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The Relationship Between Preoperative Anxiety, Postoperative Pain, and Kinesiophobia in Patients Undergoing Cardiac Surgery: A Prospective Observational Study

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Abstract

We examined associations between preoperative anxiety and postoperative pain and kinesiophobia. This single-center study included 120 patients (coronary-artery bypass grafting [CABG], $n = 85$; valve surgery, $n = 35$). State and trait anxiety were assessed preoperatively. Pain-related outcomes and kinesiophobia were assessed at three perioperative time points. Surgery-specific correlations underwent false discovery rate adjustment. In the full cohort, state anxiety (rho = −0.134, $p = 0.145$) and trait anxiety (rho = 0.017, $p = 0.856$) were not significantly correlated with the postoperative pain-related composite; corresponding postoperative kinesiophobia correlations were rho = 0.025 ($p = 0.783$) and rho = −0.063 ($p = 0.495$). The nine-item pain-related composite increased postoperatively (4.57 ± 0.40 to 7.50 ± 0.30) and declined predischarge (4.53 ± 0.37; Friedman $p < 0.001$; Kendall W = 0.766, reported as the effect-size measure for the Friedman test); kinesiophobia remained stable ($p = 0.796$). In exploratory analyses, state anxiety correlated with postoperative composite scores in valve surgery (rho = −0.409, $p = 0.015$) and predischarge kinesiophobia in CABG patients (rho = 0.230, $p = 0.034$); neither survived multiplicity adjustment (q = 0.234 and 0.276). Overall associations were not statistically significant; exploratory subgroup signals require confirmation in adequately powered, procedure-specific studies.

Keywords: cardiac surgery; preoperative anxiety; postoperative pain; kinesiophobia; valve surgery; nursing care

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1. Introduction

Ischemic heart disease remains a leading cause of death worldwide and in Türkiye [1,2]. Although cardiac surgery effectively reduces mortality and morbidity, it is a major intervention associated with substantial physical and psychological stress. Surgery-related uncertainty, perceived threat to life, the intensive care environment, and anticipated postoperative pain may contribute to preoperative anxiety [3]. Preoperative anxiety is not merely a transient emotional response, as previous studies have associated it with postoperative recovery and adverse surgical outcomes [4,5].

Pain after cardiac surgery, resulting from sternotomy-related tissue trauma, chest tubes, coughing and deep-breathing exercises, and early mobilization, is frequently experienced by patients [6]. Current Enhanced Recovery After Surgery (ERAS) approaches identify effective pain control and early mobilization as key components of perioperative recovery [6,7].

However, pharmacological pain management alone may not fully address the postoperative experience, as psychological factors such as preoperative anxiety may also influence clinical outcomes [3]. Higher preoperative anxiety has been associated with greater intraoperative anesthetic requirements, altered pain perception and responses, greater postoperative pain, and increased analgesic requirements [3,8]. It has also been identified as a possible risk factor for chronic postoperative pain [9].

Kinesiophobia, defined as fear and avoidance of movement because of concerns about pain or reinjury, is also clinically relevant to postoperative recovery. A review of kinesiophobia after cardiac surgery reported prevalence estimates of 39–82% and identified pain, psychosocial factors, and self-efficacy as possible associated factors [10]. A recent study of patients early after open-heart surgery reported a positive relationship between pain and kinesiophobia, suggesting that greater fear of movement may hinder mobilization [11]. Similarly, latent profile analysis has identified distinct patterns of kinesiophobia among patients undergoing cardiac surgery, highlighting heterogeneity in postoperative fear of movement [12,13].

The relationships among preoperative anxiety, postoperative pain, and kinesiophobia can be understood within the Fear-Avoidance Model. According to this model, interpreting pain as threatening may contribute to fear of movement and avoidance behavior, potentially interfering with functional recovery [14]. This process may be particularly relevant after cardiac surgery because respiratory exercises and early mobilization are important components of recovery [6]. Nursing care can connect preoperative psychological preparation with postoperative symptom management. Previous studies have reported that preoperative nursing visits and informational interventions may reduce anxiety and improve postoperative pain-related outcomes and analgesic use [15].

Although previous studies have examined preoperative anxiety and postoperative pain or pain and kinesiophobia after cardiac surgery, evidence evaluating preoperative anxiety, postoperative pain, and postoperative kinesiophobia together in the same cardiac-surgery population remains limited [3,10,11]. This gap supports an integrated evaluation of psychological and physical factors during recovery. Accordingly, this study aimed to evaluate the relationship between preoperative anxiety and postoperative pain and kinesiophobia in patients undergoing cardiac surgery. The findings may help identify patients requiring additional support and inform holistic nursing care strategies consistent with ERAS principles. The prespecified overall-cohort hypotheses concerned associations of preoperative state and trait anxiety with postoperative pain-related outcomes and kinesiophobia. Procedure-specific subgroup analyses were conducted post hoc and were treated as exploratory.

2. Materials and Methods

2.1. Aim and Hypotheses

This study aimed to evaluate associations between preoperative state and trait anxiety and postoperative pain-related outcomes and kinesiophobia in patients undergoing cardiac surgery. Prespecified overall-cohort hypotheses concerned anxiety–postoperative pain and anxiety–postoperative kinesiophobia associations. Additional procedure-stratified analyses were conducted post hoc and labeled exploratory.

2.2. Design, Setting, and Duration

This single-center, prospective, observational, correlational study involved no intervention, with the researcher solely acting as an observer. The study was conducted in the Cardiovascular Surgery Wards 1–3 (24 beds each, tertiary care) and Cardiovascular Surgery

Intensive Care Unit (13 beds, 24-h service) of Gaziantep City Hospital, Gaziantep, Türkiye, from 1 May to 30 November 2025.

2.3. Population, Sample, and Flow

The population comprised patients undergoing cardiac surgery at the study center during the study period. An a priori sample-size calculation was performed using G*Power version 3.1.9.7 for Windows (Heinrich Heine University Düsseldorf, Düsseldorf, Germany),based on an effect-size assumption derived from a previous thoracic surgery study [16], a two-sided alpha of 0.05, and 80% statistical power. The minimum required sample size was 107 patients, and the target was increased to 120 to account for potential attrition. Of the 159 patients assessed, 39 were excluded or did not complete the study due to a Mini-Mental State Examination (MMSE) score of <24 ($n = 12$), surgery cancellation ($n = 9$), death ($n = 14$), or withdrawal of consent ($n = 4$). Thus, 120 patients were included in the final analysis (Figure 1). Of these, 85 underwent coronary-artery bypass grafting (CABG), 12 underwent valve repair, and 23 underwent valve replacement. The initial sample-size calculation was based on the overall cardiac surgery cohort. For exploratory subgroup analyses, valve repair and replacement were combined into a single valve surgery group ($n = 35$) and compared with patients who underwent CABG ($n = 85$).

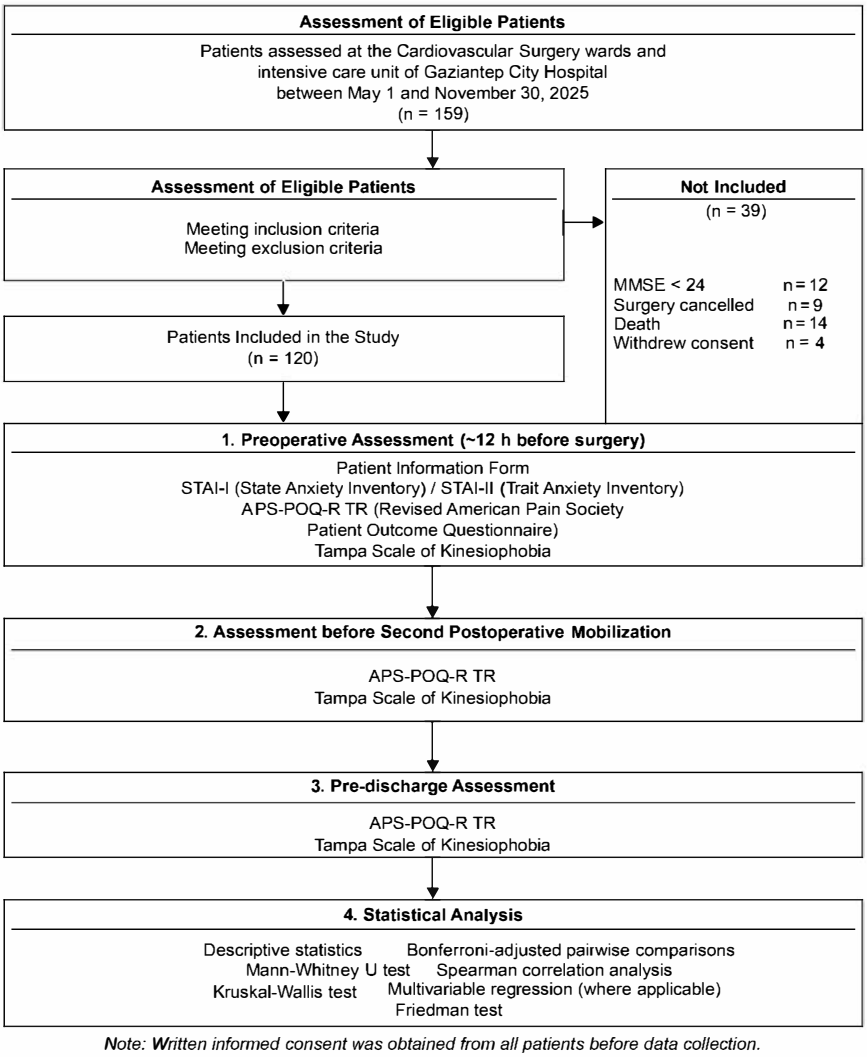

Figure 1. Patient selection, study flow, and measurement points.

Inclusion criteria were age 18–80 years; MMSE score ≥ 24 for patients aged ≥65 years, assessed only in this age group because of possible age-related cognitive decline; planned CABG or valve repair/replacement; preoperative admission after the surgical decision; no known physical disability preventing postoperative movement; conscious, communicative, and oriented status; ability to speak and understand Turkish; and voluntary participation. Exclusion criteria were psychiatrist-diagnosed anxiety or current pharmacological treatment for anxiety, chronic pain lasting >3 months (e.g., fibromyalgia, chronic low back pain, arthritis, migraine, neuropathic pain, or pain requiring medical treatment before surgery), and physical disability preventing movement. Withdrawal criteria were consent withdrawal after enrollment, surgery cancellation or postponement, treatment refusal, a newly developed condition restricting movement, inability to complete instruments because of impaired consciousness or orientation, and death during follow-up.

2.4. Data Collection Instruments

Data were collected using the researcher-developed Individual Characteristics Questionnaire and three validated Turkish-language instruments. The State–Trait Anxiety Inventory (STAI-I and STAI-II; 20 items each, score range 20–80) was administered preoperatively. The Turkish Revised American Pain Society Patient Outcome Questionnaire (APS-POQ-R TR), validated by Erden et al. [17], assesses pain severity, interference with functioning and sleep, emotional impact, adverse effects, perceived relief, participation in decisions, and satisfaction with pain management. The Tampa Scale of Kinesiophobia (17 items, score range 17–68; items 4, 8, 12, and 16 reverse-scored) assesses fear of movement [18–20]. Higher STAI and Tampa total scores denote greater anxiety and kinesiophobia, respectively. Composite scoring for this revision is described in detail in Section 2.6.

2.5. Data Collection Procedure

Preoperative preparation followed the standard ward protocol (physiological and legal preparation for surgery), and no structured counseling program addressing pain expectations, safe postoperative movement, or kinesiophobia was routinely used during the study period. The researcher collected data through face-to-face interviews in three stages, averaging 15 min per patient. Stage 1, approximately 12 h before surgery, included the Individual Characteristics Questionnaire, STAI-I/II, APS-POQ-R TR, and Tampa Scale. The first postoperative mobilization was performed according to standard ward protocol at the surgeon's request within 24 h after surgery, with the researcher solely observing. At Stage 2, before the second mobilization following the initial mobilization, the APS-POQ-R TR and Tampa Scale were re-administered. At Stage 3, before discharge, both scales were administered again.

2.6. Data Analysis

Continuous data are described with mean ± standard deviation (SD), and categorical variables with *n* (%). The original analyses were performed using SPSS 23.0 (IBM Corp., Armonk, NY, USA); all scores, descriptive results, nonparametric comparisons, and correlations in this revision were independently recalculated from the latest item-level CSV file using Python (SciPy 1.17.0 and statsmodels version 0.14.6). For each participant, standard reverse-scored items were applied to STAI-I (items 1, 2, 5, 8, 10, 11, 15, 16, 19, and 20), STAI-II (21, 26, 27, 30, 33, 36, and 39), and Tampa (4, 8, 12, and 16). The APS-POQ-R TR nine-item pain-related composite was the arithmetic mean of items 1, 2, 3/10, 4a–4d, 10-item 7/10, and 10-item 9; percentages were converted to a 0–10 metric, and favorable relief and satisfaction scores were reverse-coded. This transparent derived composite reflects pain, functional interference, perceived relief, and satisfaction; it is not a stand-alone validated

pain-intensity measure. Therefore, mean pain intensity (items 1 and 2) was examined separately as a sensitivity outcome. Emotional impact (items 5a–5d), treatment side effects (items 6a–6d), and satisfaction (item 9 on the original 0–10 scale) were reported separately; the four-item emotional impact score differs from the full five-item affective/perceptions-of-care factor of Erden et al. [17]. Friedman tests and Kendall W were used to evaluate repeated measurements, with Wilcoxon signed-rank pairwise tests adjusted with Bonferroni correction for the three contrasts. Spearman's rho was used to assess associations. Exploratory analyses were stratified by CABG ($n = 85$) versus combined valve surgery ($n = 35$), with Benjamini–Hochberg false discovery rate adjustment for the 16 subgroup correlations involving two anxiety scales, two postoperative outcomes, two time points, and two surgery groups. Unadjusted p values and adjusted q values are both reported; $p < 0.05$ was set as the descriptive significance threshold. The separate valve repair and replacement groups were additionally examined as a limited-precision sensitivity analysis (Supplementary Table S1).

2.7. Ethical Considerations

Written permission to use the scales was obtained from the researchers who conducted the respective Turkish validity-reliability studies. Ethical approval was obtained from the Tınaztepe University Non-Interventional Clinical Research Ethics Committee (Date: 20 February 2025, Decision No: MUKCE2025/06) and institutional permission was obtained from the Gaziantep Provincial Health Directorate. The study followed the principles of the Declaration of Helsinki. All patients received verbal and written information and provided written informed consent to participate using the Informed Voluntary Consent Form. Data were coded to preserve confidentiality.

3. Results

3.1. Participant Characteristics

A total of 120 patients completed the study. Of the participants, 12.5% were aged ≤49 years, 31.7% were aged 50–59 years, 35.8% were aged 60–69 years, and 20.0% were aged ≥70 years; 55.0% were male and 91.7% were married. Regarding body mass index, 47.5% had normal weight, 10.8% were overweight, 20.0% had grade I obesity, and 21.7% had grade II or III obesity. Smoking was reported by 50.8% of patients, and 80.8% used anticoagulants.

CABG was the most common procedure (70.8%), followed by valve replacement and repair. Perioperative complications occurred in 20.0% of patients, including bleeding in 14.2% and atelectasis in 5.8%. Most patients received first-step analgesic treatment before transfer. The mean anesthesia awakening time was 3.62 ± 0.64 h, postoperative stay was 8.11 ± 0.98 days, total hospital stay was 16.93 ± 2.09 days, and pain level during the 24 h before transfer was 7.92 ± 1.68. Detailed characteristics are presented in Table 1.

Table 1. Demographic and clinical characteristics of the participants.

Variable	Category	*n* (%) or Mean ± SD
Age	≤49 years	15 (12.5)
	50–59 years	38 (31.7)
	60–69 years	43 (35.8)
	≥70 years	24 (20.0)
Sex	Male	66 (55.0)
	Female	54 (45.0)

Table 1. *Cont.*

Variable	Category	*n* (%) or Mean ± SD
BMI	Normal	57 (47.5)
	Overweight	13 (10.8)
	Grade I obesity	24 (20.0)
	Grade II–III obesity	26 (21.7)
Chronic disease	Present	96 (80.0)
Chronic disease type *	Hypertension	31 (32.3)
	Diabetes mellitus	28 (29.2)
	Hypertension + diabetes mellitus	37 (38.5)
Marital status	Married	110 (91.7)
Education	Literate	38 (31.7)
	Primary school	57 (47.5)
	Middle school	14 (11.7)
	High school	11 (9.2)
Smoking	Yes	61 (50.8)
Anticoagulant use	Yes	97 (80.8)
Surgery type	CABG	85 (70.8)
	Valve repair	12 (10.0)
	Valve replacement	23 (19.2)
Complication	Present	24 (20.0)
Bleeding	Present	17 (14.2)
Atelectasis	Present	7 (5.8)
First-step analgesic	Yes	103 (85.8)
Anesthesia awakening time, h		3.62 ± 0.64
Postoperative stay, days		8.11 ± 0.98
Hospital stay, days		16.93 ± 2.09
Pain during previous 24 h before transfer		7.92 ± 1.68

* Percentages for chronic disease types were calculated among participants with chronic disease. BMI, body mass index; CABG, coronary-artery bypass grafting; SD, standard deviation.

3.2. Changes in Pain and Kinesiophobia Across Measurement Time Points

The mean preoperative state and trait anxiety scores were 51.23 ± 2.35 and 48.61 ± 3.83, respectively. Kinesiophobia scores were 57.20 ± 2.23, 56.91 ± 1.87, and 57.14 ± 2.16 preoperatively, postoperatively, and before discharge, respectively, with no significant change across time (Friedman $p = 0.796$; Kendall W = 0.002; Table 2).

The corrected nine-item pain-related composite was 4.57 ± 0.40 preoperatively, increased to 7.50 ± 0.30 postoperatively, and decreased to 4.53 ± 0.37 before discharge (Friedman $p < 0.001$; Kendall W = 0.766). The distinct two-item pain-intensity score showed a similar pattern (4.55 ± 0.82, 8.33 ± 0.63, and 4.61 ± 0.55; $p < 0.001$; Kendall W = 0.805). The emotional-impact score changed from 5.50 ± 0.91 to 7.35 ± 0.58 and then to 3.52 ± 0.61 (Kendall W = 0.944), while treatment side effects changed from 4.10 ± 0.88 to 5.11 ± 0.58 and 3.95 ± 0.84 (Kendall W = 0.346; both $p < 0.001$). Satisfaction with pain treatment, measured directly by item 9, fell from 7.38 ± 1.33 to 3.03 ± 1.45 after surgery and rose to 7.46 ± 1.40 before discharge ($p < 0.001$; Kendall W = 0.759). Pairwise comparisons and details are shown in Table 2.

Table 2. Anxiety, pain, satisfaction, and kinesiophobia scores across measurement time points.

Measure	Preoperative Mean ± SD	Postoperative Mean ± SD	Predischarge Mean ± SD	Friedman *p*	Kendall W	Pairwise (Bonferroni)
State anxiety (STAI-I)	51.23 ± 2.35	—	—	—	—	—
Trait anxiety (STAI-II)	48.61 ± 3.83	—	—	—	—	—
Kinesiophobia (Tampa)	57.20 ± 2.23	56.91 ± 1.87	57.14 ± 2.16	0.796	0.002	None
Pain-related nine-item composite (0–10)	4.57 ± 0.40	7.50 ± 0.30	4.53 ± 0.37	<0.001	0.766	Post > Pre ≈ Disch
Pain intensity (items 1–2 mean; 0–10)	4.55 ± 0.82	8.33 ± 0.63	4.61 ± 0.55	<0.001	0.805	Post > Pre ≈ Disch
Emotional impact of pain (items 5a–5d; 0–10)	5.50 ± 0.91	7.35 ± 0.58	3.52 ± 0.61	<0.001	0.944	Post > Pre > Disch
Pain-treatment side effects (items 6a–6d; 0–10)	4.10 ± 0.88	5.11 ± 0.58	3.95 ± 0.84	<0.001	0.346	Post > Pre ≈ Disch
Satisfaction with pain treatment (item 9; 0–10)	7.38 ± 1.33	3.03 ± 1.45	7.46 ± 1.40	<0.001	0.759	Pre ≈ Disch > Post

Note: STAI-I and STAI-II were administered only preoperatively. All repeated-measure comparisons used the Friedman test (Kendall W); pairwise Wilcoxon signed-rank tests were Bonferroni-adjusted for three comparisons. The nine-item composite is a transparently derived 0–10 mean of APS-POQ-R TR items 1, 2, 3/10, 4a–4d, 10 − item 7/10, and 10 − item 9 (higher scores, less favorable outcomes). It combines pain severity, interference, relief, and satisfaction. Pain intensity and original item-9 satisfaction are reported separately. APS-POQ-R TR, Turkish Revised American Pain Society Patient Outcome Questionnaire; SD, standard deviation; STAI, State–Trait Anxiety Inventory.

3.3. Clinical and Demographic Factors Associated with Kinesiophobia

Kinesiophobia did not differ significantly by age, sex, body mass index, chronic disease presence, marital status, education, smoking, anticoagulant use, surgery type, atelectasis, or analgesic category at any assessment (all $p > 0.05$) (Table 3).

Table 3. Clinical factors associated with differences in kinesiophobia scores.

Clinical Factor	Assessment	Groups, Mean ± SD	*p*	Pairwise Finding
Chronic disease type	Predischarge	HT: 56.90 ± 2.07, DM: 56.32 ± 1.79, HT + DM: 57.73 ± 1.91	0.019	HT + DM > DM
Perioperative complication	Predischarge	Present: 57.88 ± 2.09, Absent: 56.96 ± 2.15	0.046	Higher with complication
Bleeding	Preoperative	Present: 55.53 ± 2.07, Absent: 57.48 ± 2.15	0.001	Lower among patients who subsequently experienced bleeding
Bleeding	Predischarge	Present: 58.18 ± 2.40, Absent: 56.97 ± 2.08	0.044	Higher with bleeding

Note: Only statistically significant subgroup findings are presented. These subgroup analyses were exploratory and should be interpreted cautiously given multiple comparisons and the relatively small sizes of some subgroups. DM, diabetes mellitus; HT, hypertension; SD, standard deviation.

Predischarge kinesiophobia differed by chronic disease type ($p = 0.019$), with higher scores among patients with both hypertension and diabetes mellitus than among those with diabetes mellitus alone. Scores were also higher among patients with perioperative complications than among those without complications (57.88 ± 2.09 vs. 56.96 ± 2.15, $p = 0.046$) (Table 3).

Bleeding was associated with kinesiophobia at two assessments. Patients who subsequently experienced bleeding had lower preoperative scores than those who did not (55.53 ± 2.07 vs. 57.48 ± 2.15, $p = 0.001$), whereas predischarge scores were higher among patients who experienced bleeding (58.18 ± 2.40 vs. 56.97 ± 2.08, $p = 0.044$) (Table 3).

3.4. Correlations Among Anxiety, Pain, Kinesiophobia, and Clinical Variables

For the full cohort ($n = 120$), no significant associations were found between either preoperative STAI subscale and the postoperative or predischarge nine-item pain-related composite or Tampa total (all unadjusted $p > 0.05$). Postoperative composite correlations were rho = −0.134 ($p = 0.145$) for state anxiety and rho = 0.017 ($p = 0.856$) for trait anxiety. Postoperative Tampa correlations were rho = 0.025 ($p = 0.783$) and rho = −0.063 ($p = 0.495$), respectively. The two-item pain-intensity sensitivity analyses similarly revealed no significant association with preoperative anxiety at either postoperative assessment (Table 4). A nonsignificant result does not establish equivalence or the absence of a relationship.

Table 4. Full-cohort Spearman correlations of preoperative anxiety with pain-related outcomes and kinesiophobia ($n = 120$), and selected secondary associations.

Relationship	Spearman Rho	*p*
State anxiety vs. Pain-related composite, preoperative	0.007	0.939
State anxiety vs. Pain-related composite, postoperative	−0.134	0.145
State anxiety vs. Pain-related composite, predischarge	−0.037	0.686
State anxiety vs. Pain intensity (items 1–2), preoperative	0.174	0.058
State anxiety vs. Pain intensity (items 1–2), postoperative	−0.154	0.092
State anxiety vs. Pain intensity (items 1–2), predischarge	−0.023	0.807
State anxiety vs. Kinesiophobia, preoperative	0.035	0.703
State anxiety vs. Kinesiophobia, postoperative	0.025	0.783
State anxiety vs. Kinesiophobia, predischarge	0.155	0.091
Trait anxiety vs. Pain-related composite, preoperative	−0.131	0.153
Trait anxiety vs. Pain-related composite, postoperative	0.017	0.856
Trait anxiety vs. Pain-related composite, predischarge	0.026	0.779
Trait anxiety vs. Pain intensity (items 1–2), preoperative	0.040	0.662
Trait anxiety vs. Pain intensity (items 1–2), postoperative	0.103	0.264
Trait anxiety vs. Pain intensity (items 1–2), predischarge	0.061	0.511
Trait anxiety vs. Kinesiophobia, preoperative	−0.127	0.167
Trait anxiety vs. Kinesiophobia, postoperative	−0.063	0.495
Trait anxiety vs. Kinesiophobia, predischarge	−0.041	0.657
STAI-I vs. STAI-II	−0.252	0.005
Kinesiophobia pre vs. Kinesiophobia discharge	−0.193	0.035
Kinesiophobia pre vs. emotional pre	0.233	0.010
Kinesiophobia post vs. emotional post	0.201	0.028
Kinesiophobia discharge vs. hospital stay	−0.282	0.002

Note: Spearman rho (two-sided *p* values) is reported for the 120-patient full cohort. The pain-related composite includes pain, interference, perceived relief, and satisfaction; the two-item pain-intensity score is reported separately as a sensitivity measure. Secondary findings are exploratory and unadjusted for multiple testing. STAI, State–Trait Anxiety Inventory.

Several secondary correlations were weak: state and trait anxiety were inversely correlated (rho = −0.252, $p = 0.005$); preoperative and predischarge kinesiophobia were inversely correlated (rho = −0.193, $p = 0.035$); and kinesiophobia was modestly correlated

with emotional impact and length of hospital stay. Unlike the original report, the correlation of postoperative kinesiophobia with an ambiguously derived satisfaction score was not retained because satisfaction is now defined as the raw item-9 response (Table 4).

3.5. Exploratory Analyses by Surgical Category

Surgical procedures were grouped as CABG ($n = 85$) or valve surgery (repair or replacement; $n = 35$). In the valve-surgery subgroup, state anxiety was inversely correlated with the postoperative pain-related composite (rho = −0.409, unadjusted $p = 0.015$; Benjamini–Hochberg q = 0.234). In the CABG subgroup, state anxiety was positively correlated with predischarge kinesiophobia (rho = 0.230, unadjusted $p = 0.034$; q = 0.276). Neither finding remained significant following adjustment across 16 exploratory subgroup tests; all other subgroup correlations had unadjusted $p > 0.05$. The two-item pain-intensity sensitivity correlations were also nonsignificant in both groups (all $p > 0.05$).

The composite did not significantly differ between CABG and combined valve surgery at the preoperative, postoperative, or predischarge assessments (Mann–Whitney $p = 0.689$, 0.767, and 0.552, respectively). Both groups demonstrated a postoperative rise and subsequent decline in the pain composite (CABG Kendall W = 0.766; valve surgery W = 0.767; both $p < 0.001$), while kinesiophobia did not significantly change in either group ($p = 0.565$ and 0.213). These are descriptive comparisons, not evidence that correlation coefficients significantly differed between surgery groups (Table 5 and Supplementary Table S1).

Table 5. Exploratory anxiety–outcome correlations for patients undergoing CABG and pooled valve surgery (postoperative and predischarge assessments).

Surgery	Preoperative Anxiety	Outcome	Assessment	Rho	Unadjusted p	BH-Adjusted q
CABG	State	Pain composite	Postoperative	−0.041	0.706	0.912
CABG	State	Pain composite	Predischarge	−0.058	0.598	0.912
CABG	State	Kinesiophobia	Postoperative	0.115	0.297	0.791
CABG	State	Kinesiophobia	Predischarge	0.230	0.034	0.276
CABG	Trait	Pain composite	Postoperative	0.097	0.377	0.813
CABG	Trait	Pain composite	Predischarge	0.026	0.811	0.912
CABG	Trait	Kinesiophobia	Postoperative	−0.117	0.286	0.791
CABG	Trait	Kinesiophobia	Predischarge	0.001	0.990	0.990
Valve surgery	State	Pain composite	Postoperative	−0.409	0.015	0.234
Valve surgery	State	Pain composite	Predischarge	0.032	0.855	0.912
Valve surgery	State	Kinesiophobia	Postoperative	−0.327	0.055	0.293
Valve surgery	State	Kinesiophobia	Predischarge	0.063	0.718	0.912
Valve surgery	Trait	Pain composite	Postoperative	−0.207	0.233	0.791
Valve surgery	Trait	Pain composite	Predischarge	0.041	0.815	0.912
Valve surgery	Trait	Kinesiophobia	Postoperative	0.096	0.584	0.912
Valve surgery	Trait	Kinesiophobia	Predischarge	−0.145	0.407	0.813

Note: The 16 subgroup tests comprise 2 surgical categories × 2 anxiety scales × 2 outcomes × 2 postoperative time points. Benjamini–Hochberg q values were calculated across this 16-test family. Absence of significance after false discovery rate adjustment does not establish absence of effects. BH, Benjamini–Hochberg; CABG, coronary-artery bypass grafting.

4. Discussion

In the overall cohort, preoperative anxiety was not significantly associated with the postoperative pain-related composite, pain intensity, or kinesiophobia. Pain-related outcomes substantially changed from the preoperative assessment to the postoperative period and again before discharge, whereas mean kinesiophobia remained relatively stable. Exploratory surgery-specific analyses identified isolated unadjusted associations that did not withstand adjustment for multiple comparisons and therefore require cautious interpretation.

4.1. Sample Profile

The study population was characterized by older age, male predominance, a high burden of chronic disease, and CABG as the most common procedure, broadly consistent with contemporary cardiac-surgery populations [6,21,22]. The MMSE was used to assess eligibility among patients aged ≥65 years. However, excluding patients with cognitive impairment limits the generalizability of the findings to older cardiac-surgery populations with cognitive limitations.

4.2. Temporal Changes in Pain-Related Outcomes and Patient Satisfaction

Using the corrected final dataset, the nine-item pain-related composite and distinct two-item pain-intensity score both increased after surgery and had declined by discharge (Kendall W = 0.766 and 0.805, respectively; both $p < 0.001$). The emotional impact of pain changed even more markedly (W = 0.944), whereas treatment side effects showed a smaller but significant temporal change (W = 0.346). These observations are compatible with the known importance of early postoperative pain control following cardiac surgery [6,23]. However, because the composite combines pain and favorable-care items reversed to a common direction, it should not be interpreted as reflecting pure pain intensity.

Satisfaction with pain treatment (APS-POQ-R TR item 9) decreased immediately after surgery (7.38 ± 1.33 preoperatively versus 3.03 ± 1.45 postoperatively), before returning to 7.46 ± 1.40 prior to discharge. This corrects the direction of the satisfaction trend reported in the previously submitted version. Satisfaction is multidimensional and may reflect expectations, communication, and responsiveness as well as pain intensity [6,24]; no causal inference can be drawn from these paired observational scores.

4.3. Stability of Kinesiophobia Across the Perioperative Period

Notably, kinesiophobia remained stable at the group level across all three assessments despite marked changes in pain-related outcomes. Mean Tampa scores changed minimally from the preoperative to postoperative and predischarge assessments, with negligible temporal change ($p = 0.796$, Kendall W = 0.002). This contrast suggests that kinesiophobia may follow a different perioperative pattern from that of pain. The Fear-Avoidance Model provides a potential explanation, as kinesiophobia may reflect not only current pain intensity but also perceptions of pain as threatening and expectations regarding movement and reinjury [14]. Findings in patients undergoing open-heart surgery similarly suggest that the relationship between pain and kinesiophobia may involve multiple clinical and psychological factors [11]. The reported prevalence of kinesiophobia after cardiac surgery and concerns about movement following sternotomy further support its assessment as a distinct dimension of recovery [10]. Stable group-level mean scores do not establish that every patient's kinesiophobia followed the same trajectory; individual changes were not examined as a separate outcome. In comparison, Gülşen et al. [11] reported that the strength and direction of the association between pain and fear of movement varied across early postoperative measurements and mobilization status. This finding does not explain the stable group-level kinesiophobia scores in our cohort. Furthermore, in a descriptive study of 170 patients who underwent cardiac surgery, Çatal and Yaman Aktaş [25] found no statistically significant correlation between pain intensity and kinesiophobia. This comparison involves pain–fear-of-movement associations rather than our primary analysis of preoperative anxiety and subsequent outcomes.

The relatively narrow distribution of Tampa scores should also be considered. Although mean scores remained stable, preoperative and predischarge kinesiophobia were weakly and negatively correlated ($r = -0.193$, $p = 0.035$), indicating that group-level stability does not imply consistent individual rankings over time. Correlations between kinesiophobia

and other variables were also generally weak, indicating modest associations and potential individual variation despite group-level stability. Larger, more heterogeneous studies with longer follow-up and measures of functional recovery are needed to clarify the course of kinesiophobia after cardiac surgery.

4.4. Clinical Factors Associated with Kinesiophobia

Kinesiophobia did not significantly differ by age, sex, marital status, education, or smoking status. However, exploratory subgroup analyses identified differences according to chronic disease type, perioperative complications, and bleeding. Patients who subsequently experienced bleeding had lower preoperative kinesiophobia but higher predischarge kinesiophobia than those without bleeding. Preoperative kinesiophobia may reflect anticipatory concerns, whereas predischarge kinesiophobia may reflect experiences during postoperative recovery; however, this explanation was not directly tested and remains speculative. Predischarge kinesiophobia was also higher among patients with both hypertension and diabetes mellitus than among those with diabetes mellitus alone and among patients with perioperative complications. These findings suggest that selected clinical characteristics may be associated with greater predischarge kinesiophobia. However, because these analyses were exploratory, involved multiple comparisons, and included relatively small subgroups, the findings require cautious interpretation and confirmation in future studies. A possible explanation for the higher predischarge kinesiophobia among patients who experienced bleeding is that they may have worried that movement could cause further bleeding or other complications. However, the fear of bleeding was not directly assessed, and thus, this remains a possible explanation rather than an established cause. Bleeding occurred after the preoperative assessment and therefore cannot explain why patients who later experienced bleeding had lower baseline kinesiophobia scores. This preoperative difference may reflect differences between patients, unmeasured factors, or chance. Hence, these exploratory findings should not be interpreted as causal.

4.5. Relationships Among Anxiety, Pain, Kinesiophobia, and Clinical Variables

The primary full-cohort analysis did not detect significant monotonic correlations between preoperative state or trait anxiety and subsequent pain-related composite scores, pain intensity, or kinesiophobia. In the procedure-stratified exploratory analysis, state anxiety was inversely correlated with postoperative composite scores in valve surgery (rho = −0.409, unadjusted $p = 0.015$) and positively correlated with predischarge kinesiophobia in CABG (rho = 0.230, unadjusted $p = 0.034$). Neither signal remained significant after adjustment across 16 exploratory subgroup correlations (q = 0.234 and q = 0.276), and sample sizes were unequal (85 versus 35). These findings neither establish a difference in association strength between surgical categories nor exclude clinically relevant associations. For the two-item pain-intensity sensitivity outcome, no anxiety correlations were significant in either group at the postoperative or predischarge assessment. Studies employing prespecified interaction tests and larger, procedure-specific samples are needed to assess effect modification. Differences from the results of studies on anxiety and kinesiophobia may reflect differing patient groups, assessment methods, and analytic approaches [3,13]. The comparison with previous studies requires attention to specific outcomes and analyses. Gülşen et al. [11] studied 203 patients who underwent open-heart surgery and reported changes in the direction and strength of contemporaneous pain–fear-of-movement associations at 12, 24, and 36 h after surgery, depending on the timing of assessment and mobilization. Their research question differed from our examination of preoperative anxiety in relation to later pain and kinesiophobia. Luo et al. [13] studied 201 CABG patients using a cross-sectional latent profile analysis of the Tampa Scale for Kinesiophobia Heart; they identified low-

(46.8%) and high-kinesiophobia (53.2%) profiles, and higher anxiety was associated with membership in the high-kinesiophobia profile (odds ratio = 1.08). These categorical profile findings cannot be directly compared with our procedure-stratified Spearman correlations using preoperative state and trait anxiety. Differences in patient populations, time points, instruments, and analytic questions may contribute to apparently inconsistent findings; however, we did not test these possible explanations.

Significant secondary correlations were generally weak (absolute rho = 0.193–0.282). The strongest was a negative correlation between predischarge kinesiophobia and hospital length of stay (rho = −0.282, $p = 0.002$), the clinical interpretation of which is uncertain in this observational dataset. Exploratory secondary associations are susceptible to false-positive findings due to multiple testing.

Weak positive correlations were also observed between kinesiophobia and the emotional effects of pain preoperatively (r = 0.233, $p = 0.010$) and postoperatively (r = 0.201, $p = 0.028$), indicating modest associations at corresponding perioperative time points. These findings are broadly consistent with the Fear-Avoidance Model, which emphasizes cognitive and emotional responses to pain in pain-related fear and avoidance [14]. However, the small correlations and exploratory analyses preclude stronger conclusions regarding underlying psychological mechanisms.

4.6. Implications for Clinical Practice

These findings have several implications for perioperative nursing assessment. First, marked changes in pain-related outcomes alongside stable kinesiophobia suggest that pain improvement should not be assumed to correspond to reduced fear of movement. Assessing kinesiophobia may therefore provide information beyond pain assessment alone. Second, exploratory differences according to perioperative complications, bleeding, and chronic disease type suggest that selected clinical characteristics may be relevant when assessing kinesiophobia before discharge, although confirmation is needed before targeted screening can be recommended. Finally, the weak associations between kinesiophobia and the emotional effects of pain highlight the potential importance of considering emotional responses to pain alongside its physical consequences. Overall, the findings support multidimensional nursing assessment of pain and kinesiophobia during recovery after cardiac surgery. Perioperative nurses may provide information about pain-management expectations and assess anxiety and movement-related concerns. An existing cardiac surgery study addressed visits by operating room nurses before surgery [15]. The cardiac ERAS consensus recommends multidisciplinary perioperative care and supports early ambulation and upper-extremity exercise, including the involvement of physiotherapy services [6]. Additionally, in a qualitative study involving 21 cardiac surgery nurses, Wang et al. [26] identified effective patient education, multidisciplinary role clarification, and collaboration with family caregivers as important elements of kinesiophobia management. Cooperation between nurses and physiotherapists may promote consistent information and recovery guidance; however, the effectiveness of such educational collaboration was not evaluated in the current observational study.

4.7. Strengths and Limitations

The strengths of this study include the prospective repeated assessment of anxiety, pain-related experiences, and kinesiophobia in the same cardiac-surgery cohort. Limitations include the single-center setting, modest sample size, inclusion of both CABG and valve operations, lack of procedure-stratified a priori sample size planning, and unmeasured confounding in a correlational observational design. The original G*Power minimum of 107 applied to the pooled cohort and cannot establish adequate power in either the CABG

($n = 85$) or combined valve ($n = 35$) subgroup. Combining valve repair ($n = 12$) and replacement ($n = 23$) improved the subgroup size but does not make these procedures clinically identical; the separate sensitivity estimates are imprecise. The exploratory subgroup correlations and other secondary comparisons were numerous, and some unadjusted p values fell below 0.05, but none of the 16 planned surgery-stratified correlations survived Benjamini–Hochberg adjustment. The APS-POQ-R TR nine-item composite is explicitly derived here using 0–10 harmonization and reverse coding; it should not be mistaken for a validated pain-intensity-only score. The questionnaire was primarily developed for postoperative care, and its preoperative administration warrants caution. A constant response in item 8 after surgery prevented meaningful postoperative analysis of participation in treatment decisions. The corrected pain data could not be independently verified against paper questionnaires in this analysis, although the study team reported transcription errors and provided a corrected file. The observational design does not support causal claims, and follow-up ended before discharge. Future studies should use procedure-specific power calculations, prespecified multivariable interaction analyses, and follow-up beyond discharge.

5. Conclusions

Preoperative state and trait anxiety showed no significant overall-cohort correlation with postoperative pain-related composite scores, two-item pain intensity, or kinesiophobia in this sample. Nevertheless, the procedure-stratified analyses suggested isolated unadjusted associations that did not persist after false-discovery-rate correction and should not be interpreted as definitive evidence of surgery-specific differences. Pain-related outcomes substantially changed over time, whereas kinesiophobia remained relatively stable at the group level.

Perioperative nursing care may benefit from assessing pain intensity, interference, satisfaction with pain treatment, and fear of movement as distinct patient-reported dimensions rather than combining them into a single clinical interpretation. The temporary reduction in satisfaction after surgery and stable kinesiophobia scores highlight potential areas for perioperative assessment and patient education, subject to confirmation in independent populations.

Future multicenter studies should enroll sufficient numbers of patients in each surgical category, use prespecified surgery-by-anxiety interaction analyses, and assess postoperative function and kinesiophobia beyond discharge. Interventional designs will be needed to evaluate the causal benefits of structured nursing education or psychological support.

Supplementary Materials: The following supporting information can be downloaded at https://www.mdpi.com/article/10.3390/jcdd13110585/s1, Table S1: Sensitivity analysis distinguishing CABG, valve repair, and valve replacement. Exploratory Spearman correlations between preoperative anxiety and postoperative or predischarge pain-related outcomes and kinesiophobia are presented, with Benjamini–Hochberg adjustment across 24 comparisons. Table S2: CABG versus pooled valve surgery: descriptive results. Perioperative anxiety, pain-related outcomes, and kinesiophobia are compared between the CABG and combined valve surgery groups. These secondary comparisons are descriptive and unadjusted.

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Informed Consent Statement: All patients received verbal and written information and provided written informed consent using the Informed Voluntary Consent Form. Data were coded to preserve confidentiality.

Data Availability Statement: The data supporting the findings of this study are available from the corresponding author upon reasonable request. The data are not publicly available due to privacy and ethical restrictions related to patient data.

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Abbreviations

The following abbreviations are used in this manuscript:

APS-POQ-R TR	Revised American Pain Society Patient Outcome Questionnaire, Turkish version
CABG	Coronary-artery bypass grafting
ERAS	Enhanced Recovery After Surgery
MMSE	Mini-Mental State Examination
SD	Standard deviation
STAI-I	State Anxiety Inventory
STAI-II	Trait Anxiety Inventory

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