Virtual Reality Usage in Managing Pain Labor: A Scoping Review

Safitriana[1,2*], Yulius Tiranda[3], and Nittaya Panngam[4]

[1]Master of Nursing Student, Faculty of Nursing, Universitas Indonesia, Indonesia
[2]Nursing Staff, Obstetrics and Gynecology Ward, RSUP Mohammad Hoesin Palembang, Sumatera Selatan, Indonesia
[3]Department of Adult Nursing, Nursing Program, Faculty of Health Science, Institut Ilmu Kesehatan dan Teknologi Muhammadiyah Palembang, Sumatera Selatan, Indonesia
[4]Department of Midwifery, Faculty of Nursing, Khon Kaen University, Thailand
*corresponding author: safitriana@ui.ac.id

ARTICLE INFO

ABSTRACT

Background: Labor is one of the most memorable experiences for mothers and families where the labor process might cause intense pain. The use of non-pharmacological therapy is currently an option in reducing the pain experienced, one of which is using Virtual Reality (VR). The aim of this study was to explore and investigate the use of VR in the management of labor pain. **Method:** 4 electronic databases were used, Ebsco, Pubmed, Science Direct, and Scopus. The used keywords were (pain labor OR pain delivery OR childbirth pain) AND (virtual reality OR augmented reality OR VR). **Results:** There were 7 articles that met the inclusion criteria where 2 studies used videos of animals swimming accompanied by natural sounds and classical music, 3 studies used videos of natural scenery, 1 study used videos of newborn babies and classical music, and 1 study used videos of ultrasound results fetus. **Conclusion:** Virtual reality can be used to help reduce pain during labor and has no impact on the mother and fetus

Introduction

Childbirth is a fundamental physiological process that includes cultural, psychological, spiritual, and behavioral in a woman's life significantly [1]. During the labor process, the pain increases along with the complete cervical dilatation. Labor pain is one of the most intense pains experienced by women during this process [2] because uterine contractions affect increased intrauterine pressure resulting in tension in the cervix.

The primary maternal care during labor and delivery is maintaining the mother's control over her pain, emotions, and actions. It has become a standard of care for labor to suggest non-pharmacological treatment before the use of pharmacological interventions. Non-pharmacological interventions are usually simple, safe, and inexpensive to use. One of the nurses' obligations is to provide support and encouragement to use nonpharmacological methods to patients and their partners [1].

Nonpharmacological methods of pain relief include a variety of techniques aimed at enhancing physical sensation and preventing the psycho-emotional perception of pain [2]. In the era of society 5.0, the use of technology and information is one of the main pillars that can be developed in various aspects, including the management of pain during childbirth whereas one of them is the use of Virtual Reality (VR).

Currently, VR technology is widely used in the health sector and has also revolutionized medical techniques to distract the pain experienced [3, 4, 5]. Distraction is an effective technique for reducing

pain [6] experienced by mothers during labor. VR is used to reduce anxiety in pregnant women, reduce pain, and educate in training during labor [7]. The objective of the review is to explore, investigate, and analyze research that uses VR to reduce pain during labor.

Materials and Method

This study used the Arksey & O'Malley [8] and Aromatoris & Munn [9] review scoping methods. Four electronic databases were Ebsco, Pubmed, Science direct, and Scopus. The keywords used were "pain labor OR pain delivery OR childbirth pain" AND "virtual reality OR augmented reality OR VR", with full-text inclusion criteria, Academic Journal, the publication year 2017-2022, and focusing on pain during childbirth.

The author conducted the search process to find relevant articles usage of virtual reality in labor pain. Searching articles using several keywords that have been adjusted to Medical Subject Heading (MeSH) to filter articles using predefined keywords.

In the selection process, the researcher used the Prisma extension approach for the scoping review [10] which was divided into 2 stages, title and abstract, and then a full text review. The first stage was to identify articles in 4 databases and obtain Ebsco (72), Pubmed (134), Science direct (253), and Scopus (25), then the total number of articles obtained was 484 articles. Then, we found 26 articles duplicated. Next, the researcher screened the articles by reading the detailed titles and abstracts according to the inclusion criteria and as many as 448 articles were excluded because there were no abstracts, the titles and abstracts did not match the topic and were not academic journals. Furthermore, the remaining articles were reviewed in full text and read by the researcher (S, Y.T), hence, 3 articles were excluded because they did not meet the requirements for use in the review literature: systematic review, meta-analysis, and these articles did not answer the research objectives. Thus, 7 articles were determined that met the requirements to be used in this review.

During the study selection process, researchers (S and Y.T) conducted independent reviews at each stage, where there was no significant difference in the assessment of the articles reviewed. The selection process for selected articles used guidelines from Peters et al., (2020) regarding Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) (Figure 1) [11].

The results of data extraction were categorized: researcher's name, year of study, country/location of study, research design and instruments, results, and characteristics of the VR used (device, type of video, duration, phase/stage of labor).
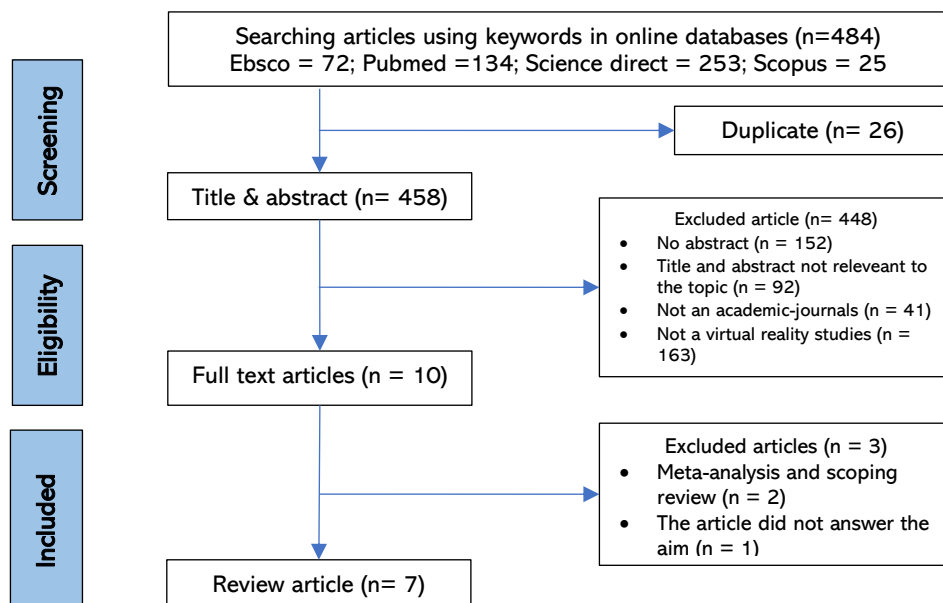

Figure 1. Article selecting process (PRISMA-ScR)

Results and Discussion

Results

A total of 2,948 articles were found in 4 electronic databases that match to the topic. Then several articles were excluded because the title and abstract were incomplete, the topic was not related to this research, it was not an academic-journals and it was not the full text (only the abstract). There are 7 articles that are in accordance with this research which will be discussed.

All articles were published between 2019-2022 and conducted in various countries. Three studies (42.8%) [13,15, 17] were conducted in Turkey, two studies in Iran (28.6%) [14, 18], one studies (14.3%) [12] in New Zealand and one in Michigan (14.3%) [16]. Most of these studies (n = 4; 57.1%) [13, 14, 15, 18] were used randomized controlled trials (RCT), and the rest were randomized controlled experiments and conducted with CONSORT [6], Prospective randomized controlled counter-balanced crossover (within-subjects) and Cross over within subjects [5].

The videos shown of swimming animals accompanied by natural sounds and classical music (n = 2; 28.6%) [12, 16], videos of natural scenery (n = 3; 42.8%) [13, 14, 18], videos of newborns accompanied by classical music (n = 1; 14.3%) [4] and videos of fetal ultrasound results (n = 1; 14.3%) [17]. Each video duration were 10 minutes [12, 15, 16, 18], 14.8-14.86 minutes [17], 20 minutes [14] and others video without including the duration of the displayed video. In addition, Virtual Reality is a type of fully immersive virtual reality with various types including using VR Oculus Go [12], VR Samsung Gear [14, 15, 16], VR Box Virtual 3D [17], and Google VR [13].

The instruments used to measure pain were Visual Analog Scale (VAS) (n = 2; 28.6%) [14, 17], Numeric Rating Scale (NRS) (n = 3; 42.8%) [12, 16, 18], one (14.3%) study using VAS & VRS [15], and one (14.3 %) study using the Wong Baker Faces Pain Rating Scale [13]. The results of this review found that all studies show VR can reduce labor pain in early labor, during active and latent labor in the 1st stage between 4th-9th cervical dilatation.

Discussion

This review was conducted to review and identify studies that use VR applications to help reduce pain during labor. It was found that the use of VR was effective and could be used to reduce labor pain. Two studies have similarities in that they use scuba diving videos (diving) by showing marine animals and the sounds of dolphins and manatees accompanied by classical music and relaxing nighttime sleep [12, 16]. Videos of natural scenery including animals and humans accompanied by natural sounds and music can provide a relaxing, relaxing effect and personal preference for scenery also has a significant effect on mood [19]. In addition, viewing videos of natural scenery on the coast has a significant effect on reducing pain [20].

Two studies used VR with videos of natural scenery accompanied by sound [14, 18], and one study showed videos of natural scenery such as sunsets, green meadows, oceans, and others [13]. In addition, 2 other articles also use videos in the form of beach views, mountains, dolphins and whales swimming, palaces and forests, or other natural scenery to relieve and reduce pain in pregnant women and distract the experience of pain [21, 22].

One study using video photos of newborns accompanied by classical music (Beethoven-Moonlight Sonata) with a duration of 10 minutes showed positive results in reducing pain during labor [15]. In addition, 1 other study showed that the use of VR with videos of fetal ultrasound results was also very influential in reducing the pain experienced [17]. In line with another study conducted by Buglione et al. (2020), it was stated that in nulliparous women with term singleton pregnancies, listening to music had a significant impact on reducing the level of pain experienced during labor. Gonenc & Dikmen stated that music can reduce pain in nulliparous women during the active phase of labor [24]. In addition, this intervention can also be easily conducted by nurses and midwives, is affordable, and effective, and can provide opportunities for women and their partners to be actively involved in maternal care during and after delivery.

The use of VR, which is rich in multisensory stimuli in the form of sight and hearing, has a high enough potential to be used as a means of restoring patient health [25]. Lier et al, explained that the use of VR can reduce pre-perceptual and perceptual brain activity after pain stimulation and has

Table 1. Data Extraction

Name	Place	Design	VR Video Characteristic	Result
Massov et al. (2022) [12]	New Zealand	Cross over within-subject, NRS	Video: Participants experienced the same scene of playful dolphins from the Ocean Rift scuba diving simulation, with accompanying dolphin sounds, breathing sounds, and an overture of classical music. Participants and their partners had received instructions on the device and antenatally had familiarised themselves with it. Tool: VR *Oculus Go* Headset (wireless), Duration: three in 10 minutes,	There were significantly lower reported pain scores (6.14 compared to 7.61, P <0.001) and maternal heart rate (79.86 beats per minute compared to 85.57, P = 0.033), and mean arterial pressure (88.78 mmHg compared to 92.61 mmHg, P = 0.022) were lower when using virtual reality compared to when not using virtual reality during active labor.
Carus et al (2022) [13]	Turkey	Randomized controlled trial, Wong Baker Faces Pain Rating Scale.	Tools: Oculus Quest All-in-one VR Gaming Headset (128 GB) VR system, Duration: 1st 20 minutes in early labor (cervical dilatation 3 cm), 2nd 20 minutes active phase (cervical dilatation 6-7 cm) after epidural analgesia, Video: The patients were offered to choose among several virtual environments, including orange sunset, green meadows, black beginning, red savannah, blue deep, blue moon, blue ocean, white winter, and red fall.	Immersive VR may improve pain scores likely through distraction in the latent phase of labor prior to epidural administration.
Ebrahimian et al (2022) [14]	Iran	Randomized controlled trial, VAS	Tools: Not explained, Duration: In the active (dilation of 4–5 cm) and second (dilation of 7–8 cm) phases of parturition for 20 minutes each, Video: A 360° video of natural sceneries such as rivers, shores, waterfalls, and lakes were used	Watching virtual reality videos enhanced childbirth satisfaction, and curtailed parturition stages in our sample of pregnant women.
Gur & Apay (2020) [15]	Turkey	Randomized controlled trial, VAS, and VRS	Tools: Samsung Gear VR2 VRG (Virtual Reality Glass), Duration: 10 minutes, Video: Expert opinions were obtained for the content suitability of videos prepared by the researcher and ' digital photograph album' composed of photographs of healthy, not crying, and calm newborns. Additionally, professional support was obtained for video qualifications such as quality, pixels, sound, and sound level. The type of music in the videos was classical music (Beethoven-Moonlight Sonata).	All cognitive techniques applied with virtual reality reduced labor pain during the active phase of labor. The video of newborn photographs with classical music and newborn photograph albums has been found more effective than other interventions evaluated in reducing labor pain.
Frey et al (2019) [16]	America	Prospective, randomized controlled, counter-balanced, crossover (within-subjects) study, NRS.	Tool: immersive and interactive VR system was developed using a Samsung GearVR (Samsung, San Jose, CA) head-mounted display powered by a Galaxy S7 phone, a hand control, and noise-reducing headphones powered by a parallel S5 phone, Duration: 10 minutes, Video: Each patient experienced the same scene of curious manatees from the Ocean Rift (www.ocean-rift.com) scuba diving simulation with sounds of manatee calls and breathing underwater. Additional relaxing music was supplied from nighttime sleep by Brain. fm (www.brain.fm).	The primary outcome for worst pain intensity (sensory pain) scores was significantly lower in the VR condition, with similar decreases seen in the secondary outcomes of reported affective and cognitive pain scores
Akin et al (2021) [17]	Turkey	Randomized controlled experiment, VAS	Tool: Baby ultrasound recorded with Ultrasound Voluson 730 PRO and VR video with VR Box Virtual 3D glasses, Duration: 14,8 -14,86, Video: Fetal ultrasound results include presentation of the baby, amniotic fluid, placenta, umbilical arteries, fetal biometry, and fetal respiration.	The VAS scores of the women in the intervention group with 9 cm cervical dilatation were significantly lower than women in the control group
Momenyan et al (2021) [18]	Iran	Randomized controlled trial, NRS	Tool: The Android application was developed using the Google VR SDK, the head-mounted display was powered by a Samsung S3, and a noise reduction headphone was used, Durasi: 10 minutes, Video: the synergistic applications of VR and nature factors that light, nature, and video or VR can be effective in pain management.	There was a decrease in cognitive pain and sensory pain in the 1st stage of labor in the VR group, in the 2nd stage there was no significant difference between the VR group and the control group.

an impact on reducing pain reactions through psychological, emotion and cognitive stimulation from nociceptor stimulation [26]. Also, visual and audio factors play a pivotal role in obtaining the benefits of exposure to nature through the use of VR [27]. Today's VR devices can provide vivid audiovisual stimuli and thus can create illusions that can be transported into virtual worlds and facilitate existence in natural environments. Virtual environments for virtual landscapes are usually based on high-quality and pleasant landscapes, thus VR can offer users an optimized experience and enhance positive psychological and physiological responses [28]. However, there are several studies that state that the use of music therapy in the labor process which aims to reduce pain does not have a significant effect on both the latent and active phases. This can be caused by several factors including the sample size of the study, cultural characteristics, and the type of music they like.

Conclusion

Virtual reality is an effective non-pharmacological method for reducing pain during labor and does not affect the mother and fetus. The use of video is also very important and effective during the use of virtual reality, especially videos related to babies and natural scenery accompanied by sound effects. Although the results of the review show that VR can reduce pain, there is a need for further research regarding the effectiveness of VR using appropriate media and duration, as well as the need for guidelines in implementing the use of VR to reduce pain.

Declaration

References

1. Symon A, McFadden A, White M, Fraser K, Cummins A. Using the Quality Maternal and Newborn Care Framework to evaluate women's experiences of different models of care: A qualitative study. *Midwifery*. 2019 Jun;73:26-34. doi: 10.1016/j.midw.2019.03.002. Epub 2019 Mar 5. PMID: 30856528.
2. Báez Suárez A, Martín Castillo E, García Andújar J, García Hernández JÁ, Quintana Montesdeoca MP, Loro Ferrer JF. Evaluation of the effectiveness of transcutaneous nerve stimulation during labor in breech presentation: a case series. *J Matern Fetal Neonatal Med*. 2021 Jan;34(1):24-30. doi: 10.1080/14767058.2019.1572110. Epub 2019 Feb 6. PMID: 30654675.
3. Weber LM, Nilsen DM, Gillen G, Yoon J, Stein J. Immersive Virtual Reality Mirror Therapy for Upper Limb Recovery After Stroke: A Pilot Study. *Am J Phys Med Rehabil*. 2019 Sep;98(9):783-788. doi: 10.1097/PHM.0000000000001190. PMID: 30964752; PMCID: PMC6697203.
4. Faruki A, Nguyen T, Proeschel S, Levy N, Yu J, Ip V, Mueller A, Banner-Good-speed V, O'Gara B. Virtual reality as an adjunct to anesthesia in the operating room. *Trials*. (2019); 20(1):782. doi: https://doi.org/10.1186/s13063-019-3922-2.
5. Wang YL, Gao HX, Wang JS. et al. Immersive virtual reality as analgesia for women during hysterosalpingography: study protocol for a randomized controlled trial. *Trials*. (2020); 21:102. doi: https://doi.org/10.1186/ s13063-019-4023-y.
6. Yeung AWK, Tosevska A, Klager E, Eibensteiner F, Laxar D, Stoyanov J, Glisic M, Zeiner S, Kulnik ST, Crutzen R, Kimberger O, Kletecka-Pulker M, Atanasov AG, Willschke H. Virtual and Augmented Reality Applications in Medicine: Analysis of the Scientific Literature. *J Med Internet Res*. 2021 Feb 10;23(2):e25499. doi: 10.2196/25499. PMID: 33565986; PMCID: PMC7904394.
7. Hajesmaeel-Gohari S, Sarpourian F, Shafiei E.Virtual reality applications to assist pregnant women: a scoping review. *BMC Pregnancy and Childbirth*. (2021); 21(249). doi: https://doi.org/10.1186/s12884-021-03725-5
8. Li Q, Luo X, Li L, Ma B, Yao M, Liu J, Ge L, Chen X, Wu X, Deng H, Zhou X, Wen Z, Li G, Sun X. Toward better translation of clinical research evidence into rapid recommendations for traditional Chinese medicine interventions: A methodological framework. *Integr Med Res*. 2022 Sep;11(3):100841. doi: 10.1016/j.imr.2022.100841. Epub 2022 Mar 5. PMID: 35313565; PMCID: PMC8933510.
9. Aromataris E, Munn Z (Editors). JBI Manual for Evidence Synthesis. *JBI*, 2020. Available from https://synthesismanual.jbi.global. doi: https://doi.org/10.46658/JBIMES-20-01
10. McGowan J, Straus S, Moher D, Langlois EV, O'Brien KK, Horsley T, Aldcroft A, Zarin W, Garitty CM, Hempel S, Lillie E, Tunçalp Ö, Tricco AC. Reporting scoping reviews-PRISMA ScR extension. *J Clin Epidemiol*. 2020 Jul;123:177-179. doi: 10.1016/j.jclinepi.2020.03.016. Epub 2020 Mar 27. PMID: 32229248.
11. Peters MDJ, Godfrey C, McInerney P, Munn Z, Tricco AC, Khalil H. Chapter 11: Scoping Reviews (2020 version). In: Aromataris E, Munn Z (Editors). *JBI Manual for Evidence Synthesis, JBI*. 2020. Available from https://synthesismanual.jbi.global. doi: https://doi.org/10.46658/JBIMES-20-12
12. Massov L, Robinson B, Rodriguez-Ramirez E, & Maude R. Virtual reality is beneficial in decreasing pain in labouring women: A preliminary study. *Australian and New Zealand Journal of Obstetrics and Gynaecology*. (2022); 1-5. doi: https://doi.org/10.1111/ajo.13591
13. Carus EG, Albayrak N, Bildirici HM, & Ozmen SG. Immersive virtual reality on childbirth experience for women: a randomized controlled trial. *BMC Pregnancy and Childbirth*. (2022); 22(1), 354. doi: https://doi.org/10.1186/s12884-022-04598-y
14. Ebrahimian A & Bilandi RR. Comparisons of the Effects of Watching Virtual Reality Videos and Chewing Gum on the Length of Delivery Stages and Maternal Childbirth Satisfaction: A Randomized Controlled Trial. *Iranian Journal of Medical Sciences*. (2021); 46(1), 15-22. doi: https://doi.org/10.30476/ijms.2019.82782.1119

15. Gür EY, & Apay SE. The effect of cognitive behavioral techniques using virtual reality on birth pain: a randomized controlled trial. *Midwifery*. (2020); 91, 102856. doi: https://doi.org/10.1016/j.midw.2020.102856

16. Frey DP, Bauer ME, Bell CL, Low LK, Hassett AL, Cassidy RB, Boyer KD & Sharar SR. Virtual reality analgesia in labor: the vrail pilot study - a preliminary randomized controlled trial suggesting benefit of immersive virtual reality analgesia in unmedicated laboring women. *Anesthesia and Analgesia*. (2019); 128(6), E93-E96. doi: https://doi.org/10.1213/ANE.0000000000003649

17. Akin B, Yilmaz Kocak M, Küçükayd?n Z, & Güzel K. The effect of showing images of the foetus with the virtual reality glass during labour process on labour pain, birth perception and anxiety. *Journal of Clinical Nursing*. (2021); 30(15-16), 2301-2308. doi: https://doi.org/10.1111/jocn.15768

18. Momenyan N, Safaei AA & Hantoushzadeh S. (2021). Immersive virtual reality analgesia in un-medicated laboring women (during stage 1 and 2): a randomized controlled trial. *Clinical and Experimental Obstetrics and Gynecology*. (2021); 48(1). 110-116. doi: https://doi.org/10.31083/j.ceog.2021.01.2116

19. Naef AC, Jeitziner MM, Knobel SEJ, Exl MT, Müri RM, Jakob SM, Nef T, Gerber SM. Investigating the role of auditory and visual sensory inputs for inducing relaxation during virtual reality stimulation. *Sci Rep*. 2022 Oct 12;12(1):17073. doi: 10.1038/s41598-022-21575-9. PMID: 36224289; PMCID: PMC9560033.

20. Duan G, Takemi T, Ngan K. Evaluation of pollutant exposure using virtual walkers and large-eddy simulation: Application to an idealised urban neighbourhood. *Sci Total Environ*. 2023 Jun 15;877:162640. doi: 10.1016/j.scitotenv.2023.162640. Epub 2023 Mar 13. PMID: 36921850.

21. Wong MS, Spiegel BMR & Gregory KD. Virtual Reality Reduces Pain in Laboring Women: A Randomized Controlled Trial. *American journal of perinatology*. (2021); 38(S 01), e167-e172. doi: https://doi.org/10.1055/s-0040-1708851

22. Buglione A, Saccone G, Mas M, Raffone A, Di Meglio L, Di Meglio L, Toscano P, Travaglino A, Zapparella R, Duval M, Zullo F & Locci M. Effect of music on labor and delivery in nulliparous singleton pregnancies: a randomized clinical trial. *Archives of gynecology and obstetrics*. (2020); 301(3), 693-698. doi: https://doi.org/10.1007/s00404-020-05475-9

23. Gönenç ?M & Dikmen HA. Effects of Dance and Music on Pain and Fear During Childbirth. Journal of obstetric, gynecologic, and neonatal nursing: JOGNN. (2020); 49(2), 144-153. doi: https://doi.org/10.1016/j.jogn.2019.12.005

24. van Loon WEE, Borgsteede SDS, Baas GWG, Kruijtbosch MM, Buurma HH, De Smet PAGMP, Egberts ACGT, Bouvy MM, Floor-Schreudering AA. Nature and frequency of prescription modifications in community pharmacies: A nationwide study in the Netherlands. *Br J Clin Pharmacol*. 2021 Mar;87(3):1455-1465. doi: 10.1111/bcp.14548. Epub 2020 Sep 24. PMID: 32901959; PMCID: PMC9328355.

25. Lier EJ, Oosterman JM, Assmann R, de Vries M, & van Goor H. The effect of Virtual Reality on evoked potentials following painful electrical stimuli and subjective pain. *Sci Rep*. (2020); 10, 9067. doi: https://doi.org/10.1038/s41598-020-66035-4

26. Briki W & Majed L. Adaptive effects of seeing green environment on psychophysiological parameters when walking or running. *Front. Psychol*. (2019); 10:252. doi: 10.3389/fpsyg.2019.00252

27. Li H, Zhang X, Wang H, Yang Z, Liu H, Cao Y, & Zhang G. Access to Nature via Virtual Reality: A Mini-Review. *Frontiers in psychology*. (2021); 12, 725288. doi: https://doi.org/10.3389/fpsyg.2021.725288

28. Ida H, Mohapatra S, Aruin AS. Perceptual distortion in virtual reality and its impact on dynamic postural control. *Gait Posture*. 2022 Feb;92:123-128. doi: 10.1016/j.gaitpost.2021.11.017. Epub 2021 Nov 18. PMID: 34844150.

29. Nanji JA, Carvalho B. Pain management during labor and vaginal birth. *Best Pract Res Clin Obstet Gynaecol*. 2020 Aug;67:100-112. doi: 10.1016/j.bpobgyn.2020.03.002. Epub 2020 Mar 7. PMID: 32265134.

30. Tanvisut R, Traisrisilp K, Tongsong T. Efficacy of aromatherapy for reducing pain during labor: a randomized controlled trial. *Arch Gynecol Obstet*. 2018 May;297(5):1145-1150. doi: 10.1007/s00404-018-4700-1. Epub 2018 Feb 3. PMID: 29397442.