**Original Research Article**

# A STUDY ON PROGNOSTIC NUTRITIONAL INDEX[PNI] IN EVALUATION OF PATIENTS UNDERGOING ABDOMINAL SURGERIES

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**ABSTRACT**

**Background:** The Prognostic Nutritional Index (PNI) is commonly utilized to assess surgical risk in individuals with gastrointestinal cancers. **Aim:** This study aimed to analyze PNI values to forecast outcomes across several types of abdominal surgeries, with the goal of identifying high-risk patients to prevent complications and death.
**Material and Methods:** This prospective study included 100 patients, aged 18 to 80 years of both genders, who underwent surgical procedures for abdominal conditions in either emergency or elective settings. The PNI for each patient was determined using the formula: $10 \times$ albumin (g/dl) + $0.005 \times$ total lymphocyte count (per mm³). The patients were divided into two groups based on their PNI: low PNI (PNI < 46) and high PNI (PNI > 46). Statistical analysis was performed using the chi-square test or Fisher's exact test, with a p-value of < 0.05 considered significant.
**Results:** In the present study, Female patients were more likely to have a low PNI. Additionally, there was a higher prevalence of co-morbidities in patients with low PNI, and more of these patients required ICU care. The PNI < 46 group also had longer hospital stays and a higher mortality rate.
**Conclusion:** The Present study concluded that the PNI proved to be a simple and effective biomarker for identifying baseline risk, predicting postoperative complications, and forecasting long-term outcomes in abdominal surgery.
**Keywords:** PNI, Gastrointestinal cancers, ICU, Albumin, Mortality.

## INTRODUCTION

Nutritional status plays a pivotal role in the clinical outcomes of patients undergoing abdominal surgeries, influencing both postoperative recovery and long-term prognosis. The Prognostic Nutritional Index (PNI) has emerged as a valuable, objective tool for assessing a patient's nutritional and immune status, providing insight into their surgical risk. Originally developed to predict outcomes in patients with gastrointestinal malignancies, the PNI has since gained wider applicability in evaluating various abdominal surgeries.[2] By quantifying serum albumin levels and lymphocyte count, the PNI offers a straightforward yet powerful method for identifying patients at greater risk of complications, prolonged hospital stays, and mortality.[3] This study aims to explore the predictive value of PNI in patients undergoing abdominal surgeries in both emergency and elective settings, with the goal of improving preoperative assessment and postoperative management.[4]

The Prognostic Nutritional Index (PNI) serves as a key nutritional marker and predictor for a range of diseases. It is believed to reflect both systemic inflammation and nutritional health and is linked to patient survival and prognosis.[5]Originally developed to assess preoperative nutritional status and surgical risk in cancer patients, PNI has become an important tool in evaluating overall outcomes(1).

The Prognostic Nutritional Index (PNI) is straightforward to calculate using the formula: [($10 \times$ serum albumin (g/dL)) + ($0.005 \times$ total lymphocyte count)]. The parameters included in this index are regularly assessed during preoperative laboratory tests and can be easily repeated when necessary.This

study aimed to assess PNI status to predict outcomes across several types of abdominal surgeries, with the goal of identifying high-risk patients and implementing appropriate interventions to prevent complications and reduce mortality.

The predictive value of the PNI for surgical outcomes is well-established in various solid organ cancers, such as esophageal, colorectal, liver, and pancreatic cancers. However, there have been limited studies assessing the significance of PNI in predicting both short- and long-term outcomes in patients undergoing abdominal surgeries in general, and no comprehensive study has yet been conducted.[6] Additionally, there remains debate regarding the ideal cut-off values for PNI in predicting surgical outcomes over both the short and long term.

# MATERIAL AND METHODS

**Patients and Methods**

This study was conducted in Dept of General surgery, GGH, Kurnool, in a period of 12 months duration from March 2023 to March 2024.The study included one hundred patients, aged 18 to 80 years, of both genders, who underwent surgical procedures for abdominal conditions in both emergency and elective settings. Each patient's PNI was determined using laboratory data for total lymphocyte count (TLC) and albumin levels. Onodera's formula for calculating PNI=$10 \times$ albumin (g/dl) + $0.005 \times$ total lymphocyte count (per mm³), was applied for this purpose.

Demographic information, type of abdominal surgery performed, postoperative complications, need for ICU care, duration of hospital stay, and mortality rates were documented. Following statistical analysis of the entire patient cohort, a PNI cut-off value of 46 was established as the standard for the study. Patients were categorized into low PNI (PNI < 46) and high PNI (PNI > 46) groups accordingly. All patients were monitored from the start of treatment through to the 30th day, as well as at the conclusion of the study period (1 year).

**Statistical Analysis**

The data was entered in Microsoft Excel 2010 version. Data was analysed using Microsoft Excel 2010 and Epi Info 7.2.0. Descriptive and inferential statistical analysis were used in the present study. Results on continuous measurements were presented on Mean±SD [Min-Max] and results on categorical measurements were presented in Number [%]. Significance was assessed at 5% level of significance. ANOVA was used to compare inter group variation for continuous variables. Chi square test was used to compare categorical variables. A P value of <0.05 was considered as statistically significant.

**Ethical Clearance:** Ethical clearance was obtained from the Institutional Ethical Committee, Kurnool Medical College, Kurnool.

# RESULTS

There were 48 patients in the low PNI group and 52 patients in the high PNI group. The highest number of patients were found in the 5thdecade with a high incidence of low PNI (PNI<46) whereas a high PNI was observed among the patients in the 3rd decade of age. The mean age in the PNI<46 group was 54 years with a standard deviation of 14. In the PNI>46 group, the mean age was found to be 44 with a standard deviation of 16. There were more women in the PNI<46 group and more numbers of men in the group of PNI>46 which was found to be statistically significant. The low PNI value was associated with co-morbidities. Diabetes (21%), cardiac disorders (16%), and hypertension (13%) were common amongst the patients with PNI<46 which was found to be statistically significant. There were patients with thyroid disorders (18%) in the low PNI group.
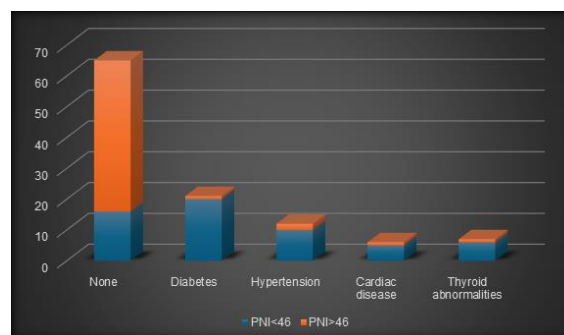


**Figure 1: Co-morbidities observed in the study population in PNI groups**



**Figure 2: Rate of postoperative complications in both groups**

Anastomotic leak was the most common postoperative complication among PNI<46 group (16.4%). The wound infection (6.4%) was the most common complication amongst the patients with PNI>46 which was found to be significant. More patients in the PNI<46 group needed ICU care (mean of 5.8 days) than that of patients in the PNI>46 group with a mean of2.1days. The length of hospital stay increases as the PNI value decreases. Patients undergoing emergency surgery were more in numbers in the PNI<46 group than in the elective one. This might be due to pre-operative non-optimization. The rate of complications in this group was found to be more compared to those undergoing

elective surgeries. The mortality was 8% in the PNI<46 group. There was a mortality of 2% in the PNI>46group.

**Table 1: Comparison of various variables between both PNI groups**

| Variable | PNI < 46 | PNI >46 |
|---|---|---|
| Pt's with co-morbidities (%) | 32% | 11% |
| ICU Stay (in days) | 5.8 days | 2.1 days |
| Post-operative complications (%) | 68.75% | 17.3% |
| Length of hospital stay (in days) | 10 days | 4 days |
| Mortality (%) | 8% | 2% |

**Table 2: Type of surgery and rate of complications in both PNI groups**

| Type of surgery | PNI<46 | | PNI>46 | |
|---|---|---|---|---|
| | Total cases | Complications | Total cases | Complications |
| Elective | 13 | 4(30.7%) | 44 | 8(18.1%) |
| Emergency | 35 | 29(82.8%) | 8 | 1(12.5%) |

# DISCUSSION

Clinical Relevance of PNI in Abdominal Surgery:
The Prognostic Nutritional Index (PNI) is increasingly recognized as a valuable tool in the preoperative evaluation of patients undergoing abdominal surgeries. Based on Onodera's formula, the PNI is derived from serum albumin levels and lymphocyte counts, both of which reflect the nutritional and immune status of the patient.[3,7] A low PNI score indicates potential malnutrition and associated risks. A PNI of 50 was regarded as normal. Statistical analysis of the entire patient cohort indicated that they could be separated into two groups based on a PNI cut-off of 46.[8] The study demonstrated that a low PNI was linked to various comorbidities, including diabetes, hypertension, thyroid disorders, and cardiac diseases.[9,10,11] Patients with low PNI were more susceptible to postoperative complications.[12]

### Role in Risk Stratification
The PNI, calculated using serum albumin levels and total lymphocyte counts, serves as a marker for a patient's nutritional and immune status. In abdominal surgery, especially for cancer and emergency procedures, this index helps clinicians identify patients at higher risk for complications. A PNI below 46, as seen in this study, has been consistently associated with a higher likelihood of adverse outcomes such as infections, anastomotic leaks, and prolonged recovery periods.

### PNI and Postoperative Complications
In our study, patients in the PNI < 46 group who underwent emergency surgeries had a higher rate of complications compared to those having elective procedures (82.8% vs 30.7%). The most frequent postoperative complication in the PNI < 46 group was an anastomotic leak,[13] while wound infections were the most common complication in the PNI > 46 group. Other severe complications were more prevalent among patients with a PNI < 46.[14,15]
Bhattacharjee et al. found that 62.5% of patients with low PNI had postoperative complications, compared to 20% in those with higher PNI. This emphasizes the predictive value of PNI for complications.[1]

Fengming Xu et al,[16] found that patients with a low preoperative PNI were more vulnerable of surgical complications compared with patients with a higher one (61.1% vs. 31.2%).

**Impact on ICU Care and Hospital Stay**
In present study, the increased risk of complications in the low PNI group necessitated more intensive postoperative care, including prolonged ICU stays. On average, patients in the PNI < 46 group spent six days in the ICU compared to two days for those in the PNI > 46 group.[17] Additionally, hospital stay duration increases as PNI decreases, with patients in the low PNI group staying up to 10 days on average versus 4 days in the high PNI group.[2]
The inclusion of a greater number of emergency cases in the PNI < 46 group may have contributed to the longer hospital stays observed. The study indicated that hospital stay duration increases as the PNI decreases.[18,19]
This can be compared to other studies like:
Fengming Xu et al,[16] where patients with preoperative low PNI were observed to have prolonged postoperative stay (10.4 days vs.7.8 days) and ICU stay(8.2 vs.3.6).
Bhattacharjee A et al,[1] The patients in the low PNI group needed more ICU care with a mean of 4.7 days than that of the high PNI group with a mean of 2.3 days. And length of hospital stay was also seen higher in low PNI group (8 days) when compared to high PNI group(4 days).

**General Findings from Multiple Studies**
- Low PNI and ICU Care: Among various studies, patients with lower PNI consistently required more ICU care, with ICU stays typically ranging from 4 to 6 days, compared to 2 to 3 days in patients with higher PNI.
- Low PNI and Hospital Stay: Hospital stays in the low PNI group are generally prolonged, ranging from 10 to 11 days, while those with higher PNI tend to be discharged within 4 to 7 days. These extended stays are attributed to a higher frequency of complications and slower recovery

**Mortality and Prognosis**
Mortality rates are notably higher in patients with a low PNI, particularly in those undergoing emergency

abdominal surgeries. The higher mortality observed in these patients underscores the importance of addressing nutritional deficiencies preoperatively to improve prognosis.[2,16]

In the present study, Mortality occurred in both groups but was notably higher in the PNI < 46 group, indicating a poorer prognosis.[20,15] Mortality rates were especially elevated in patients undergoing emergency surgeries.[21]

In a study done by Bhattacharjee A et al,[1]Mortality rate was also higher in low PNI group patients(11%), which in turn are seen significantly elevated emergency settings.

In a study done by Fengming Xu et al,[16]mortality rates were not included. Nonetheless, the study confirms that a low PNI is a significant risk factor for adverse outcomes, though mortality data is absent.

Across different studies, patients with a low PNIconsistently exhibit higher mortality rates, ranging from 11% to 18%, depending on the type of surgery and whether it was performed in an elective or emergency setting. These findings confirm that the PNI is a powerful prognostic tool for assessing surgical risk and potential mortality.

This comparison highlights the need for enhanced preoperative nutritional management, particularly for high-risk patients with low PNI, to potentially mitigate these elevated mortality risks.

**Recommendations and Future Research**

While the current studies underscore the importance of the PNI in predicting surgical outcomes, their limitations—such as single-centre designs and small sample sizes—call for larger, multicentre cohort studies. Future research should focus on specific patient categories and evaluate the potential of PNI to guide preoperative nutritional interventions aimed at improving surgical outcomes.

**Table 3: Comparison of post-operative complications between both PNI groups from various studies**

| Studies | Post-operative complications | |
|---|---|---|
| | Low PNI | High PNI |
| Bhattacharjee A et al | 62.5% | 20% |
| Fengming Xu et al | 61.1% | 31.2% |
| Present study | 68.75% | 17.3% |

**Table 4: Comparison of ICU care and hospital stay required between both PNI groups from various studies**

| Studies | ICU care(days) | | Hospital stay (days) | |
|---|---|---|---|---|
| | Low PNI | High PNI | Low PNI | High PNI |
| Bhattacharjee A et al | 4.7 | 2.3 | 8 | 4 |
| Fengming Xu et al | 8.2 | 3.6 | 10.4 | 7.8 |
| Present study | 5.8 | 2.1 | 10 | 4 |

# CONCLUSION

The Prognostic Nutritional Index (PNI) serves as a valuable and reliable tool in the preoperative assessment of patients undergoing abdominal surgeries, particularly in predicting postoperative complications, ICU care, hospital stay, and mortality. Our study, along with others, demonstrates that patients with a low PNI are significantly more susceptible to adverse outcomes, especially following emergency procedures. A low PNI is closely associated with an increased incidence of severe complications, including anastomotic leaks and infections, which subsequently lead to prolonged ICU stays and extended hospitalizations. Furthermore, mortality rates are notably higher in patients with a low PNI, underlining the importance of addressing preoperative nutritional deficiencies to improve prognosis.

Incorporating PNI into the preoperative evaluation allows for more accurate risk stratification, guiding clinicians in optimizing preoperative nutritional support. This proactive approach could potentially reduce postoperative complications, shorten hospital stays, and improve overall survival in patients undergoing abdominal surgeries

Despite the above limitations, PNI was confirmed to be a potentially novel prognostic factor for predicting outcomes after abdominal surgeries. Because the PNI is convenient, useful, and readily available at low cost, it has the potential to serve as a biomarker for predicting the survival of patients undergoing abdominal surgeries.[22]

**Conflict of Interest:** None
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