Effect of Virtual Reality on Anxiety, Satisfaction level and Hemodynamic Parameters among Women during Cesarean Section

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Abstract

Background: Cesarean section is the most frequently performed, with increasing prevalence worldwide. It often results in heightened anxiety, potentially affecting hemodynamic parameters and maternal satisfaction. Virtual Reality has demonstrated its capability to alleviate anxiety and enhance women's experiences within the healthcare system. Therefore, **this study aimed to**: Determine the effect of virtual Reality on anxiety, satisfaction level and hemodynamic parameters among women during cesarean section. **Design**: A non-randomized controlled clinical trial research design was used to achieve the aim of the study. **Setting:** The study was conducted in the Obstetric and Gynecological operating room of Shubrakhit General Hospital. **Subjects**: A sample of 100 laboring women who were selected and classified into two equal groups of 50 study and control. **Tools:** Four tools were used in this study. **Tool (I):** Basic data structured interview schedule included three parts. Part I: Socio-demographic data, Part II: Reproductive history and Part III: History of cesarean section. **Tool II:** Beck Anxiety Inventory((BAI). **Tool III:** The Birth Satisfaction Scale -Revised (BSS-R). Tool IV: Maternal hemodynamic parameters assessment sheet. **Results:** The study group showed significantly lower anxiety levels after intervention ($p<0.001$), with no significant change in the control group. Maternal satisfaction two hours after the cesarean section showed that 74% of the participants expressed satisfaction in the study group, compared to only 6% reported satisfaction in the control group. The study group showed highly statistically significant relations with hemodynamic parameters compared to the control group. **Conclusion:** It was concluded that virtual Reality had a positive effect on reducing anxiety and improving satisfaction level as well as hemodynamic parameters among women during cesarean section. **Recommendation:** Virtual Reality is recommended and should be included as an alternative to non-pharmacological therapy to reduce anxiety level among women during cesarean section.

Keywords: Anxiety, Cesarean Section, Satisfaction level, Virtual Reality.

Introduction

The global incidence of cesarean section (CS) deliveries has been on a consistent upward trajectory, raising major public health concerns. The World Health Organization (WHO) reports a significant rise in the global cesarean section rate, which has escalated from approximately 7% in 1990 to 21% in 2021, with projections indicating a potential rise to nearly 29% by 2030 if current trends persist. **(World Health Organization, 2021)**

In Egypt, the situation is particularly alarming. Data from the Central Agency for Public Mobilization (CAPMAS) Survey reveals that the proportion of births through CS surged from 52% in 2014 to an

astonishing 72% in 2021. This rate is nearly five times higher than the WHO's recommended threshold of 10 -15%. Notably, cesarean deliveries have become more prevalent than vaginal births in both public and private healthcare settings across the country. This significant increase can be linked to various factors, including economic instability, the dominance of private health services, fear of labour pain, cultural attitudes, and the scheduling convenience of surgical births **(Worldcrunch, 2022; Hendy & Shaheen, 2024).**

Cesarean section (CS), often performed under regional anaesthesia, allows for conscious childbirth and immediate mother-newborn bonding; over 80% of women experience significant anxiety during the procedure. This can lead to complications such as postpartum depression, delayed recovery, and increased anaesthesia risks (**Almedhesh et al., 2022)**.

Non-pharmacological treatments such as virtual Reality (VR) have drawn interest in order to address these problems. VR creates immersive, calming environments that can reduce stress and improve maternal satisfaction during CS. Its ease of use and effectiveness make it a promising tool for enhancing the birth experience, particularly when pharmacological options are limited **(Almedhesh et al., 2022).**

Virtual Reality (VR) is a computer-simulated approach that creates a visually immersive digital environment using a headset connected to a computer or smartphone. It is a non-pharmacological therapeutic and distraction intervention that provides a pleasant experience accompanied by images and audio. This technology alleviates pain and anxiety by modulating non-painful neural signaling, enabling individuals to perceive, experience, and interact with stimuli in the virtual environment as if they were in the actual physical world **(Latif & Ragab, 2024).**

It is widely believed that virtual Reality (VR), with enhanced immersion, results in a heightened sense of presence. It has the potential to serve as an effective diversionary method for attaining the desired analgesic outcomes. This is in contrast to less immersive VR systems, traditional video games, and music alone **(Momenyan& Safaei, 2021).**

Implementing VR in clinical settings is feasible, as it requires minimal preparation and can be administered through VR glasses connected to a smartphone, providing immersive 3D content to distract and relax women during the procedure**.** However, challenges such as the cost of VR equipment, the need for women's cooperation, and limited accessibility in low-resource settings may hinder its widespread application. Effective VR implementation requires healthcare teams to select suitable VR materials, provide adequate training, and address ethical issues related to data protection and obtaining informed consent from women, enabling responsible VR usage in nursing. **(Baniasadi et al., 2022; Almedhesh et al., 2022).**

Significance of the study

Immersive virtual reality (VR) has demonstrated promise as an option for pain relief and reducing the need for sedation. It appears to lower anxiety in women receiving regional anesthesia, potentially eliminating the need for some anxiety medications and opioids**.** Using VR in surgical settings may increase

patient satisfaction, lower anxiety before and during surgery, stabilize vital signs, speed up recovery, and is generally well-received by surgical teams. It also requires minimal setup or guidance for both patients and healthcare providers. However, research on how effective VR truly is in reducing anxiety during surgery remains limited **(Huang et al., 2020; Molina, 2021).**

Aim of the study:

Determine the effect of virtual Reality on anxiety, satisfaction level and hemodynamic parameters among women during cesarean section

Research hypotheses:

H0: Laboring women who use virtual reality goggles during cesarean section experience similar anxiety level, satisfaction level, and hemodynamic parameters as those who don't use it.

H1: Women who wear virtual reality (VR) goggles during cesarean sections report lower levels of anxiety compared to those who do not use VR.

H2: Women who use virtual reality (VR) goggles during cesarean sections report higher satisfaction levels compared to those who do not use it.

H3: Women who use virtual reality (VR) goggles during cesarean sections exhibit more stable hemodynamic parameters compared to those who do not use VR.

MATERIALS AND METHOD

MATERIALS

Research design:

A non-randomized controlled clinical trial research design was followed in this study.

Setting:

The study was carried out in the Obstetric and Gynecological operating room of Shubrakhit General Hospital, which is equipped with non-invasive blood pressure, pulse oximeter and cardiac monitor to record maternal hemodynamic parameters. This hospital is affiliated with the Ministry of Health in El-Beheira Governorate, Egypt, and was specifically selected due to its adequate Women turnover for the study.

Subjects:

The study included a sample of 100 laboring women selected from the previously described setting, based on the following criteria:

- Age ranged from 20 to less than 35 years old.
- Free from visual or auditory disability.
- Full term (38-42 weeks of gestation).
- Normal pregnancy (Not diagnosed with any medical conditions, including preeclampsia or hypertension)
- Undergoing elective cesarean delivery with spinal anaesthesia.
- No previous diagnosis of generalized anxiety disorder or any other mental health condition.
- Voluntarily agreed to participate in the study.

Sampling technique:

A sample of 100 laboring women who met the established inclusion criteria was conveniently chosen from the previously mentioned setting and randomly allocated into either the control (50 participants) or the study group (50 participants) using the fishbowl draw method.

Study group: which wore VR glasses starting immediately after receiving spinal anesthesia and continued wearing them

throughout the entire procedure until skin suturing was completed.

Control group: which received only the standard hospital care provided for cesarean sections.

Tools of data collection:

Four tools were used for data collection.

Tool (I): Basic data structured interview schedule:

This tool was designed and utilized by the researcher to gather essential demographic and clinical information about the study participants, based on current and relevant literature. **(Abdel-Tawab et al., 2018).** It included three main parts:

Part I: Socio-demographic data, including age, level of education, occupation, current residence, income as well as weight, height and BMI.

Part II: Reproductive history: including gravidity, parity, abortions, stillbirth, number and sex of living children as well as gestational age

Part III: History of cesarean section: including a number of previous cesarean sections and the reason for the current one.

Tool II: Beck Anxiety Inventory (BAI).

This tool was originally developed by **Beck et al. (1988)** to measure the severity of anxiety. It was translated into Arabic and adapted by the researcher for use in this study. The inventory includes 21 items, each reflecting a common symptom of anxiety, such as the sensation of numbness or tingling, feeling hot and nervous. The responses were measured on a 4-point Likert scale from 0 ("not at all") to 3 ("severely"). Total scores range from 0 to 63, with anxiety levels classified into the following categories:

- Low anxiety level. 0-21
- Moderate anxiety level. 22-35
- High anxiety level ≥36

Tool III: The Birth Satisfaction Scale-Revised (BSS-R):

Originally created by **Hollins Martin et al. (2012),** this scale assesses women's satisfaction with the care and overall experience during labor. It was adapted and translated into Arabic for the purposes of this study. The scale includes 10 statements, each rated on a 5-point Likert scale from 1 (“strongly disagree”) to 5 (“strongly agree”). Four items (2, 4, 7, and 8) are reverse-scored. The total score ranges from 10 to 50. Satisfaction levels are categorized as follows:

- Unsatisfied. 10-23
- Neutral. 24-37
- Satisfied. 38-50

Tool IV: Maternal hemodynamic parameters monitoring sheet:

This tool was developed by the researcher based on current and relevant literature to record key hemodynamic indicators. It documents heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and peripheral oxygen saturation (SpO_2) at specific time points: upon admission to the operating room, immediately after administration of anesthesia, at skin incision, during delivery of the baby, at skin suturing, and two hours postoperatively.

METHOD:

The study was carried out through the following steps:

Administrative process

- Approval from the Ethical Research Committee, Faculty of Nursing, Damanhour University was obtained. The research code was (72-C)
- An official letter from the faculty of nursing was submitted to the

authorized personnel at the study setting to gain permission for conducting the research, following a clear explanation of its objectives.

- The content validity of tools I, II, III, and IV was assessed by a panel of five experts in the relevant field. Their feedback and recommendations were carefully considered and integrated.
- The reliability of the tools was confirmed through internal consistency testing using Cronbach's alpha. The results showed high reliability: Tool II had a Cronbach's alpha of 0.95, and Tool III had 0.94.

Pilot study

A pilot study was conducted on 10 women, representing 10% of the total sample, during their cesarean deliveries. These participants were not included in the main study.

The main purposes of the pilot study were to:

- Assess the clarity, feasibility, and practicality of the data collection tools.
- Detect any potential challenges or barriers during the implementation process.
- Estimate the time required to complete data collection for each participant.

Results of the pilot study:

- The tools were found to be clear, relevant, and suitable for use; no revisions were necessary.
- No issues or complications affecting the data collection process were observed.

Data collection process

Each participant was interviewed individually by the researcher in a private setting within the waiting room, following a clear explanation of the study's purpose and the collection of informed consent. Preoperative interviews lasted approximately 15 to 20 minutes, while intraoperative observations and follow-up during the procedure took around 40 to 50 minutes. Data collection was scheduled three days a week, from 8:00 a.m. to 2:00 p.m., over a three-month period from May to August 2024. On average, 3 to 4 participants were interviewed each day.

The subjects were assigned into two groups as follows:

The control group consisted of 50 pregnant women who received standard hospital care. Each participant was individually interviewed by the researcher for approximately 15 to 20 minutes during the preoperative preparation period in the waiting area. During this time, basic demographic and clinical information was collected using Tool I, and anxiety levels were assessed using Tool II.

Throughout the cesarean procedure—lasting about 40 to 50 minutes—the women were observed to monitor vital signs, including blood pressure, pulse rate, and oxygen saturation. These parameters were recorded at five specific time points: upon admission to the operating room, immediately after spinal anesthesia, at skin incision, at the time of baby delivery, and at skin suturing, using Tool IV.

Two hours postoperatively, in the recovery room, participants were re-assessed for anxiety using Tool II, satisfaction using Tool III, and vital signs using Tool IV.

The study group included 50 women who applied the VR headset. It included three phases: assessment, implementation and evaluation.

1. **Assessment phase:**

Each participant in the study group was individually interviewed by the researcher for approximately 30 minutes during the preoperative preparation period in the waiting area. During this time, basic demographic and clinical data were collected using Tool I, and baseline anxiety levels were assessed using Tool II.

Following the interview, the study's purpose, procedures, participants' roles, and the rationale for using virtual reality (VR) were clearly explained. The VR device used was the Oculus Rift SPC-powered headset, manufactured in China.

The researcher applied the "tell-show-do" technique to introduce the VR headset. This method included a verbal explanation of how the headset functions within a virtual setting (tell), a demonstration of how to navigate and display various virtual environments (show), and finally, allowing each woman to use the headset herself (do).

Participants were offered a selection of calming virtual environments to choose from, including the Blue Ocean, Blue Deep, Green Meadows, Blue Moon, Red Savannah, Orange Sunset, Red Fall, and White Winter. Each scene featured soothing natural visuals accompanied by either calming music or recitations from the Holy Quran.

To help participants make an informed choice, printed cards featuring images were provided. These visual aids served as a guide for the women to select their preferred immersive experience in advance.

Figure 1. VR googles

2. Implementation phase (During operation):

This phase began immediately after the administration of spinal anesthesia. The VR headset was adjusted to fit the participant's head securely and positioned accurately over her eyes. The preselected virtual environment—specifically, the 3D Aquarium VR—was then activated.

Participants were encouraged by the researcher to relax and immerse themselves in the virtual setting, helping them feel fully engaged and present in the calming experience.

The VR headset remained in use throughout the entire cesarean procedure until skin suturing was completed.

Hemodynamic parameters—blood pressure, heart rate, and oxygen saturation—were recorded at five key time points: prior to the intervention,

immediately after spinal anesthesia, at the time of incision, during baby delivery, and at the time of suturing. These measurements were taken using Tool IV.

3. Evaluation phase:

The subjects were interviewed 2 hours after completion of skin suture in the recovery room. The anxiety level was reassessed using tool II, satisfaction level using tool III and hemodynamic parameters (tool IV)

Statistical analysis of the data:

After data collection, the information was entered into a computer and analyzed using IBM SPSS software, version 20. Qualitative data were summarized using frequencies and percentages, while quantitative data were presented as means and standard deviations. Statistical significance was determined at a 5% level ($p < 0.05$).

Ethical Consideration:

For each participant, the following ethical considerations were upheld:

- Oral informed consent was obtained prior to data collection, following a clear explanation of the study's purpose.
- Participants' anonymity and privacy were strictly protected.
- All collected data were treated with full confidentiality.
- Each woman was informed that her participation was entirely voluntary and that she could withdraw from the study at any point without any consequences.

Results

Table (I) The findings show no significant differences between the study and control groups in terms of demographic and baseline characteristics, including age, education, occupation, residence, income, weight, height, and BMI. The mean ages were 27.7 ± 4.7 years for the study group and 27.2 ± 4.6 years for the control group. Secondary education was completed by 40% of the study group and 32% of the control group. A sizable proportion of participants were housewives (66% in the study group and 60% in the control group), and A substantial proportion of participants resided in rural areas (66% and 62%, respectively). Regarding income, 62% of the study group and 56% of the control group reported having sufficient income. Nearly one- half of each group were classified as overweight (48% of the study group and 52% of the control group).

Table (II) The table demonstrates that there were no statistically significant differences between the study and control groups regarding their reproductive history. Regarding the gravidity, it was 26% of the study group and 28% of the control group being primigravida, while parity showed that 34% and 38% were nulliparas in the study and control groups, respectively. A sizable proportion of participants in both groups had no history of abortion (76%

and 80%). Most of participants (98%) had no stillbirths in both groups. Additionally, the number of living children and their gender distribution were comparable across the groups, with around one-third having one living child and only a small percentage having both male and female children. The mean gestational age was nearly identical between the two groups (39.2 ± 1.2 and 39.3 ± 1.2 weeks).

Figure (I) The figure reveals no statistically significant differences between the study and control groups in the number of previous cesarean sections. One- half (50%) of the women in each group had no previous cesareans, while a slightly smaller proportion had one previous cesarean 30% in the study group compared to 26% in the control, and a minority had two or more 20% in the study group compared to 24% in the control group.

Figure (II) The figure outlines the main causes of cesarean section in both groups were fetal malposition and placental abnormalities. Maternal request was more common in the control group 26% than in the study group 20%. Previous cesarean was a notable cause in both groups 24% in the study group compared to 18% in the control group. Maternal health problems were reported only 6% in the control group. Other causes, such as precious baby and failed induction, were more frequent in the study group 20% compared to 8% in the control group.

Figure (III) The figure presents the duration of cesarean sections in both the study and control groups, revealing similar surgical times between them. The study group had a duration range of 38 to 56 minutes, with a mean of 47.9 ± 4.1 minutes, while the control group's duration ranged from 40 to 55 minutes, with a mean of 48.6 ± 4.0 minutes.

Table (III) The table shows highly statistically significant differences were observed in anxiety levels between the study and control groups following the VR intervention ($P < 0.001$), with only 4% reporting high anxiety compared to 32% in the control group. Additionally, 48% of the study group had low anxiety levels post-intervention compared to 20% in the control group. The study group's mean anxiety score dropped significantly to 21.2 ± 6.2, while the control groups remained higher at 30.0 ± 8.1.

Table (IV) The table shows highly statistically significant differences were observed in birth satisfaction levels between the study and control groups. A total of 74% of the study group, who received the VR intervention, reported being satisfied compared to only 6% in the control group. Dissatisfaction was notably

lower in the study group (4%) than in the control group (44%). Additionally, the study group had a significantly higher mean satisfaction score (38.7 ± 4.9) than the control group (25.2 ± 5.8)

Table (V) The table summarizes A highly statistically significant difference was observed in maternal hemodynamic parameters between the study and control groups during various stages of the cesarean section. Although no significant differences were found at admission to the OR immediately after anesthesia, the study group, which received virtual reality (VR) intervention, consistently showed significantly lower heart rate and blood pressure values during skin incision, baby exit, skin suturing, and two hours postoperatively. For example, at baby exit, the study group had significantly lower heart rate ($p = 0.001$) and systolic BP ($p = 0.002$), and higher oxygen saturation ($p = 0.048$). During skin suturing and two hours post-operative, significant reductions in heart rate, systolic and diastolic BP were also noted in the study group (all $p < 0.01$).

Table(I)Number and percent distribution of the laboring women according to their socio- demographic data.

Socio-demographic data	Study (n=50)		Control (n = 50)		Test of Sig.	p
	No.	%	No.	%		
Age (years):						
20-	17	34.0	21	42.0	χ^2= 0.728	0.695
25-	18	36.0	15	30.0		
30 and more	15	30.0	14	28.0		
Min–Max.	20.0-34.0		20.0-34.0		t =0.602	0.549
Mean± SD.	27.7±4.7		27.2±4.6			
Level of Education:						
Illiterate/read and write	5	10.0	8	16.0	χ^2= 2.861	0.414
Primary	8	16.0	13	26.0		
Secondary or its equivalent	20	40.0	16	32.0		
University or higher	17	34.0	13	26.0		
Occupation:						
Housewife	33	66.0	30	60.0	χ^2= 0.571	0.751
Worker	9	18.0	12	24.0		
Employee	8	16.0	8	16.0		
Current residence:						
Urban	17	34.0	19	38.0	χ^2= 0.174	0.667
Rural	33	66.0	31	62.0		
Income:						
More than enough	7	14.0	7	14.0	χ^2= 2.819	MC_p= 0.468
Enough	31	62.0	28	56.0		
Barely enough	12	24.0	12	24.0		
Not enough	0	0.0	3	6.0		
Weight (Mean± SD)	162.9±3.6		164.7±4.3		t=1.220	0.092
Hight (Mean ±SD)	80.8±7.4		81.9±9.6		t=0.414	0.680
BMI(Mean±SD):	30.4±2.7		29.8±3.5		t=0.865	0.398
Normal	0	0.0	2	4.0	χ^2= 3.110	MC_p= 0.210
Overweight	24	48.0	26	52.0		
Obese	26	52.0	22	44.0		

SD:standard deviation
χ^2:**Chi square test** MC:**Monte Carlo** **t: Student t-test**
p:p value for comparing between the studied groups
*: Statistically significant at p≤0.05

Table(II): Number and percent distribution of the study and control groups according to their reproductive history

Reproductive history	Study (n=50)		Control (n=50)		χ^2	^{MC}p
	No.	%	No.	%		
Gravidity:						
1	13	26.0	14	28.0		
2	16	32.0	18	36.0	0.385	0.825
≥3	21	42.0	18	36.0		
Parity:						
0	17	34.0	19	38.0		
1	18	36.0	18	36.0	2.798	0.483
2	12	24.0	13	26.0		
≥3	3	6.0	0	0.0		
Number of abortions:						
None	38	76.0	40	80.0		
Once	9	18.0	7	14.0	0.402	0.928
Twice or more	3	6.0	3	6.0		
Number of still birth:						
None	49	98.0	49	98.0	1.010	1.000
Once	1	2.0	1	2.0		
Number living children:						
None	19	38.0	19	38.0		
One	18	36.0	19	38.0	1.739	0.747
Two and more	13	26.0	12	24.0		
Gender of living children:						
None	19	38.0	19	38.0		
Males only	11	22.0	13	26.0	0.548	0.908
Females only	14	28.0	11	22.0		
Males and females	6	12.0	7	14.0		
Gestationalage:						
Min – Max.	38.0-42.0		38.0-42.0			
Mean ± SD.	39.2±1.2		39.3±1.2		t=0.421	0.675

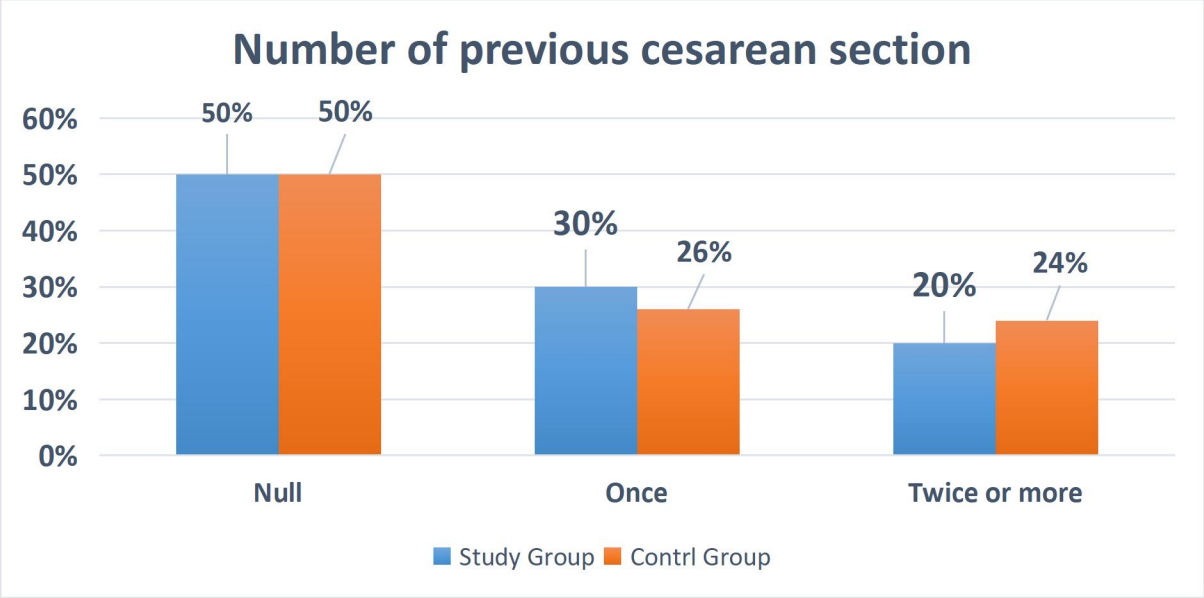
SD:standarddeviation

χ^2:**Chisquaretest** MC:**MonteCarlo** **t:Studentt-test**

p:pvaluefor comparingbetween thestudiedgroups

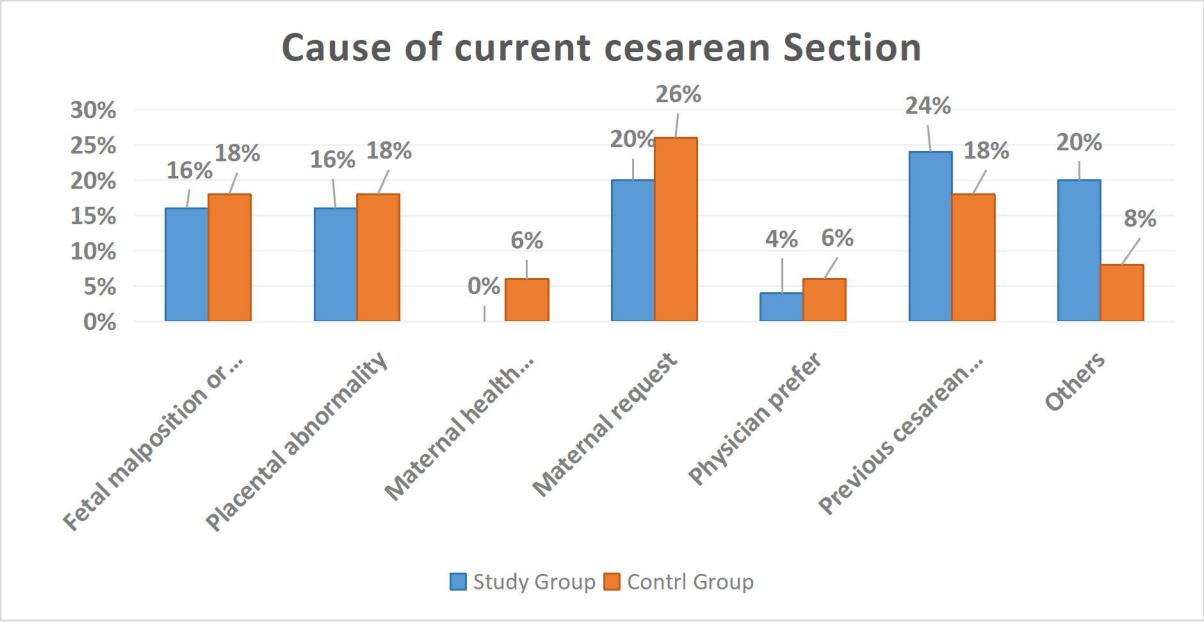
*:Statisticallysignificantat p≤0.05

Figure (I): Percent distribution of the study and control groups according to the number of previous cesarean section.



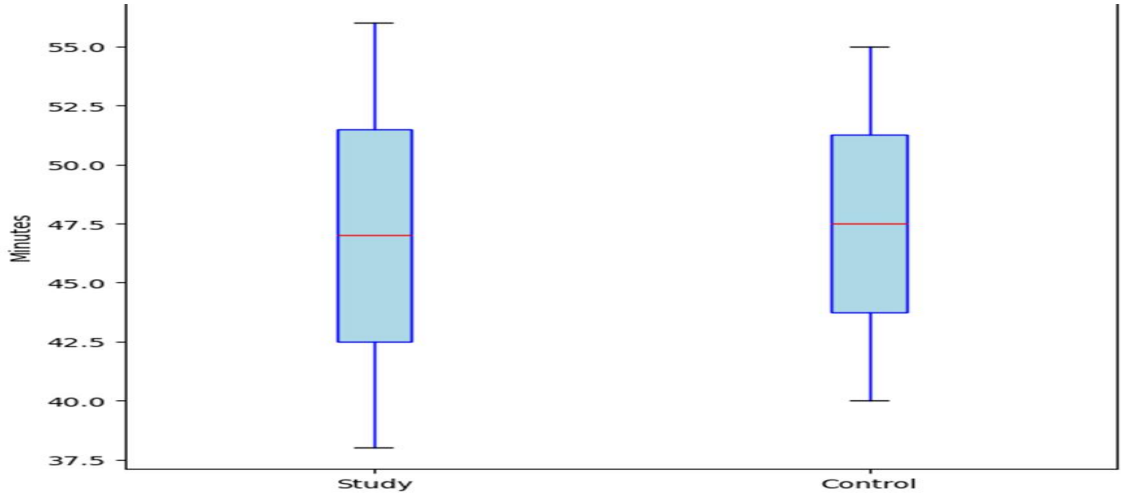
$\chi^2 = 0.185$ $^{MC}p = 0.875$

Figure (II): Percent distributionofthestudy and control groupsaccordingtothe causes of the current cesarean section.



$\chi^2 = 6.370$ $^{MC}p = 0.386$

Figure (III): Distributionofthestudy and control groupsaccordingtothe duration of the current cesarean section.



t=0.367 $^{MC}p = 0.715$

Table (III): Distribution of the study and control groups according to their total score of anxiety levels before and after the VR intervention.

Beck Anxiety Inventory(BAI)	Study (n=50)				Control (n=50)				Test of sig. studyvscontrol	
	Before intervention		After intervention		Before intervention		After intervention			
	No.	%	No.	%	No.	%	No.	%	Before	After
Lowanxietylevel (≤ 21)	3	6.0	24	48.0	9	18.0	10	20.0	χ^2=3.733 p=0.155	χ^2=16.654* p<0.001*
Moderateanxiety level (22-35)	27	54.0	24	48.0	26	52.0	24	48.0		
Highanxietylevel (≥36)	20	40.0	2	4.0	15	30.0	16	32.0		
MH	**<0.001***				**1.000**					
▪ Min–Max.	15.0-43.0		9.0-39.0		14.0-48.0		13.0-45.0		t =1.707 p=0.091	t=6.234*p<0.001*
▪ Mean±SD.	33.0±6.2		21.2±6.2		30.6±8.2		30.0±8.1			
p_0	**<0.001***				**0.717**					

SD:standarddeviation

χ^2:Chisquare testforcomparingthetwogroups**MC:Monte Carlo**

t:Studentt-testfor comparingthetwogroups

MH:MarginalHomogeneityTest for comparingbetween preandpostin eachgroup P_0: p value for Paired t test for comparing between pre and post in each group

* Statisticallysignificantp-valueat≤0.05

Table (IV): Distribution of the study and control groups according to their total score of satisfaction levels after the VR intervention.

Birth Satisfaction Scale-Revised (BSS-R)	Study (n=50)		Control (n=50)		χ^2	p
	No.	%	No.	%		
Unsatisfied	2	4.0	22	44.0	51.011*	<0.001*
Neutral	11	22.0	25	50.0		
Satisfied	37	74.0	3	6.0		
Min– Max.	23.0-48.0		15.0-40.0		t=12.603*	<0.001*
Mean±SD.	38.7±4.9		25.2±5.8			

SD:standarddeviation

χ^2:**Chisquaretest t: Student t-test**

* Statisticallysignificantp-valueat≤0.05

Table(X):Distributionofthestudyand control groupsaccordingtotheirhemodynamicparameters(HR, systolic BP, diastolic BP and Oxygen saturation)

Maternalhemodynamicparameters	Operation room admission	Immediately after anesthesia	Incisiontime	Babyexit	skin suture	After2hours	F	p
	Mean±SD.	Mean±SD.	Mean±SD.	Mean±SD.	Mean±SD.	Mean±SD.		
Heartrate (HR)								
▪ Study	90.1±7.6	85.7±7.6	84.6±6.4	83.6±5.9	82.9±5.3	81.0±5.6	14.243*	<0.001*
▪ Control	89.7±10.2	89.9±13.8	92.4±15.9	96.8±22.0	96.6±21.8	89.9±16.2	3.033*	0.088
t(p)	0.234 (0.816)	1.907 (0.060)	3.210* (0.002*)	4.091* (0.001*)	4.306* (<0.001*)	3.683* (<0.001*)		
Systolicbloodpressure(SBP)								
▪ Study	119.7±5.9	108.9±6.9	109.0±7.4	110.5±9.4	111.0±10.1	111.2±11.8	5.882*	0.019*
▪ Control	120.0±5.1	111.7±7.1	108.9±14.1	115.7±5.2	115.7±5.3	113.0±5.0	1.541	0.220
t(p)	0.237 (0.813)	1.980 (0.051)	0.053 (0.958)	3.456* (0.002*)	3.207* (0.002*)	2.956* (0.004*)		
Diastolicbloodpressure(DBP)								
▪ Study	77.0±8.6	67.0±6.7	67.2±4.7	67.1±4.9	67.3±5.3	67.1±5.4	33.870*	<0.001*
▪ Control	79.4±7.4	66.8±6.1	68.7±5.4	69.8±4.1	71.8±6.4	70.9±4.8	0.385	0.538
t(p)	1.509 (0.134)	0.188 (0.851)	1.533 (0.129)	1.454 (0.104)	3.861* (<0.001*)	3.664* (<0.001*)		
Peripheraloxygensaturation(SpO2)								
▪ Study	97.9±1.5	97.4±1.6	97.4±1.2	98.2±1.7	98.3±0.7	98.6±0.8	34.987*	<0.001*
▪ Control	97.7±1.4	96.8±1.8	94.8±12.5	97.1±1.9	97.8±1.0	98.0±1.0	0.916	0.343
t(p)	0.819 (0.415)	1.955 (0.053)	1.466 (0.149)	2.000* (0.048*)	1.148 (0.085)	1.350 (0.101)		

SD:standarddeviation F:ANOVAwithrepeatedMeasure t:Studentt-test*Statisticallysignificantp-valueat

Discussion

The rate of cesarean sections (CS) has risen sharply in both developed and developing countries, making it the most common abdominal surgery and one of the most frequently performed procedures overall. CS is typically carried out under regional anesthesia, without the use of preoperative sedatives, to allow the mother to remain awake during delivery, minimize the risk of neonatal resuscitation, and support immediate skin-to-skin contact between mother and baby. **(Shah et al., 2022).**

The findings of the current study suggest that virtual reality (VR) can significantly reduce anxiety in women undergoing cesarean delivery under regional anesthesia. By creating a calming and immersive environment, VR helps lower anxiety levels during the procedure. Its engaging nature distracts women from the clinical surroundings, minimizing exposure to distressing sights and sounds in the operating room. This distraction serves as a powerful tool to ease emotional stress and improve the overall comfort of the surgical experience.

This result aligns with research conducted by **Chan et al. (2021)** in Singapore, which showed that VR interventions significantly reduced preoperative anxiety, with a 45% decrease in anxiety scores following the intervention. Similar outcomes have been reported in another research. For example, **Althobiti and Alanzi (2022)** Conducted a quasi-experimental investigation at the Maternity and Children's Hospital in Najran, Saudi Arabia, it was found that patients utilizing VR glasses exhibited significantly reduced anxiety levels immediately following surgery as well as two hours after the procedure, in comparison to the control group. Likewise, a systematic review by **Ioannou et al. (2020),** which analyzed 23 studies, confirmed that VR consistently helps reduce stress and anxiety across diverse medical contexts and patient groups. Collectively, these studies support the use of immersive VR as an efficient on-pharmacological strategy for alleviating emotional stress during medical procedures.

Additional studies have supported this conclusion, showing reduced anxiety levels during surgical, dental, and diagnostic interventions **(van den Berg et al., 2019).** These findings showed VR's potential as an adjunct to enhance women's comfort and reduce preoperative anxiety. A study by **Ahmed et al. (2022)** conducted in Egypt partially aligns with these findings and reported that while VR reduced anxiety, it was less effective in patients with extreme preoperative fear.

Conversely, a study by **Hernandez et al. (2022)** conducted in Mexico found that VR had limited effects on reducing anxiety, attributing this to cultural differences and limited exposure to VR technology. Moreover, studies by **Walker et al. (2014) and Glennon et al. (2018)** found no meaningful reduction in anxiety levels between patients using virtual Reality and those in control groups during cystoscopy and bone marrow aspiration procedures. These inconsistent findings may stem from differences in the quality of VR technology and the content presented through the headsets, both of which play a crucial role in how effectively VR can divert attention and alleviate psychological distress. This discrepancy in results suggests that the effectiveness of VR may depend on the context, content type, timing of use, and patient-specific variables.

As part of the present study, maternal satisfaction was evaluated, recognizing its growing importance in assessing and improving the quality of healthcare services. The results revealed that women in the VR group reported significantly higher overall satisfaction with the delivery experience compared to those in the control group. This result is agreed with **Duan et al. (2021),** who conducted a

randomized controlled trial in China, finding that the majority of patients using VR reported higher satisfaction during surgical procedures compared to the control group.

As well as **Gupta et al. (2022)** who performed a cross-sectional study in India, concluding that the majority of women undergoing cesarean sections with VR support were satisfied due to reduced anxiety and better pain distraction. These findings are consistent with the results of the VR-PERLA Study by **Alaterre et al. (2020),** which demonstrated that the use of virtual reality during peripheral regional anaesthesia significantly enhanced patient satisfaction. Participants reported a more positive overall experience, highlighting VR's role not only in reducing anxiety but also in improving procedural comfort and satisfaction.

On the other hand, there are studies reporting lower satisfaction levels of VR. A study conducted by **Acaroğlu et al. (2020)** in Turkey partially agrees with these results, suggesting that only about half of patients were satisfied with VR use during surgical procedures, citing technical difficulties and discomfort with the headset as reasons for dissatisfaction. In comparison, this study conducted by **Kariuki et al. (2021)** in Kenya identified that half of the participants were unsatisfied due to a lack of cultural adaptation of the VR content, which reduced engagement.

The significantly higher satisfaction levels in the study group post-VR intervention indicate that VR effectively reduces anxiety and enhances women's experience during cesarean sections. This aligns with evidence from studies showing VR's ability to distract from pain and anxiety, making the procedure more tolerable and improving women's satisfaction. However, contrasting findings emphasize that factors such as technical issues or cultural mismatches in VR content can hinder its effectiveness. This highlights the need for customized VR interventions to address diverse women's needs and settings.

The findings of this study demonstrate that virtual Reality (VR) significantly influenced heart rate (HR), systolic blood pressure (SBP), and diastolic blood pressure (DBP) in the two hours post-cesarean section. The VR group showed improved hemodynamic stability, as indicated by lower HR and BP compared to the control group. These results suggest that VR not only reduces intraoperative anxiety but may also help stabilize the autonomic nervous system, potentially leading to improved postoperative recovery.

This result is congruent with a randomized controlled trial in Saudi Arabia at Najran University conducted by **Almedhesh et al. (2022).** This study reported that women exposed to VR during cesarean sections experienced significant reductions in HR, SBP, and DBP compared to the control group. **Zhao et al. (2021)** conducted a similar randomized controlled trial in China, which also found that VR had a lasting effect on lowering HR and BP even hours after cesarean surgery. Additionally, a randomized controlled trial in South Korea conducted by **Kim et al. (2021)** showed VR use significantly reduced heart rate and systolic BP during surgeries compared to controls. Their findings were in line with the present study, suggesting that VR's calming effects persist beyond the immediate post-surgical period, contributing to more stable hemodynamics and reduced anxiety. However, no significant difference in oxygen saturation between groups indicates VR's effect on hemodynamics may be limited to specific parameters.

On the other hand, a prospective cohort study conducted in India by **Singh et al. (2021)** reported no significant differences in HR and BP between the VR and control groups two hours after cesarean delivery. They speculated that the calming effects of VR might not last as

long as expected or that other factors, such as medication and anaesthesia, might have had a stronger influence on postoperative hemodynamics. **Liu et al. (2022),** in a study in the UK, examined the effect of VR on postoperative anxiety and hemodynamics and found no statistically significant changes in HR or BP after two hours. The researchers suggested that VR intervention might not be potent enough to affect these parameters in the long-term recovery phase and that other environmental factors, such as the immediate postoperative care setting, could have overridden VR's effects.

Conclusion

Based on the findings of this study, it can be concluded that women undergoing cesarean sections who used VR google exhibit less severity of anxiety, more satisfaction level and more stable hemodynamic parameters than those who did not use it.

Recommendations

Based on the results of the present study, the following recommendations are proposed:

- The curricula for both basic nursing/midwifery education and ongoing professional development should incorporate non-pharmacological techniques for alleviating anxiety during obstetric and gynecological procedures.
- Maternity nurses should explain the importance of technology in anxiety reduction and satisfaction improvement for the clients to enhance preoperative counseling.

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