



## Original Research Article

# ROLE OF PREOPERATIVE NUTRITIONAL STATUS IN PREDICTING SURGICAL OUTCOMES IN GASTROINTESTINAL SURGERY: A RETROSPECTIVE OBSERVATIONAL STUDY

Sathish Kumar Jayaraj<sup>1</sup>, Manikandan Periyasamy<sup>2</sup>, Premkumar Subramani<sup>3</sup>

<sup>1</sup>Assistant Professor, Department of General Surgery, Government Medical College Dindigul, Tamil Nadu 624003, India.

<sup>2</sup>Assistant Professor, Department of General surgery, Government Medical College Karur, Tamil Nadu, India.

<sup>3</sup>Assistant Professor, Department of General surgery, Government Medical College Karur, Tamil Nadu, India.

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### Corresponding Author:

**Dr. Sathish Kumar Jayaraj,**

Assistant Professor, Department of General Surgery, Government Medical College Dindigul, Tamil Nadu 624003, India.

Email: doctorsathish01@gmail.com

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### ABSTRACT

**Background:** Malnutrition is a common yet frequently underrecognized condition among patients undergoing gastrointestinal surgery and has been associated with adverse postoperative outcomes. Early identification of nutritional risk may facilitate perioperative optimization and improve surgical outcomes. **Objective:** To evaluate the role of preoperative nutritional status in predicting surgical outcomes among patients undergoing gastrointestinal surgery and to determine its association with postoperative complications, length of hospital stay, and recovery outcomes.

**Materials and Methods:** A retrospective observational study was conducted among 320 patients who underwent elective gastrointestinal surgery at Dindigul Medical College and Karur Medical College, Tamil Nadu, India, between January 2025 to October 2025. Demographic, clinical, and nutritional data were extracted from medical records. Nutritional status was assessed using Body Mass Index (BMI), serum albumin levels, and Prognostic Nutritional Index (PNI). Postoperative outcomes, including surgical site infection (SSI), anastomotic leak, ICU admission, reoperation, and mortality, were analyzed. Multivariable logistic regression was performed to identify independent predictors of postoperative complications.

**Results:** The mean age of the study population was  $54.8 \pm 13.6$  years, and 61.3% were male. Malnutrition (PNI <45) was observed in 33.8% of patients. Overall postoperative complications occurred in 26.3% of cases. Malnourished patients demonstrated significantly higher rates of SSI (28.7% vs. 10.4%;  $p < 0.001$ ), anastomotic leak (9.3% vs. 2.8%;  $p = 0.021$ ), ICU admission (15.7% vs. 5.2%;  $p = 0.004$ ), and mortality (4.6% vs. 0.9%;  $p = 0.031$ ). Low PNI (adjusted OR: 2.84, 95% CI: 1.65–4.91;  $p < 0.001$ ) and hypoalbuminemia (adjusted OR: 2.37, 95% CI: 1.29–4.11;  $p = 0.002$ ) were independent predictors of postoperative complications.

**Conclusion:** Preoperative nutritional status is a significant predictor of postoperative outcomes in gastrointestinal surgery. Routine nutritional assessment using simple measures such as PNI and serum albumin may aid risk stratification and facilitate targeted nutritional interventions to improve postoperative recovery and reduce complications.

**Keywords:** Gastrointestinal surgery; Malnutrition; Prognostic Nutritional Index; Serum albumin; Postoperative complications; Nutritional assessment.

## INTRODUCTION

Gastrointestinal (GI) diseases are a major cause of morbidity worldwide and frequently require surgical intervention for conditions such as gastric cancer, colorectal cancer, esophageal malignancies, inflammatory bowel disease, and intestinal obstruction. Despite advances in surgical techniques, anesthesia, and perioperative care, postoperative complications continue to contribute significantly to patient morbidity, mortality, and healthcare costs. Surgical outcomes are influenced not only by disease characteristics and operative factors but also by patient-related factors, among which nutritional status has gained increasing attention as a potentially modifiable risk factor.

Malnutrition is common among patients undergoing gastrointestinal surgery due to reduced oral intake, impaired nutrient absorption, chronic inflammation, and cancer-related metabolic alterations. However, it often remains underrecognized during routine preoperative assessment. Several studies have demonstrated a significant association between poor nutritional status and adverse postoperative outcomes. Previous research has shown that compromised nutritional status negatively affects outcomes following gastric cancer surgery.<sup>[1]</sup> Similarly, poor preoperative nutrition has been associated with increased postoperative complications after colorectal cancer surgery.<sup>[2]</sup> Nutritional deficiencies have also been shown to adversely affect short-term surgical outcomes among patients undergoing gastrectomy,<sup>[3]</sup> while nutritional indicators have been identified as important prognostic factors in colorectal cancer patients.<sup>[4]</sup> Adequate nutrition is essential for maintaining immune function, promoting wound healing, supporting tissue repair, and facilitating recovery after surgical stress. Malnutrition can impair collagen synthesis, reduce immune competence, and delay tissue regeneration, thereby increasing the risk of postoperative complications. Studies have reported that poor nutritional status is associated with higher complication rates following major gastrointestinal procedures.<sup>[5]</sup> A significant relationship between malnutrition and adverse clinical outcomes in colorectal cancer surgery has also been demonstrated.<sup>[6]</sup> Increased rates of postoperative morbidity and prolonged hospital stay among nutritionally compromised patients have been consistently reported.<sup>[7]</sup> Furthermore, nutritional risk has been identified as an independent predictor of postoperative complications and delayed recovery in gastrointestinal surgical patients.<sup>[8-10]</sup> Several methods are available to evaluate nutritional status before surgery. Commonly used indicators include Body Mass Index (BMI), serum albumin levels, and total lymphocyte count. Standardized screening tools such as the Nutritional Risk Screening 2002 (NRS-2002), Subjective Global Assessment (SGA), and Malnutrition Universal

Screening Tool (MUST) are widely used to identify patients at nutritional risk. More recently, composite indices such as the Prognostic Nutritional Index (PNI) have been increasingly utilized to predict postoperative outcomes and guide perioperative management.

Despite growing evidence, the predictive role of preoperative nutritional status remains insufficiently explored in many resource-limited healthcare settings. Local data are necessary to support evidence-based nutritional interventions and improve perioperative care. Therefore, the present retrospective observational study was conducted to evaluate the role of preoperative nutritional status in predicting surgical outcomes among patients undergoing gastrointestinal surgery and to determine its association with postoperative complications, length of hospital stay, and recovery outcomes.

## MATERIALS AND METHODS

### Study Design and Setting

This retrospective observational study was conducted in the Department of General Surgery at Dindigul Medical College and Karur Medical College, Tamil Nadu, India. The study reviewed medical records of patients who underwent elective gastrointestinal surgical procedures between January 2025 to October 2025. The retrospective design was chosen to evaluate the association between preoperative nutritional status and postoperative surgical outcomes using routinely collected clinical and laboratory data.

### Study Population

The study population consisted of adult patients who underwent elective gastrointestinal surgery during the study period. Surgical procedures included upper and lower gastrointestinal surgeries performed for both benign and malignant conditions. A total of 320 eligible patients were included after screening hospital records according to predefined inclusion and exclusion criteria.

### Inclusion Criteria

Patients were included in the study if they:

1. Were aged 18 years or older.
2. Underwent elective gastrointestinal surgery during the study period.
3. Had complete preoperative clinical and laboratory records.
4. Had documented postoperative follow-up data available for analysis.

### Exclusion Criteria

Patients were excluded if they:

1. Underwent emergency gastrointestinal surgery.
2. Required re-operative surgical procedures.
3. Had incomplete medical records or missing nutritional assessment data.
4. Had severe hepatic failure or end-stage renal disease that could independently influence nutritional parameters.
5. Were pregnant at the time of surgery.

## Data Collection

Data were collected retrospectively from hospital medical records, electronic health records, operative notes, anesthesia charts, laboratory databases, inpatient progress notes, and discharge summaries. All patient identifiers were removed before data analysis to maintain confidentiality.

The collected information included demographic characteristics, clinical variables, preoperative nutritional parameters, operative details, and postoperative outcomes.

## Study Variables

Demographic Characteristics: Age (years), Sex (male/female), Place of residence (urban/rural), Smoking history, Alcohol consumption

Clinical Characteristics: Primary diagnosis, Presence of malignancy, Diabetes mellitus, Hypertension, American Society of Anesthesiologists (ASA) physical status classification, Type of surgical procedure performed

## Nutritional Parameters

Preoperative nutritional status was evaluated using routinely available anthropometric and laboratory measurements obtained within one week before surgery. These included:

- Height (meters)
- Weight (kilograms)
- Body Mass Index (BMI)
- Serum albumin concentration (g/dL)
- Total lymphocyte count (/mm<sup>3</sup>)
- Hemoglobin level (g/dL)

## Nutritional Assessment

### Body Mass Index

Body Mass Index (BMI) was calculated using the standard formula:

$$\text{BMI} = \text{Weight (kg)} / \text{Height}^2 \text{ (m}^2\text{)}$$

BMI was used as an indicator of overall nutritional status and classified according to World Health Organization guidelines.

### Prognostic Nutritional Index

The Prognostic Nutritional Index (PNI), a validated marker of nutritional and immunological status, was calculated using the following formula:

$$\text{PNI} = 10 \times \text{Serum Albumin (g/dL)} + 0.005 \times \text{Total Lymphocyte Count (/mm}^3\text{)}$$

Based on PNI values, patients were categorized into four nutritional groups:

- Normal nutritional status: PNI  $\geq 45$
- Mild malnutrition: PNI 40–44.9
- Moderate malnutrition: PNI 35–39.9
- Severe malnutrition: PNI  $< 35$

PNI was selected because it integrates serum albumin and lymphocyte count, providing a comprehensive

assessment of nutritional reserve and immune function.

## Outcome Measures

### Primary Outcome

The primary outcome of interest was the occurrence of postoperative complications within 30 days following surgery. Postoperative complications were identified from inpatient records and follow-up documentation.

### Secondary Outcomes

Secondary outcome measures included:

- Surgical site infection (SSI)
- Anastomotic leak
- Intensive Care Unit (ICU) admission
- Length of hospital stay (days)
- Requirement for reoperation
- Thirty-day postoperative mortality

Postoperative complications were categorized and assessed according to standard institutional clinical criteria.

### Statistical Analysis

Data were analyzed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean  $\pm$  standard deviation (SD), while categorical variables were presented as frequencies and percentages. Group comparisons were performed using the independent t-test, Chi-square test, or Fisher's exact test, as appropriate. Multivariable logistic regression analysis was used to identify independent predictors of postoperative complications. A p-value  $< 0.05$  was considered statistically significant.

### Ethical Considerations

The study was approved by the Institutional Ethics Committees. As this was a retrospective record-based study, informed consent was waived. Patient confidentiality was maintained throughout the study, and all procedures were conducted in accordance with the Declaration of Helsinki.

## RESULTS

### Baseline Characteristics of the Study Population

A total of 320 patients who underwent elective gastrointestinal surgery during the study period were included in the analysis. The mean age of the study population was  $54.8 \pm 13.6$  years. Male patients constituted the majority of the cohort (196, 61.3%), while females accounted for 124 (38.7%). Among the included patients, 98 (30.6%) had diabetes mellitus and 112 (35.0%) had hypertension. Gastrointestinal malignancies were present in 178 patients (55.6%), whereas the remaining patients underwent surgery for benign gastrointestinal conditions.

**Table 1: Baseline Characteristics of the Study Population (n = 320)**

Variable	Value
Sample size	320
Mean age (years)	$54.8 \pm 13.6$
Male, n (%)	196 (61.3)
Female, n (%)	124 (38.7)
Diabetes mellitus, n (%)	98 (30.6)

Hypertension, n (%)	112 (35.0)
GI malignancy, n (%)	178 (55.6)

### Preoperative Nutritional Status

The mean Body Mass Index (BMI) of the study population was  $22.4 \pm 3.8$  kg/m<sup>2</sup>. The mean preoperative serum albumin level was  $3.7 \pm 0.6$  g/dL, while the mean Prognostic Nutritional Index (PNI)

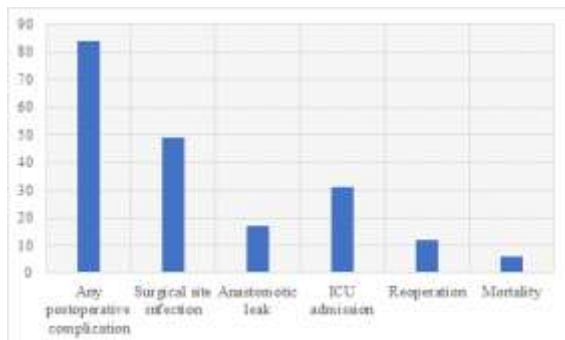
was  $44.2 \pm 6.4$ . Based on the predefined PNI criteria, 108 patients (33.8%) were categorized as malnourished (PNI <45), whereas 212 patients (66.2%) had normal nutritional status.

**Table 2: Preoperative Nutritional Parameters**

Parameter	Mean $\pm$ SD
BMI (kg/m <sup>2</sup> )	22.4 $\pm$ 3.8
Serum albumin (g/dL)	3.7 $\pm$ 0.6
PNI	44.2 $\pm$ 6.4

### Postoperative Outcomes

Overall, postoperative complications occurred in 84 patients (26.3%) within 30 days of surgery. Surgical site infection (SSI) was the most frequently observed complication, occurring in 49 patients (15.3%). Anastomotic leakage was documented in 17 patients (5.3%), while 31 patients (9.7%) required admission to the intensive care unit (ICU). Reoperation was necessary in 12 patients (3.8%), and postoperative mortality occurred in 6 patients (1.9%).

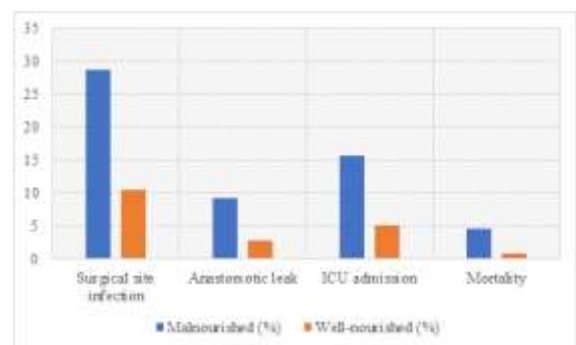


**Figure 1: Postoperative Outcomes**

### Association Between Nutritional Status and Postoperative Outcomes

Comparative analysis demonstrated that patients with preoperative malnutrition experienced significantly poorer postoperative outcomes than well-nourished patients. The incidence of surgical site infection was significantly higher among malnourished patients (28.7% vs. 10.4%;  $p < 0.001$ ). Similarly, anastomotic leakage occurred more frequently in the malnourished group compared with the well-nourished group (9.3% vs. 2.8%;  $p = 0.021$ ). Malnourished patients also exhibited a significantly higher requirement for ICU admission (15.7% vs. 5.2%;  $p = 0.004$ ). Postoperative mortality was

significantly greater among malnourished patients than among patients with normal nutritional status (4.6% vs. 0.9%;  $p = 0.031$ ).



**Figure 2: Association Between Nutritional Status and Postoperative Outcomes**

### Multivariable Logistic Regression Analysis

Multivariable logistic regression analysis was performed to identify independent predictors of postoperative complications. Low Prognostic Nutritional Index (PNI) emerged as the strongest predictor of adverse postoperative outcomes, with patients exhibiting low PNI demonstrating nearly three-fold higher odds of developing postoperative complications (adjusted OR: 2.84, 95% CI: 1.65–4.91;  $p < 0.001$ ).

Hypoalbuminemia was also independently associated with increased postoperative complications (adjusted OR: 2.37, 95% CI: 1.29–4.11;  $p = 0.002$ ). Additionally, age greater than 60 years (adjusted OR: 1.74, 95% CI: 1.01–2.98;  $p = 0.041$ ) and the presence of diabetes mellitus (adjusted OR: 1.69, 95% CI: 1.02–2.81;  $p = 0.039$ ) were identified as significant predictors of postoperative morbidity.

**Table 3: Multivariable Logistic Regression Analysis for Predictors of Postoperative Complications**

Variable	Adjusted OR	95% CI	p-value
Low PNI	2.84	1.65–4.91	<0.001
Hypoalbuminemia	2.37	1.29–4.11	0.002
Age >60 years	1.74	1.01–2.98	0.041
Diabetes mellitus	1.69	1.02–2.81	0.039

In summary, preoperative malnutrition was significantly associated with an increased risk of

postoperative complications, including surgical site infection, anastomotic leakage, ICU admission, and

mortality. Low PNI and hypoalbuminemia were identified as independent predictors of adverse surgical outcomes in patients undergoing gastrointestinal surgery.

## DISCUSSION

The present retrospective observational study demonstrated that preoperative nutritional status is a significant predictor of postoperative outcomes among patients undergoing gastrointestinal surgery. Approximately one-third of the study population was identified as malnourished based on the Prognostic Nutritional Index (PNI), and these patients experienced significantly higher rates of surgical site infection, anastomotic leakage, intensive care unit admission, and postoperative mortality. Furthermore, low PNI and hypoalbuminemia emerged as independent predictors of postoperative complications after adjustment for potential confounding factors. These findings highlight the critical role of nutritional assessment in perioperative risk stratification and reinforce the growing recognition of malnutrition as a modifiable determinant of surgical outcomes.

The prevalence of malnutrition observed in the present study is consistent with recent reports indicating that nutritional impairment remains highly prevalent among patients undergoing gastrointestinal surgery, particularly those with malignancies.<sup>[1-4]</sup> Gastrointestinal diseases are frequently associated with reduced oral intake, altered metabolism, chronic inflammation, and cancer-related cachexia, all of which contribute to progressive nutritional decline. In our cohort, more than half of the patients had underlying gastrointestinal malignancies, which may partially explain the substantial burden of malnutrition observed.

The association between poor nutritional status and adverse postoperative outcomes identified in this study is biologically plausible. Adequate nutrition is essential for maintaining immune competence, supporting collagen synthesis, promoting wound healing, and facilitating tissue repair. Malnutrition compromises both innate and adaptive immune responses, increases susceptibility to infection, and impairs recovery from surgical stress. Similar associations between poor nutritional status and increased postoperative morbidity have been reported in gastric cancer surgery, colorectal surgery, pancreatic surgery, and esophageal surgery.<sup>[1,2,5,6,9,10]</sup> Consistent with previous evidence, malnourished patients in the present study demonstrated significantly higher rates of surgical site infection and anastomotic leakage, two complications that substantially increase healthcare costs and adversely affect long-term outcomes.

Among the various nutritional indicators available, PNI demonstrated strong predictive value for postoperative complications. PNI integrates serum albumin concentration and total lymphocyte count,

thereby reflecting both nutritional reserve and immune function. Recent studies have increasingly supported the prognostic significance of PNI in gastrointestinal surgical patients.<sup>[1,3,4,5]</sup> Similarly, hypoalbuminemia remained an independent predictor of adverse outcomes in the current analysis. Although serum albumin may be influenced by inflammatory status, it continues to be one of the most widely used biomarkers for perioperative risk assessment because of its availability, reproducibility, and clinical relevance.

Our findings are also supported by recent investigations evaluating nutritional risk assessment tools such as CONUT, GNRI, NRS-2002, and other composite nutritional indices. Studies have consistently demonstrated that patients identified as nutritionally at risk experience higher complication rates, prolonged hospitalization, and poorer postoperative recovery.<sup>[7,8,11-15]</sup> These observations emphasize the importance of incorporating standardized nutritional screening into routine preoperative evaluation. Early identification of nutritional deficits provides an opportunity for targeted nutritional optimization, which may reduce postoperative morbidity and improve recovery.

The clinical implications of the present study are particularly relevant for resource-limited healthcare settings, where comprehensive perioperative optimization programs may not be universally available. Simple, inexpensive, and easily accessible measures such as serum albumin and PNI can serve as effective tools for identifying high-risk patients and guiding perioperative nutritional interventions. Strengthening preoperative nutritional assessment protocols may therefore represent a practical strategy for improving surgical outcomes in gastrointestinal surgery.

Despite its strengths, including a relatively large sample size and multicenter design, this study has certain limitations. The retrospective nature of the study may introduce selection and information bias, and causal relationships cannot be definitively established. Additionally, long-term outcomes and the impact of preoperative nutritional interventions were not evaluated. Future prospective multicenter studies are warranted to validate these findings and assess the effectiveness of structured nutritional optimization programs on postoperative outcomes.

Overall, the present study adds to the growing body of evidence demonstrating that preoperative nutritional status is a clinically important predictor of postoperative outcomes in gastrointestinal surgery and underscores the need for routine nutritional assessment as an integral component of perioperative care.

### Strengths

This multicenter study included a relatively large sample of 320 patients from two tertiary care hospitals. The use of objective nutritional parameters, including serum albumin and Prognostic Nutritional Index (PNI), enhances the clinical applicability of the findings. Furthermore, multiple postoperative

outcomes were evaluated, and multivariable analysis was performed to identify independent predictors of complications.

### Limitations

The retrospective design may be subject to selection bias and incomplete documentation. Nutritional assessment was limited to routinely available parameters, while other validated nutritional screening tools were not evaluated. Additionally, long-term outcomes and the effects of preoperative nutritional interventions were not assessed.

## CONCLUSION

Preoperative nutritional status is a significant predictor of postoperative outcomes in patients undergoing gastrointestinal surgery. In this study, malnutrition, as assessed by the Prognostic Nutritional Index (PNI), was associated with a higher incidence of postoperative complications, including surgical site infection, anastomotic leak, ICU admission, and mortality. Low PNI and hypoalbuminemia emerged as independent predictors of adverse surgical outcomes. These findings highlight the importance of routine preoperative nutritional assessment and early nutritional optimization. Incorporating simple nutritional screening tools into perioperative care may facilitate risk stratification, improve postoperative recovery, and enhance overall surgical outcomes.

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