AN EVALUATION OF VIRTUAL REALITY IN LABOR PAIN DURING VAGINAL CHILDBIRTH

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Abstract

Objectives: To determine how using virtual reality affected labouring women during a typical delivery.

Methods: Eighty primiparous, well-educated pregnant women aged 20 to 25 with body mass index scores ranging from 25 to 32 kg/m2 were included in the current study. Two groups of patients were formed: Throughout the initial stage of labour, Group B received routine intranatal care. During the active phase of the first stage of regular labour, Group A made use of virtual reality.

Results: At stage three, the difference between the two groups wasn't significant, as indicated by a p-value of >0.05, while at stage two, group A's labor time was significantly shorter than group B's (p-value<0.05). Group A's total labor duration was significantly less than group B's (P<0.05). During the latent Phase, Active Phase, and at 7-8cm diameters, group A's serum cortisol levels were lower than group B's (P<0.05). During the active Phase, group A's VAS values were significantly lower than group B's, measuring 7-8 cm (P<0.05).

Conclusions: VR had a positive effect on labouring women as it was associated with lower pain, total length of labour, serum cortisol level, and higher APGAR.

Keywords: Virtual Reality, Pain, Childbirth, Virtual Learning Environments, APGAR, Woman.

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Introduction

According to scientific definition, pain refers to an unpleasant combination of sensory and emotional feelings resulting from actual or possible harm to body tissues 1. Labor pain is a shared experience among women, with the degree of pain differing from person to person. Although most people believe labour and delivery to be normal processes, they may still be quite painful and distressing. A woman's prior experiences, such as physical weariness, anticipating pain, having a network of support, the circumstances of her labour and delivery, cultural conventions, and the level of her mental stress and anxiety, can all influence how she perceives pain. According to recent studies, a lower risk of postpartum depression may be associated with successful labour pain relief 2.

Labor pain is characterized by two distinct aspects: a physical component, where pain signals are transmitted to the brain, and an emotional component, resulting from the complex interplay of factors such as emotional responses, social influences, cultural backgrounds, and individual cognitive processes 3.

Conventional medicine primarily addresses the physical aspects when it comes to pain management, whereas alternative approaches concentrate more on emotional factors. In a woman in labor, the two stages of labor involve distinct types of pain and modes of pain transmission 4.

The objective of nonpharmacologic pain relief methods is to alleviate pain, enhance the ability to manage pain effectively and create a more positive overall experience of childbirth 5.

The global use of complementary and alternative methods to alleviate pain during childbirth is rising rapidly among women. The growing interest in this area has prompted the adoption of new technological approaches, particularly virtual reality (VR), in the healthcare sector 6.

Virtual reality has been a concept for several decades, dating back to the late 1960s.

The teaching, learning, and practice of medicine, engineering, and the physical sciences, among other fields, have expanded thanks to computer-based virtual learning environments. Studies have found that these learning environments are more effective in terms of pedagogical impact on students. Three-dimensional (3D) perspectives and comprehensions of any system under study are provided via virtual learning environments. Students may rapidly and effectively understand the basic concepts of this system in a pleasant way by interacting with and exploring the environment created for it 7. Based on seven RCTs, the meta-analysis demonstrated that the VR intervention was successful in lowering pain, anxiety, and the length of the first and second stages of labour while also improving birthing satisfaction 8. Previous studies showed that pain and anxiety encountered during the process of labor contribute to an increase in the levels of catecholamines and cortisol, leading to the occurrence of malfunctions in uterine contractions and ultimately elongating the length of the labor stages 9.

We postulated that introducing VR to laboring women during the initial stage of labor had no discernible impact. This study aimed to evaluate how virtual reality use affected working women.

Methods

The current investigation involved 80 participants, aged between 20 and 25 years, with a body mass index (BMI) ranging from 25 to 32 kg/m2, who were primiparous and had a high level of education. The study took place from 20 October 2024 to 30 October 2024 at Elmenshawy General Hospital in Tanta, Egypt, following approval from the Ethical Committee at Kafr Elsheikh University in Kafr Elsheikh, Egypt (Approval code: KFS IRB200-91) and registration on clinicaltrials.gov (ID: NCT06677463). Written consent, which was informed, was obtained from the patients.

The exclusion criteria consisted of laboring women with high-risk pregnancies, those using medication to alleviate pain during the initial stage of labor, and women with limited educational backgrounds.

Two equal groups of pregnant women were randomly assigned: Group A consisted of women who received standard intranatal care during the active Phase of the first stage of normal labour while using virtual reality (VR), and Group B consisted of women who received standard intranatal care alone during the first stage of labour.

Cortisol serum levels were determined using a radioimmunoassay (DSL-2100 ACTİVE; Diagnostic Systems Laboratories, Webster, TX, USA). Cortisol sampling occurred between 6 and 10 pm because of the natural diurnal variation in serum cortisol levels.

Virtual reality head-mounted display

This technology was applied to support creating a virtual reality environment for women in group A during the initial stage of labor in the active Phase up until delivery. A virtual reality headset is a wearable device that offers an immersive virtual reality experience. These headsets are commonly used in conjunction with virtual reality games, but they also have a range of other applications, such as simulators and training tools. Typically, a VR headset consists of a stereoscopic display that presents separate images to each eye, stereo sound, and motion-sensing technology, including accelerometers and gyroscopes, which enable the headset to track the wearer's head movements and adjust the virtual camera, accordingly, ensuring a seamless alignment with the wearer's real-world perspective.

Procedure

The primary investigator, the same therapist, conducted all interventions,

evaluations, and measurement recordings at the start and completion of the study, ensuring that all patients received safe and effective treatment. All patients' demographic and outcome measures data were recorded on specially designed sheets.

One by one, the Gynaecology and Obstetrics Specialist shows her a VR Box 3D virtual reality glass. The mother's phone was loaded with an application that transformed these two-dimensional pictures into three-dimensional ones. Pregnant women visiting a Gynaecology Polyclinic for prenatal follow-up had their phones videotaped.

Pregnant women were randomly allocated to either the intervention group (A) or the control group (B) at the time of their obstetrics and gynaecology clinic's pregnancy follow-up appointment.

A gynaecological and obstetrician specialist examined the baby's presentation, the amniotic fluid, the placenta, and the umbilical artery via Doppler, fetal biometry, and fetal breathing using a Voluson 730 PRO ultrasound device.

It was made sure that, assuming the infant was in good posture, the remaining time would total 1520 minutes for visual purposes. These expectant mothers were challenged to improve their visualisation. The mother's phone was incompatible with the ultrasound procedure, both for the foetus evaluation and the program. The Voluson 730 PRO ultrasonography was used to monitor the Doppler, foetal biometry, and foetal breathing. They brought their phone to the labour to film the footage. the researcher's phone. The amount of time spent examining the images was noted.

A gynaecological and obstetrician specialist examined the baby's presentation, the amniotic fluid, the placenta, and the umbilical artery via Doppler, fetal biometry, and fetal breathing using a Voluson 730 PRO ultrasound device. The process of applying virtual reality from a cervical dilatation of 3 cm to complete dilation.

Each labouring woman in the VR group was presented with a variety of virtual environments to select from, which included options such as the blue ocean, blue deep, black beginning, green meadows, blue moon, red savannah, orange sunset, red fall, and white winter, that include different natural view with calm music sound. The Nature Trek application's photos were printed out to create cards that represented these innovative immersion alternatives, and these cards were given to the labouring women to assist them in selecting their chosen setting in advance. VR distraction devices that allow users to navigate 360-degree video and provide a full replacement were used in this study. Through the use of mobile VR, which projected twin stereoscopic views onto the phone's screen, these devices enabled users to interact with virtual reality as though it were the real world. It took each woman about five minutes to complete the repeated exam. Before being used by two women together, the VR glasses were sterilized with alcohol to stop the spread of infection.

Group A (study group)

Forty pregnant women underwent VR during the initial Phase of standard delivery, specifically the active Phase, concurrent with standard prenatal care.

As part of standard prenatal care, a woman was assessed, which included learning about her medical and obstetric history, observing her, and maybe performing a vaginal examination (VE) to track the development of labour and ascertain her needs. The woman's emotional and psychological health, fetal movements during the previous 24 hours, vaginal bleeding characteristics (color, volume, odor, and presence of liquor), the timing of the onset of contractions, their frequency, intensity, duration, and resting tone, as well as the woman's temperature, respiratory rate (RR), blood pressure (BP), and heart rate (HR) were all assessed by the care providers, who also introduced themselves and their roles to the woman and her support team.

The abdomen of the patient was examined by palpation for 20 minutes to evaluate the size of the fetus to gestational age, measure the symphyseal-fundal height, confirm the position and presentation of the fetus, and determine its lie, station, descent into the pelvis, and the rate of the fetal heartbeat. When necessary, the option for VE was presented to the women, and a skilled clinician was consulted if abnormal results were observed 10. Throughout the labor, it is essential to offer physical and emotional comfort and assistance while safeguarding the woman's right to privacy and self-respect. The woman was advised to stay hydrated, consume a light meal, be mobile, and maintain an upright posture whenever feasible. A woman lying on her back was positioned with a wedge under her right hip. During the latent Phase of early labor, women could go home until labour had established itself, considering their needs, desires, and circumstances. She was assured that if she had anxiety or could not control her discomfort, she might return to the hospital at any moment 11. When the cervix has dilated to a length of 4 to 5 cm, the early stage of labour is generally regarded as having begun. All necessary equipment for birth and neonatal care was confirmed in place before proceeding to the 2nd stage of labour, and resuscitation facilities in the room were also checked beforehand. The woman and her support people were informed about whether any additional equipment or extra medical staff would need to be present in the room to alleviate her anxiety. Clinicians with the necessary expertise should be present during birth, especially when there are maternal or neonatal risk factors involved.

The woman received information on how to reduce the chance of a third or fourth-degree tear during childbirth, as well as information on perineal care. The woman was consulted, and the management of stage 3 was confirmed. The lady should be advised to follow her intuition throughout the second stage of labour. Still, she should also receive directions from her caregiver to facilitate gradual and controlled head delivery. Explosive pushing without control was highly discouraged because it could cause serious perineal injuries.

During the crowning process, the mother can increase her pushing forces by using costal breathing, but at this time, she should switch to shallow breathing to prevent perinatal laceration. Fundamental pressure during delivery was not applied. A hands-on approach was suggested to provide support to the perineum. A gentle counter-pressure was applied to the fetal head. Gentle traction was applied to the anterior shoulder to release it, but only after spontaneous release failed. Release the posterior shoulder, following the curve of Carus 12.

The control group, Group B, consisted of 40 pregnant women who received standard intranatal care as with Group A.

Sample size

G*Power 3.1.9.2 was used to calculate the sample size (Universitat Kiel, Germany). A prior research 13 found that group A's mean ± SD of pain score was 5.01 ± 1.41, whereas group B's was 6.20 ± 1.17. The sample size was determined by considering the following factors: group ratio of 1:1, 95% power of the study, 0.849 effect size, 95% confidence limit, and the addition of two cases to each group to overcome dropout. For each group, we therefore gathered 40 patients.

Statistical analysis

The statistical analysis was conducted using SPSS v26 (IBM Inc., Chicago, IL, USA). The Shapiro-Wilk test and histograms were used to assess the normality of the data distribution. The quantitative parametric variables were expressed as mean plus or minus standard deviation (M ± SD), and the two groups were compared using the unpaired Student's T-test. Qualitative variables were expressed as frequencies and percentages (%) and analysed using a chi-square test. A P value of less than 0.05 was deemed statistically significant in a two-tailed test.

Results

Eleven patients did not qualify for the study, while another 6 declined to participate. Two equal-sized groups were randomly selected from among the remaining patients. Every allocated patient was statistically assessed and subjected to a follow-up analysis. Every patient who was assigned was tracked down and subjected to statistical analysis. Figure 1

There was no significant difference between the two groups' delivery types; at stage 2, group A's labour duration was significantly shorter than group

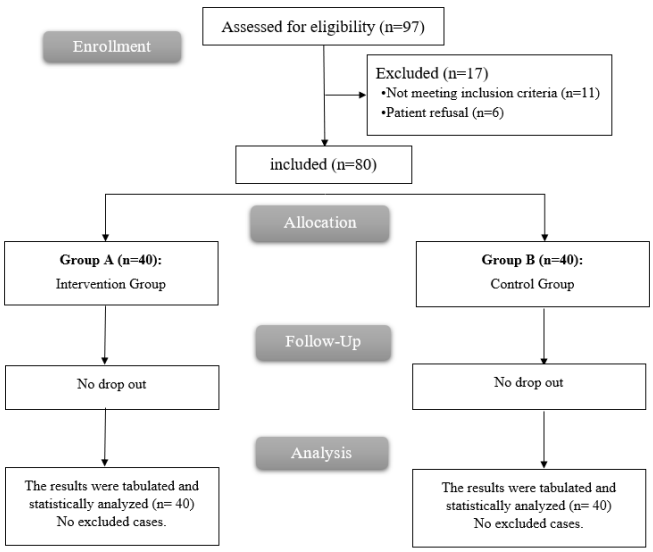

Figure 1. CONSORT flowchart of the enrolled patients.

B's (P<0.05); at stage 3, there was no significant difference between the two groups; and overall, group A's labour duration was significantly shorter than group B's (P<0.05). Table 1

Group A's serum cortisol levels were considerably lower than group B's at the latent phase, active phase, and 7-8 cm (P<0.05). Table 2

Visual analogue scale (VAS) was insignificantly different at the latent Phase between both groups. It was significantly lower at the active Phase and 7-8 cm in group A than in group B (P<0.05). Appearance, pulse, grimace, activity, and respiration (APGAR) were significantly higher after 1 min and 5 min in group A than in group B. Table 2, Figure 1-4

Discussion

Childbirth is often regarded as one of the most enduring and distressing events a woman will encounter in her lifetime. Pain levels can vary significantly in duration and intensity throughout this experience, with different pain relief

Table 1. Type and length of labor of both groups.

			Group A (n=40)	Group B (n=40)	P
Types of delivery	**CS**		1(2.5%)	0(0.0%)	1
	Normal labor	**With Epizotomy**	2(5.0%)	2(5.0%)	1
		No Epizotomy	37(92.5%)	38(95.0%)	1
Length of labor	**Stage 2 (min)**		125.58±6.94	241.79±10.73	**<0.001***
	Stage 3 (min)		33.18±2.52	33.54±3.25	0.582
	Total (min)		159.15±7.36	274.35±10.17	**<0.001***

Data are presented as mean ± SD or frequency (%). * Significant P value <0.05. CS: Caesarean section

Table 2: Serum cortisol level, VAS and APGAR of both groups.

		Group A	Group B	P
Latent Phase (min)		45.53±0.68	54.25±0.95	**<0.001***
Active Phase (min)		53.45±0.55	60.7±0.81	**<0.001***
7-8 cm		57.55±0.5	64.68±0.47	**<0.001***
(n=40)				
VAS	**Latent Phase**	1.8±0.41	1.8±0.41	1
	Active Phase	3.05±0.66	4.14±0.54	**<0.001***
	7-8 cm	0.45 ± 5.74	7.89±0.61	**<0.001***
APGAR	**After 1 min**	9.15±0.83	8.5±1.4	**0.013***
	After 5 min	9.95±0.22	9.53±1.09	**0.019***

Data are presented as mean ± SD or frequency (%). * Significant P value <0.05.VAS: visual analogue scale, APGAR: Appearance, pulse, grimace, activity, respiration

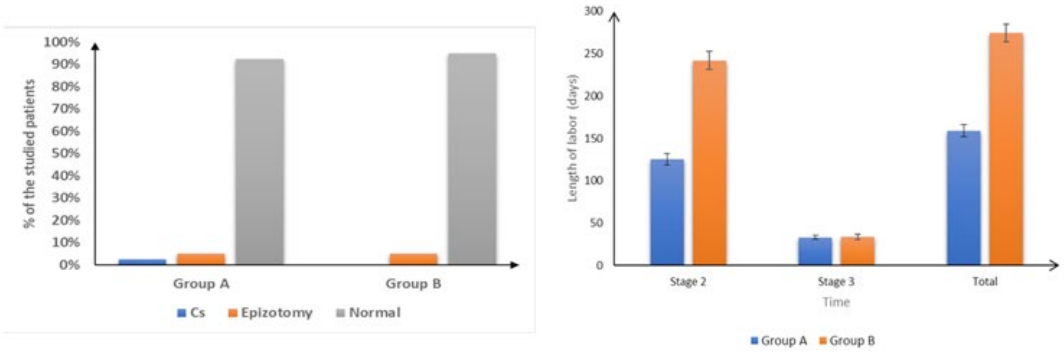

Figure 2. Type and Length of labour of both groups.

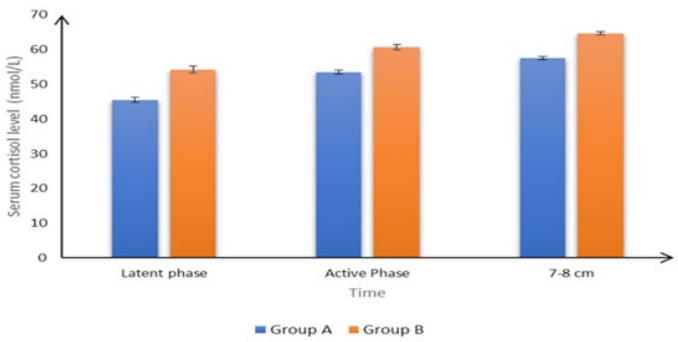

Figure 3. Serum cortisol level of both groups.

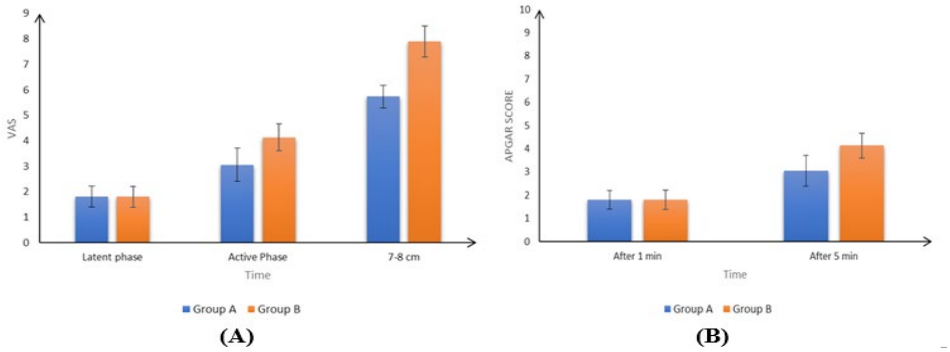

Figure 4. (A) VAS and (B) APGAR score of both groups.

options being chosen 14, 15.

In this research, group A had a significantly shorter duration of labour in Stage 2 compared to Group B. In contrast, the duration of labour in stage 3 did not vary notably between the two groups. Group A had a significantly shorter labour duration than Group B. A systematic review by Özer et al. 8 discovered that VR interventions reduce the length of labour's first and second stages. Ahmed et al. 9, the amount of time spent in the Active Phase of the initial stage of labor was significantly shortened by employing a virtual reality application during that time. El-Sayed et al. 16 found a statistically significant difference between the study and control groups. Women in the study group progressed through all stages of labour more quickly than those in the control group. Our results agreed with Ebrahimian and colleagues 17, who found that both the active and second stages of labour lasted significantly less time on average in the VR group than in the control group.

Our results showed that group A's serum cortisol levels were significantly lower than group B's at the latent Phase, active Phase, 7-8 cm, and 10 cm. A systematic review by Özer and colleagues 8 discovered that VR interventions are valuable tools for lowering anxiety and stress during typical labour.

At the active Phase of the current investigation, group A's VAS was substantially lower than group B's, measuring 7-8 cm and 10 cm, respectively. In the latent phase, however, there was no discernible difference between the two groups. A comprehensive study by Özer et al. supports the effectiveness of VR therapies in reducing pain during the first and second phases of labour 8. Ahmed et al. 9 found that using a virtual reality application during the active phase of the first stage of labour considerably decreased the severity of labour pain. Additionally, participants in the VR group reported significantly less labour pain than controls. According to research by El-Sayed et al. 16, individuals in the VR group experienced significantly lower levels of labor pain than controls. The findings of this research align with those of Güret et al. 18, which indicated that all cognitive techniques utilized in conjunction with VR decreased labor during the active phase of labor. Newborn photographs set to classical music and newborn photo albums are more effective than other interventions in reducing labor pain. The APGAR score was substantially higher in group A at 1 and 5 minutes compared to group B. The outcomes were consistent with those of El-Sayed et al. 16, who found that after one and five minutes, the VR group's APGAR score was noticeably greater than the control groups. Both the VR and control groups' mean scores on the first- and fifth-minute APGAR tests did not differ significantly, according to Ebrahimian et al. 17. The APGAR score revealed no discernible change between the VR and control groups, according Amiri et al. 19.

The study's very modest sample size was one of its limitations. There was just one location where the study was carried out. Participants having numerous pregnancies were not included in the study.

Conclusions

VR positively affected labouring women as it was associated with lower pain, the total length of labor, serum cortisol level, visual analogue scale, and higher APGAR.

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Competing Interest: The authors have no financial or proprietary interest in any material discussed in this article.

Ethical Committee

The study took place from 20 October 2024 to 30 October 2024 at Elmenshawy General Hospital in Tanta, Egypt, following approval from the Ethical Committee at Kafr Elsheikh University in Kafr Elsheikh, Egypt (Approval code: KFS IRB200-91)

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