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Association between Age and the Incidence of Acute Postoperative Pain After Laparoscopic Hysterectomy

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ABSTRACT

Introduction: Laparoscopic hysterectomy is widely performed due to its minimally invasive nature and faster recovery compared with open surgery; however, acute postoperative pain remains a common clinical challenge that may affect recovery and patient satisfaction. Various patient-related factors may influence pain perception. Therefore, this study aimed to investigate the association between age and the incidence of acute postoperative pain following laparoscopic hysterectomy.

Material and methods: This cross-sectional study was conducted in 2025 at hospitals affiliated with Tabriz University of Medical Sciences and included 73 patients undergoing laparoscopic hysterectomy, with sample size determined using the single-proportion prevalence formula. Variables assessed included age, BMI, comorbidities, surgical duration, anesthesia type, and acute postoperative pain severity measured by the Visual Analog Scale within 24 hours after surgery.

Results: Postoperative pain was common, with a mean VAS score of 4.28 ± 1.86 and an incidence of 76.71%. Moderate pain was most frequent, and younger patients reported significantly higher pain levels, while pain decreased progressively with age (ANOVA p=0.018). Age showed a strong negative correlation with VAS scores ($r=-0.711$, p=0.001), indicating markedly lower pain intensity in older patients.

Conclusion: Age demonstrated a clear inverse relationship with acute postoperative pain following laparoscopic hysterectomy, with younger patients reporting higher pain intensity and greater analgesic needs. These findings highlight the importance of age-responsive pain management protocols to ensure individualized postoperative care and optimized recovery outcomes.

Introduction

Laparoscopic hysterectomy has become one of the most commonly performed gynecologic procedures worldwide due to its advantages over open surgery, including reduced postoperative pain, shorter hospital stay, faster recovery, and improved cosmetic outcomes. Advances in minimally invasive surgical techniques and perioperative care have contributed to the widespread adoption of laparoscopic approaches for the management of benign and certain malignant gynecologic conditions.

Despite these benefits, postoperative pain remains a significant clinical concern following laparoscopic hysterectomy and can adversely affect patient recovery, mobility, and overall satisfaction with surgical care. Acute postoperative pain, particularly within the first 24 to 72 hours after surgery, may lead to delayed ambulation, prolonged hospitalization, and increased healthcare costs if not adequately controlled (1,2).

Postoperative pain after laparoscopic hysterectomy is multifactorial in origin. It may arise from several sources, including surgical incision sites, visceral manipulation, peritoneal irritation, and the residual effects of carbon dioxide insufflation used to create pneumoperitoneum during laparoscopy. In addition, inflammatory responses and individual patient

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characteristics can significantly influence the intensity and perception of postoperative pain. Although minimally invasive techniques typically reduce tissue trauma compared with open surgery, many patients still report moderate to severe pain during the early postoperative period. Consequently, identifying patient-related predictors of acute postoperative pain is essential for optimizing pain management strategies and improving clinical outcomes (3,4).

Among the various factors that may influence postoperative pain perception, age has been proposed as an important determinant. Age-related physiological changes in the nervous system, pain processing pathways, and inflammatory responses may alter how individuals perceive and respond to painful stimuli. Younger patients are often reported to experience higher levels of postoperative pain and require greater amounts of analgesics compared with older patients. Conversely, some studies suggest that elderly patients may have diminished pain perception due to changes in nociceptive processing, although this does not necessarily mean they experience less pain but rather may report it differently. These complex interactions highlight the need to further investigate the relationship between age and postoperative pain in surgical populations (5,6).

In gynecologic surgery, particularly hysterectomy procedures, patient characteristics such as body mass index, psychological status, preoperative pain sensitivity, and age may contribute to variability in postoperative pain experiences. Understanding these factors is crucial because hysterectomy is a highly prevalent procedure performed for conditions such as uterine fibroids, abnormal uterine bleeding, endometriosis, and adenomyosis. Given the large number of women undergoing hysterectomy annually, even modest improvements in postoperative pain management can have significant implications for patient well-being and healthcare resource utilization. Identifying demographic predictors such as age may therefore assist clinicians in tailoring perioperative analgesic protocols more effectively (7,8).

Age-related differences in pain perception have been widely discussed in the literature on surgical pain. Younger patients often demonstrate greater central sensitization and heightened inflammatory responses following tissue injury, which may lead to increased pain intensity after surgery. Additionally, psychological factors such as anxiety, pain expectations, and coping mechanisms may differ across age groups and influence postoperative pain reporting. In contrast, older adults may have alterations in peripheral nerve function, reduced nociceptor density, and age-associated changes in neurotransmitter systems that modulate pain transmission. These biological and psychological mechanisms collectively contribute to variations in postoperative pain experiences among different age groups (9,10).

The clinical significance of understanding age-related patterns in postoperative pain lies in its potential to guide individualized analgesic management. Effective pain control after laparoscopic hysterectomy is essential not only for patient comfort but also for facilitating early mobilization, reducing postoperative complications, and enhancing recovery. Multimodal analgesia, including the use of nonsteroidal anti-inflammatory drugs, opioids, regional anesthesia techniques, and non-pharmacological interventions, is commonly employed to manage postoperative pain. However, the optimal approach may differ depending on patient-specific characteristics, including age. Tailoring analgesic regimens according to risk factors for severe postoperative pain could improve both safety and effectiveness of pain control strategies (11,12).

Furthermore, inadequate management of acute postoperative pain can have long-term consequences. Persistent postsurgical pain is increasingly recognized as a complication that may develop after various surgical procedures, including hysterectomy. Evidence suggests that poorly controlled acute postoperative pain may increase the risk of transitioning to chronic pain conditions. Therefore, identifying factors associated with higher acute pain intensity, such as younger age or increased pain sensitivity, may help clinicians implement preventive strategies during the perioperative period. Early recognition of patients at greater risk allows for closer monitoring and more aggressive pain management when necessary (13,14).

Laparoscopic hysterectomy involves specific sources of discomfort that may influence postoperative pain patterns. In addition to incisional pain, patients may experience visceral pain related to surgical manipulation of pelvic organs as well as referred shoulder pain caused by diaphragmatic irritation from carbon dioxide insufflation. The magnitude of these symptoms may vary widely between individuals. While surgical technique and anesthetic management play important roles, patient-related variables remain critical determinants of postoperative pain intensity. Investigating demographic factors such as age may therefore provide valuable insights into patient susceptibility to postoperative discomfort after minimally invasive gynecologic surgery (15,16).

Despite growing interest in personalized perioperative care, the relationship between age and acute postoperative pain following laparoscopic hysterectomy has not been fully clarified. Some studies suggest that younger patients report greater postoperative pain and require higher doses of analgesics, whereas others have reported inconsistent findings. Differences in study design,

sample size, surgical techniques, and pain assessment methods may partly explain these variations. Consequently, further research is needed to better understand how age influences postoperative pain experiences in women undergoing laparoscopic hysterectomy and to determine whether age should be considered a significant predictor in clinical practice (17,18).

A clearer understanding of the association between age and acute postoperative pain may help clinicians develop more targeted and individualized pain management strategies. By identifying age-related differences in pain perception and analgesic requirements, healthcare providers can improve perioperative care, enhance patient satisfaction, and potentially reduce complications associated with inadequate pain control. Therefore, investigating the relationship between age and the incidence of acute postoperative pain following laparoscopic hysterectomy may contribute valuable evidence to the ongoing efforts aimed at optimizing postoperative recovery and improving the quality of surgical care in gynecology.

Material and methods

Study Design

This cross-sectional observational study was conducted in hospitals affiliated with Tabriz University of Medical Sciences, Tabriz, Iran, during the year 2025. The study aimed to evaluate the association between patients' age and the incidence of acute postoperative pain following laparoscopic hysterectomy. Eligible participants were recruited among women undergoing elective laparoscopic hysterectomy in the participating centers during the study period.

Sample Size and Sampling Method

The required sample size was calculated using the single-proportion sample size formula for estimating prevalence. Based on an expected prevalence of acute postoperative pain of 50% (p=0.5), a confidence level of 95% (Z=1.96), and a precision (d) of 0.11, the calculated minimum sample size was 73 patients. Participants were enrolled using a convenience sampling method among eligible patients who underwent laparoscopic hysterectomy during the study period and agreed to participate.

Eligibility Criteria

Women aged 18 years or older who were scheduled for elective laparoscopic hysterectomy for benign gynecological conditions and were able to understand and report pain intensity were included in the study. Patients who provided informed consent and had complete perioperative records were considered eligible. Exclusion criteria included conversion of laparoscopic surgery to open laparotomy, history of chronic pain disorders, long-term opioid or analgesic use before surgery, known neurological or psychiatric disorders affecting pain perception, presence of postoperative complications requiring reoperation, inability to communicate pain intensity adequately, and incomplete clinical or follow-up data.

Study Procedure and Variables

Baseline demographic and clinical variables were recorded for all participants, including age, body mass index (BMI), indication for hysterectomy, comorbidities, duration of surgery, and type of anesthesia. All surgeries were performed by experienced gynecologic surgeons using a standard laparoscopic hysterectomy technique under general anesthesia. Pneumoperitoneum was established using carbon dioxide insufflation, and several small abdominal ports were inserted to allow introduction of the laparoscope and surgical instruments. The uterus was detached laparoscopically and removed through the vaginal canal or by morcellation when necessary. Postoperative pain management was provided according to standard institutional protocols.

Acute postoperative pain was defined as pain occurring within the first 24 hours after surgery. Pain intensity was assessed using the Visual Analog Scale (VAS), a validated tool consisting of a 10-cm scale ranging from 0 (no pain) to 10 (worst imaginable pain). Pain scores were recorded during the early postoperative period, and patients were categorized according to the presence and severity of acute postoperative pain based on their reported VAS scores.

Statistical Analysis

Statistical analyses were performed using SPSS software (version XX). Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. The normality of continuous variables was assessed using the Kolmogorov Smirnov test. Independent samples t-test or Mann Whitney U test was used to compare continuous variables between groups, depending on data distribution. The chi-square test or Fisher's exact test was applied to compare categorical variables. The association between age and the incidence of acute postoperative pain was evaluated using appropriate correlation or regression analyses when applicable. A p-value of less than 0.05 was considered statistically significant.

Ethical Considerations

This study was approved by the Ethics Committee of Tabriz University of Medical Sciences (Ethics code: IR.TBZMED.FMD.REC.1404.211). All procedures were conducted in accordance with the ethical standards of the institutional research committee and the principles of the Declaration of

Helsinki. Written informed consent was obtained from all participants prior to enrollment, and the confidentiality of patient information was strictly maintained throughout the study.

Results

A total of 73 women who underwent laparoscopic hysterectomy were included in the study. The mean age of the participants was 46.37 ± 8.52 years, and the mean body mass index (BMI) was 27.84 ± 3.91 kg/m². The average duration of surgery was 94.63 ± 21.47 minutes, while the mean length of hospital stay was 2.16 ± 0.74 days. Previous abdominal surgery was reported in 29 patients (39.73%). The most common indication for hysterectomy was uterine fibroids in 31 patients (42.47%), followed by abnormal uterine bleeding in 18 patients (24.66%). Additionally, 38 participants (52.05%) had no underlying comorbidities, whereas hypertension and diabetes were reported in 17 (23.29%) and 11 (15.07%) patients, respectively (table 1).

Table 1. Baseline Demographic and Clinical Characteristics of Patients Undergoing Laparoscopic Hysterectomy

Variable	Value
Age (years), mean ± SD	46.37 ± 8.52
BMI (kg/m²), mean ± SD	27.84 ± 3.91
Duration of surgery (minutes), mean ± SD	94.63 ± 21.47
Hospital stay (days), mean ± SD	2.16 ± 0.74
Previous abdominal surgery, n (%)	-
Yes	29 (39.73)
No	44 (60.27)
Type of anesthesia, n (%)	-
General anesthesia	73 (100.00)
Indication for hysterectomy, n (%)	-
Uterine fibroids	31 (42.47)
Abnormal uterine bleeding	18 (24.66)
Endometriosis	12 (16.44)
Adenomyosis	7 (9.59)
Other benign conditions	5 (6.85)
Comorbidities, n (%)	-
None	38 (52.05)
Hypertension	17 (23.29)
Diabetes mellitus	11 (15.07)
Both hypertension and diabetes	7 (9.59)

The postoperative pain profile of the participants during the first 24 hours after laparoscopic hysterectomy is summarized in Table 2. The mean postoperative pain intensity measured by the Visual Analog Scale (VAS) was 4.28 ± 1.86. Acute postoperative pain was reported in 56 patients (76.71%). Regarding pain severity, moderate pain was the most common category and was observed in 28 patients (38.36%), followed by mild pain in 17 patients (23.29%) and severe pain in 11 patients (15.07%). The mean postoperative analgesic consumption was 62.47 ± 18.39 mg (morphine equivalent), and the mean time to the first analgesic request was 3.41 ± 1.27 hours.

Table 2. Postoperative Pain Characteristics Within the First 24 Hours After Laparoscopic Hysterectomy

Variable	Value
Mean VAS pain score, mean ± SD	4.28 ± 1.86
Incidence of acute postoperative pain, n (%)	56 (76.71)
Pain severity category, n (%)	-
No pain (VAS = 0)	17 (23.29)
Mild pain (VAS 1-3)	17 (23.29)
Moderate pain (VAS 4-6)	28 (38.36)
Severe pain (VAS 7-10)	11 (15.07)
Analgesic consumption (mg morphine equivalent), mean ± SD	62.47 ± 18.39
Time to first analgesic request (hours), mean ± SD	3.41 ± 1.27

The comparison of postoperative pain intensity across age groups demonstrated a clear decreasing trend in mean VAS scores with increasing age. Patients younger than 40 years had the highest pain levels, while those aged 50 years or older reported the lowest scores. The incidence of acute postoperative pain also declined progressively with age. ANOVA testing showed a statistically significant difference across groups (p=0.018), indicating an age-related pattern in postoperative pain severity (figure 1).

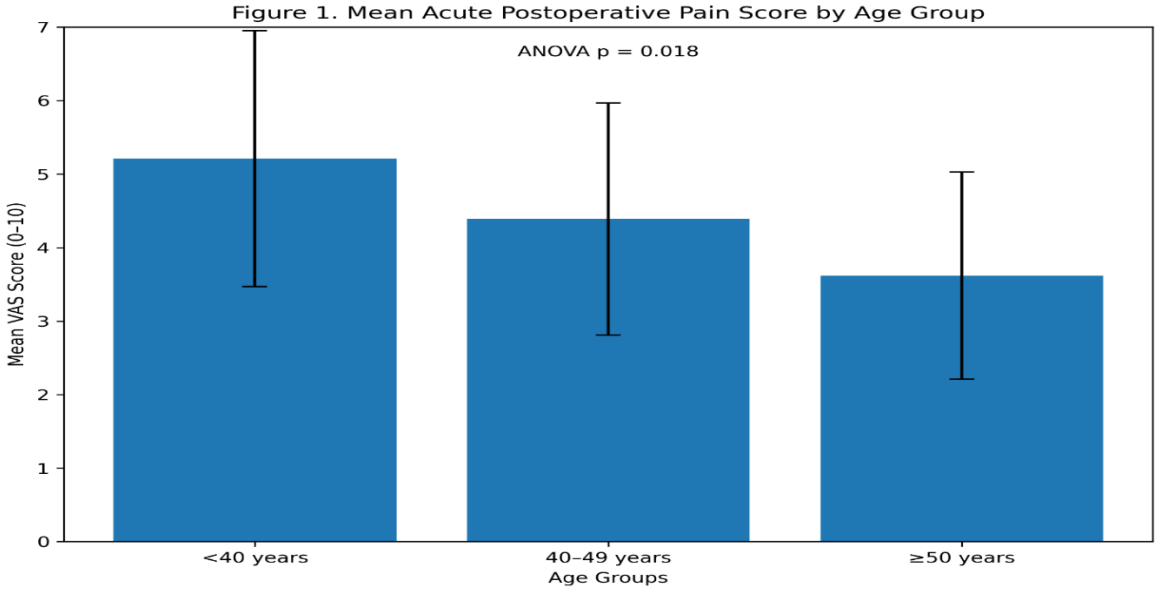

Figure 1. Association Between Age Groups and Acute Postoperative Pain

The relationship between patient age and the severity of acute postoperative pain was evaluated using Pearson's correlation analysis. As illustrated in the scatter plot, a statistically significant negative correlation was observed between age and Visual Analog Scale (VAS) scores (r=−0.711, p=0.001). This inverse association indicates that younger patients experienced higher levels of acute pain in the first 24 hours following laparoscopic hysterectomy, while advancing age was consistently associated with lower reported pain intensity (figure 2).

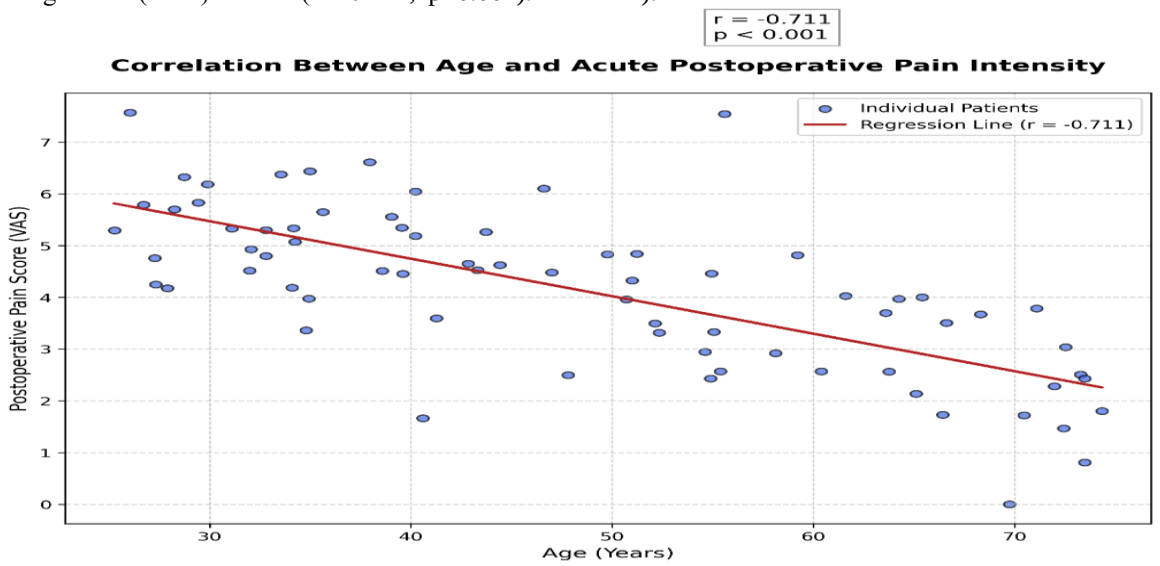

Figure 2. Correlation Analysis of Age and Acute Postoperative Pain Intensity

Discussion

The present study demonstrated a clear pattern in which younger patients experienced more intense postoperative pain during the first 24 hours after laparoscopic hysterectomy, whereas older individuals reported considerably lower levels of discomfort. Pain was common among the participants, and although moderate pain emerged as

the most frequently reported category, its distribution varied distinctly across age groups. The data further indicated that pain medication requirements and the timing of the first analgesic request followed similar age-related trends, emphasizing that age served as an influential determinant of postoperative pain experience in this population. These findings collectively highlight age as an important clinical variable worthy of consideration when tailoring postoperative pain management strategies in minimally invasive gynecologic surgery (19).

Understanding why younger individuals exhibit greater sensitivity to postoperative pain involves examining both biological and psychosocial determinants of nociceptive processing. Biologically, age-related changes in the peripheral and central nervous system play a major role. Younger patients known to have more robust nociceptor density, higher peripheral nerve conduction, and more responsive pain pathways, which naturally lead to stronger pain signaling following surgical injury. In contrast, normal aging is associated with progressive decline in nociceptor function, reduced neurotransmitter responsiveness, and alterations in descending inhibitory pathways. These physiologic changes collectively diminish the intensity with which older patients perceive postoperative noxious stimuli. This neurobiological attenuation of pain perception has reported consistently in pain physiology literature, offering a plausible explanation for the inverse relationship observed in the present study (20).

Psychological and behavioral aspects may further contribute to the heightened pain reports among younger patients. Younger individuals tend to exhibit higher pain vigilance, greater anticipatory anxiety, and lower thresholds for perceiving pain as threatening, especially during their first major surgical experience. Older adults, by comparison, often possess superior coping mechanisms, greater emotional regulation, and more extensive previous medical experiences that facilitate adaptive responses to postoperative pain. Psychological resilience and contextual interpretation of discomfort have shown to modulate postoperative pain ratings, suggesting that cognitive-emotional processing operates as an important mediator in the age–pain relationship identified in this study (21).

The pattern of analgesic consumption observed in this research aligns well with the age-related differences in pain intensity. Younger patients, due to their heightened nociceptive responsiveness and reduced pain tolerance, commonly exhibit greater analgesic demand and require earlier or more frequent dosing to achieve adequate relief. Older adults, conversely, may require less opioid medication not only due to reduced pain perception but also because of concerns regarding medication side effects such as sedation, constipation, or falls factors that may make older individuals more conservative in reporting pain or requesting additional analgesics. Previous studies on postoperative opioid use consistently demonstrate lower analgesic requirements in older surgical patients, reinforcing the interpretation that both physiologic and behavioral mechanisms underlie the differences observed in the present study (22).

The significant negative correlation between age and VAS scores found here is consistent with broader literature on postoperative pain following gynecologic and general surgical procedures. Several investigators have similarly reported that younger women experience more intense pain after laparoscopic procedures, particularly in surgeries involving the pelvis where visceral pain pathways may interact with hormonal factors. Younger women also exhibit greater autonomic reactivity and higher basal levels of inflammatory mediators, which may exacerbate postoperative pain perception. Although hormonal differences not directly measured in this study, the consistent trend across existing studies lends support to the notion that age-specific physiological and hormonal profiles exert meaningful influence on postoperative pain after hysterectomy (23).

Another possible explanation for the age-related findings relates to differences in inflammatory response. Research has shown that younger adults often mount a stronger pro-inflammatory cytokine response after tissue injury, including elevated levels of interleukin-6 and tumor necrosis factor-alpha. Inflammation plays a central role in sensitizing nociceptors and amplifying postoperative pain. Conversely, immunosenescence in older adults leads to a comparatively blunted inflammatory response, which could contribute to lower postoperative pain intensity. Although inflammatory markers were outside the scope of this study, the well-documented age-related variation in immune activation provides a biologically plausible rationale for the observed inverse association between age and pain severity. The consistent decline in pain incidence and intensity across increasing age groups also underscores the need for patient-specific pain management strategies. Younger patients may benefit from more proactive, multimodal analgesia protocols that incorporate preemptive analgesics, regional techniques, or adjunctive non-pharmacological strategies such as cognitive-behavioral interventions. Because younger patients may experience greater anxiety or pain anticipation before surgery, perioperative counseling and anxiolytic measures could meaningfully reduce postoperative pain burden. In contrast, older individuals may require cautious dosing approaches due to comorbidities, polypharmacy, and increased opioid sensitivity, emphasizing that age-informed analgesic plans are essential for optimizing both safety and comfort.

The findings of this study also carry broader implications for postoperative recovery and patient satisfaction. Pain during the first postoperative day is strongly associated with delayed mobilization, prolonged hospitalization, decreased patient satisfaction, and increased risk of chronic postoperative pain syndromes. Younger patients, being more susceptible to intense postoperative discomfort, may face higher risk of these unfavorable outcomes if pain is not effectively controlled. Conversely, the naturally diminished pain perception in older adults may facilitate smoother early recovery, although this advantage balanced against increased vulnerability to opioid-related adverse effects. Recognizing these age-specific trends allows clinicians to implement targeted interventions that mitigate risk and improve postoperative experience. Overall, the present findings reinforce the conclusion that age is a significant and independent factor influencing acute postoperative pain after laparoscopic hysterectomy. Younger patients consistently reported higher levels of discomfort and demonstrated greater early postoperative pain burden, likely due to a combination of neurobiological, psychological, and inflammatory mechanisms. Recognizing age-related differences in pain perception has meaningful implications for tailored analgesic management and improved postoperative outcomes in women undergoing minimally invasive gynecologic surgery (24).

Conclusion

This study revealed that younger women experience significantly more severe acute postoperative pain after laparoscopic hysterectomy, as evidenced by higher VAS scores and earlier analgesic demand. Pain intensity and incidence declined steadily with advancing age, supported by both ANOVA and correlation analyses. These results underscore age as a critical determinant of postoperative pain perception. Incorporating age-tailored analgesic strategies may improve pain control, enhance patient comfort, and reduce complications associated with inadequate postoperative analgesia.

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Conflicts of interest

The authors declare that they have no competing interests.

Disclosure Statement

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Authors' Contributions

All authors contributed to data analysis, drafting, and revising of the paper and agreed to be responsible for all the aspects of this work.

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