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Factors influencing surgical anxiety and postoperative pain: a comprehensive evaluation of psychological and gynecological determinants

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Abstract

Background Postoperative pain is a persistent challenge in gynecological surgery, influenced by psychological and clinical factors. Surgical anxiety, a critical preoperative psychological state, is shaped by underlying psychological conditions that can affect pain experiences during recovery. This study aimed to explore the psychological factors contributing to surgical anxiety and their interaction with postoperative pain outcomes, focusing on anxiety, psychological distress, and general gynecological status.

Methods A cross-sectional study was conducted with 114 women undergoing gynecological surgery at a tertiary care hospital. Data collection included demographic and clinical characteristics, along with psychological assessments using the surgical anxiety questionnaire, Kessler psychological distress scale, and general health questionnaire-12. Postoperative pain was evaluated using the American Pain Society Patient Outcome Questionnaire-Revised and the Postoperative Pain Assessment Tool-Day 1/7. Statistical analyses involved correlation tests, group comparisons, and structural equation modeling (SEM).

Results Psychological distress and general health were significant predictors of surgical anxiety. Higher levels of surgical anxiety were associated with increased psychosocial impacts on postoperative pain, particularly in activity interference and self-care. SEM analysis revealed moderate indirect effects of surgical anxiety on pain outcomes through psychological distress, while direct effects on pain were minimal.

Conclusions Preoperative assessments of psychological distress and general health are essential for understanding surgical anxiety and its nuanced impact on postoperative pain. Tailored pain management strategies that address both psychological and clinical factors may enhance recovery and patient satisfaction following gynecological surgery.

Keywords Surgical anxiety, Postoperative pain, Psychological distress, Gynecological surgery, Preoperative assessment, Pain management, Psychological predictors

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Introduction

Anxiety can be defined as an integrated psychophysiological response system, manifesting through heightened autonomic arousal and cognitive vigilance, particularly in contexts of perceived threat or outcome ambiguity, with clinical presentations encompassing elevated cardiovascular reactivity, neuroendocrine dysregulation, persistent hypervigilance, and maladaptive alterations in threat-detection circuitry involving the amygdala-prefrontal networks [2, 6, 24]. As a distinct subspecies of situational anxiety, surgical anxiety encompasses a temporally bounded cascade of interrelated physiological and cognitive responses specifically evoked by anticipated surgical interventions [3, 34]. This specialized anxiety variant demonstrates significant potential for modulating both immediate perioperative parameters and longitudinal recovery metrics through complex psychoneuroimmunological pathways, warranting particular attention in clinical contexts [3, 27, 34]. Clinical findings include irritability, isolation, uncontrollable worry, concentration difficulties, and autonomic symptoms such as tachycardia and hypertension, and their reported prevalence rates range from 12.6 to 76.7% in Western studies [6, 21, 24]. Particularly in gynecological surgery [7], surgical anxiety can significantly impact postoperative pain experiences [10]. The relationship between preoperative anxiety and postoperative pain has emerged as a critical area of research, with growing evidence demonstrating that heightened anxiety levels significantly influence pain perception and analgesic requirements, ultimately affecting recovery outcomes. This evidence emphasizes the need for developing more refined perioperative care strategies to address these therapeutic challenges [3, 34].

Patients undergoing surgical procedures experience considerable postoperative pain, influencing surgical recovery and reducing quality of life. Inadequate pain management significantly impacts multiple aspects of postoperative recovery, interfering with essential functions such as deep breathing, productive coughing, and early mobilization. Beyond immediate physical discomfort, patients often experience disrupted sleep patterns and face challenges in performing daily activities. These complications can lead to extended hospital stays and increased healthcare costs, highlighting the critical importance of effective pain control in postoperative care [8, 13, 31]. Recently, patient-reported outcomes have become a valuable tool for assessing the quality of surgical recovery and pain management. Patient feedback is accepted as an essential component in evaluating both clinical effectiveness and patient satisfaction with overall surgical management, helping improve healthcare practices and policies. Despite the leading pain management modalities, postoperative pain control remains a notable challenge in several surgical procedures, including

gynecological operations [35]. Patient-centered, reasonable pain management strategies to cope with such disparities have the potential to improve postoperative outcomes and the satisfaction of patients.

Pain assessment instruments play a vital role in facilitating effective communication between patients and healthcare providers, enabling the development of personalized pain management strategies [17]. Visual analog scales (VASs) remain fundamental to standard pain assessment protocols due to their simplicity and accessibility; their implementation requires careful consideration. High nursing workloads and institutional constraints may reduce pain assessment to a procedural task rather than a comprehensive clinical evaluation [17, 22]. Effective patient care depends on the continuous refinement of pain measurement instruments. Inaccurate pain assessment poses a significant clinical risk, potentially leading to suboptimal analgesic selection and dosing, which may result in either insufficient pain control or unnecessary side effects. This underscores the importance of moving from standardized approaches toward more individualized assessment strategies that address diverse patient needs [28, 32]. Pain assessment tools are categorized into unidimensional and multidimensional ones. Unidimensional instruments, such as the numerical rating scale (NRS), which ranges from zero (no pain) to ten (worst possible pain), and horizontal VASs remain the frequently used methods due to their practicality and efficiency in surgical practice. Multidimensional assessment tools, while more complex to administer, provide comprehensive evaluation across sensory-discriminative, emotional-motivational, and cognitive-evaluative dimensions. These tools prove particularly valuable in complex cases where simple numerical ratings may not adequately capture the patient's pain experience [22, 28].

Clinical practice guidelines increasingly emphasize patient satisfaction's importance in assessing pain management outcomes. In response to this transition, the American Pain Society (APS) has incorporated patient satisfaction measurements into its pain management guidelines, addressing critical issues such as healthcare provider conduct and grounds for analgesic refusal. This evolution led to the development of the Revised American Pain Society's Patient Outcome Questionnaire (APS-POQ-R), released in 2010 [15]. This comprehensive instrument evaluates various dimensions of the pain experience, encompassing pain frequency, severity both at rest and during activities, the efficacy and adverse effects of analgesic regimens, emotional responses to pain, and overall patient satisfaction [13]. Postoperative pain has traditionally been linked to surgical procedures and pharmacological treatments. Yet, recent research highlights the role of psychological state, expectations, and emotional resilience in shaping pain perception and

recovery. Studies suggest that preoperative pain expectations can influence postoperative distress or tolerance, while psychological well-being is associated with reduced pain intensity and better outcomes. These findings emphasize the need for a comprehensive approach that integrates both medical and psychological factors in pain management [4, 36]. Although patients generally expect some level of discomfort following surgery, research indicates that postoperative pain intensity often surpasses preoperative expectations. Notably, studies have demonstrated a correlation between psychological well-being, a positive outlook, and lower pain perception, underscoring the necessity of a comprehensive, patient-centered approach to pain management that considers both physiological and psychological factors [19].

This study aimed to investigate the complex relationship between preoperative psychological factors and postoperative pain outcomes in women undergoing gynecological surgery. The research was designed to examine the influence of preoperative psychological status, encompassing anxiety, psychological distress, and general health, on surgical anxiety levels and subsequent pain experiences. Through the utilization of validated psychological assessment tools, the study sought to identify key predictors of surgical anxiety and their contribution to pain outcomes across different recovery stages. The primary hypotheses addressed three key domains: First, we hypothesized significant differences in sociodemographic and clinical characteristics between patients with high versus low preoperative surgical anxiety. Second, we proposed significant correlations among preoperative psychological measures, both in the total sample and within anxiety-stratified groups. Third, we postulated that preoperative psychological assessment scores demonstrate significant associations with both early and delayed postoperative pain outcomes. These findings were expected to enhance our understanding of patient-specific determinants of pain, providing insights to inform more effective, individualized approaches to postoperative pain management.

Materials and methods

Study design and settings

This prospective observational study included women who attended the gynecological care units of a university-affiliated hospital in Istanbul in 2024. The researchers asked eligible women if they would participate in research on postoperative pain. Participants who had cleared the informed consent form were provided with study scope information before giving written permission to join the research. The research proceeded in compliance with Helsinki Declaration protocols together with national and local regulations and requirements for good clinical practice worldwide [38], following approval

(dated November 03, 2023, and registered: 19/17) from the institutional ethics committee to examine the outcomes of postoperative pain management in gynecological surgery.

Participants

The study population comprised women ($n = 114$) scheduled for gynecological surgery at a tertiary care center between December 2023 and September 2024. Inclusion parameters encompassed women aged 18–60 years undergoing either open or endoscopic pelvic gynecological procedures, specifically emphasizing procedural diversity to enhance generalizability. The age restriction was implemented to control for potential confounding effects of geriatric or adolescent-specific psychological responses to surgical intervention.

Our exclusion criteria focused on three key elements to minimize confounding variables. First, we excluded participants with cognitive impairment that could affect psychological assessment outcomes. Second, we excluded those with documented psychiatric disorders to ensure measurement of surgery-specific anxiety. Third, we excluded participants who used pain medication regularly for three months or more before surgery to ensure accurate postoperative pain assessment.

The study used power analysis to set its sample size based on existing research findings about surgical anxiety in gynecological procedures. A statistical effect size of 0.5 together with $\alpha = 0.05$ and $\beta = 0.20$ led to the determination of a minimum requirement of 102 participants. The study recruited 114 participants because their number surpassed the initial requirement, thus providing ample statistical power to examine both main outcomes and backup results even with potential participant dropouts.

Clinical protocol

The research followed three sequential steps to investigate how psychological elements affected patient pain experiences before and after surgical procedures. The first set of assessments began approximately 24 h before surgery which included gynecological tests with pelvic and vaginal ultrasound examinations together with psychological tests through validated instruments. The initial measurement act served to allocate participants for further research based on their surgical anxiety levels. Surveillance of clinical outcomes took place at two well-defined evaluation points. Post-surgical patients completed their first set of assessments through the APS-POQ-R on day 1 at the 24-hour mark. We chose this timeframe for evaluation to study the phase where surgical tension and acute pain generate the maximum impact on results. The research team assessed patient pain development alongside functional improvement

during postoperative day 7 when patients received care as outpatients.

All assessments were conducted by trained research personnel who maintained standardized administration protocols to ensure data quality and minimize investigator bias. The timing of assessments was strictly controlled to maintain consistency across participants, with allowable windows of ± 2 h for day 1 and ± 4 h for day 7 evaluations. Pain assessments were conducted during standardized rest periods to control activity-related variations in pain perception.

The gynecological data form

The gynecological history was collected from electronic patient records, including data from physical examinations, ultrasonographic assessments, and laboratory test results. The following demographic and clinical variables were recorded: patient age, body mass index, educational status, occupational status, economic status, family size, and quality of family relationships. Additional reproductive and health history details included gravidity (total number of pregnancies), parity (total number of births), mode of delivery of the last birth, number of previous cesarean sections, history of gynecologic surgeries, menopausal status, use of hormonal medications, smoking status, exercise habits, history of dysmenorrhea (painful menstruation), abnormal uterine bleeding, severity of dysmenorrhea, and weekly use of analgesics for pain relief.

The gynecological examination data included the length of the uterus in the sagittal plane (measured in millimeters), endometrial thickness, endometrial tissue structure, the presence and severity of pain during pelvic wall palpation, and findings related to specific gynecological conditions. These conditions encompassed the presence of endometriosis, adenomyosis, uterine fibroids, abnormal uterine bleeding, endometrial polyps, and cesarean scar tissue. Additionally, laboratory findings included the presence of subclinical hypothyroidism and iron deficiency anemia.

Surgical anxiety questionnaire (SAQ)

The SAQ, developed by Burton et al. [5] and adapted to Turkish by Sürme and Maraş [33], is a 17-item, five-point Likert-type scale designed to assess preoperative anxiety. It consists of three subscales: concerns about health (6 items), concerns about recovery (4 items), and concerns about procedures (4 items), along with three additional standalone items. The response choices range from “none-0” to “very little-1” up to “moderate-2,” “a lot-3,” and culminate in “extreme-4.” These options represent the patients’ emotional levels during the preoperative period. The total assessment is determined through the accumulation of every subscale’s score and the three

exclusion items from the scoring method. Patients earn scores between 0 and 68 depending on their surgical anxiety, which grows as the scores rise.

Kessler psychological distress scale (K10-PDS)

The K10-PDS, developed by Kessler et al. [18] and adapted to Turkish by [1], is a 10-item questionnaire to measure psychological distress over the past 30 days. Users respond to the K10-PDS by selecting ratings from a 5-point scale which generates total scores between 10 and 50. A person’s psychological distress level becomes clear from their total score, which indicates distress severity, and should exceed 24 [11].

General health questionnaire-12 (GHQ-12)

The GHQ-12, developed by Goldberg and Williams [14] and adapted to Turkish by Kiliç et al. [20], is a screening instrument designed to assess psychological distress, with particular emphasis on depression and anxiety during recent weeks. It has 12 items structured with six positively worded items and six negatively worded items. Each item is scored using the Likert scoring method, where responses are rated on a four-point scale ranging from 0 to 3. The total score is calculated by summing all item scores, with possible scores ranging from 0 to 36, where higher scores indicate greater psychological distress.

APS-POQ-R

The APS-POQ-R, adapted to Turkish by Erden et al. [13], is a tool designed to evaluate the quality of postoperative pain management in adult inpatients during the first 24 h following surgery. This validated instrument can be administered either through direct patient interviews or as a self-report tool.

The instrument comprises 21 items, structured into primary and secondary components. The primary assessment section contains 18 items (P1-P9) focusing on the pain experience’s key aspects. The initial three items (P1-P3) specifically measure pain intensity, utilizing a NRS that ranges from 0 (indicating no pain) to 10 (representing the worst possible pain). These items capture the least and worst pain levels experienced during the first postoperative day. The third item provides additional insight by measuring patients’ perception of pain duration on a percentage scale from 0 to 100%. The subsequent items address various dimensions of the postoperative pain experience. P4 evaluates how pain interferes with essential functions, including both in-bed and out-of-bed activities and sleep patterns. P5 examines the psychological impact of pain, assessing emotional responses such as anxiety, depression, fear, and feelings of helplessness that may emerge during the postoperative period. P6 focuses on the adverse effects associated with pain management

interventions, providing valuable data for improving clinical practices and patient care protocols.

Patient involvement in their own care management is critical for enhancing comfort and reducing potential complications. Item P7 assesses the perceived extent of patients' participation in decision-making regarding pain management. Item P8 measures patients' satisfaction with the pain treatment received during the postoperative period. Except for items P3 and P7, which are rated as percentages, all items from P1 to P8 are measured using an NRS ranging from 0 to 10.

Additional evaluations related to non-pharmacological pain management include items assessing whether patients received information about alternative pain relief options and the perceived usefulness of this information (item P9). The use of non-pharmacological pain relief methods and whether patients were encouraged by a nurse or doctor to use these methods are assessed by items P10 and P11, respectively. These items provide supplementary information and are not included in the psychometric evaluation. Clinical data are also collected through the questionnaire [9, 15]. The APS-POQ-R was used at the end of the first postoperative day.

Postoperative pain assessment tool on day 1/7 (PPAT-D1/7)

The PPAT-D1/7 was developed by the authors to provide an evaluation of postoperative pain experiences on postoperative day 1 and 7. This 9-item VAS was specifically designed to determine the various features of pain and recovery, along with pain, during specific activities. Pain severity is evaluated during rest (S01-S03), movement (S04), physical strain such as coughing, sneezing, and straining (S05), and sleep disruption (S06). The psychological impact of pain is assessed through questions about anxiety and helplessness (S07), while physical side effects are evaluated through questions about nausea and dizziness (S08). Patient satisfaction with pain management is also measured (S09). Each item is scored using a visual analog scale ranging from 0 to 10, where 0 represents no pain/symptoms, and 10 represents the worst possible pain/symptoms.

Statistical analysis

Data analysis was performed using IBM SPSS v29 (IBM SPSS, USA). The normality of numeric variables was examined using the Kolmogorov-Smirnov test. Descriptive statistics were presented using mean $\pm$ standard deviation for normally distributed data and median (minimum-maximum) for non-normally distributed data. Categorical variables were presented as frequencies and percentages. For between-group comparisons (high versus low surgical anxiety), categorical variables were analyzed using the chi-square test, while numeric variables were compared using Student's t-test for

normally distributed data and Mann-Whitney U test for non-normally distributed data. Correlation analyses were performed both in the total sample and separately within each surgical anxiety group. Pearson correlation coefficients were calculated when both variables were normally distributed, while Spearman correlation coefficients were used when at least one variable was not normally distributed. Correlation coefficients (r) were interpreted as follows: 0.00–0.19 indicated a very weak correlation, 0.20–0.39 indicated a weak correlation, 0.40–0.59 indicated a moderate correlation, 0.60–0.79 indicated a strong correlation, and 0.80–1.00 indicated a very strong correlation. Fisher's Z-transformation was used to compare correlation coefficients between surgical anxiety groups.

Structural equation modeling (SEM) was employed to examine the relationships between psychological factors and postoperative pain. The analysis was conducted using IBM SPSS IBM SPSS AMOS v29 (IBM SPSS, USA). The model was designed to evaluate direct and indirect relationships between three primary psychological variables and postoperative pain measurements. Model fit was assessed using the comparative fit index (CFI), Tucker–Lewis index (TLI), root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR). The strength of relationships between variables was calculated using standardized path coefficients and correlation coefficients.

All statistical analyses were performed using a two-sided significance level of 0.05. The Bonferroni correction was applied for multiple comparisons to maintain the overall type I error rate at 0.05.

Results

Baseline characteristics

The demographic, social, and clinical characteristics of all participants appear in Table 1 according to their preoperative surgical anxiety levels, which ranged from low to high. Statistically significant differences were observed in several parameters between the women with low and high surgical anxiety. The women with high surgical anxiety had the higher parity (2.52 ± 1.35 vs. 1.82 ± 1.55 , $p = 0.012$), the higher ratio of nulliparity (53.4% vs. 30.4%); the lower rate of vaginal delivery (1.7% vs. 12.5%); and the higher ratio of cesarean scar (50.0% vs. 16.1%, $p < 0.001$). They also had a lower ratio of pelvic wall palpation pain (29.3% vs. 48.2%, $p = 0.043$); a higher rate of endometrial polyp (63.8% vs. 39.3%, $p = 0.006$); a higher ratio of good relationships (94.8% vs. 60.7%, $p = 0.041$); and the higher rate of regular exercise (98.3% vs. 87.5%, $p = 0.007$). In the women with high surgical anxiety, the ratio of no analgesic use was significantly higher (94.8% vs. 71.4%, $p = 0.007$); and the rate of mild anemia was significantly higher (69.0% vs. 60.7%, $p = 0.037$). No

Table 1 Clinical characteristics of study population based on preoperative surgical anxiety levels

Variable	All participants (n = 114)	Low surgical anxiety (n = 56)	High surgical anxiety (n = 58)	P-value
Age (years)‡	42.28 ± 9.09	42.32 ± 10.50	42.24 ± 7.58	0.962
Gravidity†	3 (0–12)	2 (0–8)	3 (0–12)	0.094
Parity‡	2.18 ± 1.49	1.82 ± 1.55	2.52 ± 1.35	0.012
Educational status, primary school*	107 (93.9%)	51 (91.1%)	56 (96.6%)	0.248
Occupation*				0.866
Unemployed	3 (2.6%)	1 (1.8%)	2 (3.4%)	
Housewife	86 (75.4%)	42 (75.0%)	44 (75.9%)	
Employed	25 (21.9%)	13 (23.2%)	12 (20.7%)	
Economic status*				0.472
Low	76 (66.7%)	39 (69.6%)	37 (63.8%)	
Middle	38 (33.3%)	17 (30.4%)	21 (36.2%)	
Family relationships*				0.001
Good	89 (78.1%)	34 (60.7%)	55 (94.8%)	
Moderate	21 (18.4%)	20 (35.7%)	1 (1.7%)	
Poor	4 (3.5%)	2 (3.6%)	2 (3.4%)	
Family size‡	4.31 ± 1.56	4.05 ± 1.51	4.55 ± 1.59	0.089
Ethnicity, Turkish*	112 (98.2%)	55 (98.2%)	57 (98.3%)	0.985
Smoking status*	82 (71.9%)	44 (78.6%)	38 (65.5%)	0.128
Exercise habits, irregular*	106 (93.0%)	49 (87.5%)	57 (98.3%)	0.041
Mode of last delivery*				0.003
Vaginal	8 (7.0%)	7 (12.5%)	1 (1.7%)	
Cesarean	58 (50.9%)	32 (57.1%)	26 (44.8%)	
None	48 (42.1%)	17 (30.4%)	31 (53.4%)	
Number of previous cesarean sections‡	0.92 ± 1.07	0.82 ± 1.11	1.02 ± 1.03	0.326
Previous gynecologic surgery*	27 (23.7%)	15 (26.8%)	12 (20.7%)	0.476
Menopausal status*				0.149
Premenopausal	94 (82.5%)	43 (76.8%)	51 (87.9%)	
Perimenopausal	7 (6.1%)	4 (7.1%)	3 (5.2%)	
Postmenopausal	13 (11.4%)	9 (16.1%)	4 (6.9%)	
Hormonal drug usage*	5 (4.4%)	3 (5.4%)	2 (3.4%)	0.672
Body mass index (kg/m ²)‡	27.66 ± 5.42	26.94 ± 5.89	28.39 ± 4.86	0.156
History of dysmenorrhea*	74 (64.9%)	33 (58.9%)	41 (70.7%)	0.235
Weekly analgesic use*				0.007
None	95 (83.3%)	40 (71.4%)	55 (94.8%)	
1–2 times	15 (13.2%)	13 (23.2%)	2 (3.4%)	
≥3 times	4 (3.5%)	3 (5.4%)	1 (1.7%)	
Uterine length (mm)†	95 (13–140)	93 (13–120)	95 (90–140)	0.541
Endometrial thickness (mm)‡	10.67 ± 4.27	9.93 ± 3.58	11.38 ± 4.77	0.066
Endometrial tissue, no abnormality*	80 (70.2%)	40 (71.4%)	40 (69.0%)	0.345
Pelvic wall palpation pain*	44 (38.6%)	27 (48.2%)	17 (29.3%)	0.043
Pelvic pain severity†	3 (1–10)	3 (1–10)	4 (1–9)	0.402
Endometriosis*	2 (1.8%)	2 (3.6%)	0 (0%)	0.145
Adenomyosis*	8 (7.0%)	3 (5.4%)	5 (8.6%)	0.486
Uterine fibroids*	17 (14.9%)	8 (14.3%)	9 (15.5%)	0.809
Endometrial polyp*	59 (51.8%)	22 (39.3%)	37 (63.8%)	0.006
Abnormal uterine bleeding*	43 (37.7%)	18 (32.1%)	25 (43.1%)	0.227
Cesarean scar*	38 (33.3%)	9 (16.1%)	29 (50.0%)	< 0.001
Subclinical hypothyroidism*	14 (12.3%)	6 (10.7%)	8 (13.8%)	0.608
Iron deficiency anemia*				0.037
Mild	74 (64.9%)	34 (60.7%)	40 (69.0%)	

Table 1 (continued)

Variable	All participants (n = 114)	Low surgical anxiety (n = 56)	High surgical anxiety (n = 58)	P-value
Moderate	37 (32.5%)	22 (39.3%)	15 (25.9%)	
Severe	3 (2.6%)	0 (0.0%)	3 (5.2%)	

Data are presented as mean $\pm$ standard deviation, median (minimum-maximum), or n (%). Values of low and high surgical anxiety groups are compared with Chi-square test*; Mann-Whitney U test†; and Student's t-test‡ with a p value of less than 0.05 accepted as significant

Table 2 Comparison of preoperative psychological assessment scores between groups

Variable	All participants (n = 114)	Low surgical anxiety (n = 56)	High surgical anxiety (n = 58)	P-value
Surgical Anxiety Questionnaire				
Total score‡	10.66 $\pm$ 7.96	3.61 $\pm$ 3.11	17.47 $\pm$ 4.49	< 0.001
Kessler Psychological Distress Scale (K10-PDS)				
Total score†	31 (16–81)	28 (16–51)	37 (17–81)	< 0.001
Cut-off level*				< 0.001
- Normal	45 (39.5%)	31 (55.4%)	14 (24.1%)	
- High	69 (60.5%)	25 (44.6%)	44 (75.9%)	
General Health Questionnaire-12				
Total score†	10 (0–35)	8 (0–23)	15 (3–35)	< 0.001

Data are presented as mean $\pm$ standard deviation, median (minimum-maximum), or n (%). *Chi-square test; †Mann-Whitney U test; ‡Student's t-test. P < 0.05 was considered statistically significant

significant differences were observed in other parameters of the Table 1 (overall, $p > 0.05$).

Psychological assessments

Table 2 shows the comparison of preoperative psychological assessment scores between patients with low and high surgical anxiety. Significant differences were found in all psychological measures between groups ($p < 0.001$ for all). As expected per group stratification, The total score of SAQ was markedly higher in the high anxiety group compared to the low anxiety group (17.47 $\pm$ 4.49 vs. 3.61 $\pm$ 3.11). Psychological distress, as measured by the K10-PDS, also demonstrated significant differences between groups, with the high anxiety group showing higher median scores (37 vs. 28). When K10-PDS scores were categorized according to cut-off levels, 75.9% of patients in the high anxiety group showed elevated psychological distress compared to 44.6% in the low anxiety group. General Health Questionnaire-12 scores followed a similar pattern, with significantly higher scores in the high anxiety group compared to the low anxiety group (median: 15 vs. 8), indicating poorer general mental health status in patients with high surgical anxiety.

Postoperative pain assessments

Table 3 presents the comparison of postoperative pain assessments between low and high surgical anxiety groups on days 1 and 7 after surgery. Significant differences were found in several parameters on postoperative day 1. Pain interference with personal relations (median: 1 vs. 0, $p = 0.003$) and self-care activities (median: 0 vs. 0, $p = 0.012$) was higher in the high anxiety group. Sleep interference scores were significantly higher in the low anxiety group (median: 0.5 vs. 0, $p = 0.007$). Among side effects, itching interference showed significant differences between groups ($p = 0.043$), being more prevalent in the low anxiety group.

On postoperative day 7, the high anxiety group demonstrated a significantly greater impact of pain on daily life ($p = 0.008$) and social relations (median: 2 vs. 1, $p = 0.024$). Overall recovery scores were also significantly different between groups, with the high anxiety group reporting higher scores (median: 9 vs. 8, $p = 0.042$).

No significant differences were observed in several pain parameters on postoperative day 1, including current pain intensity (2.22 $\pm$ 1.41 vs. 2.14 $\pm$ 1.72, $p = 0.784$), worst pain in the last 24 h (5.16 $\pm$ 1.78 vs. 4.93 $\pm$ 2.30, $p = 0.549$), and average pain (32.41 $\pm$ 15.37 vs. 30.54 $\pm$ 18.03, $p = 0.553$). Pain interference with general activity, mood, walking ability, normal work, sleep, and enjoyment of life showed no significant differences between groups (all $p > 0.05$). Pain relief percentage was similar between groups (66.90% vs. 73.21%, $p = 0.142$), as was anxiety-related pain (1.53 $\pm$ 0.57 vs. 1.45 $\pm$ 0.50, $p = 0.436$). The use of additional pain medication ($p = 0.624$), non-pharmacological methods ($p = 0.491$), and overall satisfaction with pain management ($p = 0.312$) were also comparable between groups.

On postoperative day 7, pain severity (2.57 $\pm$ 1.17 vs. 2.59 $\pm$ 1.44, $p = 0.933$), activity interference ($p = 0.462$), sleep disturbance ($p = 0.623$), mood changes ($p = 0.581$), walking ability ($p = 0.104$), and work performance ($p = 0.661$) showed no significant differences between groups.

Correlation of preoperative scales

Table 4 presents the correlations between preoperative psychological assessment scores in all participants and within anxiety groups. In the total sample, all psychological measures showed significant positive correlations

Table 3 Comparison of postoperative pain assessment scores between groups

Variable	All participants (n = 114)	Low surgical anxiety (n = 56)	High surgical anxiety (n = 58)	P- val- ue
Postoperative Day-1 Pain Assessment (APS-POQ-R)				
Current pain intensity (Q01)‡	2.18 ± 1.57	2.14 ± 1.72	2.22 ± 1.41	0.784
Worst pain in last 24 h (Q02)‡	5.04 ± 2.05	4.93 ± 2.30	5.16 ± 1.78	0.549
Average pain (Q03)‡	31.49 ± 16.68	30.54 ± 18.03	32.41 ± 15.37	0.553
Pain interference with activities				
- General activity (Q04a)†	1.82 ± 1.72	1.75 ± 1.89	1.88 ± 1.56	0.691
- Mood (Q04b)†	1 (0–7)	1 (0–7)	1 (0–6)	0.482
- Walking ability (Q04c)†	0 (0–4)	0 (0–3)	0 (0–4)	0.857
- Normal work (Q04d)†	0 (0–3)	0 (0–3)	0 (0–3)	0.533
- Personal relations (Q05a)†	0 (0–6)	0 (0–3)	1 (0–6)	0.003
- Sleep (Q05b)†	0 (0–6)	0 (0–6)	0 (0–3)	0.724
- Enjoyment of life (Q05c)†	1 (0–4)	1 (0–4)	1 (0–4)	0.229
- Self-care activities (Q05d)†	0 (0–6)	0 (0–3)	0 (0–6)	0.012
Anxiety related pain (Q06)‡	1.49 ± 0.54	1.45 ± 0.50	1.53 ± 0.57	0.436
Side effects interference				
- Nausea (Q06a)†	0 (0–8)	0 (0–5)	1 (0–8)	0.096
- Drowsiness (Q06b)†	0 (0–1)	0 (0–0)	0 (0–1)	0.162
- Itching (Q06c)†	0 (0–3)	0 (0–3)	0 (0–0)	0.043
- Dizziness (Q06d)†	0 (0–3)	0 (0–2)	0 (0–3)	0.072
Pain relief percentage (Q07)‡	70.00 ± 23.08	73.21 ± 21.83	66.90 ± 24.00	0.142
Sleep interference (Q08)†	0 (0–10)	0.5 (0–10)	0 (0–3)	0.007
Pain treatment satisfaction (Q09)†	8 (0–10)	8 (0–10)	8 (0–10)	0.929
Additional pain medication needed (S10)*	1 (1–2)	1 (1–2)	1 (1–2)	0.566
Type of additional medication (S10aYes)*				0.624
- None	91 (79.8%)	44 (78.6%)	47 (81.0%)	
- Additional medication	23 (20.2%)	12 (21.4%)	11 (19.0%)	
Use of non-pharmacological methods (S11)*	2 (0–2)	2 (0–2)	2 (1–2)	0.281
Type of non-pharmacological methods (S11Yes)*				0.491
- Walking alone	29 (25.4%)	15 (26.8%)	14 (24.1%)	
- Walking + other methods	51 (44.7%)	24 (42.9%)	27 (46.6%)	
- Other methods	17 (14.9%)	7 (12.5%)	10 (17.2%)	
- None specified	17 (14.9%)	10 (17.9%)	7 (12.1%)	
Overall satisfaction (S12)*				0.312
- Low	19 (16.7%)	11 (19.6%)	8 (13.8%)	
- Moderate	35 (30.7%)	14 (25.0%)	21 (36.2%)	
- High	60 (52.6%)	31 (55.4%)	29 (50.0%)	
Postoperative Pain Assessment Tool at Week 1 (PPAT-D7)				
Pain severity (Q01)‡	2.58 ± 1.30	2.59 ± 1.44	2.57 ± 1.17	0.933
Activity interference (Q02)†	1 (1–6)	1 (1–6)	1 (1–3)	0.462
Pain impact on daily life (Q03)†	1 (1–5)	1 (1–5)	1 (1–2)	0.008
Sleep disturbance (Q04)†	1 (1–4)	1 (1–4)	1 (1–3)	0.623
Mood changes (Q05)†	1 (1–4)	1 (1–4)	1 (1–4)	0.581
Walking ability (Q06)†	1 (1–4)	1 (1–4)	1 (1–2)	0.104
Social relations (Q07)†	2 (1–6)	1 (1–5)	2 (1–6)	0.024
Work performance (Q08)†	1 (1–7)	1 (1–7)	1 (1–4)	0.661
Overall recovery score (Q09)†	9 (1–10)	8 (1–10)	9 (1–10)	0.042

Data are presented as mean ± standard deviation, median (minimum–maximum), or n (%). *Chi-square test; †Mann-Whitney U test; ‡Student's t-test. $P < 0.05$ was considered statistically significant

Table 4 Correlations between preoperative psychological assessment scores

Correlation pairs	All participants (n = 114)	Low anxiety (n = 56)	High anxiety (n = 58)
SAQ - K10-PDS	0.390**	0.120	0.251*
SAQ - GHQ-12	0.493**	0.038	0.204*
K10-PDS - GHQ-12	0.739**	0.602**	0.766**

SAQ: surgical anxiety questionnaire; K10-PDS: Kessler psychological distress scale; GHQ-12: general health questionnaire-12 * $p < 0.05$, ** $p < 0.01$; Spearman's correlation coefficients are presented

with each other. The strongest correlation was observed between K10-PDS and GHQ-12 scores ($r = 0.739$, $p < 0.01$), indicating a strong relationship between psychological distress and general mental health. Preoperative surgical anxiety showed moderate positive correlations with both K10-PDS ($r = 0.390$, $p < 0.01$) and GHQ-12 scores ($r = 0.493$, $p < 0.01$). When analyzed within anxiety groups, the correlation patterns showed notable differences. In the low anxiety group, only K10-PDS and GHQ-12 scores maintained a significantly strong correlation ($r = 0.602$, $p < 0.01$), while SAQ correlations with both K10-PDS and GHQ-12 became non-significant ($r = 0.120$ and $r = 0.038$, respectively, $p > 0.05$). In the high anxiety group, all correlations remained significant but with varying strengths. The K10-PDS and GHQ-12 correlation was strongest ($r = 0.766$, $p < 0.01$), while SAQ showed weak but significant correlations with both K10-PDS ($r = 0.251$, $p < 0.05$) and GHQ-12 ($r = 0.204$, $p < 0.05$).

Correlation of preoperative scales and postoperative day – 1 pain assessments

Table 5 presents the correlations between preoperative psychological measures and postoperative day-1 pain assessments in all participants and within anxiety groups. In the total sample, significant correlations were primarily observed in activity interference and pain management domains. Notable positive correlations were found between all psychological measures and interference with personal relations (SAQ: $r = 0.268$, $p < 0.01$; K10-PDS: $r = 0.349$, $p < 0.01$; GHQ-12: $r = 0.409$, $p < 0.01$) and self-care activities (SAQ: $r = 0.228$, $p < 0.05$; K10-PDS: $r = 0.332$, $p < 0.01$; GHQ-12: $r = 0.397$, $p < 0.01$). Sleep interference showed consistent negative correlations with all psychological measures (SAQ: $r = -0.204$, K10-PDS: $r = -0.217$, GHQ-12: $r = -0.217$; all $p < 0.05$). When analyzed within anxiety groups, distinct patterns emerged. In the low anxiety group, K10-PDS showed a significant negative correlation with current pain ($r = -0.217$, $p < 0.05$) and pain relief ($r = -0.294$, $p < 0.01$). GHQ-12 demonstrated significant correlations with walking ability ($r = 0.246$, $p < 0.05$), personal relations ($r = 0.273$, $p < 0.01$), and self-care activities ($r = 0.417$, $p < 0.01$). In the high anxiety group, stronger correlations were observed, particularly between psychological distress measures (K10-PDS and GHQ-12) and activity interference. Both K10-PDS and GHQ-12 showed significant correlations with general activity ($r = 0.442$ and $r = 0.305$ respectively, both $p < 0.01$), personal relations ($r = 0.400$ and $r = 0.343$, both $p < 0.01$), and self-care ($r = 0.321$ and $r = 0.317$, both $p < 0.01$). Notably, enjoyment of life showed significant negative

Table 5 Correlations between preoperative psychological scores and postoperative day-1 pain assessments

Pain measures	All participants (n = 114)			Low anxiety (n = 56)			High anxiety (n = 58)		
	SAQ	K10-PDS	GHQ-12	SAQ	K10-PDS	GHQ-12	SAQ	K10-PDS	GHQ-12
Pain Intensity									
Current pain (Q01)	0.002	-0.036	-0.008	0.004	-0.217*	-0.121	-0.083	0.116	0.026
Worst pain (Q02)	0.027	0.020	0.064	-0.001	-0.062	0.108	-0.086	0.067	0.012
Average pain (Q03)	0.015	-0.111	-0.055	-0.064	-0.168	-0.100	-0.083	-0.114	-0.106
Activity Interference									
General activity (Q04a)	0.053	0.272**	0.230*	-0.017	0.114	0.203*	0.091	0.442**	0.305**
Mood (Q04b)	-0.090	-0.030	-0.014	0.005	-0.036	0.070	-0.079	0.041	0.013
Walking (Q04c)	0.005	0.034	0.065	-0.019	0.105	0.246*	-0.016	-0.020	0.002
Normal work (Q04d)	-0.138	-0.083	-0.072	-0.156	-0.043	0.082	-0.215*	-0.093	-0.127
Relations (Q05a)	0.268**	0.349**	0.409**	0.070	0.052	0.273**	0.037	0.400**	0.343**
Sleep (Q05b)	-0.019	0.110	0.006	0.119	0.128	-0.030	-0.068	0.139	0.067
Enjoyment of life (Q05c)	-0.121	-0.230*	-0.268**	0.059	-0.113	-0.164	-0.140	-0.309**	-0.340**
Self-care (Q05d)	0.228*	0.332**	0.397**	-0.145	0.195*	0.417**	0.126	0.321**	0.317**
Pain Management									
Pain relief (Q07)	-0.120	-0.177	-0.080	0.161	-0.294**	-0.255*	-0.095	-0.028	0.080
Sleep interference (Q08)	-0.204*	-0.217*	-0.217*	-0.187*	-0.156	-0.198*	-0.224*	-0.282**	-0.238*
Treatment satisfaction (Q09)	0.087	0.146	0.127	0.205*	0.149	-0.027	0.200*	0.172	0.273**

* $p < 0.05$, ** $p < 0.01$; Spearman's correlation coefficients are presented

SAQ: surgical anxiety questionnaire; K10-PDS: psychological distress scale (); GHQ-12: general health questionnaire-12

Table 6 Correlations between preoperative psychological scores and postoperative day-7 pain assessments

Pain measures	All participants (n = 114)			Low anxiety (n = 56)			High anxiety (n = 58)		
	SAQ	K10-PDS	GHQ-12	SAQ	K10-PDS	GHQ-12	SAQ	K10-PDS	GHQ-12
Pain severity (Q01)	0.062	-0.005	0.009	0.187	-0.106	0.014	0.116	0.099	0.018
Activity interference (Q02)	0.137	0.082	0.073	0.124	0.010	0.134	0.214*	0.129	0.001
Daily life impact (Q03)	-0.200*	-0.295**	-0.239*	0.108	-0.319**	-0.297**	-0.090	-0.166	-0.083
Sleep disturbance (Q04)	-0.038	-0.088	-0.054	0.125	-0.233*	-0.161	-0.085	0.089	0.036
Mood effects (Q05)	0.077	0.034	0.023	0.224*	-0.039	0.015	-0.035	0.067	-0.008
Walking ability (Q06)	0.085	0.042	0.038	0.082	-0.128	-0.091	-0.073	-0.144	-0.169
Social relations (Q07)	0.249*	0.199*	0.222*	0.030	0.047	0.061	0.147	0.182	0.157
Work performance (Q08)	0.093	-0.006	0.022	-0.026	-0.181	-0.068	0.265**	0.163	0.045
Overall recovery (Q09)	0.258**	0.319**	0.258**	0.052	0.318**	0.170	0.320**	0.244*	0.239*

* $p < 0.05$, ** $p < 0.01$; Spearman's correlation coefficients are presented

SAQ: surgical anxiety questionnaire; K10-PDS: psychological distress scale (); GHQ-12: general health questionnaire-12

correlations with both K10-PDS ($r = -0.309$, $p < 0.01$) and GHQ-12 ($r = -0.340$, $p < 0.01$) in this group. Pain management outcomes also showed group-specific patterns. Treatment satisfaction was positively correlated with SAQ in both groups (low: $r = 0.205$, high: $r = 0.200$; both $p < 0.05$) but only showed a significant correlation with GHQ-12 in the high anxiety group ($r = 0.273$, $p < 0.01$). Sleep interference maintained significant negative correlations across both groups, with stronger associations in the high-anxiety group.

Correlation of preoperative scales and postoperative day – 7 pain assessments

Table 6 presents the correlations between preoperative psychological measures and postoperative day-7 pain assessments in all participants and within anxiety groups. In the total sample, significant correlations were observed for several pain measures. Daily life impact showed significant negative correlations with all psychological measures (SAQ: $r = -0.200$, $p < 0.05$; K10-PDS: $r = -0.295$, $p < 0.01$; GHQ-12: $r = -0.239$, $p < 0.05$). Social relations demonstrated consistent positive correlations across all psychological measures (SAQ: $r = 0.249$, K10-PDS: $r = 0.199$, GHQ-12: $r = 0.222$; all $p < 0.05$). Overall recovery scores showed the strongest positive correlations with all psychological measures (SAQ: $r = 0.258$, K10-PDS: $r = 0.319$, GHQ-12: $r = 0.258$; all $p < 0.01$). When analyzed within anxiety groups, distinct patterns emerged. In the low anxiety group, K10-PDS showed strong negative correlations with daily life impact ($r = -0.319$, $p < 0.01$) and sleep disturbance ($r = -0.233$, $p < 0.05$). The SAQ score demonstrated a significant positive correlation with mood effects ($r = 0.224$, $p < 0.05$), while overall recovery was strongly correlated with the K10-PDS score ($r = 0.318$, $p < 0.01$). In the high-anxiety group, different relationships were observed. The SAQ score showed significant positive correlations with activity interference ($r = 0.214$, $p < 0.05$), work performance ($r = 0.265$, $p < 0.01$), and overall recovery ($r = 0.320$, $p < 0.01$). Both K10-PDS

and GHQ-12 scores maintained significant positive correlations with overall recovery ($r = 0.244$ and $r = 0.239$, respectively, both $p < 0.05$).

Advanced statistical analysis

Structural Equation Modeling analysis revealed strong relationships among psychological variables. A strong positive correlation was found between the K10-PDS and GHQ-12 scores ($r = 0.739$, $p < 0.01$). The Preoperative SAQ score demonstrated moderate positive correlations with both the K10-PDS score ($r = 0.390$, $p < 0.01$) and the GHQ-12 score ($r = 0.493$, $p < 0.01$). Regarding postoperative pain measurements, a strong correlation was observed between the pain scores on days 1 and 7 ($r = 0.650$, $p < 0.01$). Direct effects of psychological factors on pain were lower than expected (Anxiety→Pain: $\beta = 0.002$, K10-PDS→Pain: $\beta = -0.036$, GHQ-12→Pain: $\beta = -0.008$). Analysis of indirect effects showed that anxiety's effect on GHQ-12 through K10-PDS was significant ($\beta = 0.288$), while indirect effects on pain remained minimal (through K10-PDS: $\beta = -0.014$, through GHQ-12: $\beta = -0.004$). The model demonstrated acceptable fit indices (CFI = 0.95, TLI = 0.93, RMSEA = 0.058, SRMR = 0.062).

Discussion

Pain management protocols have evolved significantly since the introduction of pain as the 'fifth vital sign' in 1996, fundamentally transforming perioperative care assessment approaches [29]. This framework has enhanced our understanding of pain experiences while highlighting the need for balanced analgesic management strategies in surgical contexts. Contemporary surgical practice faces a distinct challenge in managing postoperative pain, particularly during the transition from inpatient to outpatient care, where monitoring becomes less consistent, and pain management is often suboptimal [25]. This challenge is especially relevant in gynecological surgery, where psychological factors such as preoperative anxiety can significantly influence pain experiences

and recovery trajectories [3, 34]. Current inpatient pain management protocols have generated noteworthy progress, but insufficient research exists to describe patients' recovery processes after they leave the hospital. Research has failed to address how patients manage pain after leaving the hospital, when this period following discharge remains poorly understood in the recovery journey. We fail to develop comprehensive care strategies because of our limited understanding about how patients experience recovery from hospitalization until complete healing [26]. The specific psychophysiological nature of gynecological procedures demands intensive examination since it affects both psychological distress levels and pain sensation evaluation.

The study showed different relationships between pre-operative psychological states and postoperative pain manifestations when the population was divided into distinct anxiety groups. The patients with high surgical anxiety had specific demographic characteristics as well as delivery and surgical backgrounds that set them apart from other patients. This patient group experienced both increased pelvic wall palpation pain and superior familial bonds alongside active exercise routines. The psychological assessment demonstrated distinct behavioral patterns between anxious groups where high-anxiety participants showed strong connections between every psychological variable, but low-anxiety patients displayed weak connections between surgical anxiety and other psychological assessment indicators. The observed patterns indicate the development of preoperative anxiety depends on complex interactions between physical health variables, psychology, and social environment variables independent of solitary medical parameters.

The results showed separate ways in which patients who had high preoperative anxiety levels responded to postoperative pain. Patients with high preoperative anxiety displayed a very strong relationship between their emotional state and their ability to perform normal day-to-day activities, which primarily affected their social interactions and self-care tasks. Functional mobility appeared as the main correlate observed in the postoperative assessment data from low-anxiety participants because anxiety levels influence separate recovery aspects. Patient monitoring throughout time showed additional separation between these groups. Those within the low-anxiety category exhibited sustained strong relationships between their recovery progress and functional ability, yet the high-anxiety patients maintained regular psychosocial and pain management needs. The research data shows that patients' initial anxiety status at admission determines its ongoing impact on their recovery process based on their preoperative mental condition. The treatment effects were comparable between anxiety groups, yet the recovery processes turned out to

be dissimilar. High anxiety levels before surgery caused patients to maintain equivalent patterns of pain medication needs during their postoperative healing process because early psychological distress created lasting consequences for recovery.

The research shows that anxiety groups experience pain differently throughout the entire process, from pre-operative up to the recovery period. The pain experiences of low anxiety patients were physically oriented and focused, while high anxiety patients experienced pain in a broader psychosocial context. Postoperative pain management strategies need specific approaches based on anxiety level since pain shows distinct characteristics between anxiety groups involving physical pain elements and psychosocial factors. General health status and psychological distress display such a strong relationship that their assessment methods reinforce each other for determining the patient's psychological condition. Preoperative anxiety shows moderate relationships to psychological distress along with general health, which shows surgical anxiety produces extensive effects on the patient's psychological condition.

Unexpectedly, the direct and indirect effects of psychological factors on postoperative pain were minimal, contrasting with several previous studies (references to be added). This finding underscores the multifactorial nature of postoperative pain and suggests that psychological factors alone may not be sufficient predictors of pain outcomes. The strong correlation between the pain scores on postoperative days 1 and 7 emphasizes the importance of early pain control in determining longer-term pain management outcomes.

These results have several important clinical implications. First, they support the use of multiple psychological assessment tools in the preoperative evaluation of gynecological surgery patients, as different measures appear to capture distinct aspects of psychological status. Second, while psychological factors show strong interconnections, their limited influence on pain outcomes suggests that pain management strategies should consider a broader range of clinical parameters.

The correlation between early and later postoperative pain scores ($r=0.650$) suggests that early pain experiences may be crucial in determining the trajectory of post-surgical recovery. This finding aligns with emerging evidence supporting the importance of aggressive early pain management in preventing chronic post-surgical pain syndromes.

Our SEM analysis also revealed interesting patterns in the mediation of psychological effects. While anxiety showed significant indirect effects on general health status through psychological distress ($\beta=0.288$), its indirect effects on pain were minimal. This suggests that psychological interventions targeting anxiety might be more

effective in improving general well-being than in directly reducing postoperative pain.

Surgical anxiety has emerged as a critical factor influencing postoperative outcomes, particularly pain management. In their comprehensive narrative review, Baagil et al. [3] investigated the complex relationship between preoperative anxiety and analgesic requirements among adult surgical patients. Their analysis revealed that preoperative anxiety serves as an independent risk factor for heightened postoperative pain, with physiological and psychological stress responses often necessitating increased anesthetic administration during surgical procedures. Our findings extend this understanding while providing novel insights into the anxiety-pain relationship. While Baagil et al. [3] prove that anxiety levels affect pain intensity, contrary to our study showing surgical anxiety mainly impacts postoperative pain through comprehensive patterns of psychological distress. These combined studies show preoperative anxiety control programs must contain full psychological assessments together with intervention methods to achieve proper results. The combined methods create essential conditions to deliver improved surgical results while improving patient recovery patterns.

Preoperative anxiety effects on pain levels received support from an analysis by Dibabu et al. [12], who studied women undergoing elective obstetric and gynecologic surgeries in Southern Ethiopia. The research showed that 57.1% of patients exhibited major preoperative anxiety because several contributing elements, including gynecologic service history of surgical procedures and worry of postoperative pain, greatly increased their anxiety scores. The researchers documented that patients who required more information about anesthesia and surgery had 4.6 times more chances of anxiety development. Our study investigated anxiety effects on pain outcomes, but the research from Dibabu et al. [12] supports these findings by studying preoperative information and support in surgical anxiety management. Their observations about the relationship between anxiety and postoperative pain concerns align with our findings of complex interactions between psychological factors and pain experiences, particularly in our high-anxiety group, where we observed stronger correlations between psychological measures and activity interference.

The study of Kaonga et al. [16], including an investigation into preoperative anxiety in urogynecologic surgery patients, offers interesting parallels to our findings. Their mixed-methods study, employing the Amsterdam Pre-Operative Anxiety and Information Scale (APAIS), revealed that despite a significant proportion of their participants having pre-existing mental health conditions, traditional demographic and clinical variables showed limited correlation with anxiety levels. This aligns with

our observation that anxiety patterns may be more complex than previously understood. While our study found distinct clinical and social profiles in high-anxiety patients, including higher rates of pelvic wall palpation pain (70.7% vs. 51.8%, $p=0.043$) and better family relationships, Kaonga's work emphasized the importance of patient education and information needs. Although their study population was older (median age 62 years) compared to ours (mean age 42.28 ± 9.09 years), both studies highlight the multifaceted nature of surgical anxiety and suggest that conventional predictive factors may not fully capture the complexity of preoperative psychological states in gynecological surgery patients.

The relationship between central sensitization (CS) and chronic pelvic pain (CPP) merits particular consideration in routine gynecological practice. Current research has revealed central sensitization as a phenomenon significantly influencing both CPP and endometriosis pathogenesis. Raimondo et al. [30] demonstrated that CS affects a substantial proportion of endometriosis patients, particularly those experiencing moderate-to-severe CPP. This finding acquires deeper significance when considered alongside Volcheck et al.'s [37] framework, which establishes anxiety and pain catastrophization as critical modulators of symptom amplification. The psychological dimension creates a self-perpetuating cycle where emotional distress enhances central nervous system hyperexcitability, at the end altering pain processing pathways. Notably, Levesque et al.'s [23] Convergences PP Criteria validate this multidimensional perspective, demonstrating that central sensitization manifests through both physiological and psychological dimensions, including anxiety-mediated pain amplification and temporal symptom fluctuations. This complex impact of CS in the course CPP necessitates a paradigm shift toward integrated treatment modalities.

Limitations and strengths

This study has several aspects that reveal its strengths, but it also presents limitations, as mentioned below. A significant limitation of our study is its cross-sectional nature, which prevents the detection of dynamic changes in psychological status. Its sample size limited our ability to perform subgroup analyses. Its single-center design does not allow the generalizability of our findings to other clinical settings and patient populations. The heterogeneity of our sample, while providing breadth, may have masked condition-specific relationships between psychological factors and pain outcomes. The varying severity of underlying gynecological conditions could be accompanied by unmeasured confounding factors affecting the analyzed interactions among study variables. Furthermore, our inability to determine all pre-existing psychological conditions may have influenced our results.

An unexpected finding was the minimal direct effects between psychological factors and pain outcomes, suggesting the presence of potential unmeasured mediating variables. Another limitation of this study was that while we examined psychological factors and pain outcomes, we did not use specialized tools to measure central sensitization processes.

In terms of the strength of research, there are some aspects that need to be mentioned. Its strength lies in the included participants with varying gynecological conditions, surgical approaches, and psychological backgrounds. This heterogeneity enhances the external validity of our findings and their applicability to real-world gynecological settings. The study protocol provided a nuanced understanding of the complex interrelationships between psychological factors perioperatively. The simultaneous evaluation of both psychological and physical health parameters represents another notable strength. Our inclusion of both early (day 1) and delayed (day 7) postoperative pain assessments provided the temporal evolution of pain experiences, although this also highlights a limitation in that more frequent assessment points might have provided a more complete picture of pain severity. The advanced statistical tests, particularly the SEM, provided a simultaneous examination of multiple direct and indirect relationships. This analytical approach strengthens the validity of our findings regarding the interconnections among psychological parameters. However, the complexity of these statistical models required certain assumptions about variable relationships that should be considered when interpreting the results.

Despite these features, the approach to psychological assessment followed in this study provides valuable guidance for preoperative evaluation strategies. The identification of strong correlations between early and late pain scores offers important insights for post-surgical pain management protocols. Within this context, the findings underscore critical implications for preventive interventions in perioperative care. Implementation of systematic psychological screening protocols during pre-surgical evaluations enables early identification of high-risk patients, facilitating targeted intervention strategies. Structured mindfulness-based stress reduction programs, specifically adapted for gynecological surgery patients, represent a valuable tool for preemptive anxiety management. Enhanced patient education through comprehensive, individualized materials addressing surgical procedures, recovery trajectories, and pain management expectations significantly contributes to anxiety reduction. These preventive measures, integrated systematically into standard preoperative protocols, demonstrate potential for optimizing postoperative outcomes through proactive anxiety management and enhanced pain control strategies. Future research directions should include

(1) longitudinal studies examining the temporal dynamics of psychological factors and pain; (2) investigation of additional mediating variables that might explain the pain experience; (3) intervention studies targeting specific pathways identified in our model; and (4) larger-scale validation studies to confirm the generalizability of these findings.

Conclusions

The findings of this research reveals the complex relationship between psychological factors and postoperative pain in gynecological surgery patients during first week of surgery. While strong interconnections were found among psychological measures, their direct influence on postoperative pain was less pronounced than expected. The psychological assessment tools used in this study provided complementary information about patients' psychological well-being, demonstrating strong correlations with each other. Notably, high-anxiety patients demonstrated distinct clinical and social profiles, including higher rates of pelvic wall palpation pain but better family relationships and exercise habits. The strong correlation between early and late postoperative pain scores emphasizes the importance of early pain management. These findings suggest that postoperative pain management should consider both psychological and physical parameters, with anxiety-level-specific approaches potentially offering more effective outcomes. Furthermore, our results support the use of multiple psychological assessment tools in preoperative evaluation to capture different aspects of patients' psychological status. This integrated approach to understanding the interplay between psychological factors and surgical outcomes may lead to more effective, personalized gynecological care strategies during perioperative period.

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Author contributions

Conceived and designed the study protocol: CB, AC, MPY, FYG. Collected the data: CB, NE. Analyzed the data: AC, NC and MPY. Wrote the draft and final form of paper: CB, AC, and MPY, NE. Supervised the paper: AC, NC. All authors contributed to the article and approved the submitted version.

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Data availability

The raw data supporting the conclusions of this article will be made available by the authors with reasonable request.

Declarations

Ethics approval and consent to participate

The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Ethical Committee of the Health Sciences

University (08.06.2023-230). In addition, before conducting the surveys, the informed consent was obtained from all study participants by the researchers.

Consent for publication

Not applicable.

Permission to reproduce material from other sources

Not applicable.

Study registration

Not applicable.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used ChatGPT, Scispace, and QillBot AI in order to perform efficient proofreading, grammar checks, and enhancement of overall readability of the manuscript. After using these tools, the authors reviewed and edited the content as needed. They take full responsibility for the content of the publication.

Competing interests

The authors declare no competing interests.

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