar Rathod, Dr. Avinash Jadhav & Dr. Akhil Goel**

Institutional Ethics Committee after thorough consideration accorded its approval on above project.

The investigator may therefore commence the research from the date of this certificate, using the reference number indicated above.

Please note that the AIIMS IEC must be informed immediately of:

- Any material change in the conditions or undertakings mentioned in the document.
- Any material breaches of ethical undertakings or events that impact upon the ethical conduct of the research.

The Principal Investigator must report to the AIIMS IEC in the prescribed format, where applicable, bi-annually, and at the end of the project, in respect of ethical compliance.

AIIMS IEC retains the right to withdraw or amend this if:

- Any unethical principle or practices are revealed or suspected
- Relevant information has been withheld or misrepresented

AIIMS IEC shall have an access to any information or data at any time during the course or after completion of the project.

Please Note that this approval will be rectified whenever it is possible to hold a meeting in person of the Institutional Ethics Committee. It is possible that the PI may be asked to give more clarifications or the Institutional Ethics Committee may withhold the project. The Institutional Ethics Committee is adopting this procedure due to COVID-19 (Corona Virus) situation.

If the Institutional Ethics Committee does not get back to you, this means your project has been cleared by the IEC.

On behalf of Ethics Committee, I wish you success in your research.

Dr. Praveen Sharma
Member Secretary

Member secretary
Institutional Ethics Committee
AIIMS,Jodhpur

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ANNEXURE II: INFORMED CONSENT FORM

All India Institute of Medical Sciences

Jodhpur, Rajasthan

Title of study: Relationship between the preoperative nutritional status with the postoperative complications categorized according to the Clavien Dindo classification in Paediatric Surgical patient"

Name of PG Student: Tripti Agrawal **Mobile. No:** 8302142983

Patient/Volunteer registration no. ______________________________

I, ____________ S/o or D/o ______________R/o___________ give full, free,voluntary consent for my child to be included in the study " Association between the preoperative nutritional status with the postoperative complications categorized according to Clavien Dindo classification in Paediatric Surgical patients", the nature and procedure of which has been explained to me in my own language to my full satisfaction. I confirm that I have been explained regarding the study.

I understand that my consent is voluntary, and I am aware of my right to opt my child out of the study at any time without the need for an explanation regarding the same.

I understand that the information collected about me and any of my medical records may be looked at by a responsible individual from AIIMS Jodhpur. I give permission for these individuals to have access to my records.

Date: ________________

Place: _______________

Signature/Left thumb impression

This is to certify that the above consent has been obtained in my presence.

Date: ________________ ____________________________

Place: ________________ Signature of PG Student

Witness 1 2. Witness 2

_____________________________ ___________________________

Signature Signature

Name: _______________________ Name: ______________________

Address: _____________________ Address: _________________

ANNEXURE III: INFORMED CONSENT FORM

अखिल भारतीय आयुर्विज्ञान संस्थान

जोधपुर, राजस्थान

सूचित सहमति प्रपत्र

अध्ययन का शीर्षक: **बाल चिकित्सा सर्जिकल रोगी में क्लैविन डिनो वर्गीकरण के अनुसार वर्गीकृत जटिलताओं के साथ पूर्व- सर्जिकल पोषण संबंधी स्थिति का संबंध**

पीजी छात्र का नाम: तृप्ति अग्रवाल मोबाइल: 8302142983

रोगी / स्वयंसेवक पंजीकरण नं। ____________________________________

मैं, _______________ पुत्र/पुत्री _________________ निवासी _____________ पूर्ण, मुक्त, मेरे बच्चे को अध्ययन में शामिल करने के लिए स्वैच्छिक सहमति " बाल चिकित्सा सर्जिकल रोगी में क्लैविन डिनो वर्गीकरण के अनुसार वर्गीकृत जटिलताओं के साथ पूर्व- सर्जिकल पोषण संबंधी स्थिति का संबंध" जिसकी प्रकृति और प्रक्रिया को मेरी अपनी भाषा में मेरी पूर्ण संतुष्टि के लिए समझाया गया है। मैं पुष्टि करता हूं कि मुझे अध्ययन के संबंध में समझाया गया है।

मैं समझता हूं कि मेरी सहमति स्वैच्छिक है और मुझे अपने अधिकार के बारे में पता है कि किसी भी समय स्पष्टीकरण के बिना मेरे बच्चे को अध्ययन से बाहर करने का अधिकार है।

मै समझता हूं कि मेरे और मेरे किसी भी मेडिकल रिकॉर्ड के बारे में एकत्र की गई जानकारी को एम्स जोधपुर के जिम्मेदार व्यक्ति द्वारा देखा जा सकता है। मैं इन व्यक्तियों को अपने रिकॉर्ड तक पहुंचने की अनुमति देता हूं।

दिनांक: ________________

स्थान: ________________ हस्ताक्षर / बाएं अंगूठे का निशान

यह प्रमाणित करने के लिए कि मेरी उपस्थिति में उपरोक्त सहमति प्राप्त हुई है।

दिनांक: ________________

स्थान: ____________________________________ पीजी छात्र के हस्ताक्षर

साक्षी 1.	साक्षी 2.
____________________________	_________________________
__________________________	_________________________
हस्ताक्षर	हस्ताक्षर
नाम	नाम
पता	पता

ANNEXURE IV: PATIENT INFORMATION SHEET

All India Institute of Medical Sciences

Jodhpur, Rajasthan

Protocol No: Sponsor: Nil

Principal Investigator: Dr Tripti Agrawal

Name of Participant:

Title: **Relationship between the preoperative nutritional status and the postoperative complications categorized according to the Clavien Dindo classification in Paediatric Surgical patients"**

Aim of the study: To find out the association of the preoperative nutritional status with postoperative complications categorized according to the Clavien Dindo classification in Paediatric Surgical patients."

Centre: The study will be carried out at All India Institute of Medical Sciences, Jodhpur, under the supervision of Dr Rahul Saxena.

Study procedure: Anthropometric parameters will be taken of all the patients included in the study with proper consent and willingness to participate in the study. The nutritional status will be assessed with the help of these parameters. Postoperative complications will be categorized according to Clavien Dindo classification. The correlation will be between the nutritional status and postoperative complications.

Confidentiality: The identity of each patient will be kept confidential.

Risk: Enrolment in the study will not pose any additional risk to the patient. Patients can withdraw from the study at any time without offering reasons. Not participating in the study will not lead to any treatment being denied.

For further information/questions, the following personnel can be contacted:

Dr Tripti Agrawal,

Junior Resident,

Department of Paediatric Surgery,

All India Institute of Medical Sciences, Jodhpur

Phone number: 8302142983, email address: triptiagrawal234@gmail.com.

ANNEXURE V: PATIENT INFORMATION SHEET

अखिल भारतीय आयुर्विज्ञान संस्थान

जोधपुर, राजस्थान

रोगी सूचना पत्र

प्रोटोकॉल संख्या: प्रायोजक: शून्य

प्रधान अन्वेषक: डॉ। तृप्ति अग्रवाल

प्रतिभागी का नाम:

शीर्षक: बाल चिकित्सा सर्जिकल रोगियों में क्लैविन डिंडो वर्गीकरण के अनुसार पोस्टऑपरेटिव जटिलताओं के साथ पूर्व पोषण संबंधी स्थिति का संबंध

अध्ययन का उद्देश्य: बाल चिकित्सा सर्जिकल रोगियों में क्लैविन डिंडो वर्गीकरण के अनुसार पोस्टऑपरेटिव जटिलताओं के साथ पूर्व-पोषण पोषण की स्थिति को संबंधित करना

केंद्र: डॉ। राहुल सक्सेना की देखरेख में अखिल भारतीय आयुर्विज्ञान संस्थान, जोधपुर में अध्ययन किया जाएगा।

अध्ययन प्रक्रिया: अध्ययन में शामिल सभी रोगियों को उचित सहमति और अध्ययन में भाग लेने की इच्छा के साथ एंथ्रोपोमेट्रिक पैरामीटर लिया जाएगा। इन मापदंडों की मदद से पोषण की स्थिति का आकलन किया जाएगा। पोस्ट ऑपरेटिव जटिलताओं को क्लाविन डिंडो वर्गीकरण के अनुसार वर्गीकृत किया जाएगा। पोषण स्थिति और पश्चात की जटिलताओं के बीच सहसंबंध किया जाएगा।

गोपनीयता: प्रत्येक रोगी की पहचान गोपनीय रखी जाएगी।

जोखिम: अध्ययन में नामांकन से मरीज को कोई अतिरिक्त खतरा नहीं होगा। रोगी बिना किसी कारण के किसी भी समय अध्ययन से हट सकता है। अध्ययन में भाग नहीं लेने से किसी भी उपचार से इनकार नहीं किया जाएगा।

अधिक जानकारी / प्रश्नों के लिए, निम्नलिखित कर्मियों से संपर्क किया जा सकता है:

डॉ। तृप्ति अग्रवाल,

जूनियर रेजिडेंट,

बाल चिकित्सा विभाग,

अखिल भारतीय आयुर्विज्ञान संस्थान, जोधपुर

फोन नंबर: 8302142983, ईमेल पता: triptiagrawal234@gmail.com

ANNEXURE VI: CASE RECORD

All India Institute of Medical Sciences,

Jodhpur, Rajasthan

1. PATIENT DETAIL (UHID: AIIMS/JDH/_____/__/______)
   a) Name-
   b) Age-
   c) Sex
   d) Religion/Caste/Community-
   e) Address-
   f) Phone-
   g) Diagnosis

2. **Anthropometric measurement**
   a) Height
   b) Weight
   c) Height for age z score
   d) Weight for age z score
   e) Weight for height z score
   f) BMI for age z score

3. Routine blood investigations
   a) Complete hemogram
   b) Kidney function test
   c) Liver function test
   d) Serum electrolytes
   e) Viral markers (HBsAg/HCV/HIV)

4. Surgical details
   a) Procedure performed
   b) Mode of surgery
      - Open
      - Laparoscopic
      - laparoscopic assisted
      - Cystoscopic
      - Thoracoscopic

    - Robotic

c) Duration of surgery
    - Less than 2 hours
    - More than 2 hours

d) Type of surgical wound
    - Clean
    - Clean contaminated
    - Contaminated
    - Dirty

5. Postoperative complications

- Fever
- Nausea & vomiting
- Dehydration
- Electrolyte imbalance
- Shock
- Metabolic abnormalities
- Lung atelectasis/ Pneumonia
- Acute urinary retention
- Urinary tract infection
- Surgical site infection
- Bloodstream infection
- Wound dehiscence
- Prolonged ileus

6. Categorization of postoperative complications according to Clavien Dindo Classification

- Grade 1
- Grade II
- Grade III
- Grade IV
- Grade V

7. Length of hospital stay after surgery

8. Requirement of readmission in 30 day period after discharge - yes/ no