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Impact of Preoperative Nutritional Status on Wound Healing Outcomes in Patients Undergoing Abdominal Surgery

Yashar Mashayekhi[1], Sara Baba-Aissa[2], Ahmed Gerwash[3], Muhammad Taha Shahid[4, 5], Niamat Ali[6], Abdul Rafay[7], Abali Wandala[8], Midhat Rasul Qadri[9], Behram Shaukat[10], Rammal Abdul Jabbar[11], Arzu Khattak[12] and Muhamad Naveed[13]*

[1]Department of Orthopedics, Leicester university hospital, Leicester, GBR

[2]Department of General Internal Medicine, Leicester Royal Infirmary, Leicester, GBR

[3]Department of Surgery, Tripoli Medical University, Tripoli, Libya

[4]Department of General Surgery, Abbasi Shaheed Hospital, Karachi, Pakistan

[5]Department of Surgery, Ziauddin University, Karachi, Pakistan

[6]Department of Medicine, Lahore General Hospital, Lahore, Pakistan

[7]Department of Surgery, Shaheed Mohtarma Benazir Bhutto Institute of Trauma, Karachi

[8]FCS-Medicine, Universidad Adventista del plata, Parana, Entre-Rios, Argentina, ARG

[9]Department of Surgery, Shalamar Medical and Dental College, Lahore, Pakistan

[10]Surgery, Kabir medical college, Peshawar, Pakistan

[11]Department of Surgery, Al Nafees Medical College, Islamabad, Pakistan

[12]General Physician, Dubai Medical College, Dubai, ARE

[13]Internal Medicine, Bahawal Victoria Hospital, Bahawalpur, Pakistan

ABSTRACT

Background: Postoperative healing of the wound is a critical component of post-surgery recovery and may be impacted by various patient-related conditions. The recovery of surgical procedures can be affected in areas that experience common nutritional deficiencies. Although there is current global awareness regarding its role, there is a lack of research explaining this relationship in the Pakistani population. This research examines the relationship between preoperative nutrition and postoperative wound healing in patients under surgery in tertiary care hospitals in Islamabad.

Methods: This study was a prospective cohort study carried out between February and June 2025. A convenience sampling of 387 adult patients who had an abdominal surgery was recruited. The data collection was conducted using a structured questionnaire that contained demographic and detailed information on the variables, including the Nutritional Risk Screening (NRS 2002) and postoperative wound outcomes, as assessed by the Southampton Wound Assessment Scale (SWAS). Statistical analysis was performed using SPSS v.26. Descriptive statistics, t-tests, ANOVA, Pearson correlation, and linear regression tests were employed to investigate the relationship between nutritional risk and wound healing.

Results: The nutritional risk scores were significantly higher among females (M = 7.18, SD = 1.34) than males (M = 6.88, SD = 1.22), p = 0.021. Nutritional risk was significantly but weakly related to scores on the SWAS (r = 0.116, p = 0.022), indicating that the worse the nutritional status, the poorer the healing outcome. Regression analysis confirmed that nutritional risk was a significant predictor of wound severity (p = 0.022). The wound scores were higher in older age groups, but the nutritional risk did not vary significantly between age categories.

Conclusion: The research suggests a significant correlation between inadequate preoperative nutritional status and delayed wound healing. Patients with poor dietary status had unfavourable postoperative outcomes. This evidence suggests conducting a regular nutritional screening process to enhance post-operative recovery and alleviate surgical wound complications among patients undergoing abdominal surgery.

***Corresponding author**
Muhammad Naveed, Internal Medicine, Bahawal Victoria Hospital, Bahawalpur, Pakistan.

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Introduction

Wound healing is a process involving sequential physiological events that are fundamental in reconstructing skin integrity following injury. It is essential to examine its cellular and molecular mechanisms to develop effective evidence-based care strategies [1]. Tissue repair is a complex process consisting of exudative, proliferative, and remodelling phases, all of which are controlled by cell-cell interactions and signalling pathways. The hedgehog pathway plays a crucial role in skin healing, particularly in angiogenesis and endothelial-mesenchymal transition [2].

There are four stages of the process of wound healing, including hemostasis, inflammation, proliferation, and remodelling. This process may be interrupted by factors such as infection, diabetes, or poor nutrition. New developments in genetics and targeted therapies offer hope that it may be possible to achieve better results with improved healing outcomes [3,4].

There were 1% cases of wound dehiscence and 4-7% of incisional hernia, which were similar among various methods of closure. Interestingly, the presence of a wound infection raised the likelihood of these complications tenfold, highlighting the significance of infection prevention [5].

Abdominal wound healing has well-differentiated histological characteristics; fibrinous crusts occur frequently, and inflammatory responses are more pronounced than at other surgical sites [6].

Several therapeutic interventions, including novel therapy options such as water-filtered infrared A (wIRA) therapy, have demonstrated viability in wound healing and prevention of postoperative complications when used in abdominal surgical practices [7].

Malnutrition, including protein-energy malnutrition, iron and vitamin A deficiencies, and iodine disorders, is a significant cause of child deaths in these developing nations. Major trials have shown that vitamin A supplementation can decrease child mortality by 20-50% [8]. The process of wound healing is complex and depends on numerous factors, where nutrition plays a vital role in every phase. Learning how to appropriately manage wounds and utilise malnutrition screening resources and nutritional requirements can be attributed to understanding the stages of healing and appreciating dietary needs [9].

Wound healing requires an adequate diet, as a deficiency can delay healing, decrease tensile strength, and increase the risk of infection. Nutrition is a crucial component of wound care management, as malnutrition often leads to non-healing wounds, which are frequently chronic [10]. Malnourished surgical patients exhibit diminished wound healing, with collagen deposition rates significantly lower than those of well-nourished individuals ($p < 0.01$). It implies that protein-energy malnutrition of any severity can negatively impact the course of healing within the first stages [11]. The wound healing process consists of three phases: inflammatory, proliferative, and maturation. However, this process can be derailed, resulting in a chronic wound. Healing can be adversely affected by malnutrition, particularly in geriatric or postoperative patients, and initial nutritional screening is essential [12].

Although the role of nutrition in improving surgical outcomes is increasingly understood, there is a lack of data describing the relationship between nutritional status and wound healing during abdominal surgery, particularly regarding preoperative assessment. This research aims to investigate this relationship, thereby demonstrating the relevance of nutritional screening and intervention in improving the recovery process after surgery and minimising wound-related problems.

Rationale

The process of wound healing is an essential component of postoperative recovery, especially among patients who have undergone abdominal surgery. Preoperative nutritional status is one of the many factors that influence the outcome of wound healing. Malnutrition interferes with the body's standard functionality, hindering its ability to heal damaged tissue, develop an efficient immune system, and overcome surgical stress. This leads to delays in the body's ability to heal wounds, recover from chemical exposure, prevent infectious diseases, and reduce the duration of a prolonged hospital stay. Across the globe, poor nutritional status has been found to contribute to suboptimal surgical outcomes, underscoring the importance of preoperative nutritional assessment and optimisation.

Nonetheless, there is a lack of adequate research on this topic in the Pakistani healthcare environment. Although malnutrition is quite prevalent and may affect surgical recovery, nutritional assessment is not extensively used before surgical care in Pakistan. A limited number of local studies have been conducted to investigate the effect of nutritional status on postoperative wound healing, and the available information is limited in both scope and applicability. The goal of this study is to fill the gap by examining the impact of nutritional status before surgery on wound healing outcomes in patients undergoing abdominal surgery at a tertiary hospital in Pakistan. This study will provide significant evidence to inform clinical approaches and benefit patients in this area.

Objectives

This study aims to determine the role of preoperative nutritional status in predicting wound healing outcomes in patients undergoing abdominal surgery. The other objective of the study is to document demographic data, including age, gender, and co-morbidities. It will help determine the prevalence rate of wound healing complications in patients with different nutritional statuses. It will give an impression of the importance of preoperative nutrition on wound recovery during surgery. These results demonstrate that nutrition assessment is necessary during routine pre-surgical evaluation.

Materials and Methodology

Study Design and Methods

In this study, a prospective cohort design was employed to investigate the impact of preoperative nutritional status on wound healing outcomes in patients undergoing abdominal surgery. The surgical departments in tertiary care hospitals in Islamabad, Pakistan, were used to recruit participants. A diverse group of adult patients was selected to represent a range of ages, genders, and health histories.

Data was obtained through interview-administered structured questionnaires. It included demographic, medical, and surgical histories, as well as the existence of chronic conditions. Before the surgery, each participant's nutritional status was evaluated via a validated screening tool. The effect on postoperative wound healing was then observed and measured, followed by a standardised scoring method to track wound-related complications and their severity.

The data were collected after all participants were informed about the purpose of the study, and they provided their signatures in support. Such a cohort would enable the researcher to monitor the long-term effect that preoperative nutritional conditions have on wound healing, which would be of great benefit in assisting with better procedures regarding surgical treatment and patient outcomes within the local hospital.

Sample Size and Technique

The study was conducted with an infinite population because the precise number of patients who will undergo abdominal surgery with different nutritional statuses in Islamabad is unknown. The standard formula was used to calculate the number of samples:

$$n = \frac{Z^2 \cdot p (1 - p)}{d^2}$$

Here, Z refers to the z-value at the required confidence level, p is an estimated proportion as outlined by earlier studies, and d is a margin of error. The statistical tool used was a Z value of 1.96, which corresponds to a 95% confidence level. The level of error (d) was pegged at 0.05. In cases where local prevalence data did not exist, a proportion (p) of 0.50 was chosen to provide a maximum sample size and statistical power. The calculation further helped determine the minimum required sample size of 387 participants [13].

The minimum required number of participants was oversampled to cover potential non-responses, incomplete records, or dropouts during the follow-up. Patients who were willing to participate in the study and could be recruited were selected using a convenience sampling method applied to surgical departments and other departments of tertiary care hospitals in Islamabad. Only participants who fulfilled the inclusion criteria and would be available at the time of the study were enrolled. This approach enabled the researcher to collect relevant information from a convenient and helpful group of patients in a hospital setting.

Table 1: Inclusion and Exclusion Criteria for Study Participants The Inclusion and Exclusion Criteria for study Participant Selection are Summarised in Table 1

Inclusion Criteria	Exclusion Criteria
Elective abdominal surgery in adult patients (age 18 years or above)	Patients who have a pre-existing chronic non-healing wound or skin disorder
Patients who are ready to give informed consent	Chemotherapy or immunosuppressive treatment for patients
Patients who are available to undergo postoperative follow-up	Patients with diagnosed malignancies
Patients who are determined by the surgical team to be medically stable and suitable to undergo surgery	Patients whose data are incomplete or lost to follow-up afterwards

Data Collection Tools

We administered a structured questionnaire, which includes three significant parts: demographic data, preoperative nutritional risk screening, and wound healing evaluation. The questionnaire used as a tool was an evidence-based and standardised instrument, widely used in both clinical research and surgical outcome studies.

Demographic Information

The initial part of the questionnaire collected simple demographic information to determine whether wound-healing outcomes are related to individual and social factors. Data were gathered on age, sex, marital status, educational level, occupation, comorbidities (associated diseases, including diabetes and high blood pressure), smoking status, and type of surgery. By gathering these variables, it was possible to determine whether there is an associated trend or differences in wound recovery among various patient categories.

Nutritional Risk Screening (NRS 2002)

The second section of the questionnaire involved monitoring the preoperative nutritional status of each participant, as reported with the help of the Nutritional Risk Screening (NRS) 2002 tool, which was developed by Kondrup et al. in 2003. This confirmed tool is also commonly used in hospitals to identify patients at risk of malnutrition by examining recent weight loss, decreased dietary intake, and the severity of the disease that affects their nutritional requirements. The scoring system consists of nutritional status (0-3), disease severity (0-3), and an additional point awarded when patients are aged 70 years or older. A score of 3 or more would indicate nutritional risk, and nutritional intervention would be warranted. The NRS 2002 has demonstrated acceptable inter-rater reliability (Cohen's kappa > 0.70) and was also endorsed by the European Society for Clinical Nutrition and Metabolism (ESPEN) for use in both surgical and medical patients [14].

Southampton Wound Assessment Scale (SWAS)

The third section of the questionnaire was a measure of postoperative wound healing based on the scale by Bailey et al. (1992), i.e., the Southampton Wound Assessment Scale (SWAS). This grading scheme categorises the wound healing of surgical sites into six grades (0 through 5), indicating routine healing of the surgical site with no signs of inflammation (Grade 0) to severe wound infection that requires drainage (Grade 5). Mild erythema, bruising, serous or purulent drainage, and the destruction of wounds are attributed to intermediate grades. The SWAS proved to be a reproducible and reliable instrument, and clinical studies have found inter-observer agreement to be 79- 95%. This is mainly due to its structured and objective design, which is particularly helpful when a standardised wound assessment is required in research and during regular surgical follow-ups [15].

Procedure

The study sample was recruited from surgical wards and outpatient departments of tertiary care hospitals in Islamabad, after participants provided written informed consent. Data were collected during a five-month study conducted from February 2025 to June 2025. Patients who were receiving elective surgery on the abdomen were approached during their hospital stay or at visits during the preoperative assessment. The administration of this questionnaire was either by self-reporting or through trained interviewers, depending on the participant's preference and literacy level. To ensure confidentiality and prevent identification of the subjects, all data were anonymised. The research was carried out in an inclusive, ethical, and respectful manner, allowing for the accommodation of work with people from different demographic, cultural, and socioeconomic backgrounds. This method guaranteed quality and representation of the local surgical population.

Statistical Analysis

Data analysis was done with IBM SPSS Statistics version 26 (IBM Corp.). Means, standard deviations, frequencies, and percentages were used as descriptive statistics to present the demographic characteristics of the participants. To determine which statistical tests to use, the normality of the data was evaluated using the Kolmogorov-Smirnov test and the Shapiro-Wilk test. Pearson correlation was applied to the Nutritional Risk Screening and the Southampton Wound Assessment Scale, considering any confounding factors to analyse the relationship between the correlations. The difference between internal and external data was evaluated using an independent t-test on the scores of the Nutritional Risk Screening and the Southampton Wound Assessment Scale to determine the difference in scores between male and female participants. A one-way ANOVA was used to evaluate the differences between the Nutritional Risk Screening scores and the Southampton Wound Assessment Scale scores across age groups and smoking statuses. Linear regression was also used to anticipate Nutritional Risk Screening scores when predicting Southampton Wound Assessment Scale scores and other possible confounders. The relationships between educational level and age, as well as smoking status and age, were examined using Chi-square tests. All statistical calculations were done using $p < 0.05$, which noted significant factors affecting the study participants' nutritional risk and wound healing outcome.

Ethical Considerations

The study was conducted in accordance with accepted ethical principles for researching human subjects. The study protocol was stamped by the Institutional Review Board (IRB) of the Lumina Research Foundation, Islamabad, with the authorisation number IRB-2025-0096. This ensured the study adhered to the principles of respect for persons, beneficence, and confidentiality. Each participant was aware of the research, its objectives, and the potential risks and benefits associated with it. All participants provided informed consent, as no data collection was conducted without their written permission. Participation in the study was voluntary, and each participant could withdraw at any time without incurring any penalties or loss of rewards. The privacy and confidentiality of the participants were strictly maintained during the study, and all identifying data were anonymised to ensure that the participants' identities would not be revealed.

To assess the quality and completeness of the dataset, the responses were reviewed upon completion of the collection. When it came to minor data fields with missing answers, participants were requested to elaborate or fully answer those questions when possible, without any harshness in the request. All records with significant gaps, after which no information was obtained, were excluded from the final analysis to ensure data integrity and prevent biased outcomes.

Results

Table 2: Demographic Characteristics of Participants (N=387)

Variable	f	%
Age	-	-
18-29 years	86	22
30-44 years	97	25
45-59 years	107	28
60 years and above	92	24
Gender	-	-
male	200	52
female	182	48
Marital status	-	-
single	80	21
married	101	26
divorced	105	27
widowed	96	25
Educational level	-	-
No formal education	65	17
primary school	72	19
secondary school	86	22
higher secondary	85	22
graduate or above	74	20
Occupation	-	-
unemployed	59	15
laborer	81	21
office worker	89	23
professional	84	22
retired	69	18
Type of abdominal surgery	-	-
elective	185	48
emergency	197	52
Surgical approach	-	-
open	192	50
laparoscopic	190	50
Comorbidities	-	-
diabetes mellitus	64	17
hypertension	68	18
cardiovascular disease	76	20
chronic kidney disease	66	17
chronic liver disease	60	16
none	48	13
Smoking status	-	-
never smoked	150	39
former smoker	132	34
current smoker	100	26

Note. f=frequency, %=percentage

Table 2 displays the demographic profile of the participants (N = 387). Most participants fell in the 45-59-year-old category (N = 107, 28%), followed by 30-44-year old (N = 97, 25%), 60 years and older (N = 92, 24%), and 18-29-year-old participants (N = 86, 22%). Among the genders, males (N = 200, 52%) were slightly more compared to females (N = 182, 48%). In terms of marital status, the most significant number was the divorced participants (N = 105, 27 percent), then the married ones (N = 101, 26%), the widowed (N = 96, 25%), and the single members (N = 80, 21%). The level of education was not equal, with the most significant comparative levels being secondary level (N = 86, 22%) or above secondary level (N = 85, 22%), graduates or above (N = 74, 20%), primary education (N = 72, 19%) and no education (N = 65, 17%). In terms of occupation, office workers (N = 89, 23%), professionals (N = 84, 22%) were the most prevalent with the remaining being laborers (N = 81, 21%), retired (N = 69, 18%) and unemployed (N = 59, 15%). A narrow majority had emergency abdominal surgery (N = 197, 52%) compared to elective procedures (N = 185, 48%) and surgical procedures were equal in percentage, with the open surgical method (N = 192, 50%) and laparoscopic surgery (N =

190, 50%). Comorbidity data indicated cardiovascular disease (N = 76, 20%) to be the commonest, followed by hypertension (N = 68, 18%), chronic kidney disease (N = 66, 17%), diabetes mellitus (N = 64, 17%), chronic liver disease (N = 60, 16%), and no comorbidity (N = 48, 13%). Lastly, most participants never smoked (N = 150, 39%), but some were past-smokers (N = 132, 34%) or current smokers (N = 100, 26%).

Table 3: Results of the Kolmogorov–Smirnov and Shapiro–Wilk tests indicate normal distribution of Nutritional Risk Screening and Southampton Wound Assessment Scale variables (p > 0.05)

Variable	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	p	Statistic	df	p
Nutritional Risk Screening	0.032	387	0.200	0.987	387	0.084
Southampton Wound Assessment Scale	0.027	387	0.200	0.985	387	0.067

Note: df=degree of freedom; parametric test=p>0.05; non-parametric test=p<0.05

Table 3 summarises the findings of the Kolmogorov-Smirnov and Shapiro-Wilk tests as a check on the normality of the Nutritional Risk Screening (NRS) and Southampton Wound Assessment Scale (SWAS) scores in the study participants (N = 387), respectively. Both tests, that is, NRS: Kolmogorov-Smirnov (p = 0.200) and Shapiro-Wilk (p = 0.084), and SWAS: Kolmogorov-Smirnov (p = 0.200) and Shapiro-Wilk (p = 0.067), indicated that both variables were distributed normally, as the p-values were greater than 0.05. Parametric statistical tests were found suitable since the assumptions of normality were fulfilled.

Table 4: Intercorrelation Between Study variables

Variable	Nutritional Risk Screening	Southampton Wound Assessment Scale	p
Nutritional Risk Screening	-	0.116	0.022*
Southampton Wound Assessment Scale	0.116	-	0.022*

Note: *=p<0.05, **=p<0.001 considered significant; correlation= Pearson Correlation

Table 4 presents the Pearson correlation between the Nutritional Risk Screening and the Southampton Wound Assessment Scale scores of the participants. There was a weak, positive correlation, although it was statistically significant (r = 0.116, p = 0.022), indicating that when nutritional risk is higher, people are also at a higher risk of experiencing worse wound outcomes. The correlation score is not high, but it is significant at the p-value of < 0.05, indicating a significant relationship between nutritional condition and wound healing.

Table 5: Comparison among Variables (Gender)

Variable	Male (N=226); M±S.D	Female (N=161); M±S.D	t	p	Cl 95% LL	UL	Cohen's D
Nutritional Risk Screening	6.88±1.22	7.18±1.34	-2.315	0.021*	-0.562	-0.046	0.24
Southampton Wound Assessment Scale	3.40±1.23	3.60±1.22	-1.580	0.115	-0.448	0.049	0.16

Note: M=mean, SD=standard deviation, LL=Lower limit, UL=Upper limit; Cl=confidence interval; Independent t-test; **=p<0.001 considered significant

Table 5 reports the independent t-test of Nutritional Risk Screening and Southampton Wound Assessment Scale sections as compared with the gender variable. There was a statistically significant difference between males (M = 6.88, SD = 1.22) and females (M = 7.18, SD = 1.34) in Nutritional Risk Screening scores, showing a higher nutritional risk in females (t = -2.315, p = 0.021, 95% CI: -0.562 to -0.046, Cohen d = 0.24), with the indicated difference being slight. Nonetheless, there was no significant gender difference in Southampton Wound Assessment scale scores (p = 0.115), although female participants scored significantly higher than males (m = 3.60 and m = 3.40, respectively).

Table 6: Comparison of Variables (Age)

Variable	18-29 years (N=36);M±S.D	30-44 years (N=111); M±S.D	45-59 years (N=161); M±S.D	60 years or above (N=79); M±S.D	p	F (3,383)	η2
Nutritional Risk Screening	6.78±1.27	6.94±1.24	7.02±1.32	7.15±1.27	0.427	0.840	-
Southampton Wound Assessment Scale	2.94±1.264	3.23±1.07	3.69±1.22	3.68±1.33	<0.001**	6.409	0.048

Note: M=mean, S. D=standard deviation, F=ratio of variance between groups to within groups, η2=effect size; One-way ANOVA; **=p<0.01 considered significant

Table 6 presents a comparison of Nutritional Risk Screening and Southampton Wound Assessment Scale scores across various age groups, as determined by one-way ANOVA. The difference in Nutritional Risk Screening between the age groups was not significant (p = 0.427, F(3, 383) = 0.840), which suggests that nutritional risk levels were similar to those of other age categories. Nevertheless, a substantial difference in Southampton Wound Assessment Scale scores (p < 0.001, F (3, 383) = 6.409, 0.048) was recorded since older age groups (4559 years and 6060 years) had higher wound scores on average, which reflects poorer outcomes in wound healing with increasing age. The effect size (0.048) is slight to moderate.

Table 7: Comparison of Variables (Smoking Status)

Variable	Never Smoked (N=147); M±S.D	Former Smoker (N=51); M±S.D	Current Smoker (N=150); M±S.D	p	F (2,384)	η2
Nutritional Risk Screening	6.76±1.19	7.34±1.33	7.00±1.15	<0.001**	9.612	0.048
Southampton Wound Assessment Scale	3.51±1.22	3.45±1.24	3.50±1.35	0.906	0.098	0.001

Note: M=mean, S. D=standard deviation, F=ratio of variance between groups to within groups, η2=effect size; One-way ANOVA; **=p<0.01 considered significant

Table 8: Linear Regression Analysis Predicting Southampton Wound Assessment Scale (SWAS) Scores using Nutritional Risk Screening

Variable	B	95% Cl LL	UL	S.E	β	P
Constant	2.706	2.026	3.385	0.346	-	<0.001**
Nutritional Risk Screening	0.111	0.016	0.207	0.049	0.116	0.022*

Note: B=coefficient, S. E=standard error, β =standardized coefficient, LL=Lower limit, UL=Upper limit; Cl=confidence interval, **=p<0.01 considered significant

Table 8 presents the results of a linear regression model used to predict Southampton Wound Assessment Scale (SWAS) scores, conditioned on Nutritional Risk Screening. As shown in the model, the Nutritional Risk Screening is a strong positive predictor of SWAS scores (B = 0.111, 95% CI: 0.016 to 0.207, p = 0.022), with a standardised coefficient (beta) of 0.116. This indicates that as the nutritional risk increases by 1 unit, the SWAS increases by 0.111, which is a relatively weak association between poor nutritional risk and worse outcomes regarding wound outcomes. The constant value (B = 2.706, p < 0.001) corresponds to the benefit of the SWAS score in a situation when the nutritional risk score equals 0.

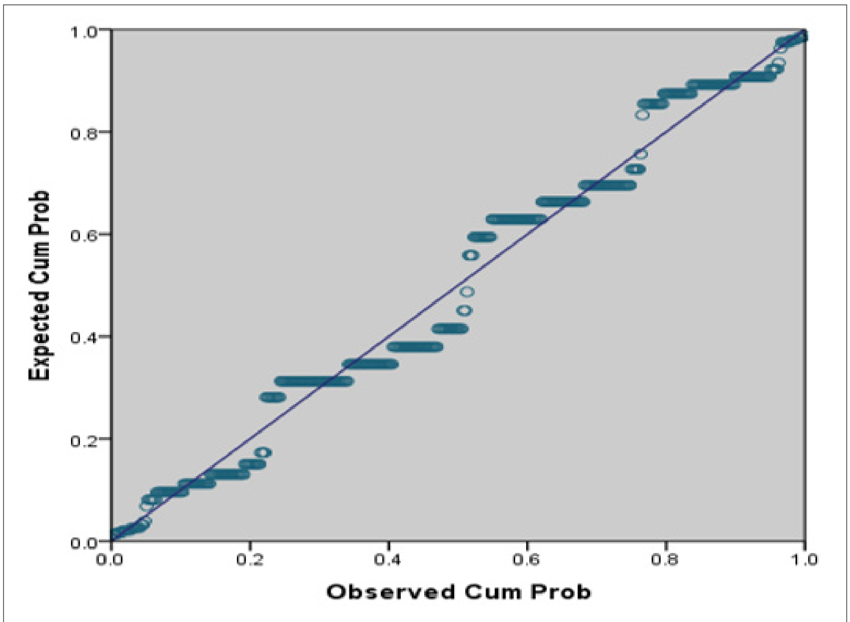

Figure1: Standard P-P Plot of Standardised Residuals for Regression Model Predicting Southampton Wound Assessment Scale

Figure 1 demonstrates a Normal P-P Plot of the standardised residuals of the regression model that determines the Southampton Wound Assessment Scale (SWAS). The plot contrasts the anticipated cumulative probability of residuals and the observed cumulative probability. The plots are almost aligned with the diagonal reference line, indicating that the scatter of the residuals is close to a normal distribution. This implies that the regression model was well-fitted to the data, and the assumption of normality of the residuals is satisfied, which is critical to the validity of the statistical inferences drawn about the model.

Table 9: Descriptive Statistics of Demographic Variables (Age, Educational Level, Smoking Status)

Variables	*f*	No Formal Education	Educational Level Primary	Secondary	Higher Secondary	Graduate or Above	df	p	x^2	Never Smoked	Smoking Status Former Smoker	Current Smoker	df	p	x^2
Age	-	-	-	-	-	-	12	0.023*	25.6	-	-	-	6	0.009**	21.3
18-29 years	36	2	4	10	12	8	-	-	-	30	5	1	-	-	-
30-44 years	111	8	15	35	40	13	-	-	-	60	45	6	-	-	-
45-59 years	161	22	32	60	34	13	-	-	-	40	90	31	-	-	-
60 years or above	79	26	33	15	5	0	-	-	-	20	45	14	-	-	-

f=frequency; %=percentage; df=degree of freedom; x2=effect size; p=level of significance; p-values calculated using the chi-square test; the significance level is set at $p < 0.05$; *=p<0.05; **=p<0.001 considered significant.

Table 9 presents the distribution of participants by age groups, which relates to their educational status and smoking status, along with the results of chi-square tests for association. The relationship between age and level of education also demonstrated a significant value (25.6, df = 12, p = 0.023), indicating that age was a significant predictor of educational level. People between 45 and 59 years old were mainly qualified in secondary or higher secondary school, while a substantial number of people aged 60 years or more had no formal education. Likewise, the study also found a strong relationship between age and smoking status (21.3, df = 6, p = 0.009), indicating that there was a difference in the smoking habits by age group. The most likely outcome was the possibility that younger respondents (18 to 29 years of age) had never smoked, and those who smoked currently or used to smoke were in the older age categories, especially those between 45 and 59 years of age and those above 60 years of age. Such results demonstrate the impact of the age factor on smoking and the level of education among the participants in the research group.

Discussion

The current research presents an investigation into the correlation between the nutritional status of patients before surgery and the postoperative wound healing outcomes in patients undergoing abdominal surgery in tertiary care hospitals in Islamabad. We have found that the correlation between nutritional risk and wound severity was weak but significant in the positive direction, indicating that poor nutritional condition is associated with insufficient wound healing. This finding is consistent with the existing literature, which has identified malnutrition as a significant factor contributing to delayed wound healing and an increased predisposition to chronic wounds [10].

In our study, the nutritional risk score was significantly higher in females compared to males; however, the effect size was small. This is consistent with the earlier studies that also highlight the higher nutritional vulnerability of women [16]. The females in our study recorded higher wound severity scores than the males, but the difference was statistically insignificant. This pattern is consistent with the literature, which indicated that female gender was an independent driving factor towards wound complications, especially in surgical settings that used groin incisions [17].

We found that the nutritional risk did not differ significantly between age groups, indicating that it was distributed relatively evenly across age groups. This, however, is not consistent with earlier studies that found the elderly population, and more specifically those aged 80 years and above, to be at a greater nutritional risk. This variance could be an indication of the variance of population traits and clinical environment [18]. Within our study, older age groups had significantly lower wound healing outcomes, but the effect was small to moderate. This suggests that age can impact healing, albeit to a limited extent. This has been supported by previous research, which shows that comorbidities, rather than the age factor alone, lead to delayed wound healing [19].

We found that former smokers had higher nutritional risk than current smokers, contrary to earlier reports in which current smoking was more closely associated with malnutrition. Such discrepancy could be a remnant of long-term smoking or the disparity in the health-seeking process after quitting [20]. The findings of our study revealed that there was no significant difference in wound healing outcomes among the various smoking groups. Conversely, a previous study reported worse healing and reduced skin perfusion in smokers. Thus, it was a possibility that smoking also hurt the wound healing process [21].

We found that an increased nutritional risk was weakly associated with a negative wound-healing process. This is supported by previous literature, which indicates that malnutrition interferes with physiological wound healing, leading to delayed tissue healing, increased infection risk, and chronic nonhealing wounds [10].

In our research, we have found a strong correlation between the age factor and the educational status, whereby older members were more likely to be uneducated. The finding is consistent with another study, which indicated a low level of educational attainment among the older group, reflecting generational gaps in educational access [22]. Our results revealed there was a strong correlation between age and smoking status, where older people are more likely to be former smokers. This is consistent with past results that are linked to the fact that smoking cessation at older ages leads to more positive cognitive outcomes that underline the long-term impact of smoking reduction [23].

Limitations

This study has several limitations. One, its design as a cross-sectional study makes it unable to determine causal relations between nutritional status before the surgery and wound healing outcomes. It does not reflect any progression or changes over time, but records associations at a particular moment. Second, the convenience sampling technique can introduce selection bias, as subjects were selected based on availability rather than randomisation. Third, the study was conducted in a few tertiary care hospitals in Islamabad; therefore, the results may lack generalizability to the rest of the country or other healthcare environments, especially in rural or resource-constrained settings. Fourth, the study focused on the short-term results of the surgery and did not consider the long-term complications, such as incisional hernias or the development of chronic wounds. Fifth, several variables, including smoking and diet, were based on self-reports, which can lead to recall bias and compromise the accuracy of the data. Finally, the comorbidities were reported; however, controls were not accounted for, as possible uncontrolled confounding factors, such as perioperative glycemic management, surgical methods, or quality of postoperative management, all of which can affect wound healing outcomes.

Future Directions

To overcome the limitations of the presented research, future studies should consider a longitudinal study design, which would enable tracing the outcomes of wound healing over time and contribute to establishing causal relationships. Additionally, the inclusion of multicenter research in various geographical and healthcare settings in Pakistan would enhance the ability to generalise the results. Further randomised controlled trials (RCTs) are needed to evaluate the effect of selective preoperative nutritional interventions on enhancing surgical recovery and limiting the onset of postoperative complications. In addition, measurements of other types of data (micronutrient concentrations, inflammatory biomarkers, glycemic controls, and physical activity) would give better insight into the impact of nutritional status on the wound healing process. Lastly, there must be a concerted effort to incorporate preoperative nutritional screening protocols (such as NRS 2002) into regular surgical practices at the healthcare level, to maximise patient outcomes within healthcare systems with limited resources.

Conclusion

This research provides evidence that a poor preoperative nutritional status has a statistically significant relationship with poor wound healing outcomes in the case of abdominal surgery patients. Nutritional risk was associated with female gender, advanced age, and history of previous smoking, whereas poor postoperative wound scores were predicted by nutritional risk. These results emphasise the importance of considering nutritional assessment instruments like NRS 2002 as an established part of the preoperative workup. Early identification of at-risk patients enables clinicians to make timely interventions, thereby boosting the recovery of these patients and minimising wound complications. This evidence can serve as a wake-up call to healthcare systems in Pakistan to recognise the importance of integrating nutrition health with surgical care.

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