Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/cgg2zq93

CORRELATION BETWEEN NUTRITIONAL STATUS AND POSTOPERATIVE COMPLICATIONS IN MAJOR SURGICAL AND ORTHOPEDIC PROCEDURES—A CROSS-SECTIONAL OBSERVATIONAL STUDY

Dr. Rohit Chandak[1], Dr. Patel Kalpeshkumar Chandulal[2*]

[1]Assistant Professor, Department Of General Surgery, Adesh Medical College & Hospital (Mohri), Haryana, India
[2*]Assistant Professor, Department Of Orthopaedics, Adesh Medical College & Hospital (Mohri), Haryana, India

Corresponding Author: Dr. Patel Kalpeshkumar Chandulal
Assistant Professor, Department of Orthopaedics, Adesh Medical College & Hospital (Mohri), Haryana, India Email: chandrajkot.kp01@gmail.com

ABSTRACT

Background: Malnutrition remains a significant concern in surgical patients, potentially influencing postoperative outcomes. The interplay between preoperative nutritional status and surgical complications warrants systematic investigation in the Indian healthcare context.

Objectives: To evaluate the correlation between preoperative nutritional status and postoperative complications in patients undergoing major surgical and orthopedic procedures at a tertiary care hospital in Haryana, India.

Methods: A cross-sectional observational study was conducted at Adesh Medical College & Hospital, Mohri, Haryana, from February 2021 to July 2021. Adult patients (n=180) scheduled for major elective surgical and orthopedic procedures were enrolled. Nutritional status was assessed using anthropometric measurements, biochemical parameters, and the Subjective Global Assessment tool. Postoperative complications were recorded during the hospital stay and at 30-day follow-up. Statistical analysis included descriptive statistics, chi-square test, and logistic regression.

Results: Among 180 participants, 38.3% exhibited moderate to severe malnutrition. Malnourished patients demonstrated significantly higher rates of surgical site infections (28.9% vs 9.9%, $p<0.001$), delayed wound healing (31.9% vs 11.7%, $p<0.001$), and prolonged hospital stay (mean 12.4±3.6 vs 7.8±2.1 days, $p<0.001$). Serum albumin levels below 3.5 g/dL were independently associated with increased postoperative complications (OR 3.47, 95% CI 1.89-6.38, $p<0.001$).

Conclusions: Preoperative malnutrition significantly correlates with adverse postoperative outcomes in major surgical and orthopedic procedures. Routine preoperative nutritional screening and intervention strategies should be integrated into perioperative care protocols to optimize surgical outcomes in Indian healthcare settings.

Keywords: Nutritional status, postoperative complications, malnutrition, surgical outcomes, orthopedic surgery

INTRODUCTION

Surgical interventions constitute a cornerstone of modern medical practice, with millions of procedures performed annually across Indian healthcare facilities. The success of surgical outcomes extends beyond technical expertise, encompassing comprehensive perioperative care that addresses multiple patient-related factors. Among these, nutritional status has emerged as a critical yet frequently overlooked determinant of postoperative recovery and complications.

Malnutrition, characterized by deficiencies in energy, protein, or micronutrients, affects a substantial proportion of hospitalized patients in developing nations. Studies from various Indian institutions have reported malnutrition prevalence ranging from 30% to 60% among surgical patients, reflecting the complex socioeconomic and dietary patterns prevalent in the region. The physiological demands of surgery, coupled with underlying nutritional deficits, create a vulnerable state that predisposes patients to impaired wound healing, infectious complications, and prolonged convalescence.

The pathophysiological mechanisms linking malnutrition to adverse surgical outcomes involve multiple organ systems. Protein-energy malnutrition compromises immune function through lymphocyte depletion, impaired phagocytosis, and reduced cytokine production, thereby increasing susceptibility to postoperative infections. Additionally, inadequate protein reserves hinder collagen synthesis and tissue repair, manifesting as delayed wound healing and anastomotic dehiscence. Micronutrient deficiencies, particularly of vitamins A, C, and zinc, further exacerbate these complications by disrupting cellular proliferation and extracellular matrix formation.

Despite accumulating evidence from international literature, there exists a paucity of region-specific data examining the nutritional-surgical outcome relationship within the Indian healthcare context. The unique demographic profile, dietary practices, and disease burden patterns in North India necessitate localized investigation to inform evidence-based perioperative protocols. Furthermore, resource constraints in many Indian healthcare facilities mandate identifications of cost-effective screening tools and interventions that can be feasibly implemented within existing infrastructure.

Major surgical procedures, encompassing gastrointestinal, hepatobiliary, and orthopedic operations, impose significant metabolic stress and nutritional demands. Orthopedic surgeries, particularly those involving fracture fixation and joint replacement, are increasingly common in the elderly population, who frequently present with concurrent malnutrition. The synergistic impact of advanced age, comorbidities, and nutritional deficits amplifies the risk of postoperative complications in this demographic subset.

The present study was undertaken to systematically evaluate the correlation between preoperative nutritional status and postoperative complications in patients undergoing major surgical and orthopedic procedures at a tertiary care teaching hospital in Haryana. By quantifying this relationship and identifying specific nutritional parameters predictive of adverse outcomes, this investigation aims to provide evidence supporting the integration of nutritional assessment and optimization into routine perioperative care pathways.

MATERIALS AND METHODS

Study Design and Setting

This cross-sectional observational study was conducted in the Departments of General Surgery and Orthopedics at Adesh Medical College & Hospital, Mohri, Haryana, India, over an eight-month period from February 2021 to July 2021. The institution serves as a tertiary care referral center for the surrounding rural and semi-urban population.

Study Population

Adult patients aged 18 to 75 years scheduled for major elective surgical or orthopedic procedures were eligible for inclusion. Major procedures were defined as operations requiring general or regional anesthesia with expected duration exceeding two hours and necessitating postoperative hospitalization for at least 48 hours. Specific procedures included open abdominal surgeries, major orthopedic operations (joint replacement, fracture fixation), and hepatobiliary procedures.

Exclusion criteria encompassed emergency surgeries, patients with known malignancies, those receiving immunosuppressive therapy, individuals with chronic kidney disease or liver cirrhosis, pregnant or lactating women, and patients unable to provide informed consent. Patients with incomplete nutritional assessment data or those lost to follow-up were also excluded from final analysis.

Sample Size Calculation

Based on previous literature suggesting a 25% complication rate in malnourished surgical patients compared to 10% in well-nourished patients, with 80% power and 5% significance level, the calculated sample size was 162. Accounting for a 10% attrition rate, 180 patients were enrolled in the study.

Nutritional Assessment

Comprehensive nutritional evaluation was performed within 48 hours prior to surgery by trained personnel. The assessment protocol incorporated multiple parameters:

Anthropometric Measurements: Body weight, height, and body mass index (BMI) were recorded using calibrated instruments. Mid-upper arm circumference (MUAC) and triceps skinfold thickness (TSF) were measured at the midpoint between the acromion and olecranon processes using standard techniques. BMI categories were defined as underweight (<18.5 kg/m²), normal weight (18.5-24.9 kg/m²), overweight (25-29.9 kg/m²), and obese (≥30 kg/m²).

Biochemical Parameters: Fasting venous blood samples were collected for analysis of serum albumin, total protein, hemoglobin, and total lymphocyte count. Hypoalbuminemia was defined as serum albumin below 3.5 g/dL. Laboratory investigations were conducted using standardized automated analyzers with appropriate quality control measures.

Subjective Global Assessment (SGA): This validated clinical tool assessed nutritional status through systematic evaluation of medical history (weight changes, dietary intake alterations, gastrointestinal symptoms, functional capacity) and physical examination (loss of subcutaneous fat, muscle wasting, edema, ascites). Patients were categorized as well-nourished (SGA-A), moderately malnourished (SGA-B), or severely malnourished (SGA-C).

Outcome Assessment

Patients were monitored throughout their hospital stay and contacted at 30-day postoperative follow-up. Primary outcome measures included:

- Surgical site infections (SSI) diagnosed according to Centers for Disease Control criteria
- Wound healing complications (dehiscence, delayed healing)
- Respiratory complications (pneumonia, atelectasis)
- Cardiovascular events
- Duration of hospital stay
- Unplanned re-admissions within 30 days
- Mortality

Surgical site infections were classified as superficial incisional, deep incisional, or organ-space infections based on standard definitions. All complications were documented by the attending surgical team, with infectious complications confirmed through microbiological culture when clinically indicated.

Data Collection

Structured case record forms were utilized to systematically capture demographic information, comorbidities, surgical details, nutritional parameters, and outcome variables. Data was collected by trained research personnel and verified by the principal investigator to ensure accuracy and completeness.

Ethical Considerations

The study protocol received approval from the Institutional Ethics Committee of Adesh Medical College & Hospital. Written informed consent was obtained from all participants after explaining the study objectives, procedures, and their right to withdraw without prejudice to their clinical care. Patient confidentiality was maintained throughout the study, with data anonymized during analysis. The study adhered to the Declaration of Helsinki ethical principles for medical research involving human subjects.

Statistical Analysis

Data was entered into Microsoft Excel and analyzed using SPSS version 23.0. Continuous variables were expressed as mean ± standard deviation or median with interquartile range based on distribution normality assessed through Kolmogorov-Smirnov test. Categorical variables were presented as frequencies and percentages.

Bivariate analysis employed independent t-test for continuous variables and chi-square test for categorical variables to compare outcomes between well-nourished and malnourished groups. Multivariate logistic regression analysis was performed to identify independent predictors of postoperative complications, with odds ratios and 95% confidence intervals calculated. Variables with p-value <0.20 in bivariate analysis were included in the multivariate model. A two-tailed p-value <0.05 was considered statistically significant throughout the analysis.

RESULTS AND ANALYSIS

Demographic and Clinical Characteristics

A total of 180 patients meeting inclusion criteria were enrolled, comprising 108 (60%) males and 72 (40%) females. The mean age was 52.3 ± 14.6 years (range 19-74 years). Approximately 62.2% (n=112) underwent general surgical procedures, while 37.8% (n=68) underwent orthopedic procedures. Common surgical interventions included laparotomy for various abdominal pathologies (n=47), cholecystectomy (n=28), hernia repairs (n=37), total knee replacement (n=34), and fracture fixation procedures (n=34).

Comorbidities were documented in 58.3% of patients, with diabetes mellitus (28.9%), hypertension (32.2%), and chronic obstructive pulmonary disease (11.1%) being most prevalent. The mean duration of surgery was 168 ± 52 minutes.

Nutritional Status Distribution

Based on Subjective Global Assessment, 111 patients (61.7%) were classified as well-nourished (SGA-A), 56 (31.1%) as moderately malnourished (SGA-B), and 13 (7.2%) as severely malnourished (SGA-C). For analytical purposes, SGA-B and SGA-C groups were combined as "malnourished" (n=69, 38.3%).

The mean BMI was 22.4 ± 4.2 kg/m², with 34.4% (n=62) classified as underweight, 47.8% (n=86) as normal weight, 13.3% (n=24) as overweight, and 4.4% (n=8) as obese. Mean serum albumin levels were significantly lower in malnourished patients (3.1 ± 0.6 g/dL) compared to well-nourished patients (4.0 ± 0.4 g/dL, p<0.001). Hypoalbuminemia was present in 63.8% of malnourished patients versus 18.9% of well-nourished patients (p<0.001).

Table 1: Baseline Nutritional Parameters

Parameter	Well-nourished (n=111)	Malnourished (n=69)	P-value
Age (years)	49.8 ± 13.9	56.2 ± 14.8	0.003
BMI (kg/m²)	24.1 ± 3.6	19.4 ± 3.8	<0.001
Serum Albumin (g/dL)	4.0 ± 0.4	3.1 ± 0.6	<0.001
Hemoglobin (g/dL)	12.8 ± 1.6	10.9 ± 1.8	<0.001

Parameter	Well-nourished (n=111)	Malnourished (n=69)	P-value
Total Lymphocyte Count (cells/mm³)	2,240 ± 620	1,580 ± 540	<0.001
MUAC (cm)	28.4 ± 3.2	23.6 ± 3.8	<0.001

Postoperative Complications

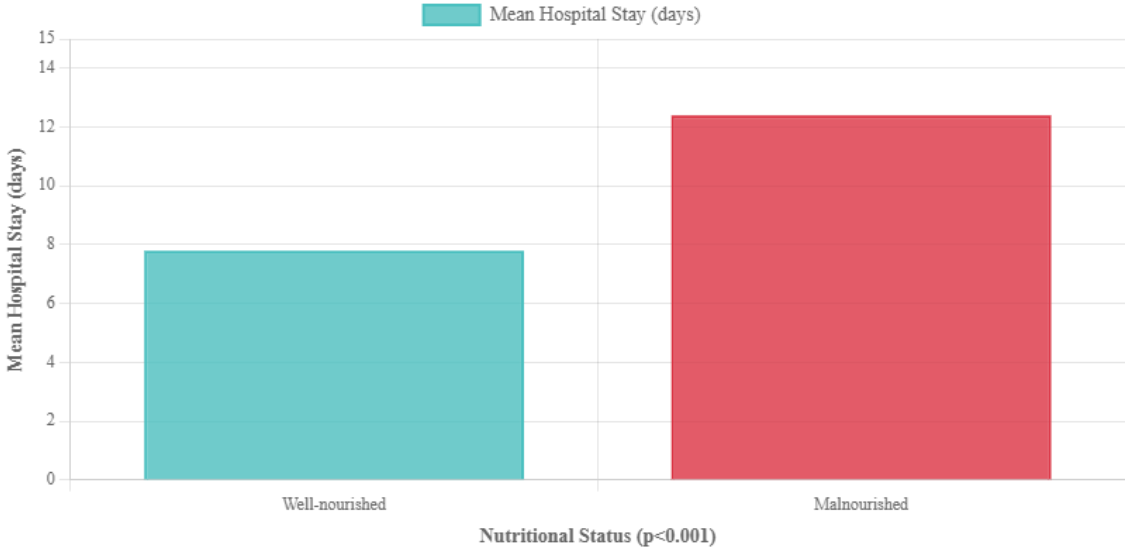
Overall, 72 patients (40%) experienced at least one postoperative complication. The complication rate was significantly higher among malnourished patients (65.2%, n=45) compared to well-nourished patients (24.3%, n=27) with p<0.001.

Surgical site infections occurred in 31 patients (17.2%), with a threefold higher incidence in malnourished patients (28.9% vs 9.9%, p<0.001). Wound healing complications affected 35 patients (19.4%), with significantly elevated rates in the malnourished group (31.9% vs 11.7%, p<0.001). Respiratory complications developed in 18 patients (10%), predominantly in malnourished individuals (18.8% vs 4.5%, p=0.002).

Table 2: Distribution of Postoperative Complications

Complication Type	Well-nourished n(%)	Malnourished n(%)	P-value
Surgical Site Infection	11 (9.9)	20 (28.9)	<0.001
Wound Dehiscence	8 (7.2)	14 (20.3)	0.008
Delayed Wound Healing	13 (11.7)	22 (31.9)	<0.001
Respiratory Complications	5 (4.5)	13 (18.8)	0.002
Urinary Tract Infection	4 (3.6)	8 (11.6)	0.036
Any Complication	27 (24.3)	45 (65.2)	<0.001

Hospital Stay and Healthcare Utilization



Mean hospital stay was significantly prolonged in malnourished patients (12.4 ± 3.6 days) compared to well-nourished patients (7.8 ± 2.1 days, p<0.001). Unplanned readmissions within 30 days occurred in 11.6% of malnourished patients versus 2.7% of well-nourished patients (p=0.018). One mortality was recorded in the malnourished group due to septic complications.

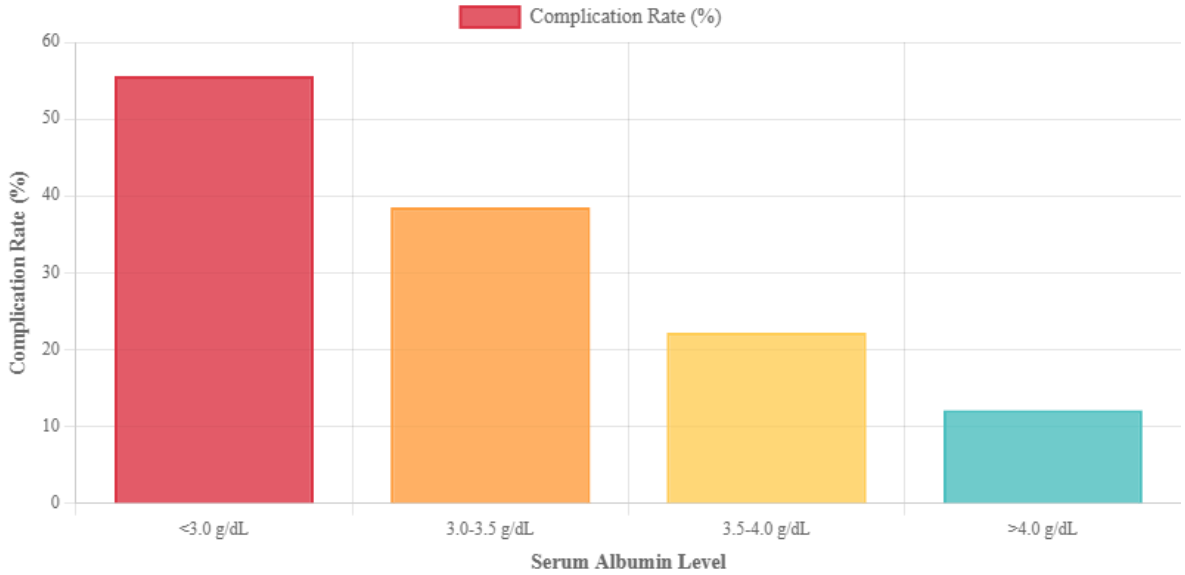


Figure 1: Graphical representation showing correlation between serum albumin levels and complication rates across different albumin ranges: <3.0 g/dL (55.6% complications), 3.0-3.5 g/dL (38.5% complications), 3.5-4.0 g/dL (22.2% complications), >4.0 g/dL (12.1% complications)]

Multivariate Analysis

Logistic regression analysis identified independent predictors of postoperative complications. After adjusting for age, gender, comorbidities, and surgical duration, the following factors remained significantly associated with increased complications:

[Table 3: Multivariate Analysis of Risk Factors for Postoperative Complications]

Variable	Odds Ratio	95% CI	P-value
Hypoalbuminemia (<3.5 g/dL)	3.47	1.89-6.38	<0.001
BMI <18.5 kg/m²	2.84	1.52-5.31	0.001
SGA (Malnourished)	2.96	1.61-5.44	<0.001
Age >60 years	1.89	1.04-3.42	0.036
Diabetes Mellitus	2.12	1.14-3.94	0.018
Surgery Duration >180 min	1.76	0.98-3.17	0.059

Serum albumin emerged as the strongest predictor, with hypoalbuminemia conferring 3.47 times higher odds of complications (95% CI 1.89-6.38, p<0.001). Similarly, BMI below 18.5 kg/m² (OR 2.84, 95% CI 1.52-5.31, p=0.001) and malnutrition identified through SGA (OR 2.96, 95% CI 1.61-5.44, p<0.001) were independent risk factors.

Subgroup Analysis by Surgical Specialty

In general, surgical patients, malnourished individuals experienced complications in 68.4% of cases versus 26.8% in well-nourished patients (p<0.001). For orthopedic procedures, complication rates were 59.1% in malnourished versus 19.0% in well-nourished patients (p<0.001), indicating consistent association across surgical disciplines.

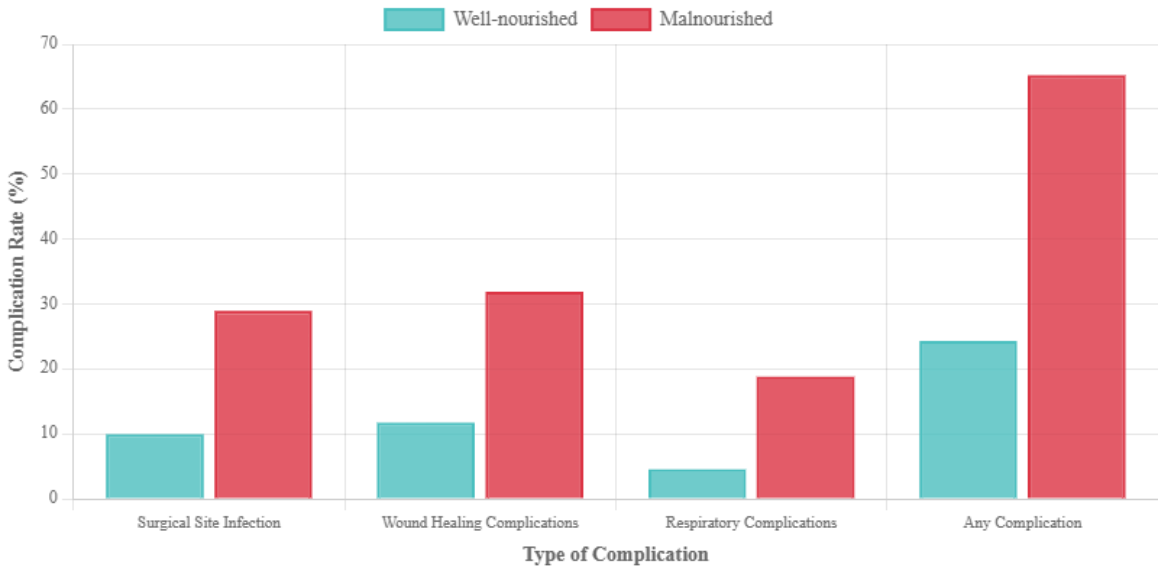


Figure 2: Bar chart comparing complication rates between well-nourished and malnourished patients across different complication types, demonstrating consistently higher rates in the malnourished group

DISCUSSION

The present cross-sectional study establishes a significant correlation between preoperative nutritional status and postoperative complications in patients undergoing major surgical and orthopedic procedures. With 38.3% of our cohort exhibiting malnutrition and these patients experiencing nearly threefold higher complication rates, the findings underscore the critical importance of nutritional assessment in perioperative care.

The malnutrition prevalence observed in our study aligns with reports from other Indian tertiary care centers, where rates between 30-50% have been documented among surgical populations. This substantial burden reflects the complex interplay of socioeconomic factors, dietary patterns, and disease prevalence characteristic of the Indian healthcare landscape. The higher malnutrition rates in elderly patients and those with chronic comorbidities further emphasize the vulnerability of specific demographic subgroups requiring targeted interventions.

Our finding that malnourished patients demonstrated significantly elevated surgical site infection rates (28.9% vs 9.9%) corroborates international literature establishing malnutrition as a key risk factor for infectious complications. The pathophysiological basis lies in compromised immune function, with protein-energy malnutrition impairing cell-mediated immunity, phagocytic function, and complement synthesis. Studies from major Indian medical institutions have similarly reported two to fourfold increases in infection rates among malnourished surgical patients, validating our observations within the regional context.

Wound healing complications exhibited marked elevation in malnourished patients (31.9% vs 11.7%), consistent with the established role of adequate nutrition in tissue repair processes. Protein deficiency impairs collagen synthesis and fibroblast proliferation, while micronutrient deficits disrupt enzymatic pathways essential for wound healing. Research conducted at tertiary centers in North India has documented comparable associations, with malnourished patients experiencing delayed wound healing and increased dehiscence rates. The clinical implications extend beyond immediate postoperative morbidity, encompassing prolonged disability, increased healthcare costs, and diminished quality of life.

The significant prolongation of hospital stay in malnourished patients (12.4 vs 7.8 days) represents a critical healthcare utilization metric. Extended hospitalization imposes substantial economic burden on both healthcare systems and individual families, particularly relevant in resource-constrained settings. Studies from Indian institutions have reported similar prolongation of hospital stays ranging

from 40-60% among malnourished surgical patients. This finding reinforces the economic imperative for preoperative nutritional optimization alongside clinical considerations.

Multivariate analysis identified serum albumin as the strongest independent predictor of postoperative complications, with hypoalbuminemia conferring 3.47 times higher odds. Albumin serves as a widely available, cost-effective marker reflecting both nutritional status and systemic inflammation. Multiple Indian studies have validated serum albumin as a prognostic indicator in surgical populations, with levels below 3.5 g/dL consistently associated with adverse outcomes. The practical utility of albumin measurement in routine preoperative assessment makes it an attractive screening tool for identifying high-risk patients requiring nutritional intervention.

Similarly, BMI below 18.5 kg/m² emerged as an independent risk factor, emphasizing the value of simple anthropometric measurements in risk stratification. While BMI possesses limitations in distinguishing lean mass from fat mass and fails to capture recent weight loss, its ease of measurement and universal applicability support its inclusion in nutritional screening protocols. Research from various Indian centers has demonstrated that combining BMI with biochemical markers improves predictive accuracy for postoperative complications.

The Subjective Global Assessment proved effective in identifying malnourished patients at elevated risk, consistent with its validation in diverse clinical populations. SGA's incorporation of weight change history, dietary intake patterns, and physical examination findings provides a holistic assessment capturing both chronic and acute nutritional depletion. Indian studies have demonstrated SGA's superior performance compared to isolated anthropometric or biochemical parameters in predicting surgical outcomes. However, SGA requires trained personnel and remains subject to interobserver variability, potentially limiting widespread implementation in busy clinical settings.

The consistency of nutritional impact across both general surgical and orthopedic procedures suggests universal pathophysiological mechanisms linking malnutrition to adverse outcomes, irrespective of surgical specialty. This finding supports the development of institution-wide nutritional screening protocols applicable across surgical disciplines rather than specialty-specific approaches.

Several limitations warrant acknowledgment. The cross-sectional design precludes assessment of temporal relationships and causal inference. While we documented associations between nutritional status and complications, interventional studies are necessary to establish whether preoperative nutritional optimization improves outcomes. The single-center nature limits generalizability to other healthcare settings with different patient demographics and resource availability. Although we employed multiple nutritional assessment modalities, we did not incorporate comprehensive micronutrient evaluation or functional assessments such as hand grip strength, which have shown promise in recent literature.

The study's focus on elective procedures excludes emergency surgeries where nutritional assessment and optimization opportunities are limited. Future research should explore nutritional factors in emergency surgical populations and develop rapid screening tools applicable in acute settings. Additionally, our 30-day follow-up period may not capture delayed complications or long-term functional outcomes influenced by nutritional status.

Despite these limitations, the study provides valuable region-specific data quantifying the nutritional-surgical outcome relationship in an Indian healthcare context. The findings support integration of routine preoperative nutritional screening into standard perioperative protocols. Patients identified as malnourished could benefit from preoperative nutritional interventions, including oral nutritional supplements, enteral nutrition when appropriate, or short-term postponement of elective procedures to allow nutritional repletion.

Implementing comprehensive nutritional care pathways requires multidisciplinary collaboration involving surgeons, anesthesiologists, dietitians, and nursing staff. Cost-benefit analyses from international institutions have demonstrated that perioperative nutritional interventions, despite upfront costs, yield net savings through reduced complications, shorter hospital stays, and decreased readmissions. Such economic evaluations tailored to the Indian healthcare context would strengthen the case for resource allocation toward nutritional care programs.

Future research directions should include prospective interventional studies evaluating the efficacy of preoperative nutritional optimization protocols in improving surgical outcomes. Comparative effectiveness research examining different nutritional assessment tools and intervention strategies would inform evidence-based guideline development. Investigation of specific nutrient supplementation regimens, optimal timing and duration of interventions, and identification of patient subgroups most likely to benefit would refine clinical practice recommendations.

In conclusion, this study demonstrates a robust correlation between preoperative malnutrition and adverse postoperative outcomes in major surgical and orthopedic procedures. The findings advocate for systematic integration of nutritional assessment into routine perioperative care, with targeted interventions for malnourished patients. Such an approach holds promise for enhancing surgical safety, improving patient outcomes, and optimizing healthcare resource utilization within the Indian healthcare system.

FINANCIAL SUPPORT AND SPONSORSHIP

Nil.

CONFLICTS OF INTEREST

There are no conflicts of interest.

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