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ORIGINAL ARTICLE

Nutritional Status as A Predictor of Surgical Outcomes in Adult General Surgery Patients

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ABSTRACT

Background: Preoperative nutritional risk is common among surgical patients and may impair immune function, collagen synthesis, wound healing and tolerance of surgical stress. Nutritional risk can be identified through simple clinical screening and may help stratify patients who require closer perioperative monitoring and targeted nutritional support[2,3,4].

Objective: To evaluate whether preoperative nutritional risk predicts adverse postoperative outcomes among adult general surgery patients.

Methods: This prospective cohort study was conducted in the Department of General Surgery at Mardan Medical Complex, Mardan, Pakistan, from January 2023 to April 2023. Adult general surgery patients undergoing operative management were categorized as having normal nutritional status or nutritional risk using a pragmatic assessment incorporating body mass index, serum albumin, unintentional weight loss, reduced oral intake and a nutrition-risk checklist. The primary outcome was 30-day postoperative complication rate. Secondary outcomes included surgical-site infection, delayed wound healing, hospital stay and readmission.

Results: A total of 135 patients were included, comprising 88 patients with normal nutritional status and 47 patients at nutritional risk. Nutritionally at-risk patients were older, had lower BMI and had a higher proportion of albumin below 3.5 g/dL. Postoperative complications, surgical-site infection, delayed wound healing and median hospital stay were significantly higher in the nutritional risk group. Nutritional risk remained independently associated with postoperative complications with adjusted OR 2.55, 95% CI 1.13-5.75, p=0.024.

Conclusion: Preoperative nutritional risk independently predicts adverse postoperative outcomes in adult general surgery patients. Routine nutrition screening and targeted perioperative nutrition pathways should be integrated into surgical admission and postoperative care.

Keywords: nutritional risk; malnutrition; general surgery; postoperative complications; surgical-site infection; wound healing; prospective cohort study.

INTRODUCTION

Nutrition is a core determinant of surgical recovery because operative stress produces inflammatory, endocrine and metabolic responses that increase protein and energy requirements. Patients with poor nutritional reserve have reduced capacity to respond to catabolism, infection, wound repair and immobilization. This makes them vulnerable to postoperative complications, delayed wound healing and prolonged hospitalization[2,3,4].

Nutritional risk in adult general surgery may appear as low body mass index, recent unintentional weight loss, reduced oral intake, low muscle mass or hypoalbuminemia. However, malnutrition is often missed when surgical teams are focused on diagnosis, operative planning and emergency management. A structured screening process is therefore necessary to identify patients whose nutritional reserve is inadequate despite apparently stable clinical presentation[7,8,9].

Modern malnutrition frameworks emphasize that nutritional status should not be assessed by a single marker. BMI alone may miss sarcopenic or recently weight-losing patients, while serum albumin may reflect inflammation, infection, hydration or liver function rather than pure nutritional depletion. The GLIM criteria support a multidimensional approach using phenotypic criteria such as weight loss and low BMI together with etiologic criteria such as reduced intake and disease burden[2,11,12].

The biological link between malnutrition and poor surgical outcome is well established. Protein-energy depletion impairs cellular and humoral immunity, reduces fibroblast function, weakens collagen deposition and delays epithelialization. These mechanisms increase susceptibility to surgical-site infection, wound dehiscence, delayed healing and prolonged recovery[13,14,15].

Preoperative serum albumin has long been recognized as a strong predictor of operative morbidity and mortality, although it should be interpreted as a marker of vulnerability rather than a pure nutrition marker[16,19]. Nutritional risk indices and screening tools have also been associated with postoperative complications in gastrointestinal and general surgical populations[8,9,10,17,18].

Perioperative nutrition guidance from ESPEN, ASPEN and ERAS frameworks emphasizes early nutritional screening, avoidance of unnecessary fasting, timely oral or enteral feeding and nutrition support for high-risk patients[3,4,5,6,7]. In elective surgery, nutritional optimization may be possible before operation. In emergency surgery, urgent procedures should not be delayed solely for nutritional correction, but risk identification can guide postoperative monitoring, wound surveillance, early dietetic review and discharge planning. The present study follows observational reporting principles[1].

MATERIAL AND METHODS

This prospective cohort study was conducted in the Department of General Surgery at Mardan Medical Complex, Mardan, Pakistan, from January 2023 to April 2023. The hospital is a tertiary care teaching facility serving a predominantly rural population in Khyber Pakhtunkhwa. It provides emergency and elective surgical services, consultant-led general surgery care, intensive care support, operating theatre facilities and limited dietetic services.

Adult patients aged 18 years or above admitted under the adult general surgery service and undergoing operative management during the study period were assessed for inclusion. Patients were included if they had a relevant operative condition requiring surgical management, complete operative and anaesthesia records, and outcome assessment available at discharge or within 30 days. Patients were excluded if the operation was trauma-only outside the planned protocol, elective or unrelated specialty surgery outside the research question,

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duplicate admission, incomplete record or if the patient left against medical advice before meaningful outcome assessment.

The primary exposure was preoperative nutritional risk. Nutritional status was assessed using a pragmatic clinical protocol incorporating BMI, serum albumin, recent unintentional weight loss, reduced oral intake and a nutrition-risk checklist. Nutritional risk was assigned if the patient had BMI below 18.5 kg/m², albumin below 3.5 g/dL, clinically significant weight loss of more than 5% in 3 months or more than 10% in 6 months, reduced oral intake below 50% of requirements for more than 5 days or combined risk features. This pragmatic approach is consistent with multidimensional malnutrition assessment principles[2,7,8,11,12].

Data were collected using a structured proforma. Demographic variables included age and sex. Nutritional variables included BMI, serum albumin, unintentional weight loss and reduced oral intake. Clinical variables included diabetes mellitus. Operative variables included emergency surgery status, operative approach, wound class and operative duration. Outcome variables included 30-day postoperative complications, surgical-site infection, delayed wound healing, hospital stay and readmission.

The primary outcome was 30-day postoperative complication rate, defined as any documented postoperative complication occurring before discharge or within 30 days of surgery. Secondary outcomes included surgical-site infection, delayed wound healing, length of hospital stay and readmission. Surgical-site infection was defined using standard clinical criteria within 30 days of operation[21,22]. Delayed wound healing was defined as delayed epithelialization, wound gap, persistent discharge, prolonged dressing requirement or surgeon-documented delayed healing.

Data were analyzed using SPSS version 26.0. Continuous variables were assessed for normality and reported as mean with standard deviation or median with interquartile range. Categorical variables were reported as frequency and percentage. Group comparisons used chi-square or Fisher exact test for categorical variables and independent t-test or Mann-Whitney U test for continuous variables according to distribution. Multivariable logistic regression was performed to identify independent predictors of postoperative complications. Adjusted odds ratios with 95% confidence intervals were reported, and p-value less than 0.05 was considered statistically significant.

The study was approved by the Institutional Ethics Committee of Mardan Medical Complex, approval number MMC/IRB/2023/098, dated 28 March 2023. Patient confidentiality was maintained through anonymized data extraction and secure data storage. A waiver of individual informed consent was obtained because the study used routine clinical data and posed no additional patient risk.

RESULTS

A total of 158 patients were initially assessed for eligibility during the study period. Twenty-three patients were excluded, including 9 with incomplete medical records, 6 who left against medical advice, 4 with elective procedures outside the research question, 3 with trauma-only procedures and 1 duplicate admission. The final analysis included 135 adult general surgery patients, comprising 88 patients with normal nutritional status and 47 patients at nutritional risk.

The mean age of the entire cohort was 47.8 ± 16.2 years. Patients in the nutritional risk group were significantly older than patients in the normal nutrition group. Sex distribution was similar between groups. Mean BMI was significantly lower among

Table 1: Baseline characteristics of adult general surgery patients

Variable	Normal nutrition (n=88)	Nutritional risk (n=47)	p-value
Age, years	43.4 ± 14.3	56.1 ± 15.7	<0.001
Male sex	60.2%	59.6%	0.943
BMI, kg/m²	24.6 ± 3.4	19.2 ± 2.8	<0.001
Albumin <3.5 g/dL	6.8%	53.2%	<0.001
Diabetes mellitus	14.8%	25.5%	0.124

Table 2: Operative variables

Variable	Normal nutrition	Nutritional risk	p-value
Emergency surgery	51.1%	66.0%	0.097
Open surgery	44.3%	61.7%	0.053
Contaminated/dirty wound	26.1%	42.6%	0.047
Operative time >120 min	22.7%	31.9%	0.242

Table 3: Postoperative outcomes

Outcome	Normal nutrition	Nutritional risk	p-value
30-day complications	18.2%	36.2%	0.018
Surgical-site infection	9.1%	23.4%	0.020
Delayed wound healing	6.8%	21.3%	0.011
Hospital stay, median	4 days	7 days	<0.001
Readmission	3.4%	10.6%	0.086

Table 4: Multivariable predictors of postoperative complications

Predictor	Adjusted OR	95% CI	p-value
Nutritional risk	2.55	1.13-5.75	0.024
Albumin <3.5 g/dL	2.88	1.19-6.98	0.019
Contaminated/dirty wound	2.31	1.02-5.24	0.045
Emergency surgery	1.84	0.78-4.32	0.162

Table 5: Practical perioperative nutrition action matrix

Risk domain	Clinical meaning	Suggested action
Low BMI or recent weight loss	Reduced reserve for stress and healing	Nutrition screening, protein-calorie plan and dietetic review
Albumin <3.5 g/dL	Marker of vulnerability and inflammatory burden	Enhanced risk labelling, infection vigilance and wound monitoring
Contaminated/dirty wound	High bacterial load with impaired host response	Antibiotic protocol, meticulous wound care and early SSI surveillance
Longer stay and readmission trend	Nutrition risk affects resource use	Discharge nutrition advice, follow-up call and outpatient wound review

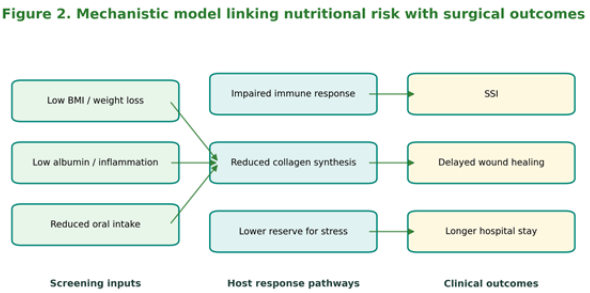

Figure 1: Mechanistic model used to interpret nutrition-related surgical risk.

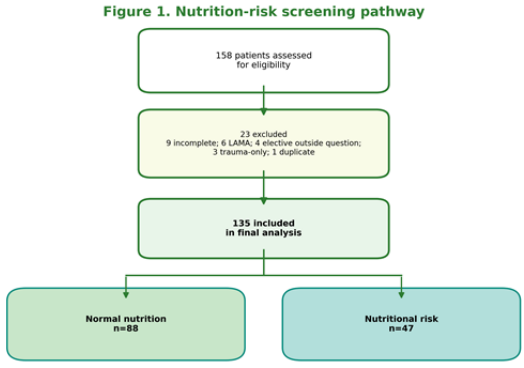

Figure 2: Patient selection and nutrition-risk classification flow diagram.

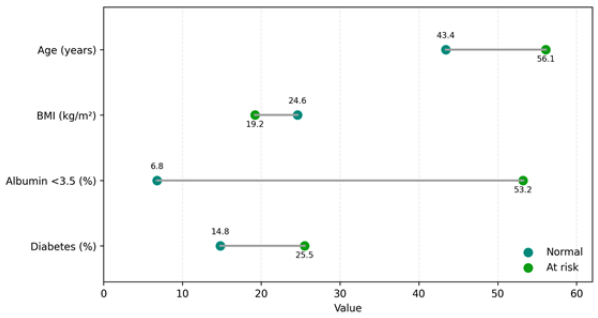

Figure 3: Baseline nutritional risk profile using a dumbbell comparison.

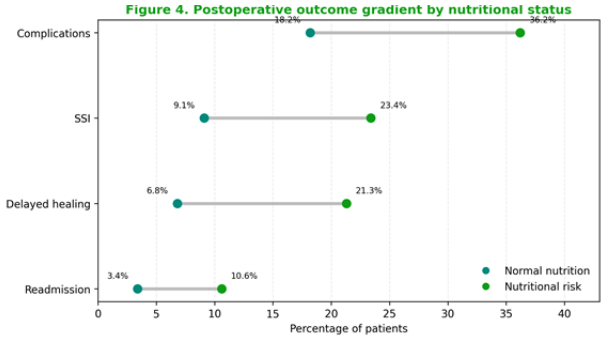

Figure 4: Postoperative outcome gradient by nutritional status.

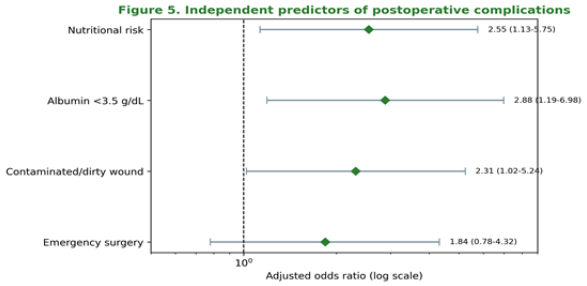

Figure 5: Forest plot of adjusted predictors of postoperative complications.

nutritionally at-risk patients. Albumin below 3.5 g/dL was markedly more frequent in the nutritional risk group. Diabetes mellitus was numerically more frequent among at-risk patients but did not reach statistical significance.

DISCUSSION

This prospective cohort study demonstrated that preoperative nutritional risk was significantly associated with worse short-term postoperative outcomes in adult general surgery patients. Nutritionally at-risk patients had higher overall postoperative complications, surgical-site infection, delayed wound healing and longer hospital stay. Nutritional risk remained independently associated with postoperative complications after adjustment for albumin level, wound contamination and emergency surgery.

The baseline pattern is clinically plausible. Patients at nutritional risk were older, had lower BMI and had a much higher frequency of hypoalbuminemia. Ageing is associated with reduced physiological reserve, reduced muscle mass and greater vulnerability to catabolic stress[14,15]. Low BMI and recent nutritional depletion reduce the body's capacity to respond to operative injury, infection and immobilization.

Albumin below 3.5 g/dL was independently associated with postoperative complications. Although albumin is not a pure marker of nutrition because it is affected by inflammation, infection and fluid status, it remains a powerful marker of surgical vulnerability. Large surgical datasets have shown that low preoperative albumin predicts morbidity and mortality across operative populations[16,19]. In the present study, albumin and nutritional risk both remained clinically important, suggesting that a multidimensional assessment is superior to reliance on a single parameter.

The increased surgical-site infection rate among nutritionally at-risk patients is biologically consistent. Malnutrition weakens immune response and impairs tissue repair, while contaminated or dirty wounds increase bacterial burden[21,22,23]. When poor host reserve and operative contamination coexist, the risk of infection and delayed wound healing increases. This explains why both nutritional risk and contaminated wound classification remained independent predictors in the adjusted model.

Delayed wound healing was more than three times higher among nutritionally at-risk patients. Wound repair requires adequate protein, energy, micronutrients, collagen synthesis and immune function[3,4]. Patients with nutritional depletion may develop delayed epithelialization, persistent discharge, wound gap and prolonged dressing needs. These complications increase patient discomfort, nursing workload and outpatient follow-up burden.

Hospital stay increased from a median of 4 days to 7 days in the nutritional risk group. This difference is clinically important because it affects surgical bed occupancy, cost and discharge planning. Hospital malnutrition has been repeatedly associated with increased length of stay, morbidity and healthcare expenditure[13,14,15]. In busy surgical units, routine nutrition screening can therefore serve both patient safety and resource-protection purposes.

The findings support current perioperative nutrition recommendations. ESPEN, ERAS and ASPEN guidance emphasizes early identification of nutritional risk, avoidance of prolonged fasting, early postoperative feeding and targeted nutrition support for high-risk patients[3,4,5,6,7,25]. In elective patients, nutritional optimization and prehabilitation may be considered when surgery can safely wait. In emergency patients, nutrition screening should not delay urgent surgery, but it should trigger enhanced postoperative surveillance and nutrition support.

Immunonutrition and specialized nutritional support have been studied in surgical populations, particularly gastrointestinal and cancer surgery. Systematic reviews and randomized trials suggest that arginine-containing or specialized nutrition formulas may reduce infectious complications in selected high-risk patients[26,27,28,29,30]. However, routine implementation should be adapted to local resources, patient risk and availability of dietetic services.

This study has limitations. It was conducted at a single centre and nutritional risk was assessed using a pragmatic departmental protocol rather than advanced body-composition analysis. Albumin may reflect both nutrition and inflammation. The sample size was adequate for overall complications but limited for less frequent outcomes such as readmission. Despite these limitations, the prospective design, clinically accessible measurements and adjusted analysis strengthen the relevance of the findings.

The practical implication is that nutrition should be embedded into surgical admission pathways. A simple screening approach using BMI, albumin, weight-loss history and oral intake can identify high-risk patients early. This should lead to dietetic referral when available, high-protein feeding plans, glucose control, wound surveillance, infection prevention and structured discharge follow-up.

CONCLUSION

Preoperative nutritional risk is an independent predictor of adverse postoperative outcomes in adult general surgery patients. Patients at nutritional risk had higher rates of overall complications, surgical-site infection, delayed wound healing and prolonged hospital stay. Routine nutritional screening should be incorporated into surgical admission protocols so that high-risk patients can

receive targeted perioperative care, enhanced wound monitoring and appropriate nutritional support.

DECLARATIONS

Conflict of interest: The authors declare no conflict of interest.
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Ethical approval: Approved by the Institutional Ethics Committee of Mardan Medical Complex, approval number MMC/IRB/2023/098, dated 28 March 2023.

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