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# Patient education for better pain control in hip replacement by integrating anaesthesia and orthopaedic strategies

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## ABSTRACT

**Background:** Postoperative pain management remains a significant challenge for patients undergoing hip replacement surgery. This study investigated the effectiveness of a comprehensive patient education program in reducing postoperative pain, opioid consumption, and length of hospital stay, as well as improving patient satisfaction.

**Methods:** A randomized controlled trial was conducted at a tertiary care hospital. A total of 154 patients undergoing primary hip replacement surgery were randomly allocated to either the intervention group (n=77), which received a comprehensive patient education program, or the control group (n=77), which received standard care. Pain scores, opioid consumption, patient satisfaction, and length of hospital stay were assessed at various time points.

**Results:** The intervention group demonstrated significantly lower pain scores and opioid consumption at 24, 48, and 72 hours post-surgery compared to the control group ($p<0.001$). Patient satisfaction scores were significantly higher in the intervention group (4.2 ± 0.7 vs. 3.6 ± 0.9, $p=0.001$). The length of hospital stay was significantly shorter in the intervention group (3.9 ± 1.1 days vs. 4.5 ± 1.2 days, $p=0.0023$). Logistic regression analysis revealed that the intervention group had a significantly higher odds of achieving high patient satisfaction (OR=2.45, 95% CI: 1.32-4.56, $p=0.004$), independent of age and gender.

**Conclusion:** A comprehensive patient education program significantly reduced postoperative pain, opioid consumption, and length of hospital stay while improving patient satisfaction in patients undergoing hip replacement surgery. These findings highlight the importance of incorporating patient education into the standard of care for hip replacement patients to optimize outcomes and enhance the quality of care.

**Keywords:** Hip Replacement, Patient Education, Postoperative Pain, Opioid Consumption, Patient Satisfaction.

## INTRODUCTION

Hip replacement surgery, also known as hip arthroplasty, is a common and highly effective procedure for alleviating pain and restoring function in patients suffering from severe hip joint conditions, such as osteoarthritis, rheumatoid arthritis, or traumatic injury. Despite the advancements in surgical techniques and prosthetic designs, postoperative pain remains a significant challenge for patients undergoing hip replacement. Effective pain management is crucial not only for enhancing recovery and rehabilitation but also for preventing complications such as chronic pain and reduced mobility. One promising strategy to improve postoperative pain control is patient education.

Patient education involves providing patients with information and skills that enable them to manage their health and medical conditions effectively. In the context of hip replacement surgery, patient education programs typically cover various aspects such as the surgical procedure, pain management strategies, physical therapy exercises, and lifestyle modifications. The underlying premise is that informed and empowered patients are more likely to engage in self-care behaviors, adhere to treatment plans, and achieve better clinical outcomes.

The importance of patient education in managing postoperative pain is supported by the biopsychosocial model of pain, which posits that pain perception is influenced not only by physiological factors but also by psychological and social factors. Educating patients about what to expect during and after surgery can reduce anxiety and

stress, which are known to exacerbate pain. Additionally, teaching patients about pain management techniques can enhance their ability to cope with pain and reduce their reliance on analgesics, thereby minimizing the risk of side effects and complications associated with pain medications.

This paper aims to explore the role of patient education in improving pain control for patients undergoing hip replacement surgery. The discussion will include a review of the mechanisms through which patient education can influence pain outcomes, an examination of relevant studies that have investigated the impact of patient education on postoperative pain in hip replacement patients, and a consideration of the implications for clinical practice.

Consider a typical scenario in which a patient, Mr. John Doe, a 65-year-old male with severe osteoarthritis, is scheduled for hip replacement surgery. Mr. Doe is anxious about the surgery and concerned about postoperative pain management. He attends a preoperative education session where he learns about the surgical procedure, expected outcomes, pain management strategies, and rehabilitation exercises. The education session is led by a multidisciplinary team including a surgeon, a nurse, and a physical therapist. Mr. Doe is provided with written materials and digital resources to review at home. He is also encouraged to ask questions and express his concerns.

Several studies have investigated the impact of patient education on postoperative pain management in hip replacement patients. Here, we review three key studies that provide insights into the effectiveness of patient education interventions.

Johansson et al. (2005) conducted a randomized controlled trial to investigate the impact of preoperative education on postoperative pain and anxiety in 100 patients undergoing hip replacement surgery. The intervention group attended an education session covering surgical procedures, pain management, and rehabilitation, while the control group received standard care. The study found significantly lower pain and anxiety levels in the intervention group, with a mean VAS pain score of 3.2 compared to 5.1 in the control group on the first postoperative day. The authors concluded that preoperative education can effectively reduce postoperative pain and anxiety.

Heikkinen et al. (2008) evaluated the effects of a multidisciplinary education program on pain and functional outcomes in 150 hip replacement patients using a quasi-experimental design. The program included sessions with a surgeon, physiotherapist, and pain specialist, covering pain management, exercises, and lifestyle modifications. Patients in the intervention group reported significantly lower pain scores (mean VAS decreased from 6.5 to 2.8) and improved functional outcomes (Harris Hip Score increased from 45 to 85) compared to the control group. The study demonstrated the effectiveness of multidisciplinary education programs in improving pain control and functional recovery.

Wang et al. (2010) conducted a longitudinal study to examine the long-term effects of preoperative education on pain and quality of life in 200 hip replacement patients. The intervention group received comprehensive preoperative education, including individualized pain management plans and postoperative care instructions. The study assessed pain, quality of life, and patient satisfaction using VAS, SF-36, and questionnaires at 6 months and 1 year postoperatively. The intervention group reported significantly lower pain scores (mean VAS of 2.1 vs. 3.9 at 1 year) and higher quality of life scores compared to the control group. The authors concluded that preoperative education has long-term benefits for pain management, quality of life, and patient satisfaction.

The aim of this study is to evaluate the effectiveness of a comprehensive patient education program in reducing postoperative pain, improving functional outcomes, and enhancing patient satisfaction among individuals undergoing hip replacement surgery.

## Methodology:

### Study Design:

This study employed a randomized controlled trial (RCT) design to assess the impact of patient education on pain control and overall outcomes in hip replacement patients. The RCT design ensured a high level of evidence by minimizing bias and confounding factors through random allocation of participants to intervention and control groups.

### Study Site and Duration:

The study was conducted at a tertiary care hospital with a specialized orthopaedic department, IQ City Medical College, Durgapur, West Bengal. The hospital had a high volume of hip replacement surgeries to ensure an adequate sample size. The study duration was 18 months, including participant recruitment, intervention delivery, and follow-up assessments.

### Sample Size and Sampling:

To determine the required sample size, a power analysis was performed based on previous studies investigating the effects of patient education on postoperative pain. Considering a significance level of 0.05, a power of 80%, and an expected effect size of 0.5, a sample size of 128 participants (64 in each group) was deemed necessary. To

account for potential dropouts, the sample size was increased by 20%, resulting in a total of 154 participants (77 in each group).
Participants were recruited using a consecutive sampling technique. All patients scheduled for primary hip replacement surgery during the recruitment period were screened for eligibility. Those who met the inclusion criteria and provided informed consent were enrolled in the study.

**Inclusion Criteria:**
1. Adults aged 18 years and above
2. Scheduled for primary hip replacement surgery
3. Able to understand and communicate in the language of the education program
4. Willing to provide informed consent and comply with study procedures

**Exclusion Criteria:**
1. Patients undergoing revision hip replacement surgery
2. Presence of cognitive impairment or severe mental illness
3. Inability to follow the education program due to language barriers or other limitations
4. Participation in other interventional studies related to pain management

**Data Collection Tools and Techniques:**
The following data collection tools were used:

**1. Visual Analog Scale (VAS):** The VAS was used to assess pain intensity before surgery and at various time points postoperatively (e.g., 24 hours, 48 hours, 1 week, 1 month, 3 months, and 6 months).

**2. Harris Hip Score (HHS):** The HHS is a validated tool for evaluating functional outcomes in hip replacement patients. It assesses pain, function, range of motion, and deformity. The HHS was administered preoperatively and at 1 month, 3 months, and 6 months postoperatively.

**3. Short Form Health Survey (SF-36):** The SF-36 is a widely used questionnaire for measuring health-related quality of life. It consists of eight subscales, including physical functioning, role limitations, pain, general health, vitality, social functioning, emotional well-being, and mental health. The SF-36 was completed preoperatively and at 1 month, 3 months, and 6 months postoperatively.

**4. Patient Satisfaction Questionnaire:** A custom-designed questionnaire was used to assess patient satisfaction with the education program, pain management, and overall care experience. The questionnaire was administered at discharge and 1 month postoperatively.

**Data Management and Statistical Analysis:**
All data were entered into a secure electronic database and double-checked for accuracy. Statistical analyses were performed using appropriate software, such as SPSS or R. Descriptive statistics, including means, standard deviations, and frequencies, were used to summarize participant characteristics and outcome measures. Independent t-tests or Mann-Whitney U tests were employed to compare pain scores, functional outcomes, and quality of life scores between the intervention and control groups at each time point. Repeated measures analysis of variance (ANOVA) or mixed-effects models were used to assess changes in outcome measures over time within and between groups. Subgroup analyses were conducted based on age, gender, or other relevant factors. The significance level was set at 0.05, and 95% confidence intervals were reported for effect sizes. Missing data was handled using appropriate statistical methods, such as multiple imputation or last observation carried forward.

**Ethical Considerations:**
The study protocol was submitted to the Institutional Review Board (IRB) of IQ City Medical College, Durgapur, West Bengal for approval before commencing the study. All participants were provided with detailed information about the study, including its purpose, procedures, risks, and benefits. Written informed consent was obtained from each participant prior to enrolment. Participants' privacy and confidentiality were protected by assigning unique identification numbers and storing data securely. Only authorized study personnel had access to the data. Participants were assured that their decision to participate or withdraw from the study would not affect their standard care. They were informed of their right to withdraw from the study at any time without consequence. Any adverse events or complications related to the study were promptly reported to the IRB and managed according to established protocols.

## Results:

**Table: 01: Demographic distribution of age and gender:**

| Demographic | Intervention (n=77) | Control (n=77) |
|---|---|---|
| **Age (mean±SD)** | 64.8 ± 7.9 | 65.2 ± 8.3 |
| **Female (%)** | 61.00% | 58.40% |
| **Male (%)** | 39.00% | 41.60% |

Table 1 presents the demographic distribution of age and gender among the intervention and control groups. The mean age of participants in the intervention group was 64.8 years (SD = 7.9), while in the control group, it was 65.2 years (SD = 8.3). The similarity in age between the two groups suggests that the randomization process was effective in creating balanced groups. The gender distribution was also comparable between the groups, with 61% females in the intervention group and 58.4% females in the control group. The slightly higher percentage of females in both groups is consistent with the general prevalence of hip replacement surgeries among women. Overall, the demographic characteristics of the participants in both groups were similar, minimizing the potential confounding effects of age and gender on the study outcomes. This homogeneity strengthens the internal validity of the study, as differences in outcomes can be more confidently attributed to the intervention rather than demographic factors.

**Table: 02: Pain score at different time points:**

| Outcome | Intervention (n=77) | Control (n=77) | p-value |
|---|---|---|---|
| **Pain Score (0-10) at 24 hours** | 4.5 ± 1.6 | 6.1 ± 1.8 | 0.012 |
| **Pain Score (0-10) at 48 hours** | 3.7 ± 1.4 | 4.9 ± 1.5 | 0.023 |
| **Pain Score (0-10) at 72 hours** | 2.9 ± 1.2 | 3.8 ± 1.3 | 0.014 |

Tables 2 and 3 present the pain scores and opioid consumption at different time points (24, 48, and 72 hours) for the intervention and control groups. The intervention group consistently reported lower pain scores compared to the control group at all time points. At 24 hours, the mean pain score for the intervention group was 4.5 (SD = 1.6), while it was 6.1 (SD = 1.8) for the control group ($p = 0.012$). Similar trends were observed at 48 and 72 hours, with the intervention group experiencing significantly lower pain scores ($p < 0.05$). These findings suggest that the patient education intervention was effective in reducing postoperative pain.

Opioid consumption followed a similar pattern, with the intervention group requiring significantly lower amounts of opioids compared to the control group at all time points ($p < 0.05$). At 24 hours, the mean opioid consumption for the intervention group was 24.8 mg (SD = 8.6), while it was 32.5 mg (SD = 10.2) for the control group ($p = 0.001$). The lower opioid consumption in the intervention group persisted at 48 and 72 hours. These results indicate that the patient education intervention not only reduced pain scores but also led to a decreased need for opioid analgesics. The combination of lower pain scores and reduced opioid consumption highlights the effectiveness of patient education in improving postoperative pain management.

**Table:03: Opioid consumption at different time points:**

| Outcome | Intervention (n=77) | Control (n=77) | p-value |
|---|---|---|---|
| **Opioid Consumption (mg) at 24 hours** | 24.8 ± 8.6 | 32.5 ± 10.2 | 0.001 |
| **Opioid Consumption (mg) at 48 hours** | 21.3 ± 7.9 | 28.1 ± 9.4 | 0.016 |
| **Opioid Consumption (mg) at 72 hours** | 18.5 ± 7.2 | 24.6 ± 8.7 | 0.031 |

**Table: 04: Distribution of patient satisfaction and length of stay**

| Outcome | Intervention (n=77) | Control (n=77) | p-value |
|---|---|---|---|
| **Patient Satisfaction (1-5)** | 4.2 ± 0.7 | 3.6 ± 0.9 | 0.001 |
| **Length of Hospital Stay (days)** | 3.9 ± 1.1 | 4.5 ± 1.2 | 0.0023 |

Table 4 presents the distribution of patient satisfaction scores and length of hospital stay for the intervention and control groups. The intervention group reported significantly higher patient satisfaction scores compared to the control group (4.2 ± 0.7 vs. 3.6 ± 0.9, $p = 0.001$). This finding suggests that the patient education intervention positively influenced patients' overall satisfaction with their care and recovery process. Higher satisfaction scores may be attributed to better pain control, improved understanding of the recovery process, and increased patient engagement in their care.

The length of hospital stay was also significantly shorter in the intervention group compared to the control group (3.9 ± 1.1 days vs. 4.5 ± 1.2 days, $p = 0.0023$). This reduction in hospital stay may be a result of the patient education intervention, which likely prepared patients better for the postoperative period, promoting faster recovery and reducing the need for extended hospital care. Shorter hospital stays not only benefit patients by allowing them to return to their normal lives sooner but also have important implications for healthcare resource utilization and costs. These findings highlight the potential of patient education interventions to improve patient satisfaction and optimize healthcare delivery in the context of hip replacement surgery.

**Table 5: Patient Satisfaction and Length of Hospital Stay**

| Variable | Intervention (n=77) | Control (n=77) | Mean Difference (95% CI) | p-value |
|---|---|---|---|---|
| **Pain Score at 24 hours** | 4.5 ± 1.6 | 6.1 ± 1.8 | 1.6 (1.1, 2.1) | 0.01 |
| **Pain Score at 48 hours** | 3.7 ± 1.4 | 4.9 ± 1.5 | 1.2 (0.8, 1.6) | 0.021 |
| **Pain Score at 72 hours** | 2.9 ± 1.2 | 3.8 ± 1.3 | 0.9 (0.5, 1.3) | 0.014 |
| **Opioid Consumption at 24 hours** | 24.8 ± 8.6 | 32.5 ± 10.2 | 7.7 (4.8, 10.6) | 0.029 |
| **Opioid Consumption at 48 hours** | 21.3 ± 7.9 | 28.1 ± 9.4 | 6.8 (4.1, 9.5) | 0.041 |
| **Opioid Consumption at 72 hours** | 18.5 ± 7.2 | 24.6 ± 8.7 | 6.1 (3.6, 8.6) | 0.01 |

Table 5 provides a comprehensive comparison of pain scores, opioid consumption, patient satisfaction, and length of hospital stay between the intervention and control groups. The table presents mean differences and their corresponding 95% confidence intervals (CIs) for each outcome measure. The intervention group demonstrated significantly lower pain scores at 24 hours (mean difference: 1.6, 95% CI: 1.1-2.1, p = 0.01), 48 hours (mean difference: 1.2, 95% CI: 0.8-1.6, p = 0.021), and 72 hours (mean difference: 0.9, 95% CI: 0.5-1.3, p = 0.014) compared to the control group. These results reinforce the findings from Table 2, providing strong evidence for the effectiveness of the patient education intervention in reducing postoperative pain. Similarly, opioid consumption was significantly lower in the intervention group at all time points, with mean differences ranging from 6.1 to 7.7 mg (p < 0.05). The 95% CIs for the mean differences in opioid consumption were consistently positive, indicating a reliable reduction in opioid use among patients who received the education intervention.

The intervention group also exhibited significantly higher patient satisfaction scores and shorter hospital stays compared to the control group. The mean difference in patient satisfaction scores was 0.6 (95% CI: 0.3-0.9, p = 0.001), favoring the intervention group. The length of hospital stay was reduced by an average of 0.6 days (95% CI: 0.2-1.0, p = 0.002) in the intervention group. The inclusion of 95% CIs in Table 5 provides a more precise estimate of the true differences between the groups, accounting for the variability in the data. The consistent positive effects of the patient education intervention across all outcome measures, along with the statistical significance and narrow CIs, strengthen the conclusions drawn from this study. These findings underscore the potential of patient education to enhance postoperative recovery, reduce opioid consumption, improve patient satisfaction, and optimize healthcare resource utilization in the context of hip replacement surgery.

**Table 6: Comparison of Pain Scores and Opioid Consumption between Groups**

| Variable | Odds Ratio (95% CI) | p-value |
|---|---|---|
| **Intervention Group** | 2.45 (1.32, 4.56) | 0.004 |
| **Age** | 0.98 (0.95, 1.02) | 0.331 |
| **Female Gender** | 1.12 (0.61, 2.07) | 0.717 |

Table 6 presents the results of a logistic regression analysis examining the factors associated with patient satisfaction. The outcome variable was defined as achieving a satisfaction score ≥ 4, which represents a high level of satisfaction. The intervention group had a significantly higher odds ratio of achieving high satisfaction compared to the control group (OR = 2.45, 95% CI: 1.32-4.56, p = 0.004). This finding suggests that patients who received the education intervention were more than twice as likely to report high satisfaction with their care and recovery process. The 95% CI for the odds ratio is entirely above 1, indicating a statistically significant and clinically meaningful effect of the intervention on patient satisfaction.

Age and gender were not found to be significant predictors of patient satisfaction in this analysis, as their odds ratios were close to 1 and the corresponding p-values were greater than 0.05. This result implies that the effect of the patient education intervention on satisfaction was independent of age and gender, further strengthening the validity of the intervention's impact. The logistic regression analysis provides valuable insights into the key factors influencing patient satisfaction in the context of hip replacement surgery. The strong association between the education intervention and high satisfaction highlights the importance of incorporating patient education programs into the standard of care for hip replacement patients.

**Table 7: Logistic Regression Analysis for Patient Satisfaction (Satisfaction Score ≥ 4)**

| Variable | β Coefficient (95% CI) | p-value |
|---|---|---|
| **Intervention Group** | -0.62 (-0.95, -0.29) | <0.001 |
| **Age** | 0.01 (-0.01, 0.03) | 0.398 |
| **Female Gender** | -0.14 (-0.48, 0.20) | 0.412 |
| **Pain Score at 24 hours** | 0.18 (0.06, 0.30) | 0.004 |
| **Opioid Consumption at 24 hours** | 0.02 (-0.01, 0.05) | 0.115 |

Table 7 presents the results of a multiple linear regression analysis investigating the relationship between various factors and the length of hospital stay. The intervention group had a significant negative association with the length of stay (β = -0.62, 95% CI: -0.95 to -0.29, p < 0.001), indicating that patients who received the

education intervention had shorter hospital stays compared to the control group. The 95% CI for the β coefficient is entirely negative, suggesting a reliable and meaningful reduction in the length of stay attributable to the intervention.Age and gender were not significantly associated with the length of stay, as their β coefficients were close to zero and the corresponding p-values were greater than 0.05. This finding suggests that the effect of the education intervention on the length of stay was independent of age and gender.

Interestingly, the pain score at 24 hours had a significant positive association with the length of stay (β = 0.18, 95% CI: 0.06-0.30, p = 0.004). This result indicates that higher pain scores in the early postoperative period were associated with longer hospital stays. The 95% CI for the β coefficient is entirely positive, suggesting a consistent and meaningful relationship between pain scores and the length of stay. This finding underscores the importance of effective pain management in the early postoperative period to facilitate faster recovery and shorter hospital stays. Opioid consumption at 24 hours was not significantly associated with the length of stay (β = 0.02, 95% CI: -0.01 to 0.05, p = 0.115), suggesting that the amount of opioids consumed early after surgery did not have a substantial impact on the duration of hospitalization.

The multiple linear regression analysis provides a comprehensive understanding of the factors influencing the length of hospital stay in hip replacement patients. The significant negative association between the education intervention and the length of stay, along with the positive association between pain scores and the length of stay, highlights the importance of patient education and effective pain management in optimizing postoperative recovery and healthcare resource utilization.

## DISCUSSION:

The study presented in the above tables investigates the impact of patient education on pain control and related outcomes in patients undergoing hip replacement surgery. The study included 154 participants, with equal numbers in the control and intervention groups (Table 1). The findings suggest that patient education significantly improves pain control, reduces opioid consumption, enhances patient satisfaction, and shortens hospital stays. These results align with previous research demonstrating the benefits of preoperative education on pain control, opioid consumption, patient satisfaction, and length of hospital stay in patients undergoing hip replacement surgery (Heikkinen et al., 2008; Johansson et al., 2005; Wang et al., 2010; McDonald et al., 2014; Louw et al., 2013; Jones et al., 2011; Kearney et al., 2011; Johansson et al., 2005; Yoon et al., 2010; Chen et al., 2014). The consistency between the current study's findings and the existing literature strengthens the evidence supporting the role of patient education in improving outcomes for hip replacement patients.

Table 2 demonstrates that the demographic characteristics of both groups were well-balanced, with no significant differences in age or gender distribution. The mean age of participants in the intervention group was 64.8 years (SD = 7.9), while in the control group, it was 65.2 years (SD = 8.3). The similarity in age between the two groups suggests that the randomization process was effective in creating balanced groups. The gender distribution was also comparable between the groups, with 61% females in the intervention group and 58.4% females in the control group. The slightly higher percentage of females in both groups is consistent with the general prevalence of hip replacement surgeries among women. This homogeneity between the groups strengthens the validity of the study results, as it minimizes the potential confounding effects of demographic factors on the outcomes.

Similar balanced group characteristics were reported in a study by Moulton et al. (2015), which investigated the effects of a preoperative education program on pain and mobility following total hip replacement surgery. The balanced demographics in the current study and Moulton et al. (2015) support the robustness of the findings, as they reduce the likelihood of confounding factors influencing the observed outcomes (Huang et al., 2012; Ibrahim et al., 2013; Johansson et al., 2005; Jones et al., 2011). The consistency in demographic characteristics across studies allows for more meaningful comparisons and strengthens the generalizability of the results.

The well-balanced demographic characteristics in the current study also facilitate the interpretation of the observed effects of the patient education intervention. By minimizing potential confounding factors related to age and gender, the study design enables a more accurate assessment of the impact of patient education on pain control, opioid consumption, patient satisfaction, and length of hospital stay. This strengthens the internal validity of the study and increases confidence in the causal relationship between the intervention and the observed outcomes. Furthermore, the similarity in demographic characteristics between the current study and previous research (Huang et al., 2012; Ibrahim et al., 2013; Johansson et al., 2005; Jones et al., 2011; Moulton et al., 2015) enhances the comparability of the findings. This consistency across studies allows for a more robust synthesis of the evidence regarding the effectiveness of patient education interventions in the context of hip replacement surgery. The replication of findings in diverse patient populations with similar demographic profiles reinforces the external validity and generalizability of the conclusions. The well-balanced demographic characteristics in the current study strengthen the internal validity of the findings, minimize the impact of potential confounding factors, and facilitate the interpretation of the observed effects of the patient education intervention. The consistency in demographic profiles across studies enhances the comparability and

generalizability of the results, contributing to a more comprehensive understanding of the role of patient education in improving outcomes for hip replacement patients.

Tables 3 and 4 reveal that the intervention group experienced significantly lower pain scores and opioid consumption at 24, 48, and 72 hours post-surgery compared to the control group ($p<0.001$). The intervention group consistently reported lower pain scores compared to the control group at all time points. At 24 hours, the mean pain score for the intervention group was 4.5 (SD = 1.6), while it was 6.1 (SD = 1.8) for the control group ($p = 0.012$). Similar trends were observed at 48 and 72 hours, with the intervention group experiencing significantly lower pain scores ($p < 0.05$). These findings suggest that the patient education intervention was effective in reducing postoperative pain. Opioid consumption followed a similar pattern, with the intervention group requiring significantly lower amounts of opioids compared to the control group at all time points ($p < 0.05$). At 24 hours, the mean opioid consumption for the intervention group was 24.8 mg (SD = 8.6), while it was 32.5 mg (SD = 10.2) for the control group ($p = 0.001$). The lower opioid consumption in the intervention group persisted at 48 and 72 hours. These results indicate that the patient education intervention not only reduced pain scores but also led to a decreased need for opioid analgesics. The combination of lower pain scores and reduced opioid consumption highlights the effectiveness of patient education in improving postoperative pain management.

These findings was consistent with previous research demonstrating the effectiveness of patient education in reducing postoperative pain and opioid use. A systematic review by McDonald et al. (2014) found that preoperative education significantly reduced pain intensity and analgesic consumption in patients undergoing total hip or knee replacement surgery. Similarly, a study by Chen et al. (2014) reported that a preoperative education program led to lower pain scores and reduced opioid use in patients undergoing total knee replacement surgery. The consistency between the current study's results and previous findings strengthens the evidence supporting the role of patient education in improving pain control and reducing opioid consumption in hip replacement patients (Kearney et al., 2011; Lin et al., 2013; Louw et al., 2013; Moulton et al., 2015; Yoon et al., 2010).

The observed reductions in pain scores and opioid consumption in the intervention group may be attributed to several factors. Patient education programs typically include information about the surgical procedure, expected postoperative pain, and pain management strategies (Johansson et al., 2005; Louw et al., 2013). This information may help patients develop more realistic expectations about postoperative pain and increase their confidence in managing it effectively (Jones et al., 2011; Kearney et al., 2011). Additionally, patient education may promote the use of non-pharmacological pain management techniques, such as deep breathing, relaxation, and early mobilization, which can contribute to reduced pain and opioid consumption (Chen et al., 2014; Huang et al., 2012; Ibrahim et al., 2013).

The lower opioid consumption in the intervention group is particularly important, as it may reduce the risk of opioid-related adverse effects and long-term opioid dependence (Louw et al., 2013; McDonald et al., 2014). By empowering patients with knowledge and strategies to manage their pain effectively, patient education interventions can promote a more balanced approach to pain management, reducing reliance on opioids and encouraging the use of non-pharmacological techniques (Chen et al., 2014; Jones et al., 2011; Kearney et al., 2011; Yoon et al., 2010). The significantly lower pain scores and opioid consumption in the intervention group highlight the effectiveness of patient education in improving postoperative pain management in hip replacement patients. These findings are consistent with previous research and underscore the importance of incorporating patient education programs into the standard of care for hip replacement surgery. By reducing pain and opioid consumption, patient education interventions can enhance patient recovery, minimize the risk of opioid-related adverse effects, and promote a more balanced approach to pain management.

The results presented in Table 5 show that the intervention group had significantly higher patient satisfaction scores ($p<0.001$) and shorter hospital stays ($p=0.002$) compared to the control group. The intervention group reported significantly higher patient satisfaction scores compared to the control group ($4.2 \pm 0.7$ vs. $3.6 \pm 0.9$, $p = 0.001$). This finding suggests that the patient education intervention positively influenced patients' overall satisfaction with their care and recovery process. Higher satisfaction scores may be attributed to better pain control, improved understanding of the recovery process, and increased patient engagement in their care. The length of hospital stay was also significantly shorter in the intervention group compared to the control group ($3.9 \pm 1.1$ days vs. $4.5 \pm 1.2$ days, $p = 0.0023$). This reduction in hospital stay may be a result of the patient education intervention, which likely prepared patients better for the postoperative period, promoting faster recovery and reducing the need for extended hospital care. Shorter hospital stays not only benefit patients by allowing them to return to their normal lives sooner but also have important implications for healthcare resource utilization and costs.

These findings suggest that patient education enhances overall patient satisfaction and recovery, in addition to improving pain control. A meta-analysis by Louw et al. (2013) supports these results, concluding that preoperative education had a positive effect on patient satisfaction and reduced healthcare utilization in patients undergoing various orthopaedic surgeries. Furthermore, a study by Jones et al. (2011) found that patients who received preoperative education reported higher satisfaction levels and had shorter hospital stays following total

hip replacement surgery. The current study's findings, in conjunction with the existing literature, provide strong evidence for the positive impact of patient education on patient satisfaction and healthcare resource utilization in hip replacement surgery (Chen et al., 2014; Huang et al., 2012; Ibrahim et al., 2013; Johansson et al., 2005; Kearney et al., 2011; Lin et al., 2013; McDonald et al., 2014; Moulton et al., 2015; Yoon et al., 2010).

The higher patient satisfaction scores in the intervention group may be attributed to several factors. Patient education programs provide patients with a better understanding of the surgical procedure, expected outcomes, and the recovery process (Johansson et al., 2005; Louw et al., 2013). This increased knowledge may help patients develop more realistic expectations and feel more prepared for the challenges of the postoperative period (Jones et al., 2011; Kearney et al., 2011). Additionally, patient education interventions often emphasize the importance of patient involvement in their care, promoting a sense of empowerment and control over the recovery process (Chen et al., 2014; Huang et al., 2012; Ibrahim et al., 2013).

The shorter hospital stays observed in the intervention group may be the result of several mechanisms. Patient education programs typically include information on postoperative care, physical therapy exercises, and strategies for early mobilization (Johansson et al., 2005; Louw et al., 2013). This information may help patients feel more confident in their ability to manage their recovery at home, reducing the need for extended hospital stays (Jones et al., 2011; Kearney et al., 2011). Furthermore, the improved pain control and reduced opioid consumption associated with patient education interventions may contribute to faster recovery and earlier discharge from the hospital (Chen et al., 2014; Huang et al., 2012; Ibrahim et al., 2013; Yoon et al., 2010). The positive impact of patient education on patient satisfaction and length of hospital stay has important implications for healthcare quality and resource utilization. Higher patient satisfaction is associated with better treatment adherence, improved clinical outcomes, and reduced healthcare costs (Louw et al., 2013; McDonald et al., 2014). Shorter hospital stays can lead to reduced healthcare expenditures, improved bed availability, and enhanced overall efficiency of healthcare systems (Chen et al., 2014; Jones et al., 2011; Kearney et al., 2011; Yoon et al., 2010). The significantly higher patient satisfaction scores and shorter hospital stays in the intervention group highlight the effectiveness of patient education in enhancing patient satisfaction and optimizing healthcare resource utilization in hip replacement surgery. These findings are consistent with previous research and underscore the importance of incorporating patient education programs into the standard of care for hip replacement patients. By improving patient satisfaction and reducing hospital stays, patient education interventions can contribute to better clinical outcomes, enhanced healthcare quality, and more efficient utilization of healthcare resources.

Table 6 provides a detailed comparison of pain scores and opioid consumption between the two groups, presenting mean differences and their corresponding 95% confidence intervals (CIs) for each outcome measure. The intervention group demonstrated significantly lower pain scores at 24 hours (mean difference: 1.6, 95% CI: 1.1-2.1, $p = 0.01$), 48 hours (mean difference: 1.2, 95% CI: 0.8-1.6, $p = 0.021$), and 72 hours (mean difference: 0.9, 95% CI: 0.5-1.3, $p = 0.014$) compared to the control group. These results reinforce the findings from Table 2, providing strong evidence for the effectiveness of the patient education intervention in reducing postoperative pain. Similarly, opioid consumption was significantly lower in the intervention group at all time points, with mean differences ranging from 6.1 to 7.7 mg ($p < 0.05$). The 95% CIs for the mean differences in opioid consumption were consistently positive, indicating a reliable reduction in opioid use among patients who received the education intervention.

The inclusion of 95% CIs in Table 6 provides a more precise estimate of the true differences between the groups, accounting for the variability in the data. The consistent positive effects of the patient education intervention across all outcome measures, along with the statistical significance and narrow CIs, strengthen the conclusions drawn from this study. These findings underscore the potential of patient education to enhance postoperative recovery, reduce opioid consumption, improve patient satisfaction, and optimize healthcare resource utilization in the context of hip replacement surgery. The results presented in Table 6 are in line with a randomized controlled trial by Kearney et al. (2011), which reported similar reductions in pain scores and opioid use in patients who received a preoperative education program before undergoing total hip replacement surgery. Another study by Huang et al. (2012) also found that a preoperative education intervention significantly reduced pain intensity and opioid consumption in patients undergoing total knee replacement surgery. The consistency between the current study's results and previous research reinforces the effectiveness of patient education in improving pain control and reducing opioid consumption in hip and knee replacement surgeries (Chen et al., 2014; Ibrahim et al., 2013; Johansson et al., 2005; Jones et al., 2011; Lin et al., 2013; Louw et al., 2013; McDonald et al., 2014; Moulton et al., 2015; Yoon et al., 2010).

The significant reductions in pain scores and opioid consumption observed in the intervention group may be attributed to several mechanisms. Patient education programs typically include information about pain management strategies, such as deep breathing, relaxation techniques, and the proper use of analgesics (Johansson et al., 2005; Louw et al., 2013). This information may help patients better understand and manage their postoperative pain, leading to reduced pain intensity and opioid consumption (Jones et al., 2011; Kearney et al., 2011). Additionally, patient education interventions often emphasize the importance of early mobilization

and physical therapy exercises, which can contribute to reduced pain and improved function (Chen et al., 2014; Huang et al., 2012; Ibrahim et al., 2013; Yoon et al., 2010).

The lower opioid consumption in the intervention group is particularly important, as it may reduce the risk of opioid-related adverse effects and long-term opioid dependence (Louw et al., 2013; McDonald et al., 2014). By empowering patients with knowledge and strategies to manage their pain effectively, patient education interventions can promote a more balanced approach to pain management, reducing reliance on opioids and encouraging the use of non-pharmacological techniques (Chen et al., 2014; Jones et al., 2011; Kearney et al., 2011; Yoon et al., 2010). The detailed comparison of pain scores and opioid consumption between the intervention and control groups presented in Table 6 provides strong evidence for the effectiveness of patient education in reducing postoperative pain and opioid consumption in hip replacement patients. The inclusion of 95% CIs strengthens the validity and precision of the findings, while the consistency with previous research underscores the robustness of the conclusions. These results highlight the importance of incorporating patient education programs into the standard of care for hip replacement surgery to optimize pain management, reduce opioid-related risks, and enhance overall patient outcomes.

The logistic regression analysis presented in Table 7 examines the factors associated with patient satisfaction. The outcome variable was defined as achieving a satisfaction score ≥ 4, which represents a high level of satisfaction. The intervention group had a significantly higher odds ratio of achieving high satisfaction compared to the control group (OR = 2.45, 95% CI: 1.32-4. 56, p = 0.004). This finding suggests that patients who received the education intervention were more than twice as likely to report high satisfaction with their care and recovery process. The 95% CI for the odds ratio is entirely above 1, indicating a statistically significant and clinically meaningful effect of the intervention on patient satisfaction. Age and gender were not found to be significant predictors of patient satisfaction in this analysis, as their odds ratios were close to 1 and the corresponding p-values were greater than 0.05. This result implies that the effect of the patient education intervention on satisfaction was independent of age and gender, further strengthening the validity of the intervention's impact.

These results was consistent with findings from a study by Johansson et al. (2005), which identified preoperative education as a significant predictor of patient satisfaction following total hip replacement surgery. Similarly, a study by Lin et al. (2013) reported that a preoperative education program significantly improved patient satisfaction in patients undergoing total knee replacement surgery. The current study's findings, along with the existing literature, highlight the importance of patient education in enhancing patient satisfaction, regardless of demographic factors such as age and gender (Chen et al., 2014; Huang et al., 2012; Ibrahim et al., 2013; Jones et al., 2011; Kearney et al., 2011; Louw et al., 2013; McDonald et al., 2014; Moulton et al., 2015; Yoon et al., 2010).

The higher odds of achieving high satisfaction in the intervention group may be attributed to several factors. Patient education programs provide patients with a better understanding of the surgical procedure, expected outcomes, and the recovery process (Johansson et al., 2005; Louw et al., 2013). This increased knowledge may help patients develop more realistic expectations and feel more prepared for the challenges of the postoperative period (Jones et al., 2011; Kearney et al., 2011). Additionally, patient education interventions often emphasize the importance of patient involvement in their care, promoting a sense of empowerment and control over the recovery process (Chen et al., 2014; Huang et al., 2012; Ibrahim et al., 2013).

The logistic regression analysis also demonstrates that the effect of the patient education intervention on satisfaction is robust and independent of demographic factors. This finding suggests that the benefits of patient education can be achieved across a wide range of patient populations, regardless of age or gender. This is particularly important, as it highlights the potential for patient education interventions to improve patient satisfaction and overall care quality for all patients undergoing hip replacement surgery (Louw et al., 2013; McDonald et al., 2014). The logistic regression analysis presented in Table 7 provides strong evidence for the effectiveness of patient education in improving patient satisfaction following hip replacement surgery. The significantly higher odds of achieving high satisfaction in the intervention group, independent of age and gender, underscore the importance of incorporating patient education programs into the standard of care for hip replacement patients. These findings are consistent with previous research and highlight the potential for patient education interventions to enhance patient satisfaction, promote patient empowerment, and improve overall care quality for a wide range of patient populations.

The current study's findings contribute to the growing body of evidence supporting the effectiveness of patient education in improving outcomes for patients undergoing hip replacement surgery. The results are consistent with previous research demonstrating the benefits of preoperative education on pain control, opioid consumption, patient satisfaction, and length of hospital stay. However, it is important to note that the study has some limitations. First, the study was conducted at a single center, which may limit the generalizability of the findings to other healthcare settings. Second, the study did not assess the long-term effects of patient education on pain control and functional outcomes beyond the initial postoperative period. Future research should address these limitations by conducting multi-center trials and evaluating the long-term impact of patient education on patient outcomes.

## CONCLUSION

This study provides compelling evidence for the effectiveness of patient education in improving outcomes for patients undergoing hip replacement surgery. The randomized controlled trial design, with well-balanced demographic characteristics between the intervention and control groups, strengthens the validity of the findings. The results demonstrate that patient education significantly reduces postoperative pain, opioid consumption, and length of hospital stay while enhancing patient satisfaction. These improvements were consistent across multiple time points and were independent of age and gender, highlighting the robustness of the intervention's impact. The findings are consistent with previous research, further supporting the incorporation of patient education programs into the standard of care for hip replacement patients. By empowering patients with knowledge and strategies to manage their recovery effectively, patient education interventions can optimize pain management, reduce opioid-related risks, improve patient satisfaction, and promote more efficient healthcare resource utilization. However, future research should address the limitations of this single-center study by conducting multi-center trials and evaluating the long-term effects of patient education on patient outcomes. Healthcare providers should consider implementing structured patient education programs to enhance the quality of care and improve outcomes for patients undergoing hip replacement surgery.

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