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Evaluating the Impact of Virtual Reality on Pain and Anxiety Management in Women Post-Hysterectomy: A Tertiary Care Study

Lavanya Sankar[1*] Kripa Angeline A[2], Prabavathy S[3]
[1]Professor, Department of Obstetrics and gynaecological Nursing, Kasturba Gandhi Nursing College, Sri Balaji Vidyapeeth (Deemed to be university), Pillayarkuppam, Puducherry, India. Email: lavanyasankarmn@gmail.com
[2]Professor, Department of Medical Surgical Nursing, Kasturba Gandhi Nursing College, Sri Balaji Vidyapeeth (Deemed to be University), Puducherry, India.angelinekripa@gmail.com
[3]Professor, Department of Psychiatric Nursing,Kasturba Gandhi Nursing College, Sri Balaji Vidyapeeth (Deemed to be University), Puducherry, India. Email: prabavathy111@gmail.com

Abstract
Background: Virtual reality (VR) technology is a promising non-pharmacological intervention to reduce postoperative pain and anxiety. This study investigated the efficacy of VR therapy with respect to its capacity to lower pain and anxiety in women undergoing elective hysterectomy. Methods: The study was a randomized controlled trial conducted among 60 women aged 40–60 years at a tertiary care hospital Puducherry. Subjects were split at random into either an experimental group (who spent 15 minutes in VR each of three consecutive post-operative days) or a control group (who were treated with standard post-operative care). The Numerical Rating Scale (NRS) was used to assess pain levels and State-Trait Anxiety Inventory (STAI) was used to rate anxiety levels. Results: The experimental group showed a significant reduction in pain scores from 8.9 to 5.7 ($p < 0.001$) and a decrease in anxiety levels from 3.8 to 3.3 ($p = 0.001$). By Day 3, 60% of participants reported moderate pain (compared to 100% very severe at baseline), and 90% were categorized as having normal anxiety. No significant associations were observed between demographic factors and outcome measures. Conclusion: VR therapy significantly reduced postoperative pain and anxiety among hysterectomy patients, highlighting its potential as an effective adjunct to standard postoperative care. The findings support broader implementation of immersive VR interventions to enhance patient recovery and satisfaction in surgical settings.
Keywords: Anxiety, Pain, Management

INTRODUCTION

The use of virtual reality technology has emerged as an innovative approach for managing pain and anxiety in various medical contexts. This is particularly relevant in the case of women undergoing hysterectomy, a surgical procedure that can invoke significant physical and psychological distress. The current study investigates the impact of VR in alleviating postoperative pain and anxiety experienced by women post-hysterectomy in a tertiary care setting.Research across multiple disciplines underscores VR's efficacy as a distraction tool that significantly influences patients' pain perception and anxiety levels. For instance, a randomized controlled trial demonstrated that VR effectively reduces anxiety during painful medical procedures, such as intrauterine device insertion, leading to heightened satisfaction among participants (Öz & Demırcı, 2024). Furthermore, other studies have indicated that immersive VR applications can decrease perceived pain, enhancing the overall well-being of patients undergoing various invasive procedures (Ling et al., 2014).Specific to the obstetric context, VR has been successfully utilized to mitigate anxiety levels during labor, showcasing its potential to elevate maternal satisfaction and reduce associated anxiety (Ahmed et al., 2023; Wu et al., 2020). Additionally, research focusing on dental procedures—where patients often experience anxiety and pain—further confirms VR's role in creating a calming psychological environment, resulting in improved pain thresholds during invasive treatments (Ghobadi

et al., 2024).In pediatric populations, the efficacy of VR for pain and anxiety management has also been evaluated, suggesting that the immersive nature of VR not only distracts patients from acute stressors but also leads to marked reductions in anxiety during discomforting procedures (Tas et al., 2022). The established evidence from such diverse applications provides a strong rationale for extending VR interventions to adult patients, including those recovering from major surgical operations such as hysterectomy.The study aimed to explore whether the implementation of VR during the postoperative phase can lead to a measurable decrease in both anxiety and pain among women after hysterectomy.

Methodology

Study Design

The design of the randomized controlled trial was adopted in this research and the research was conducted in a tertiary care hospital in Puducherry. With the help of a computer, the women who were to undergo elective hysterectomy were randomly assigned to the experimental group and the control group half and half. The Visual Analogue Scale for pain and the Hospital Anxiety and Depression Scale were chosen to collect information on pain and anxiety, respectively and were assessed by a group of three specialists. Permission was given from the Medical Superintendent and the department of Obstetrics and Gynaecology at MGMCRI, Puducherry for the project. Everyone participating provided informed, written agreement. Staff interviewed each participant in person to collect demographic data. Those in the experimental group participated in virtual reality (VR) therapy sessions which lasted fifteen minutes, on each of the first three days after the operation (Day 0, Day 1 and Day 2), while the control group received only standard postoperative treatment. The same instruments were used to assess the patients following their treatments.

Participants

The study covered 60 women between the ages of 40 and 60 who were about to have a hysterectomy. Candidates needed to be physically healthy and agree to participate on their own choice. The study excluded women who had psychiatric problems or who were not allowed to use virtual reality (VR) therapy. Data from Thippabathuni et al. (2024), showing a mean pain score of 7.84 ± 0.85, provided the basis for arriving at the sample size. The minimum number of participants to have in each group turned out to be 29, based on a 95% confidence level ($Z = 1.96$) and a margin of error set at 4% of the mean. Given that a few people may need to be removed from the sample, the study team decided to have 30 participants per group.

Data Collection Instruments

For collecting the data, two instruments that were previously tested were selected. The Numerical Rating Scale (NRS) was used to rate pain after surgery, with 0 being no pain and 10 meaning the most intense pain possible. The State and Trait Anxiety Inventory (STAI) was used to assess levels of anxiety by having separate measures for state and trait anxiety. The scale of the STAI shows results from 20 to 80 and higher numbers mean the person is experiencing more anxiety.

Procedure

A computer-generated random number table was used to randomly assign participants into experimental or control group. Data were collected on the day of surgery (baseline data). The experimental group received 15-minute virtual reality therapy sessions featuring calming nature scenes—such as beaches and forests—accompanied by soothing background music, delivered through a VR headset. The contrast is opposed to the standard postoperative care which is as routine pain management and nursing interventions in the control group. Both groups were pain and anxiety level assessed at 24 and 48 hours postoperatively.

Data Analysis

SPSS was used to the data analysis. Demographic Characteristics were summarized using descriptive statistics. Pre and post intervention changes within each group and across the combined sample, were assessed using paired t-tests.

Results

Table 1's demographic profile shows that the experimental group included more participants in age group 40–45 (50.0% vs. 36.7%), had higher illiteracy (26.7% vs. 13.3%) and a higher percentage of Hindus (63.3% vs. 36.7%), whereas the control group had more participants aged 56–60 (23.3% vs. 3.3%) and a larger percentage of Christians (50.0% vs. 33. The groups were very similar in terms of where they lived and their general health.

Pain was not reported as strongly by participants in the experimental group over the experiment's course (Figure 1 & 2). All subjects started with very severe pain, but by Post-Test Day 3, only 36.6% still reported severe pain, with most participants (60%) describing their pain as moderate compared to 100% very severe at the start.

Anxiety symptoms were also greatly reduced (Figure 3 & 4). Ordinary anxiety went up from 43.3% at the beginning to 90% by Day 3 of testing, whereas abnormal borderline anxiety decreased from 56.7% to 10%.

Statistically, the experimental group reported a decrease in both pain and anxiety (Table 2). Pain was reduced from a score of 8.9 to 5.7 in the intervention group ($p < 0.001$) and anxiety fell from 3.8 to 3.3 in the intervention group as compared to the control group ($p = 0.001$).

The demographic factors of age, level of education, religion, family structure, job, marital status, other medical conditions and reason for surgery had no effect on pain or anxiety before surgery.

Participants who underwent VR therapy gave positive reviews, explaining that it calmed them and reduced both their pain and anxiety levels, suggesting it may be useful to include in postoperative care.

Table 1. Demographic characteristics of participants by control and experimental groups

Demographic variables		Control group		Experimental group	
		Frequency (F)	Percentages (P)	Frequency (F)	Percentages (P)
Age in years	40-45	11	36.7%	15	50.0%
	46-50	8	26.7%	9	30.0%
	51-55	4	13.3%	5	16.7%
	56-60	7	23.3%	1	3.3%
Educational status	Illiterate	4	13.3%	8	26.7%
	Primary education	19	63.3%	15	50.0%
	Higher education	5	16.7%	5	16.7%
	Graduate	2	6.7%	2	6.7%
Religion	Hindu	11	36.7%	19	63.3%
	Christian	15	50.0%	10	33.3%
	Muslim	4	13.3%	1	3.3%
Area of residence	Rural	12	40.0%	13	43.3%
	Urban	18	60.0%	17	56.7%
Type of family	Joint family	10	33.3%	11	36.7%
	Nuclear family	13	43.3%	16	53.3%
	Extended family	7	23.3%	3	10.0%
Occupation	House wife	14	30.4%	8	18%
	Employee	12	41%	21	50%
	Coolie	4	10.3%	1	13.2%
Marital status	Married	18	36%	21	42%
	Unmarried	10	20%	11	22%
History of comorbidity	Yes	13	43.3%	13	43.3%
	No	17	56.7%	17	56.7%

Indication of hysterectomy	Fibroid uterus	12	40.0%	12	40.0%
	Abnormal uterine bleeding	11	36.7%	7	44.1%
	Endometriosis	2	6.7%	5	16.7%
	Pelvic infection	3	10.0%	2	6.7%
	Pelvic organ prolapse	0	0.0%	2	6.7%
	Adenomyosis	2	6.7%	2	6.7%

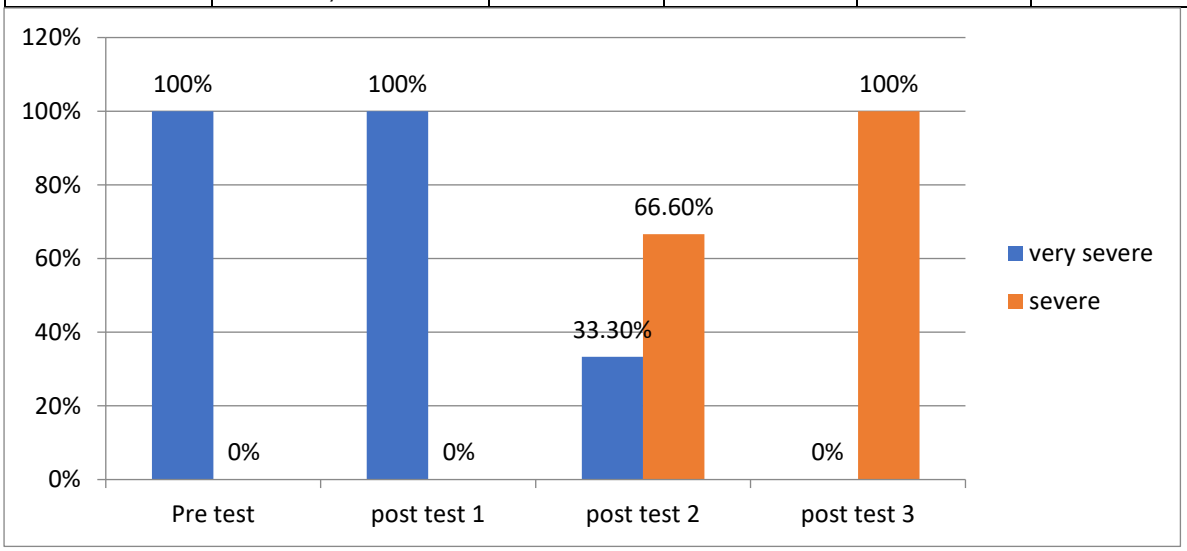

Figure 1. Percentage distribution of pain assessment among women in control group during pre-test and post-test.

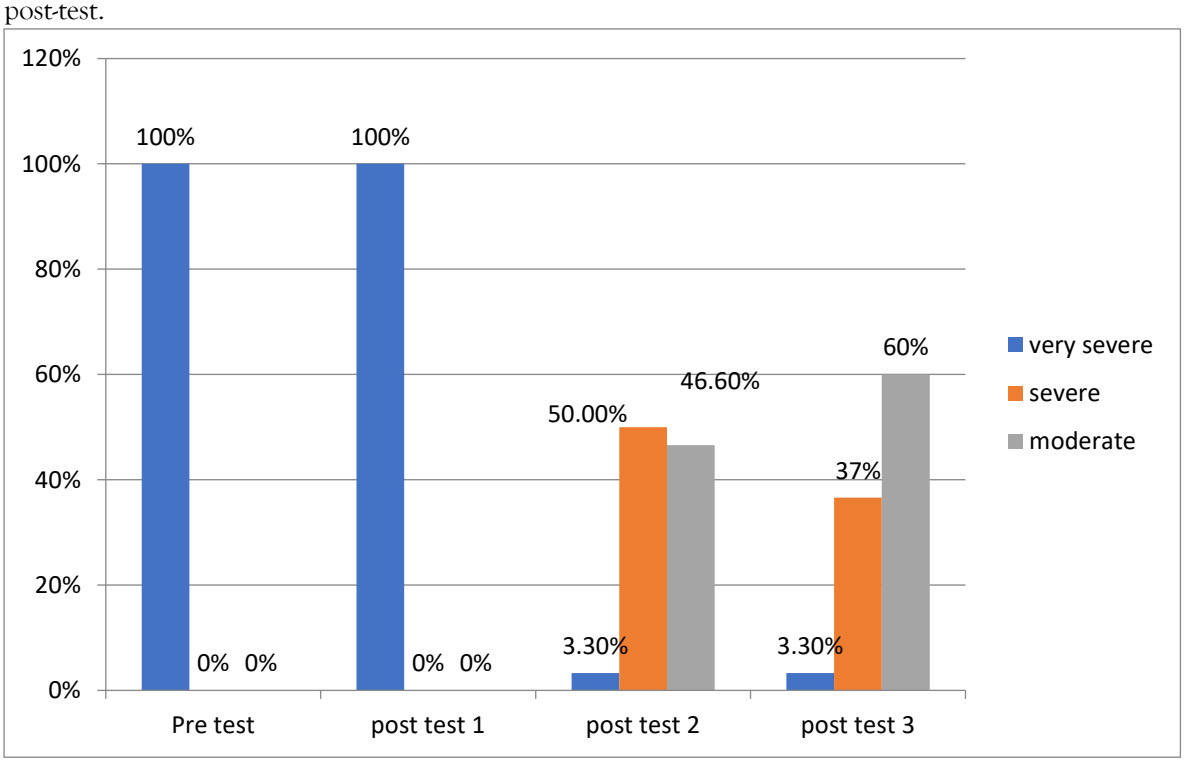

Figure 2. Percentage distribution of pain assessment among women in experimental group during pre-test and post-test.

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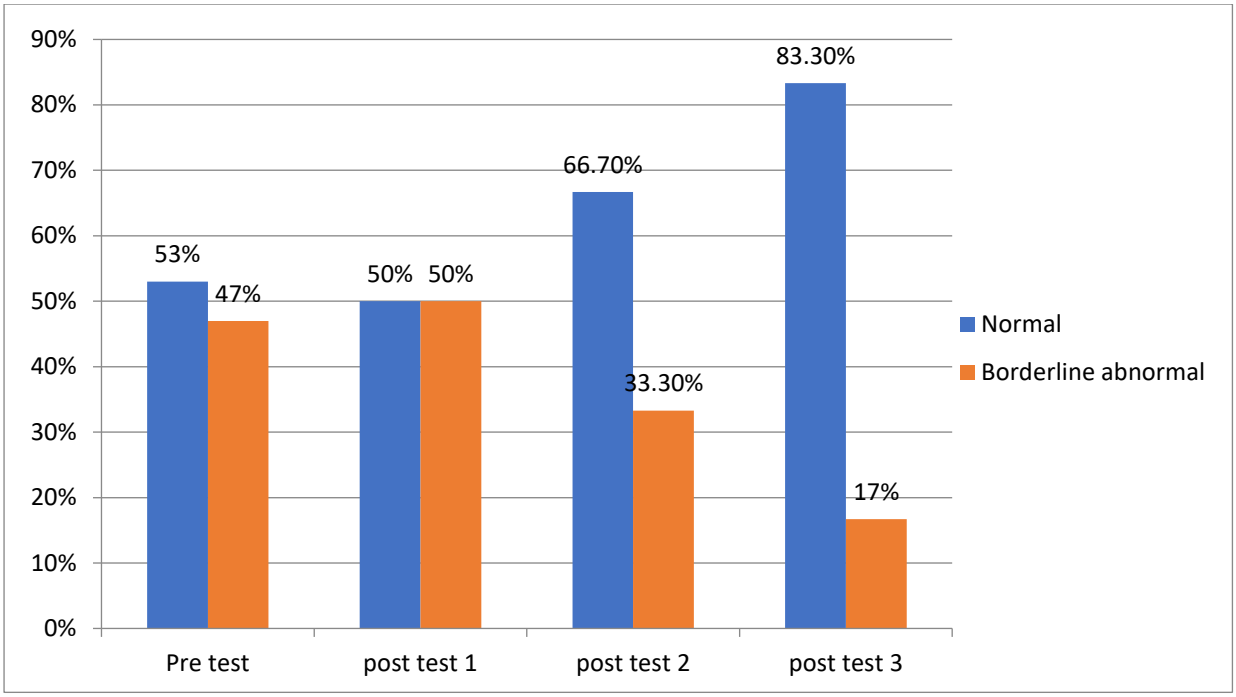

Figure 3: Percentage distribution of anxiety assessment among women in control group during pre-test and post-test.

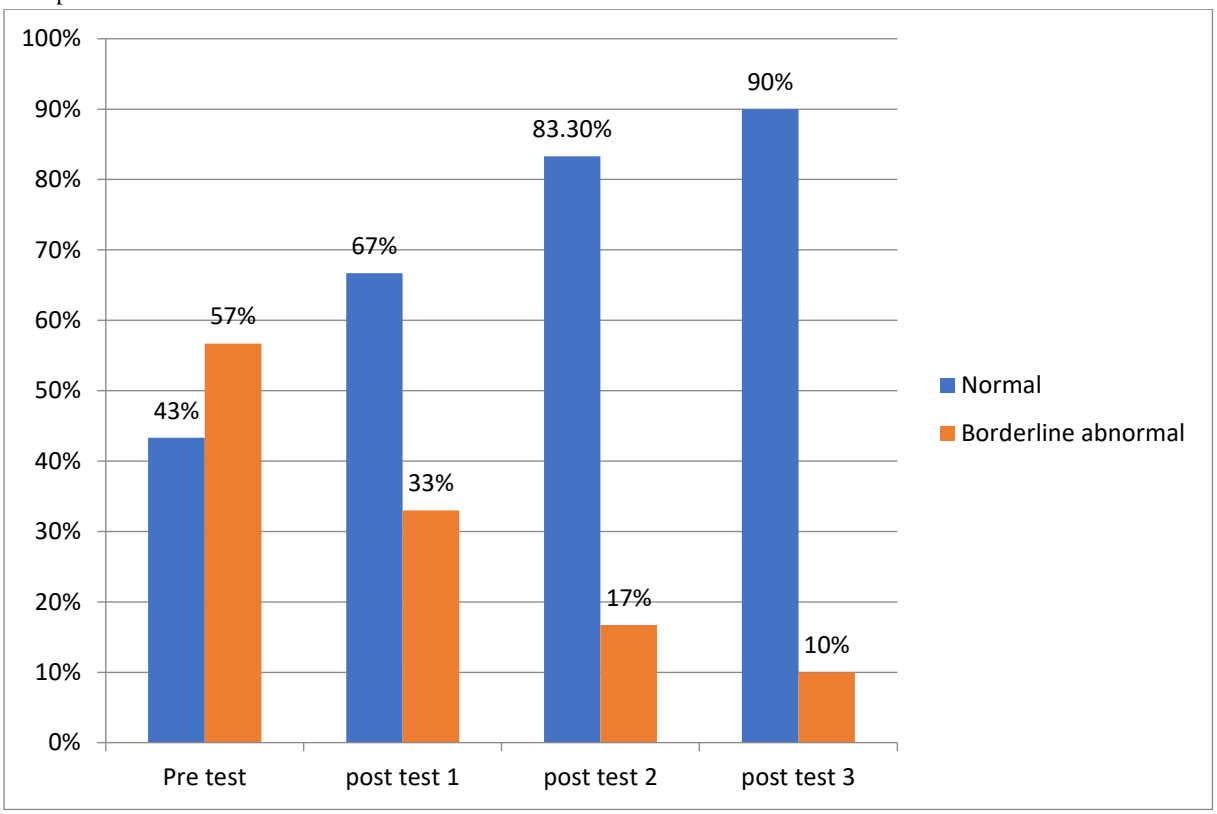

Figure 4: Percentage distribution of anxiety assessment among women in experimental group during pre-test and post-test.

Table 2. Comparison of pre and post-test level of mean and standard deviation of pain and anxiety score on women underwent hysterectomy between control and experimental group.

Score	Type of test		Mean	SD	Mean difference	Independent t-Test	p-value
Pain score	Pretest	Control group	8.967	0.183	0.034	0.584	0.561

		Experimental group	8.933	0.254			
	Post test 1	Control group	8.5	0.509	-0.067	-0.51	0.612
		Experimental group	8.567	0.504			
	Post test 2	Control group	7.333	0.479	-0.034	-0.249	0.804
		Experimental group	7.367	0.556			
	Post test 3	Control group	6.433	0.504	0.733	3.971	< .001
		Experimental group	5.7	0.877			
Anxiety score	Pre test	Control group	7.567	0.504	0.1	0.766	0.447
		Experimental group	7.467	0.507			
	Post test 1	Control group	6.6	0.498	-0.033	-0.261	0.795
		Experimental group	6.633	0.49			
	Post test 2	Control group	5.3	0.466	0.167	1.166	0.248
		Experimental group	5.133	0.629			
	Post test 3	Control group	3.867	0.776	0.567	3.428	0.001
		Experimental group	3.3	0.466			

DISCUSSION

The findings of our study reveal a statistically significant decrease in both pain and anxiety levels in the experimental group receiving virtual reality (VR) therapy after undergoing hysterectomy. Initially, participants reported very severe pain, with a mean pain score of 8.933. By Post-Test Day 3, the mean pain score had dropped significantly to 5.7 ($p < 0.001$), indicating that 60% of participants transitioned from experiencing severe pain to moderate pain levels, with none remaining in the very severe category. Concurrently, the anxiety score exhibited a noteworthy decrease from a mean score of 3.867 in the control group to 3.3 in the experimental group ($p = 0.001$). Such findings align with previous research indicating that immersive VR applications have a robust influence on pain distraction and emotional well-being, particularly within post-surgical contexts, as suggested by Ioannou et al. (Ioannou et al., 2020) and Zeng et al. (Zeng et al., 2019).The improvement in anxiety levels is particularly striking, with the percentage of participants categorized as having "normal" anxiety increasing from 43.3% at baseline to 90% by Day 3, while individuals exhibiting "abnormal borderline" anxiety decreased to merely 10%. These data suggest that VR not only alters the physical experience of pain but also contributes to an overall improvement in mental health variables. The effectiveness of VR in managing anxiety aligns with findings from a systematic review by Ioannou et al., which highlighted VR's role in managing anxiety symptoms across various healthcare settings (Ioannou et al., 2020). Furthermore, the overall enhancement in perceived well-being corresponds with previous assertions that VR can function as a non-pharmacological adjunct to conventional pain management strategies, minimizing reliance on opioids and other analgesics, as discussed in Jones et al. (Jones et al., 2016).Participants in our study consistently reported feeling calmer and less aware of their pain during VR sessions, which points to the utility of VR as a distraction technique. This is corroborated by the meta-analysis conducted by Lier et al. (Lier et al., 2023), which indicates that VR effectively decreases pain perception across different medical contexts. By immersing individuals in engaging virtual environments, users' attention is diverted from pain stimuli, thereby facilitating pain relief through focused distraction. Unlike traditional analgesic methods that might lead to adverse side effects, VR offers a complementary approach with minimal risk, paving the way for enhanced postoperative recovery profiles, as supported by Spiegel et al. (Spiegel et al., 2019).Interestingly, the results did not show significant associations between baseline pain or anxiety levels and demographic characteristics, suggesting that the beneficial effects of VR therapy may be universally applicable irrespective of patients' backgrounds. This universality is crucial, as it can inform wider implementation

of VR interventions in similar surgical populations. In connection with this, there are competing studies that display mixed results regarding demographic influences on pain outcomes, emphasizing the need for further research in this area (D'Cunha et al., 2019; Niki et al., 2019). The rapid integration of VR within clinical practice reflects an evolving attitude toward utilizing technology in acute and chronic pain management. As highlighted in the literature, various hospital environments have started to adopt VR in various forms, including immersive gaming and therapeutic interventions beyond pain control (Qian et al., 2020; Saliba et al., 2021). Our findings contribute substantially to this area of inquiry, demonstrating VR's effectiveness not only in reducing pain and anxiety associated with hysterectomy but also in potentially improving the overall patient experience during the postoperative phase. Given its promising outcomes in this study, VR therapy warrants consideration in clinical guidelines for pain management in gynecologic surgeries and potentially extends to other surgical domains, enhancing recovery approaches for diverse patient populations (Corvin et al., 2024; Araujo-Duran et al., 2023).

CONCLUSION

The findings clearly indicate that VR is helpful in lessening pain and anxiety experienced following hysterectomy surgery. The outcomes indicate that postoperative care should focus more on using immersive technologies to improve patient satisfaction, depend less on drugs and lead to better health results. Healthcare gradually shifting towards combining technology with care for patients suggests VR in surgical rehab will soon become an important and tested practice.

Conflict of interest

None

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