https://doi.org/10.53964/jmnpr.2025009

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Journal of
Modern Nursing Practice and Research

ISSN 2708-2202 (Online)

Open Access

Systematic Review

Factors Contributing to Postoperative Pain in Orthopaedic Surgeries: A Systematic Review

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Received: August 8, 2025 **Revised:** September 13, 2025 **Accepted:** October 22, 2025 **Published:** October 30, 2025

Abstract

Objective: Orthopaedic surgeries are widely performed across the globe. It is pertinent to explore approaches that contribute to alleviating pain, restoring function, and improving the quality of life of patients with musculoskeletal disorders and injuries. The aim of the review was to develop a toolkit, contributing to preoperative assessment to aid clinicians in identifying patients at higher risk of experiencing post-operative (Pre-Op) pain.

Methods: We adopted a systematic review; searched the Cumulative Index to Nursing and Allied Heath Literature (CINAHL), EMBASE, PubMed, Scopus, ScienceDirect, EBSCOhost and ProQuest Central databases for articles published between 2010 and 2024. We adopted a thematic data analysis of the extracted data.

Results: Nine articles were reviewed. Socio-demographic factors, clinical factors and Psychological/ behavioural factors were dominant factors contributing to post-orthopaedic surgical pain in patients.

Conclusion: Drawing on the best available evidence, we developed a comprehensive toolkit aimed at improving the understanding and management of post-orthopaedic surgical pain. We recommend piloting this toolkit to evaluate its effectiveness in clinical settings. Central to successful pain alleviation is the integration of pre-surgical and post-surgical pain assessments, which enables more targeted and responsive interventions.

Keywords: postoperative pain; orthopaedic surgeries; pain predictors; pain management

Citation: Bohr QE, Gerrard S, Bosun-Arije FS. Factors Contributing to Postoperative Pain in Orthopaedic Surgeries: A Systematic Review. *J Mod Nurs Pract Res*, 2025; 5(4): 9. DOI: 10.53964/jmnpr.2025009.

1 INTRODUCTION

Orthopaedic surgeries are conducted globally to improve functionality, for corrective purposes and pain alleviation. The discomfort experienced after surgery can impact not the recovery of the patient but also their mental health, mobility and length of hospital stay[1]. The main objectives of orthopaedic procedures are to alleviate pain, improve functionality and boost the wellbeing of individuals dealing with musculoskeletal conditions and injuries[2]. In the realm of surgery, managing pain remains a significant challenge that poses ongoing issues, for patients and healthcare providers alike[3].

However, with advancements in how surgeries are done and the care provided before and after, a notable number of patients who go through orthopaedic procedures continue to experience moderate to intense pain post-surgery[4]. Intense post-surgical pain could signal the likelihood of lasting pain in the future. Integrative approaches have not been successful mainly because of inconsistent medical protocols and a lack of tailored strategies for managing individual pain levels[5].

A timely identification and evaluation of postoperative pain is more critical to improving patient outcomes[6]. Anticipating pain before surgery is vital as it provides information about each patient's specific risk factors and allows for the customization of a personalized pain relief strategy[7]. This underscores the importance of gaining a comprehension of the elements that impact post-surgery pain encounters and creating effective solutions to alleviate its effects. The aim of this systematic review is to develop a toolkit for preoperative assessment that can aid clinicians in identifying patients at higher risk of experiencing significant postoperative pain. The Research question posed is: What are contributory factors to higher post-orthopaedic surgical pain?

2 MATERIALS AND METHODS

Two researchers independently searched the Cumulative Index to Nursing and Allied Heath Literature (CINAHL), EMBASE, PubMed, Scopus, ScienceDirect, Google Scholar, EBSCOhost and ProQuest Central databases for articles published between 2010 and 2024. This section encompasses the process of search strategy/data extraction, quality appraisal, data collection and data analysis, processes adopted in this systematic review (Please see Table 1 for the inclusion and exclusion and Table 2 for the search strings).

2.1 Search Strategy

Using various search strategies as truncation, quotation marks, wildcard symbols, keywords, Boolean operator and the patient, intervention and outcome (PIO), a systematic search was conducted across electronic databases over four months (February 2024-June 2024).

2.2 Quality Appraisal

The Critical Appraisal Skills Programme tool to appraise the articles reviewed[8]. All nine articles with a score between 8 and 9 was included in this study. The high score indicates that only articles with high methodological quality is included in this review. This systematic review was reported using the widely recognized four-phase PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analysis) flow diagram which is the standard for reporting systematic reviews (please see Figure 1 for the PRISMA flow diagram).

We conducted a thematic data analysis of the extracted data. A total of (9) studies were retrieved using the prescribed search strategy which were analyzed for replicability, validity and reliability using various approved critical appraisal tools[8]. See Fig. 1 for the flow diagram of the search process.

For analysis, the nine articles extracted were analysed using the six steps of thematic analysis method40s[9]. In this initial phase of data analysis, the articles were thoroughly read to gain an understanding of the methodologies and findings presented. The goal was to immerse self in the data and obtain a comprehensive overview of the different statistical and analytical techniques used[10]. After the first phase, initial codes were then generated from the summaries of the articles, focusing on predictors and different factors influencing postoperative pain and opioid usage.

Broader themes were subsequently developed to categorize the various methods of analysis from the initial codes[9]. After cross-referencing themes with original articles to ensure they accurately captured the essence of the coded data and resolve discrepancies through reviewing. Three main themes: Sociodemographic predictor of postoperative pain, clinical-related predictors of postoperative pain, psychological and behavioural predictor of postoperative pain were identified, and a summary was produced, detailing the themes identified in the articles.

3 RESULTS

This section entails an overview of the findings. See Table 3 for the summary of the evidence information. Table 4 containing a toolkit that represent the main and minor themes that capture preoperative predictors of post-op pain in orthopaedic surgeries and Tables 5-7 for the recommended aggregate scoring framework.

3.1 Theme 1: Demographic Predictors of Postoperative Pain

The factors that constitute this theme are gender, age, race, low socio-economic status, and BMI. Out of the nine articles examined, three of them noted that women tend to feel pain than men[11,15,18]. Most of the articles reviewed in this study indicate that younger individuals often mention experiencing

https://doi.org/10.53964/jmnpr.2025009

Table 1. Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Studies on preoperative predictors of post operative pain in orthopaedic surgeries in adults.	Studies on pediatric orthopaedic surgeries
Studies published in English language between 2010 and 2024.	Studies that focused on surgical specialties other than orthopaedics.
Studies that measure the association between post-op orthopedic pain and at least one preoperative predictor.	Conference abstract and opinion papers.
At least a potential predictor is identified preoperatively in the study.	Surgeries performed under local anesthetics were excluded.

Table 2. Key Words/ Search Terms/Strings

AND	Problem	Intervention	Outcome
OR	Post-op pain	Orthopaedic surgeries	Preoperative predictors
OR	Post-surgical pain	Orthopaedic operations	Preoperative indicators
OR	Acute pain	Knee surgeries	Preoperative determinants
OR	Discomfort	Hip surgeries	Preoperative factors
OR	Ache	Arthroplasty	Pain level

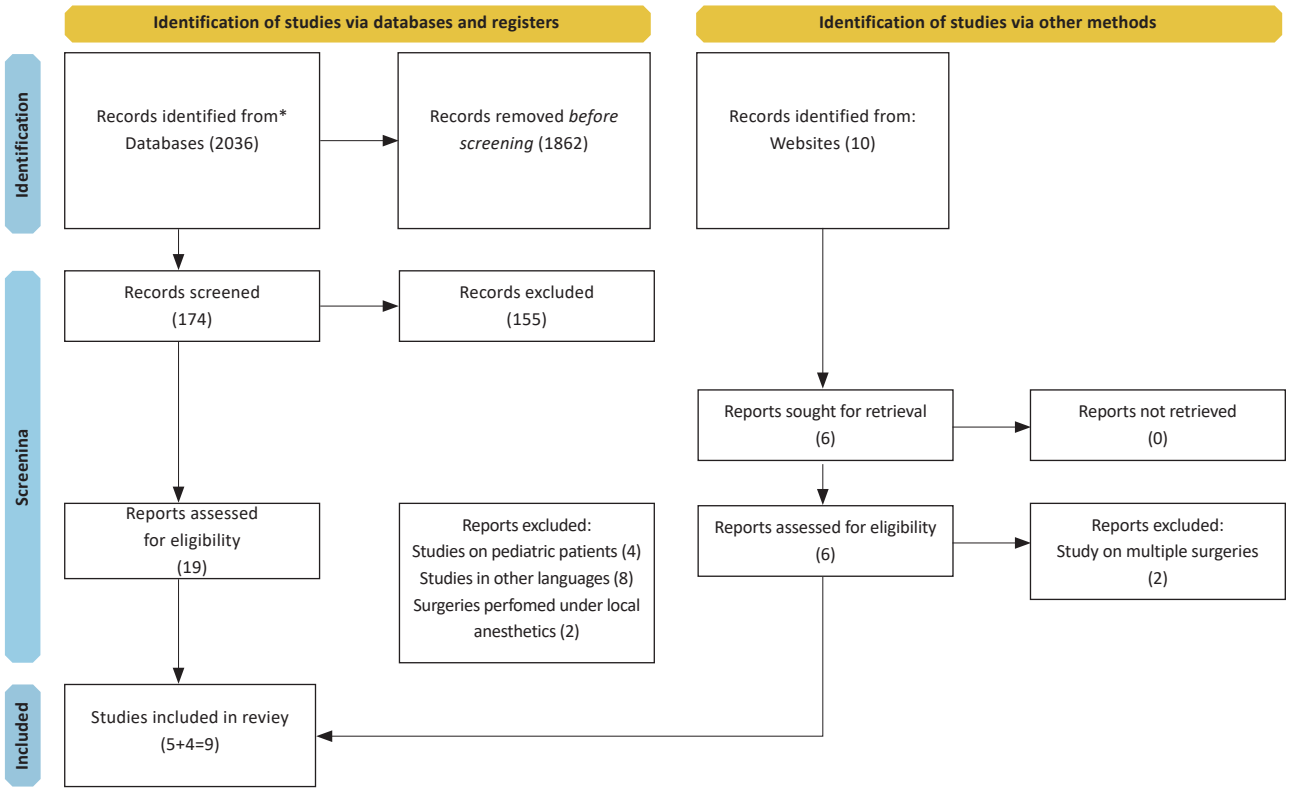

Figure 1. PRISMA Flow Diagram Depicting the Selection Process of Studies for Systematic Review.

post-surgery pain, while advancing age shows a correlation with lower levels of post-surgery pain and reduced use of opioids[15,17-19]. However, there is an argument that African Americans may experience challenges with pain outcomes hinting at potential gaps in how pain is perceived and treated[15].

However other research has shown that there are no association between pain levels and race suggesting that other factors could play a role in shaping this connection[17]. Various articles have discussed the relationship between BMI and postoperative pain with differing conclusions. While some studies highlighted BMI as the predictor, others found multiple factors such as age, gender and race[11,13-15,17,18]. However, there is an affirmation that factors that are significantly correlated with pain, entail age, female gender, BMI, preoperative pain levels, catastrophizing, somatization, average hours of sleep, TSP, and number of previous knee surgeries[11].

3.2 Theme 2: Clinical Predictors of Postoperative Pain

The factors that constitute this theme are linked to previous surgeries, tourniquet time, type of anaesthesia, type of surgery and POP status of patients. Individuals who have undergone procedures, especially those involving the knees are at a higher risk of encountering intense pain following surgery

https://doi.org/10.53964/jmnpr.2025009

Table 3. Evidence Table

Author	Study	Setting	Subject	Surgery	Result
[11]	Prospective observational cohort study.	Tertiary academic medical center.	126 patients older than 45 years	knee replacement at Brigham and Women's Hospital.	Revealed several predictors of acute postoperative pain scores including (Temporal summation of pain (TSP); P=0.001), (Body mass index (BMI); P=0.044), number of previous knee surgeries (P=0.006), and female gender (P=0.023). Similarly, predictors of opioid utilization included TSP (P=0.011), BMI (P=0.02), age (P=<0.001), and tourniquet time (P=0.003).
[12]	Multicenter prospective observational study	Hospital based conducted at two comprehensive specialized hospitals in the PACU, ICU and orthopedic ward	209 adult patients	Emergency orthopedic surgeries	The overall incidence of moderate to severe postoperative pain within the first 24 h after emergency orthopedics surgery was 70.5% (95% CI: 64, 77). On multivariable logistic regression analysis; history of having preoperative pain (Adjusted Odd Ratio (AOR): 7.92, 95% CI: 3.04, 20.63), history of preoperative anxiety (AOR: 6.42, 95% CI: 2.59, 15.90), preoperative patient expectation about postoperative pain (AOR: 6.89, 95% CI: 2.66, 17.78) and being GA (AOR: 4.08, 95% CI: 1.30, 12.77) were significantly associated with moderate to severe postoperative pain after emergency orthopedics surgery.
[13]	prospective cohort study	recuperative pain management service	97 adult patients	Primary Total Knee Arthroplasty (TKA)	After adjusting for all other variables, higher age and catastrophizing pain scores were associated with lower odds of postoperative opioid usage. Increasing age and BMI were associated with lower odds of being referred to pain management.
[14]	Prospective study	Surgeries of Total Hip Arthroplasty (THA) and TKA in the São João Hospital	95 adult patients	TKA and THA	In females, the Acetyl salicylate status 3 physical condition was also associated with higher mean pain intensity. Patients with preoperative chronic pain, without depression diagnosis, and unsatisfied with the current profession showed higher levels of reported pre-operative pain (POP).
[15]	SR	37 articles	60 years and above	Knee or hip arthroplasty	There was a strong association between post-surgical pain and female gender, low socio-economic status, higher pain, comorbidities, low back pain, poor functional status, and depression, anxiety or catastrophic pain.
[16]	Pre-operative assessment	a single urban academic institution	435 patients	Various orthopaedic surgery	435 patients (age=41.1±15.7, 47% female) were studied. Mean PI was 60.1±7.0 prior to surgery and 61.7±7.6 at 2 weeks post-operative (pre-op). Worse 2-week PROMIS PI(A scoring tool used to assess the intensity of pain) was associated with lower extremity surgery, prior surgery on the joint, preoperative opioid use, depression, lower income, lower education, and higher American Society of Anesthesiologists score (P<0.05).
[17]	prospective observational study	in the Post Anesthesia Care Unit.	153 patients	Patient who underwent orthopedic surgery procedures	Preoperative smoking and physical health status were statistically significant predictors of severe postoperative pain in the immediate postoperative period.
[18]	Multi-centre, cross sectional, observational study	Three hospitals for special Surgery (HSS) across America and Canada	897 patients between ages 18 and 99	Total hip or knee replacement	Predictors for pain at rest were female gender (OR 1.10 with 95 % CI 1.01–1.20), younger age (0.96, 0.94–0.99), increased BMI (1.02, 1.01–1.03), TKR vs. THR (3.21, 2.73–3.78), increased severity of preoperative pain at the surgical site (1.15, 1.03–1.30), preoperative use of opioids (1.63, 1.32–2.01), and GA (8.51, 2.13–33.98). Predictors for pain with activity were TKR vs. THR (1.42, 1.28–1.57), increased severity of POP at the surgical site (1.11, 1.04–1.19), GA (9.02, 3.68–22.07), preoperative use of anti-convulsant (1.78, 1.32–2.40) and anti-depressants (1.50, 1.08–2.80), and prior surgery at the surgical site (1.28, 1.05–1.57).
[19]	observational retrospective study	postoperative care unit (PCU) of a university hospital in Barcelona (Spain)	127 adult patients	prosthetic surgery (hip, knee or shoulder arthroplasty	The prevalence of immediate postoperative pain was 28%. Anxiety was the most common emotional factor (72%) and a predictive risk factor for moderate to severe postoperative pain (OR: 4.60, 95% CI 1.38 to 15.3, P<0.05, AUC: 0.72, 95% CI: 0.62 to 0.83). Age exerted a protective effect (OR 0.96, 95% CI: 0.94-0.99, P<0.01).

https://doi.org/10.53964/jmnpr.2025009

Table 4. The Proposed Pre-op Assessment Toolkit for Post-op Pain

Pre-op Assessment Toolkit for Post-op Pain		
Category	Sub-category	Procedure
Sociodemographic	Gender	Document the patient's gender (Female and Male)
	Age	Record the patient's age (18-30 years) (30-45) (≤50)
	Race	Document the patient's race/ethnicity (White, Black or African, Asian, Indigenous and mixed race/multiracial)
	BMI	Calculate BMI (weight in kg/height in m²) BMI Categories: Underweight: <18.5 Normal weight: 18.5-24.9 Overweight: 25-29.9 Obesity: ≥30
Psychological and bahavioural	Depression	Screen for depressive symptoms using standardized tools such as PHQ-9 to assess the severity of depressive symptoms. Score Interpretation: 0-4: Minimal depression 5-9: Mild depression 10-14: Moderate depression 15-19: Moderately severe depression 20-27: Severe depression
	Anxiety	Assess patients' anxiety levels using standardized tools such as GAD-7. Score Interpretation: 0-4: Minimal anxiety 5-9: Mild anxiety 10-14: Moderate anxiety 15-21: Severe anxiety
Clinical	Previous Surgeries	Document the history of previous surgeries. Assess any complications or chronic pain related to past surgeries.
	Tourniquet Time	Record the expected tourniquet time for the surgery.
	Type of Anaesthetic	Review the planned type of anesthetic (general, regional, local).
	Type of Surgery	Identify the type of orthopaedic surgery planned.
	Preoperative Pain	Assess preoperative pain levels using tools like Numeric Rating Scale (NRS) or Visual Analog Scale (VAS) NRS/VAS Score Interpretation: 0-3: Mild pain 4-6: Moderate pain 7-10: Severe pain

Table 5. Aggregate Scoring Framework for Sociodemographic Domain (Maximum Score:9)

Variable	Category	Score
Gender	Male=1, Female=2 *(optional if gender-specific risk applies)*	1–2
Age	18–30=1, 31–45=3, ≥50=3	1–3
Race/Ethnicity	Black or African=1, White=2, Asian=2, Indigenous=0, Mixed/Multiracial=2 *(based on health disparity data)*	0–2
BMI Category	Normal=0, Underweight/Overweight=1, Obese=2	0–2

Notes: This scoring framework is designed to support risk stratification in health-related assessments, particularly where demographic and anthropometric factors may influence outcomes. Scoring Range: Each variable contributes to a cumulative risk score ranging from 1 to 9. Use Case: This tool may be used to guide tailored interventions, prioritize follow-up, or inform patient education strategies. Equity Consideration: Scores should not be used in isolation to determine care eligibility. They must be interpreted alongside clinical judgment and social determinants of health.

and longer tourniquet times were also associated with greater opioid utilization[11,12,16,18]. Extended periods of application in procedures have been linked to higher levels of pain after surgery, underscoring the importance of adopting meticulous surgical approaches to alleviate postoperative discomfort[11].

The choice of anaesthetic administered during a procedure may impact the amount of pain experienced after the operation. Specifically, regional anaesthesia has been linked to reduced levels of pain when compared to general anaesthesia[12,17,18]. Surgeries on the limbs like knee and hip replacements often result in increased pain after the operation. This highlights the importance of tailored pain management strategies for these procedures[16]. Patients who have pain before surgery tend to have pain after the procedure, highlighting the importance of managing pain before surgery[14,15].

3.3 Theme 3: Psychological and Behavioral Predictors of Postoperative Pain

Apart from smoking, depression and anxiety are the two predominant psychological factors informing this theme.

Table 6. Aggregate Scoring Framework for Psychological Domain (Maximum score:48)

Measure	Tool	Score Range
Depression	PHQ-9	10–27
Anxiety	GAD-7	10–21

Notes: Depression tool: Patient Health Questionnaire-9 (PHQ-9). Scores range from 0-4 to 20–27. Interpretation: For patients scoring in this range of 10-14 and 20-27, it suggests moderate to severe depressive symptoms. Higher scores indicate greater functional impairment and may warrant further evaluation or referral for mental health support. Anxiety tool: Generalized Anxiety Disorder-7 (GAD-7). Scores range from 0-4 to 15–21. Interpretation: For patients scoring in this range of 10-21, it suggests moderate to severe anxiety symptoms. Elevated scores may be associated with persistent worry, somatic complaints, and reduced coping capacity.

Table 7. Aggregate Scoring Framework for Clinical Domain (Maximum score: 8)

Variable	Category	Score
Previous Surgeries	No=0, Yes=1	0–1
Tourniquet Time	<60 min=0, ≥60 min=1	0–1
Type of Anaesthetic	Local=0, Regional=1, General=2	0–2
Type of Surgery	Minor=0, Moderate=1, Major=2	0–2
Preoperative Pain	Mild=0, Moderate=1, Severe=2	0–2

Notes: Clinical Score=0-8, Higher scores may indicate greater psychosocial burden, surgical complexity, or risk factors. This framework can be adapted for: preoperative risk stratification, educational simulations and patient profiling in research.

Depression is an important predictor of post-op pain. Individuals experiencing symptoms tend to describe intense pain highlighting the impact of mental wellbeing on how pain is felt and recovery processes after surgery[11,14,16,20].

Three reviewed articles pointed anxiety as a common factor if experienced before surgery, may predict pre-op pain[11,16,19]. Anxiety alleviation through counselling or medication management may relieve a patient of pre-op discomfort.

3.4 Limitations

While this study offers valuable insights into factors contributing to postoperative pain in orthopaedic surgeries, a few limitations must be acknowledged:

(1) Scope and generalisability: Only nine studies were included in this review due to limited literature published on the research topic. Therefore, it is important to note that the limited number of studies included limits the generalisability of the research outcome to a wider population of individuals who have undergone orthopaedic surgeries.

(2) Data collection constraints: Reliance on reviewed articles alone without experts and patients first hand input to the toolkit can potentially introduce biases and the absence of longitudinal data limits the ability to assess sustained impact of the toolkit over time.

The intended use of the toolkit is for clinicians supporting patients who are booked for orthopaedic surgery. The toolkit is developed from the nine practice-based articles reviewed. It was developed through a systematic process of synthesis and translation of the findings of the nine articles reviewed with a goal to transform evidence and insights into practical, user-friendly resources that support implementation, education, or decision-making of clinicians. However, it is important that the proposed toolkit be piloted and refined before disseminated and adopted in clinical settings.

4 DISCUSSION

4.1 Socio-demographic Related Factors as Preoperative Predictors of Postoperative Pain

Some studies report that females are more likely to experience more intense post-op pain compared to males[21,22]. While other studies suggest insignificant variations[23]. The way men and women feel pain differently is thought to be influenced by a mix of hormonal and social factors. There is a significant association between anxiety, current smoking, psychological conditions, and current opioid use with increased preoperative and postoperative reported pain score[23]. Female oestrogen and progesterone are believed to impact how sensitive women are to pain[24]. Younger patients tend to experience pain and the impact of age on pain levels can differs[22,25]. Older individuals may have sensitivity to pain and but are at a higher risk of experiencing complications with opioid based pain management techniques[26]. Different pain perception and analgesic effects among aged groups could be attributed to changes associated with aging[27]. Individuals with high BMI experienced intense pain after surgery and needed a higher amount of pain relief medication right after the operation[22]. While BMI may influence pain perception in some patient populations, it is not a consistent predictor across all surgical contexts[28,29]. It is suggested that when controlling for variables such as socioeconomic factors, healthcare access, and individual health conditions, racial differences in pain perception diminished[30].

4.2 Clinical Related Factors as Preoperative Predictors of Postoperative Pain

Studies have consistently shown that patients with a history of prior surgeries are more likely to experience acute postoperative pain. This phenomenon can be attributed to several factors, including pre-existing pain conditions,

altered pain perception, and psychological factors associated with previous surgical experiences. Types of surgeries were also found to have an impact on postoperative pain. Anatomical and physiological changes resulting from previous surgeries can impact pain perception[14]

Prolonged tourniquet times have been linked to increased postoperative pain and other complications. Research highlight that these associations and emphasise the importance of optimal tourniquet management[22,25]. Longer tourniquet times lead to higher levels of postoperative pain and require increased analgesia post-surgery[17]. Similarly, high-pressure inflation and extended duration can lead to muscle and nerve damage, delayed recovery, and increased use of pain medications post-surgery[17]. The choice between anesthesia significantly impacts postoperative pain experiences and outcomes for patients undergoing surgery[31].

4.3 Psychological Related Factors as Preoperative Predictors of Postoperative Pain

Lately, there has been a growing interest in studying the impact of surgery anxiety, on pain levels and recovery after surgery[20]. Confirming the link between surgery anxiety and post-surgery pain is important as it helps identify patients with high anxiety levels beforehand and tailor pain management strategies accordingly[32].

There are discrepancies in how strongly psychosocial factors correlate with surgical outcomes. While anxiety and depression are recognized as significant predictors of postoperative pain, the extent of their impact varies across studies. Some research notes weaker correlations with outcomes like analgesic use or hospital stay length[33,34].

However, psychological factors play a crucial role in postoperative pain perception. Patients with a history of painful surgical experiences may develop anxiety and fear related to new surgical interventions, which can exacerbate their perception of pain. This psychological impact was of previous negative pain impacted the intensity of future surgeries[35]. Addressing anxiety and other psychological factors before surgery can significantly reduce pain levels after the procedure[14].

Depression significantly influences postoperative pain outcomes[14]. Patients experiencing depression often experience a heightened sense of pain intensity due to the emotional and cognitive aspects of depression, which can amplify pain perception[36,37].

The interplay between depression and postoperative pain underscores the need for comprehensive preoperative psychological assessments. Studies suggest that addressing depression preoperatively may enhance overall pain management and improve surgical outcomes. Integrating mental health care into the perioperative process could lead to more effective pain control and better recovery experiences for patients[36,37].

Anxiety is another critical factor that exacerbates postoperative pain. Patients with high levels of psychological factors tend to report more intense pain following surgery[38]. This relationship can be attributed to the physiological and psychological effects of anxiety, which include increased muscle tension, heightened stress responses, and a focus on potential negative outcomes. Anxiety can magnify the perception of pain, making it more challenging for patients to cope with post-op discomfort[39,40].

5 CONCLUSION

Managing post-op pain is crucial for optimising patient outcomes across orthopaedic surgeries. Studies have consistently highlighted diverse factors influencing pain experiences, ranging from demographic, clinical-related and psychological variables are key predictors of pre-op pain. The findings show the importance of tailored pain management protocols with individual risk profiles enhance recovery and improve post-surgical pain management. As a clinical nurse, how would you promote pre and post-surgical pain assessment your practice? How will you identify psychological issues impacting pain management? Reflect and ask yourself if you utilise evidence-based approach to improve pre- and post-surgical pain assessment in your setting?

Acknowledgements

I want to thank my supervisor for her guidance and input into this research.

Conflicts of Interest

The authors declared no conflicts of interest.

Data Availability

All data generated or analysed during this study are included in this published article.

Author Contribution

Bohr QE contributed to the conceptualisation, methodology, and writing of the original draft. Gerrard S was involved in the conceptualisation, methodology, and review. Bosun-Arije FS oversaw the methodology, conceptualisation,

supervision, and the review and editing process.

Abbreviation List

AOR, Adjusted Odd Ratio
BMI, Body Mass Index
NRS, Numeric Rating Scale
POP, pre-operative pain
Pre-Op, Post-operative
THA, Total Hip Arthroplasty
TKA, Total Knee Arthroplasty
TSP, Temporal Summation of Pain
VAS, Visual Analog Scale

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