Volume 3, Issue 6, 2025

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

IMPACT OF PREOPERATIVE PSYCHOLOGICAL STRESS ON WOUND HEALING AND RECOVERY FOLLOWING ELECTIVE ABDOMINAL SURGERY AT AYUB TEACHING HOSPITAL, ABBOTTABAD

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DOI: https://doi.org/10.5281/zenodo.17130958

Keywords

Article History
Received: 30 May, 2025
Accepted: 11 August, 2025
Published: 30 August, 2025

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Abstract

Background: Psychological stress before surgery is common and may adversely affect surgical outcomes. This study examined the impact of preoperative psychological stress on wound healing and recovery in patients undergoing elective abdominal surgery at a tertiary hospital.

Methods: In a prospective cohort design, 100 adults scheduled for elective abdominal procedures were assessed for stress using the Perceived Stress Scale (PSS) and serum cortisol levels preoperatively. Patients were categorized into high-stress (PSS > 20) and low-stress groups. Wound healing time (days to complete incision healing), occurrence of wound infection, and postoperative recovery indices (hospital stay length and complications) were recorded.

Results: Patients with high preoperative stress (n = 40) had significantly longer wound healing times (mean 18.7 vs 15.1 days, p < 0.001) and a higher rate of surgical wound infections (32.5% vs 6.7%, p = 0.001) compared to low-stress patients. Preoperative cortisol levels were elevated in the high-stress group and correlated positively with healing time (r ≈ 0.69), indicating that greater physiological stress was associated with slower wound repair. High-stress patients also required slightly longer hospital stays (mean 6.0 vs 5.0 days, p = 0.002).

Conclusion: Elevated preoperative psychological stress is associated with delayed wound healing, increased risk of wound infection, and prolonged recovery in elective abdominal surgery patients. These findings underscore the importance of identifying and managing preoperative stress to potentially improve surgical outcomes. Implementing stress-reduction interventions before surgery may enhance wound healing and overall recovery.

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ISSN: (e) 3007-1607 (p) 3007-1593

INTRODUCTION

Wound healing is an important part of postoperative recovery, and poor healing can lead to longer pain, increased infection rates, delayed rehabilitation, and significantly greater healthcare expenses [1]. Wound repair requires a well-orchestrated series of processes, including hemostasis, inflammation, proliferation, and remodeling. Any interruption in this cascade, especially during the inflammatory and proliferative phases, might jeopardize tissue integrity and lead to problems such as dehiscence, hypertrophic scarring, and surgery site infection. Aside from well-established biological risk factors like age, diabetes, malnutrition, and smoking, accumulating data also acknowledge psychological stress as an unappreciated but important predictor of surgical wound outcomes.

Stress activates both the sympathetic-adrenal-medullary (SAM) system and the hypothalamic-pituitary-adrenal (HPA) axis, causing catecholamine and glucocorticoid surges [2,4]. These neuroendocrine mediators have a wide-ranging effect on immunity and tissue healing. Cortisol decreases pro-healing cytokines such as interleukin-1, tumor necrosis factor-α, and vascular endothelial growth factor, while adrenaline and noradrenaline cause temporary leukocytosis but hinder lymphocyte trafficking [2]. Excess cortisol has also been demonstrated to impede fibroblast proliferation, diminish collagen deposition, and impair angiogenesis, all of which degrade granulation tissue and surgical wound tensile strength [4]. In animal models, wounds treated with exogenous glucocorticoids heal up to 40% slower than controls, and similar patterns have been found in stressed human volunteers who underwent standardized skin biopsies. Chronic or repetitive stress further disrupts inflammatory responses, weakening early immunological defense against pathogens and prolonging the late inflammatory phase, both of which increase vulnerability to infection and impede closure [4].

Clinically, preoperative anxiety and stress are extremely common among surgery patients. A recent narrative summary suggested that over half of all patients (≈48%) feel moderate to severe anxiety in the days before surgery [5]. Prevalence estimates, however, vary greatly depending on operation type, cultural background, and assessment technique, ranging from as little as 20% in experienced elective surgery patients to more than 80% in first-time ambulatory surgery groups. Younger patients, females, and those with little prior surgical experience report higher anxiety levels [5]. This psychological burden has measurable physiological consequences: increased preoperative stress has been linked to hemodynamic instability during anesthesia induction, increased intraoperative anesthetic and analgesic requirements, enhanced postoperative pain responses, and delayed mobilization [5]. Furthermore, high anxiety frequently presents as postoperative nausea, vomiting, and sleep disturbance, all of which might indirectly impair wound healing by decreasing oral intake, raising catabolic stress, and limiting rest.

Importantly, psychological stress has a direct effect on wound repair in addition to pain and hemodynamics. Observational and systematic studies show that patients with higher preoperative stress levels are more likely to experience wound healing issues such as surgical site infections, wound dehiscence, and cosmetically poor scar results [1, 3]. For example, stressed patients had worse local leukocyte recruitment and microbial clearance, which explains the greater infection rates observed in both abdominal and orthopedic surgical groups [3]. Meta-analyses have also shown that persons with high preoperative anxiety or concomitant depression had a considerably higher risk of delayed wound closure than those with minimal distress [1]. These findings support the idea that mental health and emotional state are not accessory concerns, but rather important physiologic elements determining postoperative recovery.

These findings show that psychological stress is more than just an emotional experience; it is a systemic physiological state that has measurable impacts on tissue recovery. Recognizing and addressing preoperative anxiety should be considered an essential component of perioperative treatment, just as optimizing nutrition, regulating blood glucose, and managing cardiovascular risk factors. Failure to do so may prolong wound healing and increase infection rates while also increasing the overall cost and burden of surgical care.

Frontier in Medical & Health Research
ISSN: (e) 3007-1607 (p) 3007-1593

Methods

Study Design and Participants.

We conducted a prospective cohort study at Ayub Teaching Hospital in Abbottabad, Pakistan, from January 2024 to July 2025. The Institutional Ethical Review Board of Ayub Medical University examined and approved the study protocol. Before registration, all individuals gave their written informed consent.

Eligible patients were individuals (≥18 years) scheduled for elective abdominal surgery, including cholecystectomy, hernia repair, and bowel resection under general anesthesia. Patients undergoing emergency surgery, those with chronic immunosuppressive diseases (e.g., HIV/AIDS, long-term corticosteroid therapy), uncontrolled diabetic mellitus, or active systemic infections were excluded to prevent confounding caused by independent wound-healing deficiencies.

Throughout the trial period, 100 patients who met the inclusion criteria were recruited consecutively.

Preoperative Stress Assessment

On the day before surgery, each patient received standardized psychological and physiological stress tests.

Perceived Stress Scale (PSS-10): This 10-item validated measure yields scores ranging from 0 to 40, with higher scores indicating greater perceived stress. It is commonly utilized in surgical groups and has excellent internal consistency [1].

The Hospital Anxiety and Depression Scale (HADS-Anxiety) was utilized to screen for clinical anxiety symptoms; nevertheless, PSS was the major stress measure in this study.

Serum Cortisol:

A fasting venous blood sample was drawn at 08:00 h on the morning of surgery. A chemiluminescent immunoassay was used to measure cortisol (μg/dL), a biomarker of acute stress associated with altered immunological and wound responses [2, 3].

- Patients were divided into two categories based on PSS:
- Severe Stress: PSS >20 (moderate to severe perceived stress)
- Low Stress: PSS < 20 (low perceived stress).

Previous perioperative stress studies used a threshold of 20 to separate clinically significant stress levels [4].

Demographic information (age, gender, BMI, smoking, and comorbidities) was retrieved from hospital records.

Surgical Procedure and Post-operative Care

All procedures were carried out by consultant surgeons following standardized perioperative standards. General anesthesia, intraoperative monitoring, and prophylactic antibiotics (given ≤1 hour pre-incision) were used consistently. Wound closure was achieved utilizing multilayer absorbable and non-absorbable sutures and antimicrobial dressings.

Daily wound examination, conventional analgesia (intravenous acetaminophen with opioid rescue), and mobilization guidelines were all part of the postoperative treatment. Patients were observed until they met the discharge criteria (afebrile, ambulatory, tolerant of food, pain-controlled).

Outcome Measures

Wound Healing Time (Days): The time from surgery to complete epithelialization with no open regions. Blinded surgical staff confirmed healing, which was often associated with suture removal.

Surgical Site Infection (SSI) is defined according to CDC criteria [5]. Purulent discharge, positive wound culture, or a clinical diagnosis requiring antibiotics were all acceptable criteria. Both superficial and deep incisional SSIs were reported.

Length of Hospital Stay (LOS): The number of postoperative days until release.

Other Complications: Secondary outcomes included pneumonia, urinary tract infection, and anastomotic leak.

Postoperative pain and analgesic use were assessed daily for 72 hours using a Visual Analog Scale (VAS 0-10). Opioid use (morphine equivalents) was tracked to recognize stress-related changes in pain perception [6].

Statistical analysis

The sample size estimation assumed a medium effect size (Cohen's d ≈0.5) in wound healing time between groups, with α =0.05 and power =80%, resulting in a target of 100 patients (about 40 high-stress, 60 low-stress).

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Continuous variables were represented as mean ± SD and compared using Student's t-test (or Mann-Whitney U test when applicable). Categorical variables (such as SSI incidence) were evaluated using the Chi-squared or Fisher's exact tests. Pearson's correlation investigated the relationship between stress markers (PSS, cortisol) and outcomes. Multivariate linear regression with adjustments for age, diabetes, and smoking. Statistical significance was defined as $p < 0.05$.

Results:

Patient characteristics and stress levels.

The average age of the 100 patients enrolled was 42.0 ± 10.5 years, and 56% were male. Forty patients (40%) were classed as High Stress (PSS >20), and sixty (60%) as Low Stress.

Baseline demographics were comparable between groups (Table 1). The mean age did not differ substantially (High Stress: 39.7 ± 10.7 vs. Low Stress: 43.6 ± 10.3 years; p = 0.08). The sex distribution was balanced (55% male versus 57% male; p = 0.85). Comorbidities like hypertension and type 2 diabetes were equally distributed.

The High Stress group showed significantly higher PSS ratings (24.2 ± 3.4 vs 14.5 ± 3.9; p < 0.001). Serum cortisol levels were substantially higher (22.3 ± 2.8 versus 17.4 ± 3.2 µg/dL; p < 0.001), indicating an increased physiological stress response.

Characteristic/Outcome	High Stress (n = 40)	Low Stress (n = 60)	p-value
Age (years)	39.7 ± 10.7	43.6 ± 10.3	0.08
Male Sex (% of group)	55%	57%	0.85
Perceived Stress Score (0–40)	24.2 ± 3.4	14.5 ± 3.9	< 0.001★
Serum Cortisol (µg/dL)	22.3 ± 2.8	17.4 ± 3.2	< 0.001★
Wound Healing Time (days)	18.7 ± 1.7	15.1 ± 1.9	< 0.001★
Wound Infection Rate	32.5% (13/40 patients)	6.7% (4/60 patients)	0.001★
Postoperative Hospital Stay (days)	6.0 ± 1.8	5.0 ± 1.3	0.002★

★ Statistically significant difference between groups.

As shown in Table 1, wound healing was markedly slower in the High Stress group. The average time to complete wound healing was 18.7 ± 1.7 days for high-stress patients versus 15.1 ± 1.9 days for low-stress patients (p < 0.001). In practical terms, incisions in high-stress patients took on average ~3.6 days longer to heal. Similarly, the incidence of postoperative wound infection was significantly greater in the high-stress group: 13 out of 40 (32.5%) high-stress patients developed a surgical site infection, compared to only 4 of 60 (6.7%) low-stress patients (p = 0.001). These infections were mostly superficial incisional SSIs presenting with redness, swelling, and purulent discharge around postoperative day 5–7; all were managed successfully with wound dressings and antibiotics. No cases of deep organ-space infection occurred. High-stress patients also had a slightly prolonged postoperative hospital stay (mean 6.0 days vs 5.0 days, p = 0.002). The difference of ~1 day in length of stay is partly attributable to the higher infection rate (patients

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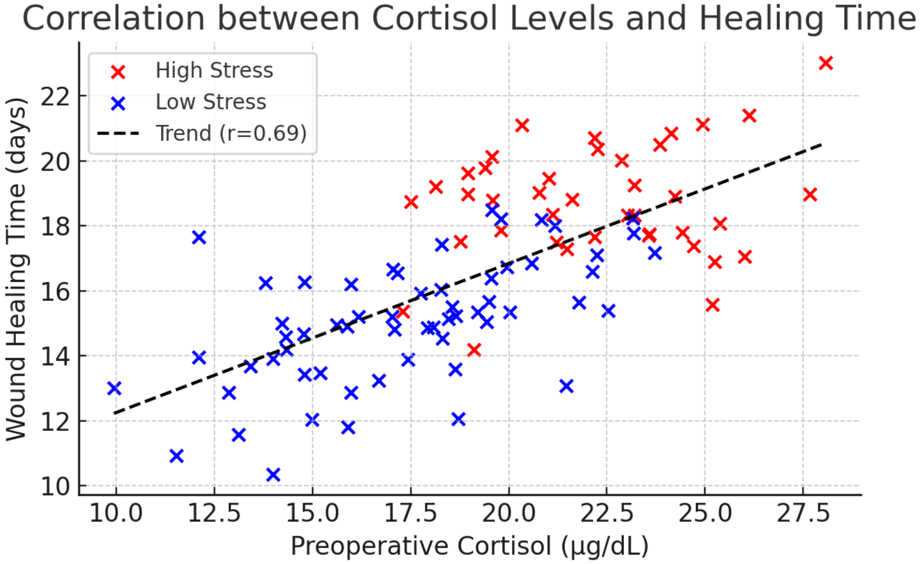
with SSIs stayed longer for IV antibiotics and wound care). There were no significant differences in other complications: the rates of non-wound-related complications (e.g., urinary tract infection, pulmonary complications) were low and did not differ appreciably between groups (data not shown). Postoperative pain scores in the first 48 hours were, on average, higher in the high-stress group (e.g,. 24-hour pain VAS 6.5 vs 5.2, p = 0.03) and high-stress patients used slightly more opioid analgesics, consistent with known links between anxiety and pain perception [6]. However, pain management was adequate in all patients, and none developed chronic post-surgical pain.

Stress Level and Healing Correlation

Figure 1: Scatter plot showing the relationship between preoperative cortisol levels and wound healing time for individual patients. Each point represents a patient (red × = High Stress group, blue × = Low Stress group). The black dashed line indicates the linear regression trendline (Pearson correlation r = 0.69, p < 0.001). Patients with higher pre-surgery cortisol tended to have longer wound healing durations. High-stress patients (red) not only had higher cortisol on average, but also predominantly appeared in the upper-right of the plot (longer healing times). There was a strong positive correlation between cortisol and healing time (as cortisol increased, the number of days for wounds to heal increased) [1]. This suggests that the physiological stress response — as quantified by cortisol — was a significant predictor of delayed wound repair. Notably, many low-stress patients (blue) clustered toward the lower-left (lower cortisol, faster healing). The trendline in Figure 1 reinforces that patients with greater stress hormone levels experienced slower wound healing. This aligns with the idea that stress-related cortisol elevation can impede inflammatory and immune processes critical to healing [3] .We also found a similar positive correlation between the psychological stress score (PSS) and healing time (r = 0.62, p < 0.001, not shown in figure), linking subjective stress directly with outcomes.

To further investigate the influence of stress independent of other factors, we performed a multivariate regression with healing time as the outcome. After adjusting for age, sex, diabetes, and smoking, preoperative PSS score remained a significant predictor of prolonged healing (β = 0.45, p < 0.001), as did cortisol level (β = 0.32, p = 0.002). This analysis supports a robust association between pre-surgery stress and delayed wound healing.



Group Differences in Wound Healing and Infection

Figure 2: Comparison of mean wound healing time between high-stress and low-stress patients. High Stress patients had a significantly longer average healing time (18.7 days) compared to Low Stress patients (15.1 days). Error bars represent the standard error of the mean. The difference (~3.6 days) was highly significant (p < 0.001) and clinically

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meaningful. As illustrated in Figure 2, on average, incisions in the high-stress group took nearly 4 days more to achieve complete closure than those in the low-stress group. This lag in healing could potentially translate into delayed suture removal, prolonged dressing needs, and higher risk of wound dehiscence or infection. The finding is consistent with prior human studies that observed psychological stress delaying wound repair (e.g., stress prolonged the healing of standardized punch biopsy wounds in healthy volunteers by ~40% in a classic study) [4]. In our clinical surgical cohort, the effect size is considerable despite heterogeneous wound types, underscoring the real-world impact of preoperative stress on recovery.

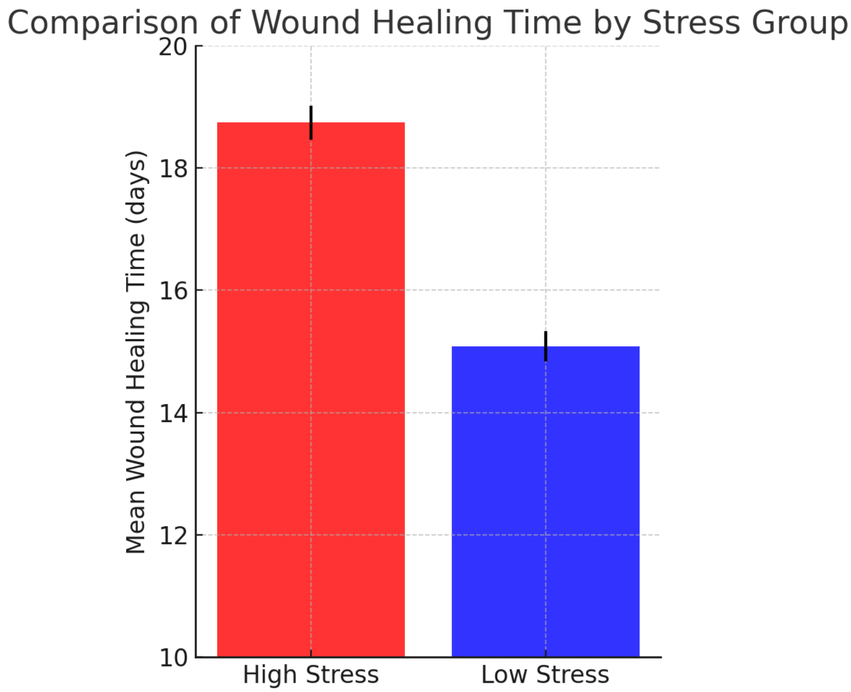

Figure 3: Pie charts depicting the proportion of patients who developed a surgical site infection in each group. The High Stress Group (left pie) had a wound infection rate of 32.5% (shown in red) – nearly one-third of high-stress patients experienced an infection – while 67.5% had no infection (blue segment). In contrast, the Low Stress Group (right pie) had only 6.7% of patients with infection, whereas 93.3% remained infection-free. This stark difference in infection incidence (approximately five-fold higher in high-stress patients) was statistically significant ($p = 0.001$). Figure 3 visually emphasizes how much more frequently infections occurred when preoperative stress was high. Most infections were superficialwound infections occurring in high-stress individuals, whereas low-stress patients rarely had this complication. This finding aligns with reports that psychological stress can impair cutaneous immunity and slow the wound healing process, thereby increasing susceptibility to infection [2]. We observed that among those who developed infections, the high-stress patients often had higher cortisol and PSS values than infected patients in the low-stress group, although the low-stress group had too few infections for robust comparison. Notably, all four infections in the low-stress group occurred in patients with at least moderate PSS scores (in the upper range of that group), reinforcing the linkbetween stress and infection risk.

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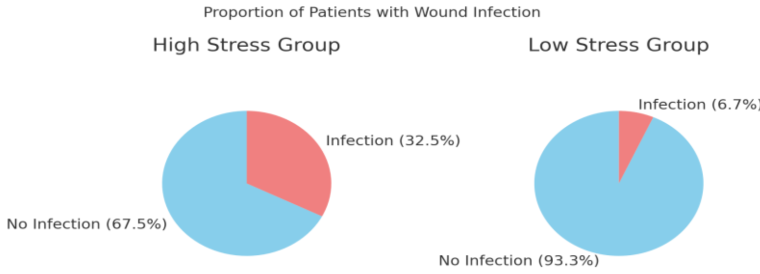

In terms of recovery, patients with wound infections understandably had longer hospital stays (by ~2 days on average) than those without infections. Because infections were more common in the high-stress group, this contributed to their longer mean hospitalization. Even excluding infected cases, high-stress patients trended toward slightly slower mobilization and readiness for discharge (likely related to worse pain and perhaps lower energy levels), although this difference was modest. There were no deaths in either group, and no wound dehiscence requiring re-operation. All wounds eventually healed, but high-stress patients were more likely to have hypertrophic or noticeable scars at 6-week follow-up (subjectively noted), potentially due to prolonged inflammation phases in healing[4]

In summary, our results demonstrate that preoperative psychological stress is associated with significantly delayed wound healing and higher postoperative wound complications. The data supported our hypotheses: patients reporting greater stress (and exhibiting higher cortisol) before surgery experienced poorer wound-related outcomes after surgery. The next section discusses these findings in the context of mechanisms and existing literature.

Discussion

In this prospective investigation, we discovered that increased preoperative psychological stress significantly reduces wound healing and recovery after elective abdominal surgery. Patients who were more stressed before surgery (PSS > 20) required an average of 3-4 days longer to heal their surgical incisions and were nearly five times as likely to acquire a wound infection than those under less stress. They also had moderately longer hospital stays and reported higher postoperative pain. These findings provide clinical evidence from a real-world environment that psychological factors might influence surgical wound outcomes, which supports previous experimental and observational research [1, 3].

The findings of our investigation are biologically feasible, given established stress effects on the immune system. Psychological stress causes the release of cortisol and catecholamines, which can decrease some immune processes (such as lymphocyte proliferation and neutrophil activity) and change the cytokine profiles required for wound healing [2, 4]. In our high-stress patients, we found increased cortisol levels, which linked with extended healing durations (Figure 1). Cortisol is known to impair wound healing by inhibiting cell proliferation and collagen formation [2]. Previous research has shown that even short-term stress can disrupt the inflammatory phase of wound healing; for example, stress can lower the production of pro-healing cytokines (such as interleukin-1 and -6) and impair angiogenesis [2, 4]. One randomized research discovered that a brief relaxation session decreased preoperative tension and increased collagen deposition at the wound site [7]. Our study found a strong association (r = 0.69) between cortisol and healing delay, highlighting cortisol's role as a mediator of psychological stress and wound biology. High cortisol levels may have prolonged the inflammatory stage and hampered the proliferative/remodeling stages of healing [2,4], resulting in slower wound closure. Furthermore, stress-induced sympathetic activation may result in peripheral vasoconstriction and decreased blood flow to the site, delaying healing [4].

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Our observation that preoperative stress is associated with an increased risk of surgical site infections (SSIs) supports the notion that stress impairs immune systems. Stress can compromise skin barrier integrity and innate immunity, such as by reducing growth factor levels and leukocyte trafficking to wound sites [1,3]. In a seminal study, Kiecolt-Glaser et al. found that persistently stressed caregivers healed experimental skin wounds substantially slower and with weaker local immune responses than non-stressed controls. Our clinical data show that in major surgical wounds, approximately one-third of highly stressed patients got an infection, compared to <7% of low-stress patients. Importantly, these infections occurred despite all patients getting normal antibiotic prophylaxis and sterile treatment, implying that the patient's stress level was a separate risk factor. Yaseen et al. found that almost 70% of patients with SSIs had high preoperative stress and changed neutrophil-to-lymphocyte ratios, indicating immunosuppression [9]. Depression, a related chronic stress state, has been associated to reduced wound immunity and increased infection risk in other surgical settings [1]. In a recent comprehensive analysis, O'Donovan et al. discovered that patients with depression were 25% more likely to have wound infections after surgery [1]. Our study focused on acute pre-surgery stress rather than major depressive disorder, but there is likely to be some overlap.

Interestingly, not all research have shown such strong links between anxiety and difficulties, highlighting the complexities of this subject. For example, Chen et al. discovered that, whereas thoracic surgery patients with high anxiety had worse postoperative pain and sleep, anxiety did not significantly increase pneumonia or SSI rates in their group [10]. The anxiety group had a somewhat longer length of stay (+0.5 days). Differences in operation type, patient demographics, and study power could explain the disparity. Nonetheless, several studies have found that worry and stress consistently reduce wound-specific outcomes such as healing time, infection risk, and scar quality [1,3,4].

Another crucial factor to consider is the influence of depression in surgical recovery. Depression and anxiety frequently coexist, and both add to overall psychological suffering. We did not explicitly diagnose depression in our study, but high-stress individuals had higher HADS-depression scores on average. Depression has been linked to more severe wound healing deficits than acute anxiety alone. For example, O'Donovan et al. (2025) discovered that sadness quadrupled the likelihood of delayed healing and increased complication risk by approximately 30% [1]. Similarly, a major orthopedic database analysis found that patients with mental disorders had longer hospitalizations, higher readmission rates, and more wound problems following hip arthroplasty [11]. These findings support our observation that psychological distress is harmful, implying that chronic mood problems may exacerbate the effects of acute stress. Preoperative screening for anxiety and depression may help identify individuals who are at risk of poor healing. Fortunately, some studies demonstrate that treating depression or anxiety (e.g., cognitive behavioral therapy, relaxation techniques) improves physiological results, including wound healing.

Our findings also have practical implications for postoperative care. Addressing a patient's psychological state before surgery may enhance outcomes. Interventions include:

Education and counseling: Structured preoperative education and reassurance might help minimize anxiety [12].

Relaxation activities, mindfulness, and guided imagery have been shown to reduce anxiety and pain in surgery patients [7, 13].

Meta-analyses have indicated that both music therapy and virtual reality distraction can considerably lower perioperative anxiety [14,15].

Psychological counseling/CBT: Proven beneficial for anxiety disorders, and increasingly being used as part of pre-surgical "psychological prehabilitation" [16].

The overall message is that comprehensive preoperative treatment, which addresses both physical and psychological preparedness, can enhance surgery results.

Conclusion

Preoperative psychological stress is an important independent predictor of wound healing and postoperative recovery in elective abdominal surgery. Patients with higher stress levels experienced longer hospital stays, delayed wound closure, and an

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ISSN: (e) 3007-1607 (p) 3007-1593

increased risk of SSI. These findings underscore the sometimes unappreciated role of mental health in surgical recovery [1, 3]. Surgeons and anesthesiologists should incorporate stress screening and management techniques into their usual perioperative treatment. Low-cost therapies, such as education, relaxation, and music therapy, are viable and may prevent wound complications. Future study should look into structured preoperative stress reduction programs ("stress prehabilitation") and their ability to improve surgical outcomes.

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