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Effect of Virtual Reality on Anxiety and Pain Perception in Primigravida Undergoing Cesarean Delivery under Spinal Anesthesia

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Abstract: Background: Perioperative anxiety and pain are common occurrences among primigravida women who are under spinal anesthesia during cesarean delivery, and may adversely impact the maternal health and experience of birth. Virtual reality (VR) has become a valuable non-pharmacological intervention for addressing anxiety during clinical procedures. A**im**: The present research was carried out to determine whether virtual reality decreases perioperative anxiety and enhances the pain perception in the primigravida undergoing cesarean section under spinal anesthesia. **Design:** a quasi-experimental research design was adopted. **Sample:** A purposive sample of 154 primigravida women who undergiong cesarean delivery were recruited and equally divided into two groups: the control group (n = 77) and the study group (n = 77). **Setting:** The operating room and postpartum unit at Obstetrics and Gynecological Hospital, 6 October University. **Tools:** three tools were used: 1) A structured interviewing questionnaire, 2) A validated instrument with acceptable reliability, the Numerical Analog Scale (NAS, and 3) the Anxiety Rating Scale. The VR intervention was delivered using a head-mounted display for 20 minutes, beginning at the start of skin suturing. Participants viewed immersive calming visual content accompanied by either Qur'an recitation or soothing music, based on their preference. **Results** During skin suturing, virtual reality was found to significantly lower anxiety levels compared to the control group (2.36 ± 1.17 vs. 7.74 ± 1.15), as well as at 2, 4, and 6 hours after the procedure (all $p < 0.05$). In contrast, there was no notable difference in pain scores between the groups either during or following the surgery (e.g., during skin suturing: 0.58 ± 1.16 vs. 0.86 ± 1.39; $p > 0.05$). **Conclusion**: VR can be considered an efficient, safe, and inexpensive non-pharmacological intervention for reducing perioperative anxiety in primigravida women undergoing cesarean delivery with spinal anesthesia. But with limited evidence for pain reduction**, Recommendations:** Integrating virtual reality (VR) into obstetric anesthesia protocols as a supportive intervention for primigravida women undergoing cesarean delivery under spinal anesthesia may enhance maternal psychological well-being. Training healthcare providers and promoting further research are key to maximizing its effectiveness and broader application.

Keywords: Anxiety, Spinal Anesthesia, Cesarean Delivery.Maternal Well-Being, Non-Pharmacological Treatments, And Virtual Reality Therapy.

Introduction

Caesarean delivery (CD) is an obstetric intervention that is often performed, and its incidence has almost doubled in recent decades all over the world [1]. The World Health Organization (WHO) reports a significant rise in the global cesarean section rate, approximately 21% in 2021 [2]. In Egypt, the rate is much higher, at 72% in 2021, with rural areas being higher than urban areas [3]. Even though CD is a life-saving intervention, it is often accompanied by high maternal anxiety and high levels of postoperative pain [4]. Anxiety before and during surgery not only affects maternal psychological well-being but also impacts physiological parameters such as heart rate, blood pressure, and pain perception [5]. Primigravida women, experiencing childbirth for the first time, are particularly vulnerable to heightened anxiety due to fear of the unknown and concerns regarding the surgical outcome [6]. The negative long-term results are life-threatening to a woman in various spheres of her life, and the negative birth experience predicts negative outcomes that can affect the relationships with her partner and the baby, and postpone or even prevent having more children.

Spinal anesthesia is typically used during caesarean deliveries rather than prior sedatives in order to support the woman's conscious labour, promote skin-to-skin contact between the newborn baby and its mother immediately after delivery [7]. Postoperative pain remains a significant challenge affecting early mobilization, breastfeeding, and overall recovery [8]. Preoperative anxiety was shown to be very common among elective caesarean deliveries [9].

Moreover, excessive stress and anxiety before and during cesarean delivery have been shown to increase the risk of

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anesthesia-related complications [10,11]. Maternal anxiety needs to be reduced [12]. Due to the limited pharmacological options available for pregnant women undergoing cesarean section, especially those receiving spinal anesthesia, there is a strong need for alternative, low-risk interventions to alleviate intraoperative stress and anxiety [13,11]. Virtual reality (VR) is a non-pharmacological treatment because it is a distraction intervention to establish a pleasant mood. This technology reduces pain and anxiety by enabling users to interact with stimuli in a virtual environment that imitates a real-life environment. With the help of a computer-simulated method of seeing, or rather getting a visual image, together with audio by listening to a headset that is then linked to a computer or a smartphone [14]. Virtual reality (VR) can induce a deep sense of relaxation even in highly stressful situations such as cesarean section (CS), thereby contributing to improved surgical outcomes and women's satisfaction [15]. Virtual reality has become widely used in the healthcare field, with medical education, pain management, treatment of posttraumatic stress disorder (PTSD), and decreasing anxiety and stress levels being some of its applications. [16,17].

The promising effects of VR make it a suitable non-pharmacological strategy to alleviate stress and anxiety during surgical procedures [18]. VR works by engaging multiple senses, creating a distraction, and inducing relaxation through immersive visual and auditory experiences. Several studies have demonstrated the effectiveness of VR in reducing preoperative anxiety and intraoperative discomfort in various surgical settings, including gynecological and orthopedic procedures [19]. The neuromatrix theory states that the perception of pain is determined by sensory, cognitive, and affective factors; therefore, any attention-diverting intervention, including VR, can affect the level of anxiety and pain [20]. Nonetheless, VR has already been experimented with in other surgery areas [14, 15, 17], yet little evidence is available in obstetric anesthesia in primigravida, and there is an obvious knowledge gap concerning the impact of VR on anxiety and pain control during and after cesarean delivery among primigravida women undergoing spinal anesthesia. The research was carried out in Egypt, where most of the births are currently taking place in health-care institutions that are monitored by obstetricians as opposed to being supported by midwives. The Egyptian obstetric care system is based on both public and private hospitals, where most of the deliveries are done in the private hospitals. Since C-sections are relatively common and the related obstacles have been reported, our virtual-reality intervention targeting primigravida who have C-sections under anesthesia can be viewed as a significant non-pharmacological resource that can enhance maternal experience.

Aim of the Study

The current study aimed to determine whether virtual reality versus standard care decreases perioperative anxiety and enhances the pain perception in the primigravida undergoing cesarean section under spinal anesthesia

Research Hypotheses

H_0 (Null): There is no statistically significant difference in pain intensity during and after caesarean delivery between primigravida women receiving virtual reality intervention and those receiving standard care.

H_0 (Null): There is no statistically significant difference in anxiety levels during and post-cesarean delivery between primigravida women receiving VR intervention and those receiving standard care.

Subjects and Methods

Research Design

This research utilised a quasi-experimental design featuring two parallel groups: an intervention group and a control group. A total of 154 primigravida women scheduled for elective caesarean delivery under spinal anaesthesia were recruited via purposive sampling. They were divided into two groups: the study (n = 77) that received the virtual reality (VR) intervention in the course of the surgery and the control group (n = 77) that received traditional care. Unlike randomised controlled trials, this methodology was a quasi-experimental method which did not involve the assignment of intervention randomly; however, it enabled the determination of the effect of the intervention in a realistic clinical setting [21].

Setting

The research was carried out in Egypt at the October 6 University Gynecological Hospital, a tertiary care institution linked to October 6 University. Egypt's healthcare system integrates public, private, and university hospitals, all of which provide maternity services within obstetric units. Although most people rely on maternal services in public hospitals, university hospitals, such as the one highlighted in this study, offer both general and specialized obstetric care, including cesarean deliveries using spinal anesthesia. The medical teams in these facilities typically include obstetricians, anesthesiologists, midwives, and obstetric nurses, all proficient in handling both routine and high-risk pregnancies. Obstetric services in Egypt cover prenatal check-ups, labor and delivery, and postpartum care, with university hospitals often acting as referral centers for more complicated cases. This study was conducted at the Obstetrics and Gynecology hospital of October 6 University, specifically within the operating theaters and postpartum teaching wards. The department is outfitted with two operating theaters that manage all planned and emergency procedures for the obstetric departments. The postpartum teaching unit consists of seven rooms with a total of fifteen beds, where postpartum women receive standard clinical care and engage in teaching activities according to the hospital's follow-up protocols. This environment was ideal for implementing and evaluating the virtual reality intervention.

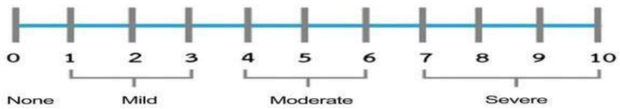
Sample

A purposive non-random allocation sample was selected, comprising 154 women who were experiencing their first pregnancy and were scheduled for elective cesarean delivery with spinal anesthesia. This sampling approach was employed to ensure that all participants met the specific clinical and physiological criteria required for an accurate evaluation of the VR intervention. The inclusion criteria included women aged 18–35 years who were undergoing their first pregnancy, scheduled for elective cesarean delivery with spinal anesthesia, possessing normal visual and auditory abilities to engage with VR, and capable of effective communication and providing informed consent. The exclusion criteria encompassed psychiatric or neurological disorders, significant obstetric complications requiring emergency surgery, visual or auditory impairments that would impede VR use, chronic pain conditions affecting pain perception, and the use of sedatives or anxiolytics beyond standard spinal anesthesia. Sample size: The sample size was calculated using Cochran's formula (95% confidence level, 5% margin of error). After applying the finite population correction, the necessary sample size was determined to be 154 women, which constituted the final recruited sample, evenly split into intervention (n = 77) and control (n = 77) groups [22].

Tools for Data Collection

Three tools were utilized:

1. A structured interview questionnaire: This instrument, designed by the researcher, included two parts: a) The first part collected socio-demographic details such as age, education level, job, and residence location b) The second part gathered information on medical history (including visual or auditory impairments, anxiety disorders) and obstetric profile. The researchers created a structured questionnaire to gather data on participants' sociodemographic traits, obstetric history, and clinical information pertinent to the study's goals. To ensure the questionnaire's content validity, a panel of five experts in obstetrics, anesthesia, and maternal health nursing evaluated it for clarity, relevance, and suitability. Their feedback led to necessary adjustments, thereby improving content validity. Internal consistency reliability was tested in a pilot study using Cronbach’s alpha, which showed an acceptable reliability coefficient for the current study. The questionnaire was a crucial tool for characterizing the sample and providing context for the outcome measures.
2. Numerical Analog Scale (NAS): Created by McCaffery & Beebe [23]. The NAS is commonly used in clinical and perioperative studies due to its simplicity, quick administration, and strong face and construct validity for assessing acute pain. Although its test–retest reliability (r = 0.62) shows moderate consistency, this level is considered acceptable for tools that measure subjective and variable experiences like postoperative pain. Furthermore, its extensive use in obstetric and surgical settings highlights its appropriateness and relevance for evaluating pain during caesarean delivery in this study.It was adopted to assess the severity of the pain measured on a scale between (0-10 points) with two extreme ends of the scale to include no pain or unbearable pain. 0 indicates no pain,1–3 indicates mild pain,4–6 indicates moderate pain, and 7–10 indicates severe pain. Participants were asked to rate their pain intensity on this scale, with visual anchors at each end to guide interpretation.



3. Anxiety Rating Scale: It was developed by Bloch et al. (2009 [24]. This is a tool that is easy, quick, and visually intuitive to evaluate the level of anxiety experienced by women during labor; therefore, it is most appropriate in the fast-paced clinical setting, including surgery and obstetric units. According to Bloch et al, face and content validity of the scale were satisfactory, and its reliability indices were acceptable for use in measuring emotions during labor. The fact that it is sensitive to the change in the level of anxiety and can be easily administered makes it especially applicable to the purpose of the research, which is to explore whether a VR intervention can be effectively used to reduce perioperative anxiety levels in primigravida women who have caesarean delivery.

The tool consists of a straight horizontal line, where the two endpoints represent the extremes of anxiety: 0 = balanced mood and 10 = completely out of control

Participants were asked to mark their level of anxiety on the line, providing a quantitative measure of subjective emotional state. The scale is divided into six interpretive categories:

1. **Score 0** – Balanced mood
2. **Scores 1–2** – Slight fear and worry
3. **Scores 3–4** – Mild fear
4. **Score 5** – Moderate fear
5. **Scores 6–7** – Strong agitation
6. **Scores 8–10** – Out of control behavior

(Anxiety Rating Scale achieved a Cronbach’s alpha of 0.87, indicating a high degree of internal reliability suitable for psychological evaluations in clinical environments

Pilot Study

A pilot study was carried out on 10 percent of the total sample (n = 15 primigravida women), randomly selected to take part in the study. The main goals included determining the comprehensibility, clarity, and appropriateness of the data collection tools, and also determining the amount of time needed to complete the instruments. The pilot study results proved that all the tools were comprehensible and reasonable to administer in the primary research. These results did not indicate any reason to make any adjustments to the instruments. The respondents used in the pilot were later incorporated into the study sample.

Ethical consideration

This research was approved by the Research Ethics Committee of the Faculty of Medicine of the October 6 University (Approval No. PRC-NU-2311002; dated 5/11/2024). Moreover, the director of the study setting gave administrative consent before data collection, approached the eligible individuals individually, and explained the purpose, study procedures, the potential risks of the study, and its possible benefits. Informed consent was taken in writing before all the participants were included. The women were made very clear that participation was fully optional and that they could also pull out of the study at any time without citing any reasons, and this would not affect the quality of their medical services. There was complete confidentiality and anonymity in the study. All the data obtained were coded and utilized in the research only. The following study was carried out in compliance with the principles that were described in the Declaration of Helsinki, with all participants being respected in terms of their rights, safety, and well-being.

Procedure

The administrative authorities of the hospital gave official consent to hold the study. Aboriginal primigravida women who were planned to have an elective birth via cesarean section were approached individually, and a detailed explanation was given on the purpose of the study, procedures, involved risks, and benefits. All of the participants were required to sign informed consent before being included. Both groups were sampled on baseline information regarding socio-demographic features and obstetric history. The first measure of the level of anxiety was administered to all participants by administering the Anxiety Rating Scale, which took about five minutes per respondent.

The virtual reality (VR) intervention was provided to the participants of the intervention group immediately after the spinal anesthesia. The VR glasses were used throughout the surgery, from the start of the surgery till the skin suturing was done, and the researcher and educated nursing staff continuously monitored the safety and proper use. To harmonize the experience, all participants were subjected to either one of two VR content options, namely listening to calming music in the background accompanied by scenery with a calming effect, or reciting the Quran in peace, accompanied by nature scenery and imagery with spiritual connotations. Although this was done to fit the preference of the participants, it can also bring about cultural or religious discrimination, which must be noted as a source of limitation. The anxiety and pain perception levels were reassessed at various time points: at skin suturing, 2, 4, and 6 hrs postoperative periods. The environmental conditions, such as lighting, noise, staff interaction, etc., were maintained at the same level among the participants to decrease external factors impacting results.

The control group participants were provided with the usual hospital treatment without the VR activity and no other distraction programs. Regular clinical work, including monitoring, interpersonal staff interaction, procedural communication, etc., was regular. The same time intervals were used in the assessment of anxiety and pain to compare them to the intervention group to reduce bias by an assessor who was not aware of group assignment. A single standardized VR content was used to make sure that any observed variations in the levels of anxiety or pain were due to the VR intervention instead of differences between different content. The research team continuously tracked the safeguarding and compliance of the intervention, and the participants were not allowed to take the VR glasses off at any point during the action unless medically necessitated.

Results

Table 1 demonstrates the sample distribution of the studied sample based on its socio-demographic features. The statistical test showed that there was no significant difference of the control and the study group on all the measures variables, such as age, residence, educational level, and the occupation (p > 0.05).

Table (1): Distribution of the studied sample according to their socio-demographic characteristics (n=154).

Characteristics	Control group n=77		Study group n=77		P-value
	No	%	No	%	
Age (in years)					1 .0
Mean ±SD	28.42± 3.7		27.35± 4.1		
Residence					
Urban	19	24.7	18	23.4	
Rural	58	75.3	59	76.6	
Educational level					0.835
Read and write	2	2.6	1	1.3	
Primary education and preparatory education	6	7.8	7	9.1	
Secondary education	31	40.2	33	42.9	
High education	38	49.4	36	46.7	
Occupational status					0.869
Housewife	46	59.7	48	62.3	
Working	31	40.3	29	37.7	

The groups did not significantly differ in terms of the mean age of the participants (28.42 +3.7 years in the control group, and 27.35 +4.1 years in the study one). Concerning residence, most of the participants in the two groups lived in rural areas (75.3% and 76.6% in the control and the study group, respectively) with no significant difference in the two groups (2 = 0.001, p = 1.0).

There was also an equal distribution of education whereby, majority of the participants had received secondary or higher education. The same patterns were observed regarding occupational status as the majority of the respondents (59.7% in the control group and 62.3% in the study group) were housewives, and there was no significant difference between the groups (2 = 0.027, p = 0.869).

The findings indicate that both groups were homogenous in regard to socio-demographic factors hence making the comparison of the two groups homogenous. This increases the internal validity of the research and minimizes the possibility of confounding factors in regard to differences in the baseline.

After the pain outcome analysis, it was found that there was no statistically significant difference between experimental and control groups during or after caesarean section. The latter was found to be similar with both categorical pain measures (Table 2) and average pain scores (Table 4) as it was found that VR intervention did not reduce the perceived pain. On the other hand, the results of anxiety showed statistically significant and consistent reduction of the study group over the control group at every measurement period (p < 0.05). This was supported by categorical anxiety measurements (Table 3) as well as mean anxiety measurements (Table 5). The VR group had significantly lower levels of anxiety during skin suturing and there was significantly lower anxiety levels in the VR group during the postoperative period.

Table (2): Distribution of Pain Severity During and After Cesarean Section in the Control and Virtual Reality (VR) Groups.

Pain level assessment time	Control group n=77		Study group n=77		P-value
	No	%	No	%	
While completing the skin suture					0.359
None	50	64.9	57	74	
Mild	19	24.7	16	20.8	
Moderate & Severe	8	10.4	4	5.2	
After 2h postoperative					0.456
None	12	15.6	9	11.7	
Mild	45	58.4	52	67.5	
Moderate & Severe	20	26	26	20.8	
After 4h postoperative					1.000
None & Mild	28	36.4	28	36.4	
Moderate	47	61	48	62.3	
Severe	2	2.6	1	1.3	
After 6h postoperative					0.478
None & Mild	3	3.9	6	7.8	
Moderate	59	76.6	60	77.9	
Severe	15	19.5	11	14.3	

Table (3): Distribution of Anxiety Level During and After Cesarean Delivery in the Control and Virtual Reality (VR) Groups.

Anxiety level assessment time	Control group n=77		Study group n=77		P-value
	No	%	No	%	
While completing the skin suture					0.001**
Balanced mode, slight fear, worry and Mild fear Moderate	4	5.2	76	98.8	
Strong Agitation and out-of-control behavior	73	94.8	1	1.3	
After 2h postoperative					0.001**
Balanced mode & slight fear and worry	1	1.3	22	28.6	
Mild fear	28	36.4	38	49.4	
Moderate	25	32.5	12	15.6	
Strong Agitation & Out-of-Control Behavior	23	29.9	5	6.5	
After 4h postoperative					0.001**
Balanced mode & slight fear and worry	14	18.2	54	70.1	
Mild fear	44	57.1	19	24.7	
Moderate & Strong Agitation	18	23.4	3	3.9	
Out-of-control behavior	1	1.3	1	1.3	
After 6h postoperative					0.008**
Balanced mode	9	11.7	20		26
slight fear and worry	39	50.6	44		57.1
Mild fear & Moderate	27	35.1	11		14.3
Strong Agitation	1	1.3	1		1.3
Out-of-control behavior	1	1.3	1		1.3

Table (4): Pain Scores Comparison between Virtual Reality and Control Groups During and After Cesarean Delivery.

Pain assessment time	Control group n=77	Study group n=77	Mean Difference (MD)	95% CI of MD	P-value
	Mean ±SD	Mean ±SD			
While completing the skin suture	.86±1.39	.58±1.16	–0.28	–0.75 to 0.19	0.189
After 2h postoperative	2.43±1.73	2.32±1.65	–0.11	–0.62 to 0.40	0.704
After 4h postoperative	4.17±1.48	4.05±1.31	–0.12	—0.54 to -0.30	0.606
After 6h postoperative	5.16±1.29	2.32±1.65	–2.84	—3.28 to –2.40	0.901

Table (5): Comparison of Anxiety Levels between Study and Control Groups Following Virtual Reality Intervention During and After Cesarean Delivery.

Anxiety level assessment time	Control group n=77	Study group n=77	Mean Difference (MD)	95% CI of MD	P-value
	Mean ±SD	Mean ±SD			
While completing the skin suture	7.74±1.152	2.36±1.168	-5.38	–5.79 to –4.97	0.001*
After 2h postoperative	5.10±1.28	3.35±1.57	–1.75	—2.23 to -1.27	0.001*
After 4h postoperative	3.78±1.46	2.29±1.53	–1.49	–1.98 to -1.00	0.001*
After 6h postoperative	2.10±1.40	1.52±1.49	–0.58	—1.01 to –0.15	0.013*

Effect sizes (mean differences with confidence intervals) were used to test how different the groups were. The pain scores did not show any significant divergence between the two groups at any of the measured intervals and all 95 percent confidence intervals contained zero, which implies that the VR intervention did not make any significant difference in pain. (Table 4). On the other hand, clinically relevant changes were observed in the anxiety scores in the VR group, and there was significant mean difference at each point in time (MD range: -5.38 to -0.58), and the confidence intervals were not equal to zero. These findings confirm a very large positive impact of VR on the anxiety. (Table 5).

Discussion

The present study explored how virtual reality (VR) affects anxiety and pain tolerance during and after cesarean sections performed with spinal anesthesia in women experiencing their first pregnancy. Both groups had similar socio-demographic characteristics, with no significant differences in age, education, occupation, or residence (p > 0.05), which enhances internal validity and minimizes potential confounding factors [25, 26]. This baseline similarity is consistent with the findings of [27]. The main result of this research is that VR significantly reduced anxiety at all measured times, while there were no significant differences in pain scores between the experimental and control groups. The decrease in anxiety aligns with existing evidence that shows VR as an effective distraction tool that reduces psychological stress by immersing individuals in soothing sensory environments [28]. Similar anxiety-reducing effects were observed in women in labor using VR during childbirth [29] and in various surgical populations in [30]. Our results are consistent with previous studies indicating that VR consistently lowers anxiety but has variable or limited effects on pain [31]. A similar pattern was observed in a Singapore study by [32], which reported a significant reduction in preoperative anxiety, as well as in research by [33] and a systematic review by [34], both confirming VR's ability to alleviate stress and anxiety in different contexts. Additional studies support the positive role of VR in reducing anxiety during medical and dental procedures [24, 25, 35] and in treating anxiety disorders in mental health settings [38]. Findings from Egypt by [36] further partially support our results, noting that VR was less effective in individuals with high baseline fear. Conversely, some studies reported inconsistent or absent anxiety reduction with VR [29, 37, 38], often attributing these differences to cultural factors, variations in VR immersion levels, or limited familiarity with VR technology. Although VR led to significant reductions in anxiety, its lack of effect on pain may be due to several factors. First, pain associated with cesarean delivery under spinal anesthesia is primarily physiological, and the sensory blockade limits the extent to which distraction-based interventions can alter pain perception during surgery. Second, the duration of VR exposure may not have been sufficient to influence postoperative pain pathways. Similar explanations have been proposed by studies reporting inconsistent VR effects on pain outcomes [31, 38]. Socio-demographic influences such as education, occupation, and residence can shape women's experiences.

Various methodological elements might have influenced the study's outcomes. Initially, participants could select between two VR content types—music paired with natural landscapes or Quran recitation with spiritual imagery—which could have introduced confounding due to differing psychological responses. Moreover, participants were aware of their inclusion in the VR group, potentially leading to placebo or expectation effects that could alter their self-reported anxiety levels. The absence of blinding for assessors also raises the possibility of measurement bias. Additionally, unusual pain scores were noted 6 hours post-surgery, showing significant mean differences without statistical significance. These variations might stem from group variability, sample size limitations, or potential measurement inconsistencies. Consequently, these results emphasize the need for future research with larger sample sizes and more stringent blinding or control methods to ascertain whether VR significantly impacts postoperative pain trajectories. The original data did not report effect sizes, limiting the understanding of clinical significance. Other limitations include the quasi-experimental design without randomization, which increases the risk of selection bias, and the single-center setting, which restricts the generalizability of the findings. The sample size was relatively small, and the follow-up period was limited to 6 hours post-surgery, hindering the assessment of long-term anxiety and pain outcomes. Despite these limitations, the study highlights the potential of VR as a non-pharmacological approach to reduce perioperative anxiety in first-time mothers undergoing cesarean sections. By ensuring that the study and control groups were statistically comparable in socio-demographic factors, the study strengthens the attribution of observed anxiety reductions specifically to the VR intervention. Future studies should employ randomized controlled designs, standardize VR content to minimize confounding, implement assessor blinding, recruit larger and more diverse populations, and extend follow-up to evaluate longer-term outcomes. Reporting both effect sizes and p-values will further enhance the clinical relevance of the findings. In conclusion, VR effectively reduced anxiety during and after cesarean delivery; however, it did not significantly affect pain perception under spinal anesthesia. These findings suggest that VR could be a valuable addition to standard care for managing perioperative anxiety, while its impact on pain remains limited in situations where effective pharmacological pain relief is available.

Conclusion

This paper highlights virtual reality (VR) as a potential non-pharmacological adjuvant to be used in the treatment of perioperative anxiety in primigravida women who undergo the caesarean section under the spinal anaesthesia. Despite the significant effect of VR on reducing the level of anxiety, it did not have a measurable effect on the perception of pain after surgery. Virtual reality is shown to be a promising intervention in terms of supporting the psychological well-being of mothers; however, its role as a medicine alternative remains in the phase of exploration. It is recommended that future studies use randomized controlled designs, standardized virtual reality materials, and that the samples be large multi-centers in order to confirm these results and wider clinical implications.

Recommendations

On the findings of the current paper, the following are the recommendations suggested: Healthcare provider training and, further research are relevant in terms of optimizing the utility and extending its use.

The introduction of virtual reality (VR) into the obstetric anesthesia guidelines to be used to support the women of primigravida who will have cesarean section with the use of spinal anesthesia could potentially help improve the psychological condition of a woman.

Disclosure Statements

- **Consent for publication:** NA
- **Availability of data and materials:** The corresponding author will provide the data supporting the study's findings upon a reasonable request.
- **Author's contribution:** All authors T.G, E.A, A.M, D.R and F.M had a major. input in drafting the editorial or revising it critically for important intellectual content. All the authors have equally contributed to conceptualizing, designing, analyzing, and Manuscript preparation. The researchers A.M and D.R collected the data.
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