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ORIGINAL ARTICLE

Facilitators and Barriers to Implementing Virtual Reality (VR) Interventions for Women with Labour Pain: A Scoping Review

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Abstract

implementing a VR intervention for women with labour pain.

Design: A scoping review was conducted using guidelines published by the Joanna Briggs Institute. The scoping review was registered with the Open Science Framework (https://doi.org/10.17605/OSF.IO/K5HSP)

Data sources: English-language studies from 2021 to 2024 from CINAHL, MEDLINE, WEB OF SCIENCE, and PubMed.

Methods: Reviewers systematically screened retrieved articles based on inclusion criteria. Facilitators and barriers were identified and extracted using the theoretical domain framework.

Results: Among the eight included studies, 23 facilitators and 21 barriers were identified from the participant's perspective. Facilitators were commonly categorised in the areas of environmental context and resources (30%), emotions (22%) and beliefs about consequences (13%). Barriers were most commonly categorised in the areas of environmental context (52%) and skills (24%).

Conclusion: The results of this study present a complete review of the existing literature on the facilitators and barriers to the implementation of VR interventions for women with labour pain. Based on the barriers identified in this study, the development and use of VR interventions and devices need to consider the viewpoints of the women with labour pain. This could reduce physical (e.g., language) and cognitive barriers that are important to women with specific barriers.

Impact: The results of this study identified facilitators and barriers to the implementation of VR interventions for women with labour pain, and the results of the review may contribute to the establishment of future strategies for the implementation of VR interventions to reduce labour pain. Furthermore, further investigation needs to fill the gaps in knowledge regarding healthcare practitioner perspectives on VR interventions for women with labour pain.

Patient or Public Contribution: No Patient or Public Contribution.

Keywords: VR, virtual reality, VR intervention, labour pain, facilitators, barriers.

Introduction

Labour pain is a high level of pain that occurs during labour and is prolonged in duration (Smith et al., 2021). Although labour pain is universal, extreme pain in labour can lead to negative effects

such as excessive maternal neuroendocrine stress, prolonged labour, maternal acidosis, irregular contractions and increased rates of post-partum haemorrhage (Alan Dikmen et al.,2024; Whitburn et al.,2019; Lowe,2002). Moreover, labour pain not only affects the mother's physical health, her emotional relationship with her child, leading to a decrease in labour satisfaction and comfort, but also affects her thoughts about future births (Hosseini Tabaghdehi et al.,2020; Mortazavi et al.,2012). Therefore, rational and safe reduction of pain intensity and duration is essential from both medical and humanistic perspectives. Currently the most commonly used clinical methods of pain relief during labour include opioid analgesia and epidural analgesia (Baldo, 2021; Anim-Somuah et al.,2018; Smith et al., 2018). Opioids have been shown to be helpful in reducing painful labour but can increase maternal nausea and vomiting and narcoleptic responses, and in more severe cases can suppress respiration (Baldo, 2021; Smith et al., 2018). Epidurals have been determined to be safe and effective in reducing labour pain, but this approach is associated with more surgical interventions and longer labour times (Anim-Somuah et al.,2018). Therefore, WHO has increased its recommendation for the adoption of non-pharmacological ways of reducing pain (WHO,2018).

In order to reduce the use of medication, VR (virtual reality) technology, aromatherapy and music therapy have been developed as non-pharmacological treatments for pain reduction (Baradwan et al., 2022; Ghaderi & Solhjou, 2020; Howlin & Rooney, 2020). Currently, VR technology is a relatively new modality of non-pharmacological treatment of pain through distraction (distraction is a frequent intervention in healthcare environments and can be useful in decreasing pain (Lambert et al.,2020)).VR works by stimulating multiple perceptions of the user, allowing them to interact with realistic 3D virtual environments, and by distracting them from changing the complex activity of physiological pain modulation systems, thereby reducing the level of attention to pain (Son et al.,2022; Wu et al.,2022; Navarro-Haro et al.,2017). VR has been shown to help people with chronic pain, and VR interventions for chronic pain include VR visual hallucinations and positive thought-based interventions (Goudman et al.,2022).

However, this technology has not been implemented on a large scale in the field of obstetrics, where the prevalence of labour pain is high. Moreover, labour pain is very different to other kinds of pain because it is not only related to severe emotions, but its intensity is also related to the progression of the labour; as the implementation of VR interventions may be influenced by these factors, it is crucial to identify facilitators and barriers to the use of VR in the population (‘women with labour pain’) in order to develop targeted implementation strategies. A systematic implementation strategy is essential for the successful use of VR interventions for labour pain relief at scale. All facilitators and barriers need to be comprehensively reviewed. The Theoretical Domain Framework (TDF) provides a method for systematically identifying facilitators and barriers to develop implementation strategies (Cane et al.,2012). The TDF is a framework for implementing behaviour change. It integrates 128 concepts from 33 various behaviour change theories and organises them within 14 domains into which they (facilitators and barriers) can be categorised (Cane et al.,2012). Thus, the aim of the scoping review was to provide a comprehensive review of the existing literature using the TDF to extract and categorise facilitators and barriers regarding the implementation of VR interventions for women with labour pain. All of the identified factors will contribute to the theoretical basis to integrate virtual reality interventions successfully into clinical practice, as well as a basis for recommendations for future research on labour pain management and VR development.

Methods

- Registration & Design

The scoping review was registered in the Open Science Framework https://doi.org/10.17605/OSF.IO/K5HSP and guided by the methodology for conducting scoping reviews published by Arksey & O'Malley, 2005 and the Joanna Briggs Institute [Peters et al., 2020a]. The report utilised PRISMA flow charts and checklists (see Figure1 in Appendix 1) to report on the study selection process (Page et al., 2021).

- Search strategy

A literature search was conducted in the databases

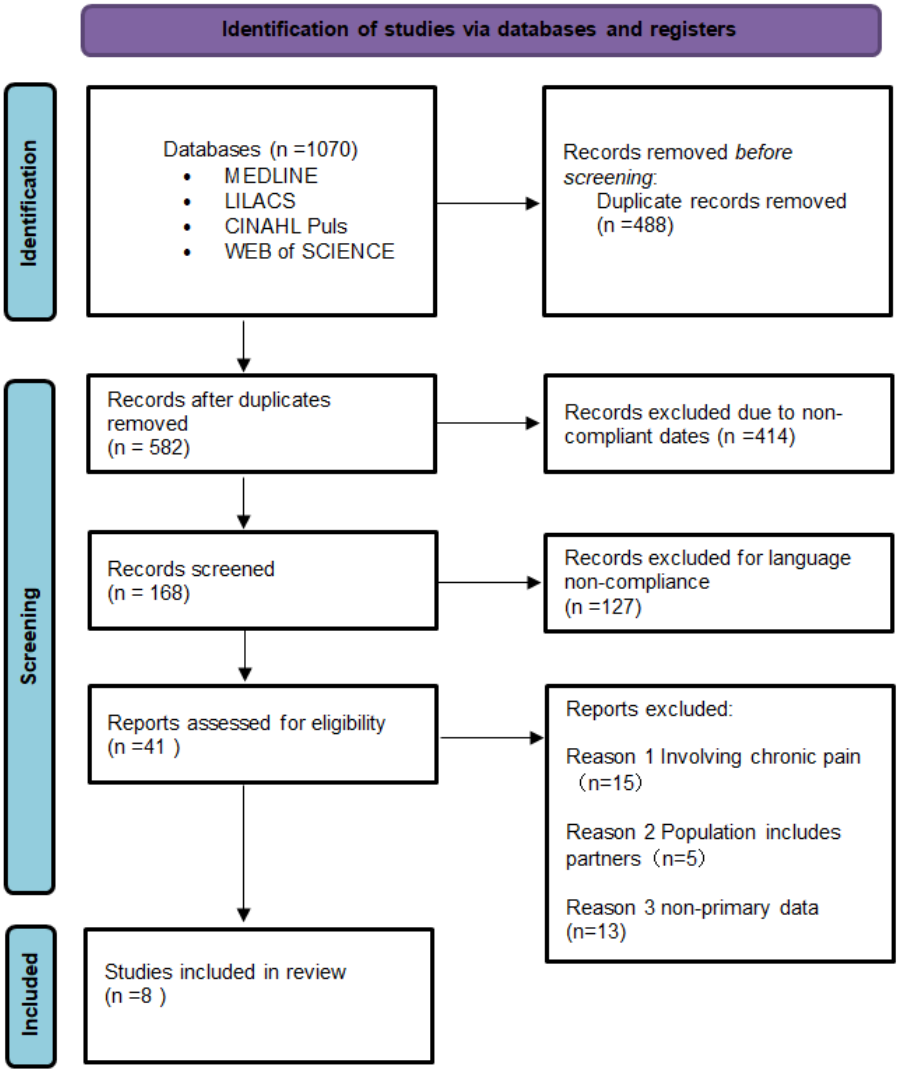
MEDLINE (PubMed), CINAHL Puls, Web of Science and LILACS. The literature was searched using keywords ('labour pain', 'pregnant women', 'virtual reality', 'barriers', and 'facilitators') and their derivatives to develop a search strategy (see Table1 in Appendix 1). The reviewer (Chen) screened the list of references for inclusion in the study. Inclusion criteria for the literature were (1) people involved with labour pain, (2) the intervention was a VR technique (of any type), (3) articles published in English in the last 5 years, (4) full text available and reporting final results, and (5) primary research (qualitative, quantitative, or mixed studies). Exclusion criteria were studies not related to labour pain and interventions not involving VR.

Reviewers (Chen and Xu) tested inclusion and exclusion criteria by screening a random selection of 30 articles (titles and abstracts) to assure consistent application. The criteria were modified if consistency was less than 75% (Peters et al., 2020b). After screening titles and abstracts, the reviewers (Chen and Xu) discussed refining the full-text screening criteria. All factors that positively facilitated or influenced participants use of the VR intervention were termed facilitators; conversely, factors that negatively or adversely influenced participants use of the VR intervention were termed barriers. Two reviewers (Chen and Xu) independently screened the full text and resolved any inconsistencies or disagreements during the review process through discussion.

Results

The database search identified 1070 publications. After removing 488 duplicates, 582 were screened based on title and abstract. Among them, 41 studies met the inclusion criteria. Finally, eight articles were included (see PRISMA flowchart).

PRISMA Flowcharts：



- Data extraction

The reviewer (Chen) extracted the data and organised it into a custom data template that was created (see Appendix 2). The reviewer (Xu) reviewed the data extracted, made comments on the discrepancies and resolved them by discussion. Reviewers (Chen and Xu) extracted study characteristics (e.g. author, year, country, title, design, sample size and population), kinds of intervention and outcomes (facilitators and barriers). In the case of quantitative studies, the facilitators and barriers were extracted if at least 50% of the participants indicated that the relevant factor affected the implementation of the VR intervention (Weatherson et al., 2017). In the case of qualitative studies, all of the facilitators and barriers reported by the participants were extracted.

- Collation and reporting

Transfer of acquired data to MAXQDA Plus 2022 (VERBI software, 2021) by the reviewers. Based on the TDF, the reviewers (Chen and Xu) coded and categorised the facilitators and barriers reported by the participants separately (see Appendix 3(Atkins et al., 2017.p4-5; Cane et al.,2012)), then resolved inconsistencies through discussion, and finally categorised the facilitators and barriers into a number of different domains. After assessing the quantity of facilitators and barriers allocated to each of the TDF domains, the reviewers analysed the most common facilitators and barriers to identify potential themes.

- Included studies

Among the eight studies, there were two mixed-methods studies (Massov et al.,2024; Massov et al.,2023), three qualitative studies (Van Leugenhaege et al.,2024; Musters et al.,2023; Wong et al.,2022), and three randomised controlled studies (Mohammadi et al.,2023; Carus et al.,2022; Wong et al.,2021) (see Table2 in Appendix 1 for characteristics of the included studies). Facilitators and barriers from the participants' (maternal) perspective were reported in all studies; no factors reported from the healthcare practitioner's perspective were identified. The included studies were published between 2021 and 2024. Study sample sizes ranged from 10 (Van Leugenhaege et al., 2024) to 130 (Mohammadi et al., 2023) participants. Several VR interventions were included in the study, e.g. a 10-minute visualisation experience for distraction, etc. (Wong et al.,2022).

Facilitators and barriers

The reviewers identified a total of 44 facilitators and barriers (23 (52 %) facilitators and 21 (48 %) barriers) (see Table 1) and summarised all the identified facilitators and barriers in the TDF domain (Table3 in Appendix 1):

Table 1: Facilitators and barriers were assigned to each of the TDF (Cane et al.,2012)**.**

TDF domains	Facilitators (n=23), n (%)	Barriers (n=21), n (%)
Environmental context and resources	7（30）	11（52）
Skills	2（9）	5（24）
Memory, attention, and decision processes	2（9）	2（10）
Emotion	5（22）	1（5）
Beliefs about consequences	3（13）	1（5）
Reinforcement	1（4）	0（0）
Knowledge	1（4）	0（0）
Optimism	1（4）	0（0）
Beliefs about capabilities	1（4）	1（5）

- Facilitators

Twenty-three facilitators were allocated to nine separate TDF domains (no facilitators were allocated to the remaining seven domains (See Table 2 for major classifications)).

Table 2: Primary themes related to facilitators based on the TDF (Cane et al.,2012)**.**

Themes		Quote	References
Environmental context and resources	Gamification	"….it helped the feeling of being at the hospital, I think, which is quite a sterile place, it [the VR] made it more colourful and entertaining…it takes you to a different world, it makes your mind wander, to dream…Well, I can rest here and still be in this world of colour and fun and beauty."	Massov et al., 2024.p6
	VR devices	"There used to be an information session before you go into labor, perhaps some explanation [on VR] at that time?"	Van Leugenhaege et al., 2024.p578
	Midwifes	"If the midwife would have put more effort into convincing me to try the VR meditation of VR game again, I might have used VR another time… The support and persuasiveness of the caregivers regarding VR partly determines the success of VR." "When the labour pain got worse, I needed more coaching guidance and lots of positive mental support."	Musters et al., 2023.p6
Beliefs about consequences	Increase reuse probability	"I would definitely use the VR glasses again during a next delivery."	Musters et al., 2023.p6
	Positive expectations	"Several patients wanted to encourage other patients to use VR during labor or to at least "try it before any pain medication"."	Wong et al., 2022.p4
	Helpful for pain reduction	"Yes, it surely was a positive experience... A good way to detach myself from labour pain… I think VR is especially useful to relax in between the contraction"	Musters et al., 2023.p3
Emotion	Fun and enjoyment	"The experience was so beautiful", "I really liked the messages about thinking of your contractions as waves of love".	Wong et al., 2022.p4
	Novel and entertaining experiences	"…I really loved the scene that I looked at, the beach scene… I was just sitting on the floor leaning against the chair and felt really calm and relaxed." ''time wasn't time….it moved a lot faster."	Massov et al., 2024.p6p7

The first major facilitator was identified as the domain of ECR, and three themes were identified in this domain; (1) VR devices (2) midwives (3) gamification. The VR devices should be simple to use for women with labour pains(maternal) and there should be a good tutorial on the information of the VR devices prior to the birth, this would be considered as facilitators. Meanwhile, midwives were perceived by the participants to contribute the successful implementation of VR interventions, as the support of midwives (healthcare practitioners) can guidance the use of VR in labour for participants and give them "lots of positive mental support (Musters et al., 2023.p6)". Gamification of the intervention through the VR intervention was also seen as a facilitator by participants as it facilitated distraction by immersing participants in different VR worlds.

The second facilitator was identified as the domain of beliefs about consequences, and three themes were identified in this domain: (1) participants' positive expectations about the effect of reducing labour pain; (2) the VR intervention was useful in alleviating labour pain; and (3) the VR intervention increased the probability that participants would use it again for their next birth. Among the positive expectations of the effectiveness of labour pain reduction, the expectation that the VR intervention was superior to conventional therapy (medication) were identified as contributing factors. Also, VR intervention was effective in reducing labour pain because VR intervention improved participants' mood and made them feel relaxed (e.g.it was "a good way to detach myself from labour pain… VR is especially useful to relax in between the contraction (Musters et al., 2023.p3)"). Similarly, participants indicated that using the VR intervention increased the probability that they would use it again to reduce labour pain the next time they gave birth.

The third facilitator was identified as the emotion area of TDF. Among the domain, 2 themes were identified; (1) enjoyment and fun, with participants noting that the VR intervention elicited positive emotions and gained a sense of calm and relaxed, and eventually forgetting about the passage of time; (2) participants gained the novelty and fun of being in a VR world that made them "really liked the messages about thinking of your contractions as waves of love (Wong et al., 2022.p4)".

- Barriers

Twenty-one barriers were allocated to six separate TDF domains (no barriers were allocated to the remaining eight domains (See Table 3 for major classifications)).

Table 3: Primary themes related to barriers based on the TDF domains.

Themes		Quote	References
Environmental context and resources	VR devices	"it felt a little heavy", "as time progressed it became more heavy on my face". "the development of a lightweight device, that 'has less weight on the nose'"; "When the labour pain got worse, I needed more coaching guidance and lots of positive mental support." "It would be nice to try the VR glasses before being in labour, so you feel more comfortable using them when in pain..."; "There used to be an information session before you go into labor, perhaps some explanation [on VR] at that time?"	Wong et al., 2022.p5; Musters et al., 2023.p6; Van Leugenhaege et al., 2024.p578
	VR software	"I could not relax during the game which caused no reduction in pain." "The game could be really fun, but from my perspective it is not suitable during labour. I could not focus on the game"; "When experiencing severe labour pain, I needed a voice to help me cope with the contraction. Unfortunately, it was not possible with this application." "I was glad there was a chair because I became kind of nauseous."	Musters et al., 2023.p5; Musters et al., 2023.p6; Van Leugenhaege et al., 2024.p578

	Notable events	"Using the VR in other than a sitting position (which the VR headset is used in most cases) was uncomfortable and awkward for six women. The headset felt heavy, particularly in the neck area."	Massov et al., 2024.p9
Skills	Gaming skills	"Practicing how to use the controllers (i.e., which fingers to use to press the buttons) and exploring which content is available and how to navigate the virtual world (i.e. where to click and how to access different digital content options) were deemed important."	Van Leugenhaege et al., 2024.p577
	Language skills	"Listening to a non-native language requires more energy."	Musters et al., 2023.p5

The first barrier was identified as the domain of ECR, and three main themes were identified (see Table 3): (1) VR devices, participants who wore goggles with devices that were too heavy and insufficient support during implementation were considered barriers, e.g., not being guided through the process of using the VR device; and no explanation or use of the VR devices related to VR devices was given to the user before user go into labour; (2) VR software, some participants pointed out that VR software caused the women giving birth to feel more pain or other discomforts (e.g., dizziness, nausea). Additionally, the game for the software were perceived by participants to be less appropriate for use during labour. These were identified as barrier factors; (3) Finally, notable events included barriers due to technical issues. This included participant being in other positions where using the VR would cause the user to feel uncomfortable or awkward (in addition to the seated position).

The second barrier was in the domain of skills, where two main themes were identified (1) gaming skills, as participants did not know how to control the software and how to use the games to explore different virtual worlds, and therefore participants were not able to find the type of games that would be appropriate for women with labour pains, and (2) language skills, with the most significant barrier being language when the user's native language was different from the language of the software.

Discussion

This scoping review aimed to use the TDF to identify and classify facilitators and barriers associated with the implementation of VR interventions for women with labour pain. From the eight studies included, a total of 44 facilitators and barriers were identified. The main facilitators of using VR interventions to reduce labour pain were categorised into the domains of emotions,beliefs about consequences and ECR, and the main barriers were categorised into the domains of ECR and skills. A surprising finding was that the scoping review did not identify studies that reported directly on facilitators or barriers to the implementation of VR for labour pain relief for women with labour from the perspective of healthcare practitioners, but studies (Van Leugenhaege et al.,2024; Musters et al.,2023) have involved elements related to this topic. As far as we are aware, it is the first scoping review to summarise facilitators and barriers to implementing VR interventions for woman with labour pain.

- About VR Devices

Looking through the factors that have been categorised in the table, the review seems to draw a paradoxical result (i.e., that facilitators and barriers to implementing VR interventions coexist in the field of ECR). However, as VR device and VR software are important themes of facilitators and barriers in the field of ECR, the important factors for implementing VR interventions need to take into account the reality of the user's situation in order to select the appropriate VR device and VR software for the user. This decision is important for labour pain relief and for women suffering from labour pain as they are sensitive to the weight of the VR device, which may increase pain (Wong et al.,2022); or cause them to feel nausea, dizziness, unsteadiness, and other discomforts while using the VR device (Van

Leugenhaege et al.,2024); some participants suggested that it would have been helpful if they had been able to try out or receive more explanations about VR before they go into labour (Van Leugenhaege et al., 2024; Musters et al., 2023).

Although lighter and better VR devices will be available in the future that may improve this disadvantage, the ability to use a VR device or successfully implement a VR intervention for women with labour pain will still depend on the user's tolerance. If the factors (select the appropriate VR device and VR software for the user) are taken into account at this time, it is possible that the VR device chosen/VR intervention may facilitate the process of implementation. These findings support aspects that need to be addressed when developing a VR intervention: the appropriate VR intervention for the user (women suffering from labour pain) at the appropriate time (Spiegel, 2020; Baradwan et al., 2022). The findings are consistent with published recommendations for an approach that involves the user (maternal) throughout the development of the VR intervention, which needs to be tailored to the needs of women of childbearing age, considering all of the above aspects at an early stage (Hajesmaeel-Gohari et al.,2021; Birckhead et al.,2019 et al. 2019).

- About VR Skills

The table showed important barriers in the domain of TDF, i.e., Skills, specifically related to the language skills of the user and the skills to manipulate the game (Van Leugenhaege et al., 2024; Musters et al., 2023). Suggestions from participatory development of VR interventions suggested that both of these issues could be addressed through software development, for example through participatory development of tutorials or the use of easy-to-understand and varied language (Birckhead et al., 2019). This is consistent with a review which advocated providing healthcare practitioners and users with sufficient time to learn and use new technologies (Glegg & Levac, 2018).

However, the results of the review highlighted the significance of designing and delivering accessible language options for women with labour pain in VR interventions. This may be due to the fact that women with labour pain have a shorter attention span, they are more likely to feel pain and be disturbed as their labour progresses, as well as experience other mental health problems (e.g. anxiety) (Özer et al.,2024). Therefore, strategies to address barriers include actively developing VR applications specifically for women with labour pain (Musters et al.,2023); and to focus on the competence of healthcare practitioners in the use of VR or to improve the capacity of healthcare practitioners to support women with labour pain during VR interventions, so that healthcare practitioners are able to transfer the skills they have learnt to users with personalized needs (Kouijzer et al.,2023; Baradwan et al.,2022). It is also important that healthcare practitioners have a positive attitude towards digital technology for successful implementation (Konttila et al.,2019). Therefore, a key aspect of implementing VR in labour pain relief is to adequately train healthcare practitioners who provide VR interventions to women with labour pain to support women with labour pain during the use of VR interventions.

- Expectations about VR Interventions

Positive Expectations about reducing labour pain help the application of VR interventions for woman with labour pain (Musters et al.,2023; Wong et al.,2022). Positive beliefs about VR interventions overall lead to greater satisfaction with the outcome of the intervention and have an influence on cooperation and outcomes for women with labour pain (Wong et al.,2022). Such positive beliefs can be harnessed and encouraged by informing women of the benefits of VR interventions and providing examples of good practice when delivering VR interventions for women with labour pain.

A theme that also appeared in the area of Beliefs about Consequences was that VR interventions can enhance the likelihood that maternal women will recommend the use of VR to those around them, and that the VR will be used again the next time they give birth (Musters et al.,2023; Wong et al.,2022), as VR can help to distract maternal women from their labour, reduce pain, and increase satisfaction with their labour. Participants expressed the hope that VR could be used for interventions in their next birth (Carus et al.,2022). Furthermore, participants saw a benefit in that they would have the opportunity to choose from a number of various virtual scenarios to

immerse themselves in to alleviate the pain (Carus et al., 2022).

Shorter VR interventions for women with labour are a common problem leading to poorer pain relief, and longer VR use can reduce the problem (poorer outcomes) (Massov et al.,2024; Musters et al.,2023). The findings of this review are consistent with a study that showed that VR can motivate users to follow through with treatments or interventions (Brepohl & Leite,2023).Prolonged interventions with VR can facilitate or improve outcomes as some women feel that short (e.g., 10-minute) interventions are insufficient, and adherence to longer interventions may have a positive influence on the outcome of labour pain management outcomes positively (Massov et al., 2024; Musters et al., 2023).

The themes of fun and enjoyment as well as novelty of the experience explain the favourable effects of the aforementioned long duration of VR interventions (Massov et al.,2024; Wong et al.,2022). There is a study that has highlighted the capacity of VR to create novel experiences for people with other types of pain (Brepohl & Leite,2023). Thus, positive emotions (pleasure/enjoyment) can have a positive effect in their own right.

- About facilitators or barriers not found to be reported from healthcare practitioners' perspectives

Although no facilitators or barriers were identified in the scoping review that were reported directly from the healthcare practitioner's perspective, there are studies (Van Leugenhaege et al.,2024; Musters et al., 2023) that found content related to this topic that is worth mentioning. VR was noted as a good opportunity for labour pain relief for labouring women during labour, and studies have indirectly noted through the perspectives of labouring women that a desire for midwives to adequately inform and support labouring women in the use of VR during labour would be considered a facilitator (Van Leugenhaege et al.,2024; Musters et al.,2023). Therefore, healthcare practitioners have an important role to play in the application of digital/VR interventions (Konttila et al.,2019). This is in line with previous studies that recommend the use of these methods (VR interventions) by nurses/ midwives offering services within the field of obstetrics (Yılmaz Sezer et al.,2024); and support from health practitioners may be helpful in alleviating adverse reactions in labour (Gayeski et al., 2015)

- Combination with existing literature

Compared results of the present review with the results of previous reviews that have examined the application of VR interventions during labour, other reviews have focused on the implementation of VR interventions during labour to reduce maternal labour pain, labour anxiety, shorten the first stage of labour the second stage of labour, and increase satisfaction in normal labour (Yılmaz Sezer et al.,2024; Özer et al.,2024; Xu et al.,2022). It is noteworthy that although the topics covered were largely the same, there were significant differences in details such as barriers to providing appropriate VR interventions and VR devices to labouring women and facilitators with strong beliefs about the effectiveness of the interventions. It appears that the implementation of VR interventions for labour pain mothers in this study differed significantly from other studies in terms of details; moreover, due to the nature of labour pain, maternal cognitive issues should be considered. Furthermore, as the views of healthcare practitioners are not completely clear, this would be an area worthy of further research and further studies in this area are necessary.

Limitations

The scoping review has its own limitations. First, although the two independent reviewers of the review used standardized procedures and coding guidelines based on the TDF domains to minimize subjectivity, there may be some subjectivity in the categorisation of facilitators and barriers into TDF domains. Second, the barriers and facilitators summarised in the scoping review were ranked based on the frequency with which they were discussed in the reviewed publications, which does not always reflect their significance. However, factors that were mentioned only once in the included studies may be the most important ones. In particular, facilitators and barriers that were considered if they achieved more than 50% approval in the quantitative study.

Conclusion

The review gave an overall picture of the facilitators and barriers to implementing VR interventions for woman in labour. As a result of

the barriers identified, the perspectives of women with labour pain should be considered in the development of VR devices and VR interventions. This could reduce barriers such as linguistic, cognitive, or physical barriers that are important to the user. The facilitators or barriers identified can be used to develop effective strategies for implementing VR interventions for women with labour pain. For example, posters about the positive effects of VR could be displayed in the waiting room to reinforce positive maternal expectations of VR interventions. Additionally, it would be beneficial for future research on VR interventions and implementation to place a greater emphasis on the perspectives of healthcare professionals. This would facilitate a more comprehensive understanding of the values and needs of these key stakeholders.

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