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Effect of Utilizing Virtual Reality Technology for Pushing during Second Stage of Labour on Birth Outcomes among Primiparous Women

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Abstract
Background: Virtual reality (VR) technology is making waves in obstetric nursing, particularly for primiparous women. Research shows that VR can significantly alleviate anxiety and fatigue, creating a more serene and focused birthing environment. This study **aimed** to examine the effect of utilizing virtual reality **(**VR) technology for pushing during second stage of labour on birth outcomes among primiparous women. **Study Design** A quasi-experimental approach with a non-equivalent control group pretest-posttest was adopted. **Study Setting:** Labour and delivery unit of Mansoura University Hospital, Dakahlia Governorate, Egypt. **Study Subjects:** A convenient sample of 90 primiparous women was recruited. **Study Tools:** Data was collected using three tools, structured interview schedule, state anxiety inventory-S, visual analog scale for fatigue and birth satisfaction scale-revised. **Results:** Post-intervention, the mean anxiety score was significantly reduced in the VR group 36.5 ±11.0 as compared to 60.4 ±11.9 for the control group. Concerning the mean fatigue score, it was significantly lower in the VR group as compared to the control group (19.8 ±6.4 vs. 89.9 ± 34.4, respectively). Furthermore, the mean birth satisfaction score was significantly higher in the VR group 28.4 ± 11.8 compared to 17.8 ± 8.8 in the control group. **Conclusion:** VR technology has been shown to positively affect birth outcomes for primiparous. It significantly reduced anxiety and fatigue scores, and primiparous women utilizing VR reported higher birth satisfaction. **Recommendations:** Raise pregnant women's awareness of the VR benefits during labour by offering antenatal education classes in the third trimester.

Keywords: Birth outcomes, Primiparous, Pushing, Second stage & Virtual reality

Introduction
Childbirth is a multifaceted and challenging process that is widely recognized as one of the most significant and distressing occurrences in a woman's life. It is believed that this process is a continuous process that is segmented into four distinct stages. The first stage is when labour begins and lasts until the cervix has fully dilated. The period of time from full cervical dilatation to fetal delivery is referred to as the second stage of labour **(Hofmeyr & Singata-Madliki, 2020)**.

For women giving birth for the first time, the second stage of labour can be intimidating and challenging. Women typically experience discomfort, anxiety, tiredness, nausea, and elevated blood pressure during this stage due to activation of renin–angiotensin system as a result of the effect of uterine contractions, all of which can lead to a traumatic childbirth experience that reduces comfort and happiness with delivery **(Baradwan et al., 2022)**.

The extended duration of the second stage of labour has been correlated with an elevated likelihood of maternal morbidity, encompassing conditions chorioamnionitis, postpartum hemorrhage postpartum urinary retention, prolonged voiding dysfunction, perineal trauma and newborn morbidity such as sepsis and hypoxia. If the difficulties of the second stage of labour are not sufficiently addressed, women may have unfavorable emotional experiences and conceptions about childbirth, which will impede the development of an emotional bond with the infant **(Zipori, et al., 2019)**.

The women's pushing actions help the fetus pass through the woman's pelvis during the second stage of labour. Sufficient pushing methods, which include non-medical approaches that can improve the health of the women and the fetus. It has been suggested that starting maternal pushing when dilatation is complete can be used to augment each uterine contraction to facilitate the delivery and may shorten the second stage of labour **(Cohen & Friedman, 2021)**.

During the second stage, pushing is typically divided into two categories: directed pushing (Valsalva pushing) and spontaneous pushing, the process of taking a deep breath and holding it with a closed-glottis is called the Valsalva Maneuver (VM). Numerous physiological studies indicate that the implementation of the VM for durations extending to

10 seconds or beyond may have detrimental effects on fetal acid-base equilibrium, Apgar assessment scores, and cerebral oxygenation levels. Furthermore, it may disrupt the duration of the second stage of labour, elevate maternal exhaustion, induce trauma to the maternal pelvic floor structures, and hinder normal bladder functionality **(Hofmeyr & Singata-Madliki, 2020)**.

Spontaneous pushing is a therapeutic technique that encourages a woman to follow her body's natural urge to push. In spontaneous pushing, a woman is encouraged to push repeatedly for the duration of one uterine contraction, taking several breaths in between each push. By inducing the Ferguson's reaction, it releases more oxytocin, which enhances the effectiveness and reduces the fatigue of the women's bearing down efforts **(Araújo et al., 2022)**.

According to recommendations made by the **World Health Organization (WHO)** in **2018**, women who are in the expulsive phase of the second stage of labour should be supported and encouraged to push on their own. Effective spontaneous pushing during the second stage of labour improves mother outcomes and leads to a reduction in caesarean sections, prolonged episiotomy rates, pelvic floor injury, and perineal lacerations. Furthermore, spontaneous pushing had no detrimental effects on newborn outcomes **(Yao, et al., 2024)**.

In the second stage of labour, nurses focus on providing support and encouragement while continuously monitoring the well-being of both the mother and the fetus. Utilizing different pushing postures, such as side-lying, upright, or dorsal lithotomy, and avoiding fundal pressure are essential for managing the second stage of labour well. Therefore, during the second stage of labour, it is imperative that healthcare providers give priority to resolving unpleasant childbirth experiences and removing obstacles to childbirth education. **(Gimovsky & Berghella, 2022)**.

Current complementary non-pharmacological methods in addition to the pharmacological methods, one such method is Virtual Reality (VR)**,** VR is an innovative technology that was introduced by Jaron Lanier in the 1980s. In recent years VR have witnessed significant advancements that have introduced effective solutions across various sectors, particularly in the realm of healthcare **Ebrahimian, & Bilandi, (2021)**.

Using VR movies is a novel method with immersive and interactive characteristics; these movies have the potential to transform breathing exercises during spontaneous pushing by making them more engaging and interesting for women. Women can be taken to tranquil settings for guided meditation, or serene landscapes by combining breathing exercises with engaging virtual environments and scenarios. This combination not only helps patients stay away from traditional exercises but also encourages their enthusiasm and active participation during the maternal pushing **(Cook, et al., 2021)**.

The use of virtual reality technology during normal labour has demonstrated promise in lowering pain and anxiety, shortening the labour's duration, and improving the pleasure of the birthing process overall. It is thought that these favorable results lead to higher patient satisfaction and better care quality **(Goodier, 2020)**.

Significant of the study

Prolonged delivery stages with such concomitant maternal and fetal complications as contractile abnormalities in the uterus, fetal distress, low Apgar scores, and infant mortality can reduce satisfaction with delivery. As a result, measures aimed at decreasing pain, shortening the length of delivery stages and reducing maternal and fetal complications can enhance the satisfaction levels of women with the experience of child delivery. One of these measures is VR which is being used more and more in the field of health professional's education. It is a simple, safe, non-invasive, and efficient method during normal labour **(Chen et al., 2020)**.

For the purpose of promoting the health of the women and the child, it is imperative to provide educational videos using virtual guidance on enhancing spontaneous pushing efforts during the crucial second stage of labour **(Rimsza et al., 2023 & Choi et al., 2022)**. A systematic review and meta-analysis recommended that spontaneous pushing training given during the second stage of labour is effective for completing labour with requiring less intervention, and delivering in a shorter time. It should be included in maternal hospital protocols for enhancement of maternal and neonatal outcomes **(Yao et al., 2022)**.

According to recent research, watching virtual reality videos greatly improve women's overall happiness by increase the ability of pregnant women to choose self-doable childbirth facilitation techniques can not only alleviate labour pain, and enhance satisfaction but also augment control over the process of pushing and thus, boost self-confidence. Furthermore, reducing cortisol levels exerts a significant effect on anxiety, and thus, facilitates delivery **(Carus, et al., 2022)**. Nevertheless, there is a paucity of studies exploring the impact of VR on pushing during the second stage of labour as noted by researchers. Therefore, there is a pressing need to examine the effect of utilizing virtual reality technology for pushing during second stage of labour on birth outcomes among primiparous women.

Aim of the Study

This study aimed to evaluate the effect of utilizing virtual reality technology for pushing during second stage of labour on birth outcomes among primiparous women.

Study Hypotheses

To reach the aim of this study, the following hypotheses were formulated:

- **Hypothesis 1.** Primiparous women who utilize virtual reality technology for pushing during second stage of labour will experience lower mean anxiety and fatigue scores than those who don't utilize it.
- **Hypothesis 2.** Primiparous women who utilize virtual reality technology for pushing during second stage of labour will experience a higher satisfaction level than those who don't utilize it.

Operational definition for birth outcomes

The birth outcomes observed in this research encompass various characteristics, such as the mean scores of anxiety and fatigue experienced, as well as birth satisfaction level. The evaluation of these outcomes was conducted sequentially using the state anxiety inventory-S, the visual analog scale for fatigue, and the birth satisfaction scale-revised.

Subjects and Method

Study Design

The study adopted a quasi-experimental approach with a non-equivalent control group pretest-posttest. Participants were assigned to one of two groups: the VR group, which received the VR intervention, or the control group, which did not. Participants were separated into groups based on their serial numbers in a non-randomized manner.

Study Setting

The Mansoura University Hospital's (MUH) labour and delivery unit served as the study's site. The reason this particular site was chosen is that MUH, which is situated in Mansoura City, Dakahlia Governorate, Egypt, is regarded as the most significant and expansive tertiary-level referral teaching hospital. Throughout the reproductive life cycle, it provides free-priced obstetric care services to all women seeking care, whether they live in rural or urban areas. The labour and delivery area comprised an examination room, a large room with six beds, a pre-eclamptic women's room, an ultrasound room, and a postnatal room. Every month, the unit receives over 80 cases for delivery on Sunday, Tuesday, and Thursday, which are the three hot days of the week.

Study Subjects

Ninety participants were selected for a purposive sample using the following **inclusion criteria**: Aged 18 to 35 years, full term with a single fetus, cephalic presentation, have normal vaginal delivery, free from visual or auditory Impairments, and free from high-risk pregnancy problems. **Exclusion criteria**: Primiparous who need an emergency intervention for fetal distress and have medical or psychological conditions.

Sample size Calculation

Based on data from the literature **(El Sharkawy, et al., 2022)**, the required minimum sample size was determined to be 90 primiparous, with a level of significance of 5% and a power of study of 80%. The sample size can be obtained using the following formula: $n = \frac{(Z\alpha/2 + Z\beta)^2 \times 2(SD)^2}{d^2}$ where, SD = standard deviation obtained from previous study; $Z_{\alpha/2}$, for 5% this is 1.96; Z_{β}, for 80% this is 0.84 and d, for the expected difference. Therefore, n = $\frac{(1.96 + 0.84)^2 \times 2(0.66)^2}{(039)^2}$ = 44.9.

According to the aforementioned formula, study subjects were divided into two equal groups: the VR group consisted of 45 primiparous who use VR. The control group consisted of 45 primiparous who did not use VR and received routine hospital care.

Data Collection Tools

Four tools were utilized to collect study-relevant data. These included the structured interview schedule, state-trait anxiety inventory (STAI-S), visual analog scale for fatigue (VAS-Fatigue), and the birth satisfaction scale-revised (BSS-R)

Tool (I): A Structured Interview Schedule was designed by the researchers after examining related literature **(Araújo et al., 2022; Mohamed et al., 2022)**. It consists of two parts:

- **Part 1: Demographic Characteristics:** Age, level of education, occupation, and residence.
- **Part 2: Labour and Delivery Parameters Form:** Gestational age, duration of the first and second stages of labour, and vital signs.

Tool (II): State Anxiety Inventory-S (STAI-S)

The State Anxiety Inventory-S (STAI-S) is a 20-item questionnaire originally developed by **Speilberger et al. (1983)** and adopted its Arabic version from **Bahammam (2016)**. With a Cronbach's alpha of 0.94, the Arabic version of the STAI-S has excellent internal consistency. The STAI-S assesses individuals' current state of anxiety and how they feel by using statements that measure subjective emotions of tension, apprehension, worry, and autonomic nervous system activation.

Each item was rated using a 4-point Likert scale, with one representing "not at all" and four representing "very much so." Reverse score was assigned to statements (e.g., I feel calm or I am happy) that did not reflect anxiety. There were three levels of anxiety based on each subscale's total score, which ranged from 20 to 80: mild anxiety (20-50), moderate anxiety

(51-65), and severe anxiety (66-80). All primiparous were given a scale to assess changes in anxiety mean scores before and after pushing.

Tool (III): Visual Analog Scale for Fatigue (VAS-Fatigue)

The Visual Analog Scale for Fatigue (VAS-Fatigue) a is 18-item questionnaire adopted from **Lee, et al., (1991)**. The 18-item of the VAS-Fatigue consists of 13 items related to fatigue and 5 items related to energy. A Cronbach's alpha of 0.94 to.96 exhibits a reliable and valid tool that has undergone previous testing. After birth, VAS fatigue was assessed twice: immediately and two hours after birth. Each woman was asked to indicate how tired or energetic she felt by marking an X on a horizontal line to scale at a distance of 10 cm. Lastly, the researcher determines the fatigue score by figuring out the location of the (x) mark. If the total VAS is less than 36, it indicates mild fatigue; if it is between 36 and 90, it indicates moderate fatigue; and if it is greater than 90, it indicates severe fatigue.

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

The Birth Satisfaction Scale-Revised (BSS-R), a 10-item survey crafted by **Hollins Martin and Martin in 2014**, demonstrates exceptional internal consistency with a Cronbach's alpha of 0.94. This questionnaire, designed to measure women's birth satisfaction, is both valid and reliable, offering a swift and straightforward self-assessment tool. Participants rate their agreement or disagreement with each statement on a 5-point Likert scale, generating scores that range from 0 to 40. A score of 0 indicates minimal birth satisfaction, while a score of 40 signifies maximum satisfaction with the birthing experience.

Content Validity and Reliability:

Three professors experts specializing in woman's health and midwifery nursing were enlisted to form a consultation panel, ensuring the content validity of the research tools. Their input and suggestions were carefully considered in the process of refining the tools. A Cronbach's alpha value of 0.902 was calculated for the structured interview schedule.

Study Preparation:

Ethical Considerations:

Before the study began, the Mansoura University Faculty of Nursing's research ethics committee was consulted **(IRB. No. P. 0537) in 2023**. All recruited primiparas were informed of the aim of the study prior to the start of the intervention, and informed consent was acquired. The study participants' right to remain anonymous and to stop participating at any time was rigorously respected. The privacy of each data set was maintained. The study tools and techniques did not involve any moral, religious, or cultural themes, nor did they harm the women. Primiparous rights and dignity were also respected.

Preparation of Study Tools:

After conducting an in-depth examination of relevant and current literature, the researchers formulated Tool I. Tools II, III, and IV were adopted.

Preparation of VR Glasses and Watching Movies:

The researchers bought VR goggles from https://www.jumia.com.eg/, the Jumia website. The researchers developed the movies about the breathing techniques of maternal pushing after conducting a thorough assessment of relevant and recent literature **(Başar, & Hürata, 2018; WHO, 2020)**. The researcher explained the video teaching for spontaneous pushing as follows: to help women relax during uterine contractions during the early stage of labour, the researcher instructed them to practice deep, calm breathing exercises. The women were instructed to push during the second stage of labour in response to a spontaneous impulse to push that arises multiple times during each contraction; however, no specific instructions were given regarding when or how to push.

In accordance with the manufacturer's guidelines, the researchers utilized a VR-compatible app and video player to view the 360-degree video on a mobile device. They positioned the mobile device's screen in alignment with the headset's lenses by inserting it into the front slot of the VR cardboard. Once the device was securely placed, the VR headset was gently positioned on the woman's head, with adjustments made as needed for comfort and proper alignment. This setup allowed the woman to experience an immersive 360-degree film showcasing breathing techniques for maternal pushing.

Study Procedure:

Assessment Phase:

Pilot Study:

Nine primiparous women, who make up 10% of the study sample overall and were left out of the full-scale study, were given the Arabic version of the study tools to test in order to identify any issues with the tools, the usability of the VR glasses movies, the workflow, and the cooperation of the administrative staff. To make the questions easier to use and understand, some have been modified, while others were amended.

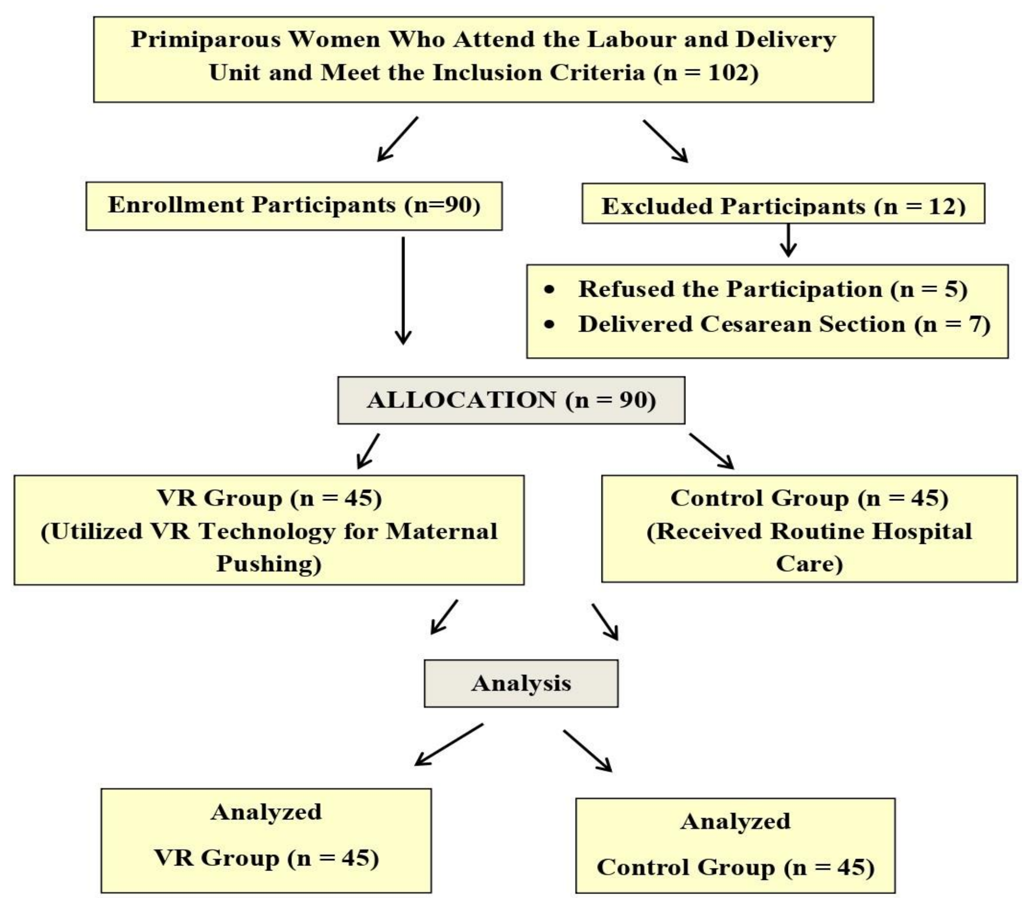
Implementation Phase:

The relevant authority in the research setting approved the official data collection after providing a thorough explanation of the study's aim. From the beginning of October 2023 to the end of April 2024, a period of seven months, was used to collect the study data. Three times a week, on Sunday, Tuesday, and Thursday, the researchers attended the labour and

delivery unit and looked through the registration book to find the primiparous who fit the inclusion criteria.
In order to exclude the potential for sample contamination, the study was started with the control group and finished before the VR group. The labour and delivery unit's routine care protocols were performed on the control group according to the guidelines of the standard of routine hospital care from the time of admission until delivery, such as continuous observation of labour progress, delivery of the baby, guidelines for active management of the third stage of labour and immediate postpartum care in the first four hours before women discharge.
In the VR group, participants utilized VR glasses to view instructional videos on maternal pushing breathing techniques post-admission during the first stage of labour, in addition to receiving standard care procedures at the labour and delivery unit. The researchers offered a concise overview of the purpose behind the VR glasses' use, the content of the videos, and guidance on how to use the headset. Women in the study identified the VR glasses during breaks between uterine contractions, donning the headset, which featured easily adjustable straps and cushioning for a comfortable fit. Throughout the second stage of labour, researchers aided the women in adhering to the prescribed breathing exercises during uterine contractions.

Evaluation Phase:

The researchers evaluated all study variables in both groups by employing the study tools. A comparative analysis was conducted between the two groups to determine the effect of utilizing VR technology to watch movies on mean scores related to anxiety, fatigue, and birth satisfaction among primiparous women.



CONSORT Diagram

Statistical Analysis

Version 20.0 of statistical package for the social sciences (SPSS) for Windows was utilized for all statistical analyses conducted (SPSS, Chicago, IL). The mean ± standard deviation (SD) was utilized for the expression of continuously distributed data following a normal distribution. Categorical data was presented using numbers and percentages. The comparison of variables with categorical data was done using the Significance test if deemed appropriate. An assessment was conducted pertaining to the internal consistency (reliability) of the questionnaires used in the study. Statistical significance was deemed to be present at a significance level of p<0.05.

Results

Table (1): Distribution of primiparous in VR and control groups according to demographic characteristics (N = 90)

Variables	VR Group (n = 45)		Control Group (n = 45)		Significance test	
	N	%	N	%	X^2	P
Age (Years)						
▪ < 25	15	33.3	16	35.6	0.061,	P=0.970#
▪ 25 – 35	30	66.7	29	64.4		
Mean ±SD	**26.9 ±4.6**		**26.4 ±4.6**		**T=0.577,**	**P=0.565$**
Educational level						
▪ Primary	2	4.4	3	6.7	2.415,	P=0.299#
▪ Secondary	10	22.2	16	35.6		
▪ University	33	73.3	26	57.8		
Occupation						
▪ Housewife	33	73.3	27	60.0	1.800,	P=0.180#
▪ Employee	12	26.7	18	40.0		
Place of Residence						
▪ Urban	24	53.3	15	33.3	3.665,	P=0.056#
▪ Rural	21	46.7	30	66.7		

Table (2): Distribution of primiparous in VR and control groups according to labour and delivery parameters (N = 90)

Variables	V R Group (n = 45)		Control Group (n = 45)		Significance test	
	N	%	N	%	X^2	P
Gestational age (Weeks)						
▪ 37	12	26.6	16	35.5		
▪ 38	18	40	14	31.1		
▪ 39	10	22.2	11	24.4		
▪ 40	5	11.1	4	8.9		
Mean ±SD	**37.9 ±1.1**		**38.2 ±1.1**		**1.032,**	**P=0.305$**
Duration of the 1st stage (hrs)						
▪ 12 or less	22	48.9	14	31.1		
▪ More than 12	23	51.1	31	68.9	2.963	
Mean ±SD	**15.3 ±5.3**		**16.5 ±5.1**		**1.072,**	**P=0.287**
Duration of the 2nd stage (min)						
▪ 30 – 60 min	42	93.3	23	51.1		
▪ >60 min	3	6.7	22	48.9	19.993	
Mean ±SD	**46.8 ±12.8**		**59.8 ±18.5**		**3.872,**	**P=<0.001****

Table (3): Distribution of primiparous in VR and control groups according vital signs (N = 90)

Variables	VR Group (n = 45)	Control Group (n = 45)	Student's T – Test	
	Mean ±SD	Mean ±SD	T	P
Admission				
▪ Temperature	36.7 ±0.3	36.6 ±0.3	0.096	0.924
▪ Pulse	70.7 ±3.3	80.5 ±3.1	14.519	<0.001**
▪ Respiration	24.9 ±1.8	45.0 ±1.8	52.968	<0.001**
▪ Systolic blood pressure	126.7 ±10.2	129.3 ±13.7	1.021	0.310
▪ Diastolic blood pressure	65.3 ±8.7	72.9 ±9.2	4.026	<0.001**

Table (4): Distribution of primiparous in VR and control groups according to anxiety scores (N = 90)

Variables	VR Group (n=45)		Control Group (n=45)		Significance test	
	N	%	N	%	X^2	P
Pre – intervention (during active phase of labour)						
▪ Mild (20-50)	0	0.0	0	0.0	0.450	0.502
▪ Moderate (51-65)	6	13.3	4	8.9		
▪ Severe (66-80)	39	86.7	41	91.1		
Mean ±SD	**67.7 ±7.1**		**68.1 ±6.5**		**t =0.295**	**P=0.768**
Post – intervention (during fourth stage of labour)						
▪ Mild (20-50)	42	93.4	3	6.6	69.490	<0.001**
▪ Moderate (51-65)	3	6.6	30	66.7		
▪ Severe (66-80)	0	0.0	12	26.7		
Mean ±SD	**36.5 ±11.0**		**60.4 ±11.9**		**t=9.883**	**P=<0.001****

Table (5): Distribution of primiparous in VR and control groups according to fatigue scores (N = 90)

Variables	VR Group (n = 45)		Control Group (n = 45)		Significance test	
	N	%	N	%	X^2	P
Immediately after intervention						
▪ Mild (<36)	35	77.8	0	0.0	59.756	<0.001**
▪ Moderate (36≤ - <90)	10	22.2	31	68.9		
▪ Severe (>90)	0	0.0	14	31.1		
Mean ±SD	**26.9 ±12.7**		**82.8 ±39.1**		**t=9.121**	**P=<0.001****
After 2hrs of intervention						
▪ Mild (<36)	42	93.3	0	0.0	79.090	<0.001**
▪ Moderate (36≤ - <90)	3	6.7	30	66.7		
▪ Severe (>90)	0	0.0	15	33.3		
Mean ±SD	**19.8 ±6.4**		**89.9 ±34.4**		**t=13.439**	**P=<0.001****

Table (6): Distribution of primiparous in VR and control groups according to birth satisfaction scores (N = 90)

Variables	VR Group (n = 45)		Control Group (n = 45)		Significance test	
	N	%	N	%	X^2	P
▪ Strongly Agree	20	44.4	5	11.1		
▪ Agree	15	33.3	7	15.6		
▪ Neither Agree or Disagree	7	15.6	4	8.9		
▪ Disagree	3	6.7	20	44.4		
▪ Strongly Disagree	0	0.0	9	20.0	34.292	<0.001**
Mean ±SD	**28.4 ±11.8**		**17.8 ±8.8**		**4.830**	**<0.001****

As shown in **table (1)**, 66.7% of the VR group, as compared to 64.5% of the control group, age ranged from 25 to 35 years. In relation to education, 73.3% of the VR group, as compared to 57.8% of the control group had completed their university education. Regarding occupation, 73.3% of the VR group, as compared to 60% of the control group, were housewives. Concerning the place of residence, 46.7% of the VR group, as compared to 66.7% of the control group lived in rural areas. There were no statistically significant differences between the VR and control groups regarding all demographic data.

As can be seen in **table (2)**, 40% of the VR group, as compared to 31.1% of the control group, had 38 weeks of gestational age. The VR group experienced 15.3 ±5.3 hours a mean first stage of labour duration, as compared to 16.5 ±5.1 hours of the control group. Additionally, the VR group's mean second-stage labour duration was 46.8 ± 12.8 minutes, compared to 59.8 ± 18.5 minutes of the control group. Lastly, all labour and delivery indicators showed no statistically significant differences between the two groups, with the exception of duration of the second stage of labour there was a highly significant difference (P = <0.001).

Table (3): Revealed that the mean temperature for the VR and control groups was 36.7 ±0.3ºC and 36.6 ±0.3ºC, respectively; the mean pulse for both groups was 70.7 ±3.3b/m and 80.5 ±3.1b/m; the mean diastolic blood pressure for both groups was 65.3 ±8.7 mm Hg and 72.9 ±9.2 mm Hg, respectively; and the mean respiration was 24.9 ±1.8 breaths/m and 45.0 ±1.8 breaths/m, respectively. Lastly, pulse, respiration, and diastolic blood pressure showed highly statistically significant differences between the VR and control groups (P <0.001).

In relation to the level of anxiety, **table (4)** displays that 86.7% of the VR group, compared to 91.1% of the control group, experienced a severe level of anxiety pre-intervention (during the active phase of labour). Post-intervention, at the fourth stage of labour, 93.4% of the VR group experienced a mild anxiety level, while 66.7% of the control group experienced a moderate anxiety level. Additionally, the table highlighted that post-intervention, there was a highly statistically significant reduction in anxiety mean score in the VR group (36.5 ±11.0) compared to (60.4 ±11.9) in the control group (P <0.001).

Table (5): Shows that, in terms of fatigue, 77.8% of the VR group reported feeling mildly fatigued right after intervention, while 68.9% of the control group reported feeling moderately fatigued. Following a two-hour intervention, 93.3% of the VR group reported feeling mildly fatigued, while 66.7% of the control group reported feeling moderately fatigued. Furthermore, the table highlighted that post-intervention, there was a highly statistically significant reduction in fatigue mean score in the VR group (19.8 ±6.4) compared to (89.9 ±34.4) in the control group (P <0.001).

Table (6): Indicates that 44.4% of the VR group reported a "strongly agree" level of birth satisfaction, while an equal percentage of 44.4% in the control group expressed a "disagree" level. Additionally, the results reveal a statistically significant difference in mean birth satisfaction scores, with the VR group scoring 28.4 ± 11.8 compared to 17.8 ± 8.8 in the control group (P < 0.001).

Discussion

Primiparous women may find the second stage of labour challenging and frightening. However, when they are equipped with the skills necessary to navigate this highly interactive stage of labour, they feel more prepared and in control of the delivery process, which increases their comfort and satisfaction **(Gür & Apay, 2020)**. VR technology has transformed medical approaches for relieving women of their pain, and it is currently used as a as a non-pharmacological intervention that is safe and effective in many obstetrics and gynecological fields **(Hajesmaeel-Gohari, et al., 2021)**.

The aim of this study was to investigate how the use of VR technology for pushing during the second stage of labour affected the birth outcomes of primiparous women. The study's major findings were that, in comparison to primiparous women who do not utilize VR technology, those who utilized it to push during the second stage of labour had significantly lower anxiety and fatigue scores and felt more satisfied with their birth experience.

These findings supported the study's hypotheses that: **Hypothesis 1:** Primiparous women who utilize VR technology for pushing during the second stage of labour will experience a lower mean anxiety and fatigue scores than those who don't utilize it. **Hypothesis 2:** Primiparous women who utilize VR technology for pushing during the second stage of labour will experience a higher level of birth satisfaction than those who don't utilize it.

The current study discovered a significant difference in the duration of the second stage of labour between the two groups (P < 0.001). The shorter second stage of labour, as well as the fact that VR intervention had no negative effects on women's efforts during uterine contractions, which are required for cervical dilatation and fetal descent, may help to explain this finding. This study's findings were consistent with a recent meta-analysis by **Xu et al. (2022)**, which looked into how VR technology affects labour and women's satisfaction. They reported that the VR intervention reduced pain during childbirth and shortened the duration of the second stage.

Similarly, an Iranian study by **Ebrahimian & Bilandi (2021)** aimed at examining the differences in the length of delivery and mother satisfaction between chewing gum and watching VR videos. They found that these durations were short-ended by both VR intervention and chewing gum. On the other hand, the current study's findings disagree with another American study undertaken by **Rimsza et al.**

(2023) aimed at examining the effect of an intrapartum video pushing education on the duration of the second stage of labour. They reported that the duration of the second stage of labour was similar in the control video groups.

When it came to the vital signs measured in the two studied groups, the current study's findings showed that there were highly statistically significant variations in maternal heart rate, respiration, and diastolic blood pressure between the VR and control groups (P <0.001). This is a reasonable finding given that the VR group's vital signs improved compared to the control group as their anxiety level reduced. This explanation is supported by **García-González et al. (2024)**, who reported that the mother's anxiety may have an impact on her blood pressure and heart rate. When VR was employed as a therapy, pregnant women's' heart rates and blood pressure improved.

These findings were consistent with those of **Goodier (2020)**, who investigated whether VR may reduce childbirth pain. He reported that there is a significantly higher heart rate in the control group. Additionally, the study's findings matched those of an American study by **Wong, et al., (2021)** which aimed to determine if VR can effectively reduce labouring women's pain. Their findings revealed that there were significant differences in post-intervention heart rate between the two groups (p = 0.01).

The current study's findings demonstrated that the VR group's anxiety level was significantly lower than the control group's following the intervention (P <0.001). These findings are explained by the fact that VR can divert a woman's attention from stressful, frightful, angry, or uncomfortable experiences. The underlying theory of this method is based on the idea that the mind is incapable of thinking about two things at once. The senses therefore work as a diversion from the exhilaration experienced when one's mind is consumed in a state of heightened excitation. These explanations are supported by an earlier study by **Tzeng, et al., (2017)**, who found clearly a positive relationship among intrapartum pain, anxiety, and fatigue, and reducing intrapartum pain led to a significant decline in anxiety and fatigue.

These findings are consistent with a Turkish study conducted in **2021** by **Akin et al.** to determine how VR affected expecting mothers' perceptions of labour pain and anxiety during childbirth. They discovered that the women in the VR group had significantly lower anxiety levels than the women in the control group. Additionally, **Ahmed, et al.,** study from Egypt **(2023)** looked at the effect of VR on primigravidae's labour pain intensity, first stage duration, anxiety, and satisfaction levels. They also found that after intervention, the VR group's anxiety level was significantly lower than that of the control group (p = 0.000).

Concerning the fatigue levels of the two studied groups, the current study's findings showed that the VR group saw a highly significant reduction in fatigue levels both immediately and two hours post-intervention when compared to the control group (P <0.001). This could be explained by the VR goggles placed on primiparous women in unfamiliar settings that prevent the mind from processing fatigue. This breaks the pain cycle, probably because the user is distracted and their brain is occupied by the vast amount of data introduced in the simulated setting, which prevents the mind from interpreting pain sensations.

The findings of the current study are in line with an Egyptian study by **Mahmoud, et al., (2022)** in the Benha governorate, aimed at investigating the effects of the spontaneous pushing technique on labour outcomes in primiparas during the second stage of labour. They found that the women in the experimental group had a lower postpartum fatigue level compared with the control group.

According to the current study's findings, nearly half and one third of the participants in the VR group reported a "strongly agree" and "agree" level of birth satisfaction, while nearly half and one-fifth of the control group expressed a "disagree" and "strongly disagree" level. Furthermore, there was a statistically significant difference in mean birth satisfaction scores between the two groups (P < 0.001). This outcome is a reasonable finding in our existing research that showed the VR applications reduced anxiety and fatigue, thereby helping primiparous women avoid prolonged labour. Consequently, this has a positive effect on their satisfaction following delivery.

The current study's findings were consistent with a comparative Egyptian study conducted in the Beni-Suef governorate by **Helmy et al. (2022)**, which examined the effect of VR on the intensity of labour pain and anxiety. They discovered that the VR group were more satisfied than the control group, with more than half of the women in the VR group stating that they were completely satisfied. Additionally, **Ebrahimian & Bilandi (2021)** found that there are higher statistically significant differences in the favorable effects of VR on labour perception and maternal satisfaction levels.

Furthermore, the finding of the current study is consistent with an Egyptian study in **2023** by **Ahmed, et al.**, which examined the effect of VR intervention on labour pain and mother satisfaction in the Sohag governorate. They discovered that the labouring women in the intervention group were more satisfied with using VR. Additionally, **Carus et al. (2022)** study in Turkey sought to assess the effectiveness of immersive VR on labouring women's pain relief and satisfaction. They found that the VR group's women reported a high level of satisfaction.

Conclusion

The current study's findings highlight the positive impact of VR technology on the birth outcomes of primiparous women during the second stage of labour. Primiparous who employed VR technology for pushing reported significantly lower scores of anxiety and fatigue. Additionally, these women experienced a shorter second stage of labour and reported higher satisfaction with their overall birthing experience. This innovative approach not only enhances comfort but also contributes to more favorable outcomes for new mothers.

Recommendations

Based on the current study's findings, the following are recommended:

- Raise pregnant women's awareness of the VR benefits during labour by offering antenatal education classes in the third trimester.
- Apply VR intervention as a routine care in the labour and delivery unit.
- Indorse VR intervention into the maternity and midwifery nursing syllabus.
- Expand the study's generalizability by conducting it in a range of settings and with larger sample sizes.

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