The use of virtual reality technologies for the relaxation of pregnant and parturient women: the results of a pilot study

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Abstract
Modern methodology of psychological support of pregnant women is represented by many effective means and focus areas, but they mainly concern the prenatal period. The aid of a psychologist during childbirth is complicated by objective factors: first of all, there is a lack of trained specialists who can be constantly present in a delivery room and work in cooperation with doctors and parturient women. Therefore, the means which can be provided to patients in audio or video format after a preliminary briefing arouse interest. In particular, the application of virtual reality technologies, which dive a person into an immersive therapeutic space, has great prospects. They are actively employed to relieve procedural and acute pain in pediatric, oncological, and burn departments. However, they are still poorly introduced into obstetric practice and perinatal psychology. The purpose of this work is to present preliminary results of the implementation of VR relaxation during contractions in women giving birth for the first time. Methods. The guided relaxation technique is intended for pregnant women; it comprises

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Використання засобів віртуальної реальності для релаксації вагітних та породіль: результати пілотажного дослідження

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Анотація
Сучасна методологія психологічного супроводу вагітних представлена багатьма ефективними засобами і напрямками роботи, але вони переважно сфокусовані на допологовому періоді. Допомога психолога безпосередньо в процесі пологів ускладнена об’єктивними чинниками, в першу чергу – браком підготовлених спеціалістів, які можуть бути постійно присутні у пологовій залі та працювати у взаємодії з лікарями і породілями. Тому викликає інтерес засоби, що можуть бути надані пацієнтам в аудіо-чи відеоформаті після попереднього інструктування. Зокрема, велики перспективи має застосування технологій віртуальної реальності, що зазнають людину в імерсивний терапевтичний простір. Вони активно використовуються для полегшення процедурного та гострого болю в педіатричних, онкологічних, опікових відділеннях, але досі мало представлені в акушерській практиці та перинатальній психології. Мета цієї роботи – представити попередні результати впровадження ВР-релаксації на етапі перейм у жінок, що

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verbatim instructions for deep muscle relaxation, guided visualization to enhance salivation and positive suggestions about delivery outcome, and 3D background video and music. The experimental group included 49 participants who used VR glasses with a relaxation program during contractions; the control group consisted of 43 women who gave birth traditionally, involving all other services of the maternity department. **Results** contain medical records (duration of delivery, anesthesia use, a newborn’s Apgar score) and a survey of women on their experience 24-48 hours after childbirth. The comparative analysis confirmed a significant decrease in the use of anesthetic, duration of delivery, intensity and discomfort of labor pain; an increase in the ability to relax between contractions and better estimates of the newborn condition. The substantial growth of overall satisfaction with labor and the desire to give birth again in the experimental group is crucial. The technology’s effectiveness proves the theory of the psychogenic origin of labor pain and hence the relevance of a psychological approach to managing it. The author concluded on the effectiveness of interventions based on muscle relaxation of parturient women in combination with virtual reality technologies. The presented technology is fully ready-to-use in the practice of maternity departments.

**Key words:** labor pain, stress of pregnant women, fear of labor, psychological support of parturient women, non-pharmacological methods of pain relief, immersion analgesia.

**Introduction**

Childbirth is a natural function of a woman’s organism, but it often becomes stressful for her body and psyche. In humans, as in many mammals, childbirth is associated with a painful experience. This is the crucial problem which affects women’s expectations and experiences during labor and causes fear of childbirth. The pain lasting for many hours can provoke parturient women’s cardiac and respiratory disorders, premature fatigue, cessation of uterine contractions, and a lack of oxygen in the fetus. Therefore, for many years, the development of obstetric care in childbirth was focused specifically on finding means of relieving or eliminating pain. Pharmacological analgesia in labor is necessary in cases of its pathological course, but it does not mean that all parturient women need such an intervention.

When labor proceeds normally (contractions are active and the baby is well positioned), women are able to cope with the pain experienced during childbirth, and it is called normal birth. However, when labor is prolonged, difficult, or complicated, women may experience chronic pain, which is childbirth pain that lasts for more than 30 minutes after delivery. This type of pain is often caused by the use of certain medications or by complications during delivery. In some cases, women may experience acute pain, which is sudden and severe pain that can occur during labor or delivery. Acute pain can be caused by conditions such as uterine rupture or placenta previa. Women who experience pain during childbirth may be at risk for developing chronic pain, which can persist for months or even years after delivery. Therefore, it is crucial to find effective methods of pain management during childbirth to improve women’s experiences and reduce the risk of developing chronic pain. The presented technology proved its effectiveness in improving women’s experiences during childbirth and reducing the risk of developing chronic pain. It is a non-pharmacological approach to pain management that can be used in combination with other interventions, such as epidural anesthesia or intravenous analgesics. The technology’s effectiveness proves the relevance of a psychological approach to managing pain during childbirth. The author concluded on the effectiveness of interventions based on muscle relaxation of parturient women in combination with virtual reality technologies. The presented technology is fully ready-to-use in the practice of maternity departments. **Results** contain medical records (duration of delivery, anesthesia use, a newborn’s Apgar score) and a survey of women on their experience 24-48 hours after childbirth. The comparative analysis confirmed a significant decrease in the use of anesthetic, duration of delivery, intensity and discomfort of labor pain; an increase in the ability to relax between contractions and better estimates of the newborn condition. The substantial growth of overall satisfaction with labor and the desire to give birth again in the experimental group is crucial. The technology’s effectiveness proves the theory of the psychogenic origin of labor pain and hence the relevance of a psychological approach to managing it. The author concluded on the effectiveness of interventions based on muscle relaxation of parturient women in combination with virtual reality technologies. The presented technology is fully ready-to-use in the practice of maternity departments.

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proper support. This is associated with the body's production of endorphins – opiates that dull the labor pain, although they do not kill it completely. During labor and immediately afterwards, the woman and the newborn are immersed in a specific neurohormonal scenario that cannot be reproduced artificially. The peaks of endogenous oxytocin, together with the gradual release of endorphins in the mother's brain, lead to an altered state of consciousness typical of non-pharmacological (natural) labor, but this phenomenon is poorly studied in psychology (Buckley, 2015).

The duration of labor and the intensity of painful sensations cannot be predicted accurately. It depends on the size and position of the fetus, the size of the woman's pelvis, and her emotions (tension, fears, anxiety), expectations and instructions, learned behavior, and understanding of what is happening. The environment in which childbirth takes place also affects the woman's sense of pain and ability to cope with it. Consequently, psychological interventions and space organization can regulate many factors of pain origin.

At the beginning of the 20th century, a British obstetrician G. Dick-Read (1933) explained that the root cause of labor pain is anxiety – the more a pregnant woman fears labor, the higher the probability of complications and painful experiences. He called it the fear-tension-pain cycle (Dick-Read, 1933). Fear causes automatic physiological reactions, including the tension of the muscles of the whole body anticipating the threat, including spasms of the uterine muscle. Muscle tension constricts blood vessels, blocking the delivery of blood and oxygen to the uterus, which makes the parturient woman feel pain. This triggers a new cycle of fear, the body begins to tense again, and each subsequent contraction is perceived as more challenging than the previous one. Muscle tensions not only exacerbate pain but also slow down contractions and labors, increase the likelihood of ruptures, weaken the woman that causes prolonged and complicated delivery. Consequently, the alleviation of negative psychological excitement in the parturient woman and the elimination of excess muscle tension can prevent unpleasant sensations during childbirth.
It is recommended informing women about childbirth and performing relaxation exercises to avoid pain.

Later, Kharkiv psychotherapists (Velvovsky et al., 2002) developed the idea of the psychogenic origin of labor pain. They explained it by the effect of subthreshold stimuli, which become painful under decreased tone of the cerebral cortex, even in the absence of nociceptive signals from the organs. Since the pain mechanism works mainly in the brain, the way to solve the problem is not medical but psychological – verbal influence. The method of psychoprophylactic training of expectant mothers developed by Ukrainian doctors is the most recognized in the world. It involves group sessions informing women about the physiology of childbirth and demonstrating the techniques which can help them and doctors, including guided breathing techniques, massage, and monitoring of contractions. This prevents excessive orienting responses during childbirth and ensuing fears. The prenatal training of pregnant women is designed to make a woman aware of her own responsible role in childbirth, hence focus not on potentially painful feelings but on facilitating the process. This prevents excessive orienting responses during childbirth and ensuing fears. The prenatal training of pregnant women is designed to make a woman aware of her own responsible role in childbirth, hence focus not on potentially painful feelings but on facilitating the process (Velvovsky et al., 2002). The relevant approach spread rapidly across Europe and America, markedly changed obstetric practices, relations between a doctor and an expectant mother, and sociocultural notions of motherhood.

Today, most authors share the opinion that labor pain arises due to fear and tension. Hence, it is necessary to teach women to quit the fear which entails purposeful psychological work. For example, the common method of hypnobirthing by M. Mongan (2005) emphasizes that the female body is a perfect tool through which the child develops and comes to the Earth. The author convinces parturient women that at the beginning of pregnancy, nature prepares the body for birth and improves it (for example, the nerve receptors of birth canals are less sensitive): “If your mind is free from fear and tension, the body will be free from pain and will be able to function as it was conceived by nature” (Mongan, 2005). Antenatal training combines the formation of positive attitudes and deep relaxation skills through self-induction.
In general, professional attitudes to labor pain can be divided into two paradigms: pain relief and pain management. The former is guided by the fact that a woman should not suffer during childbirth and thus it offers various means of pain relief, mainly pharmacological. We are more interested in the pain management paradigm because promoting natural childbirth has long-term benefits for a woman’s life experience and motherhood formation, and pain plays a crucial role in this process.

The theory of pain management during childbirth declares that pain during contractions and pushing is not similar to the pain caused by illness or injury. Labor pain is purposeful. It is a beneficial part of a physiologically natural event. It is an important signal informing parturient women about the childbirth progress, whether there is a need to change body position, etc. At the start of contractions, gradual pain increase allows a woman to realize that she is about to give birth and to prepare duly. At the stage of contractions, the gradual intensification of pain triggers a cascade of neurohormones regulating the process of childbirth. Finally, a contrast to pain heightens the joy of meeting the child and the sense of triumph after completing a complex and important task (Leap et al., 2010).

It is essential to keep in mind that the perception of pain is always subjective. Recognition, assessment, and response to sensory stimuli vary in different people and also depend on the situation. Therefore, pain in the context of helplessness and suffering differs significantly from pain in the context of successful overcoming and a sense of fulfillment. From this point of view, the childbirth process is considered as a developmental event in a woman’s life, the experience of which advances the sense of dignity and personal strength (Lowe, 2002).

All the above actualizes the search for alternative means of pain management during childbirth, primarily amidst psychosomatic medicine. Throughout the 20th century, the main target of psychological interventions was to eliminate anxiety, fears, and erroneous instructions triggering unnecessary tension in parturient women. At the same time, relaxation therapy to soothe the woman, relieve stress, і входить у світ. Авторка переконує породіль, що з початком вагітності природа готує організм до народження, вдосконалює його (наприклад, зменшується чутливість нервових рецепторів пологових шляхів): “Якщо ваш розум вільний від страху і напруги, тіло буде вільним від болю і зможе функціонувати так, як це було задумано природою” (Mongan, 2005). Допологова підготовка поєднує формування позитивних настанов та навичок глибокого розслаблення за допомогою самонавіювання.

Загалом, ставлення спеціалістів до болю під час пологів можна розділити на дві парадигми: полегшення болю та робота з болем. Перша керується тим, що жінка не повинна страждати під час пологів, і пропонує різні засоби зневролювання, переважно фармакологічні. Нас більше цікавить парадигма роботи з болем, адже сприяння природним пологам має довгострокові переваги з точки зору життєвого досвіду жінки та становлення материнства, і біль відіграє важливу роль у цьому процесі.

Теорія управління пологовим болем пропонує, що біль під час перейм та потуг не аналогічний болю через хворобу або травму. Пологовий біль має мету. Він є корисною частиною фізіологічно нормальної події. Це важливий сигнал, що інформує породіль про те, як просуваються пологи, чи потрібно змінити положення тіла та ін. На початку пологів незначний біль дозволяє жінці усвідомити, що вона ось-ось народиться, і підготуватись належним чином. У стадії перейм поступове посилення болю запускає каскад нейрогормонів, які регулюють процес пологів. Нарешті, контраст із болем посилює радість зустрічі з дитиною, відчуття тріумфу після виконання важкого й важливого завдання (Leap et al., 2010).

Важливо пам’ятати, що сприйняття болю завжди суб’єктивне. Розпізнавання, оцінка й реакція на сенсорні стимули різняться у різних людей, а також залежать від ситуації. Тому біль в контексті безпорядності і страждань суттєво різняться від болю в контексті успішного подолання і початку виконання обов’язку. З цієї точки зору процес пологів розглядається як розвиваюча подія в житті жінки, подолання якої підвищує почути власної гідності та особистої сили (Lowe, 2002).
and preserve strength to be productive during labor and childbirth. Relaxation is a state and process of conscious reduction of skeletal muscle tone and general activity of the organism through special psychophysiological techniques (slow diaphragmatic breathing, progressive muscle relaxation, etc.). Regulation of sympathetic and parasympathetic balance mitigates excitement under acute pain or situational stress (Tick et al., 2018). It is widely applied in psychotherapy, meditation, yoga practices, and other wellness systems.

In recent years, increasing attention has been paid to methods which do not require the constant presence of trained personnel but can be given to patients in audio or video format after a previous briefing. These include virtual reality (VR) technology, which combines computer graphics, 360° video, body tracking devices, visual displays, and other equipment immersing the participant in three-dimensional space in real-time. VR is effective in treating of acute and procedural pain, especially in children (Won et al., 2017); it demonstrates considerable achievements in the therapy of fears and other anxiety disorders (Carl et al., 2019). Therapeutic advantages involve the ability to produce a multisensory distraction, isolating the patient from the clinical environment and replacing it with a therapeutic virtual space. Unlike other forms of media, immersive technologies maintain the illusion of presence in a simulated space. When user experiences are stimulated by feedback, an effect of interaction with virtual objects is formed.

Nowadays, immersion analgesia is a well-established practice in pediatrics, cancer centers, and burn departments to relieve pain during intravenous injections, chemotherapy, and other procedures. In addition to distracting from pain and reducing the need for anesthesia, it contributes to eliminating stress and anxiety, mitigates pain catastrophizing, facilitates the relaxation of patients, and improves the postoperative experience (Chirico et al., 2016; Li et al., 2017; Indovina et al., 2018; Hoag et al., 2022). The clinical use of VR as a supplement to standard pain management protocols is extended to various medical practice areas and larger patient groups. Data on the effectiveness and safety of VR as an alternative method of pain management are accumulating, showing promising results in terms of patient satisfaction and reduction of opioid use.

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Все це актуалізує пошук альтернативних засобів керування відчуттям болю під час пологів, в першу чергу в руслі психосоматичної медицини. Впродовж ХХ сторіччя головною метою було усунення тривоги, страхів і неправильних настанов, які викликають зміни в самопочутті та зберегти сили для продуктивної праці в період потуг. Релаксація – це стан і процес усвідомленого зниження тонусу скелетної мускулатури та загальної активності організму шляхом спеціальних психофізіологічних технік (повільне діафрагмальне дихання, прогресивна м'язова релаксація, тощо). Регуляція симпатичного та парасимпатичного балансу забезпечує зменшення збудження при гострих болях або ситуаційному стресі (Tick et al., 2018). Вона широко застосовується в психотерапії, медитації, практиках йоги і інших зв'язках.

У останні роки все більшу увагу привертають методи, які не потребують постійної присутності медичного персоналу, а можуть бути надані пацієнтам в аудіо- чи відео-форматах після попереднього інструктування. Серед них – технологія віртуальної реальності (далі VR), що включає комп’ютерну графіку, відео 360°, пристрої стеження за тілом, візуальні дисплеї та інші пристрої, які залишають уявлення осягаючим тривимірний простір в реальному часі. VR є ефективною лікувальною процедурою і процедуруючою болю, особливо у дітей (Won et al., 2017); демонструє значні досягнення в терапії страхів і інших тривожних розладів (Carl et al., 2019). Терапевтичні переваги полягають у здатності створювати віртуальне середовище, визначаючи пациента від безпосереднього клінічного оточення і замінюючи його віртуальним простором. На відміну від інших форм медіа, імерсійні технології забезпечують ілюзію присутності в змістовно-віртуальному просторі. Коли відчуття кориснування стимулюються зворотнім зв’язком, створюється ефект взаємодії з віртуальними об’єктами.

Сьогодні імерсійна аналгезія активно застосовується в педіатрії, онкологічних центрах,
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The purpose is to justify the practicability of the relaxation technique with immersion in virtual reality as a way to manage labor pain. The results of its application at the stage of contractions in a maternity department are presented.

Research methodology

From May to September 2022, a pilot study was conducted at the Perinatal Center of the Kyiv City Maternity Hospital No. 7. Experimental impact stipulated the use of VR glasses during contractions which immerse the woman in a specially modelled three-dimensional space and broadcast a program of guided relaxation combining elements of suggestion and visualization for pregnant women (copyright registration certificate No. 75592 dated December 27, 2017). The technique lasted 25 minutes and consisted of the following parts: 1) verbal and visual support of muscle relaxation; 2) guided visualization "Room with food"; 3) fixation on positive childbirth scenario.

The developed program of psychological support for pregnant women offers them to receive an audio file with a relaxation technique which they can independently listen to at home and thus prepare the body for deep relaxation during childbirth. Moreover, labor with the use of VR glasses is available to women without prior preparation. In this case, the briefing takes place directly at the delivery department.

opікових відділеннях для полегшення боліс- них відчуттів при внутрішньовенних ін'ек- ціях, хіміотерапії й інших процедурах. Окрім відволікання від болю і зменшення потреби в анестезії, це сприяє усуненню стресу та три- воги, зменшує катастрофізацію болю, допо- магає релаксації пацієнтів, покращує після- операційний досвід (Chirico et al., 2016; Li et al., 2017; Indovina et al., 2018; Hoag et al., 2022). Клінічне використання ВР як доповнення до стандартних протоколів знищення болю поширю- ється на все більше сфер медичної практики та ширші групи пацієнтів. Накопичуються дані про ефективність та безпечність методу. Це дозволяє рекомендувати ВР як ефективне втручання для управління болем і тривогою під час болючих або неприємних медичних процедур. Логічно припустити, що цей метод здатен також полегшити переживання болю в пологах.

За останні два десятиріччя у базі PubMed опубліковано більше сімнадцять тисяч дослі- джень, що описують користь ВР-технологій для забезпечення психічного та фізичного здоров’я. Із них більше тисяч публікацій, на час написання статті, присвячені проблема- тичні знищення та заспокоєння пацієнтів в різних клінічних ситуаціях і тільки тринад- цять – допомозі в народженні дитини; пере- важливо це пілотажні дослідження у невеликих групах. Отже, це малодосліджене питання потребує додаткового вивчення.

Meta - обґрунтовати корисність методики релаксації із зануренням у віртуальну реаль- ність як способу керування пологовим болем. Представлено результати застосування мето- дики на етапі перейм у пологовому відділенні.

Методологія дослідження

У травні-вересні 2022 р. було проведено пілотажне дослідження на базі Перинаталь- ного центру Київського міського пологового будинку № 7. Експериментальний вплив полягав у використанні на етапі перейм ВР-о-кулярів, які занурюють жінку у спеціально змодельований тривимірний простір та транс- ляцюю програму керованої релаксації, що поєднує елементи навіювання та візуаліза- цію для вагітних (свідоцтво про реєстрацію авторського права № 75592 від 27.12.2017).
Efficiency checking involved a survey of the parturient women who used VR glasses during contractions. The Numeric Pain Rating Scale, which is often used in clinical experiments, has been applied to assess pain severity. As for pain intensity, the women were asked “How painful were contractions?” with response options from 0 “no pain” to 10 “the worst pain imaginable”. Score 5 meant moderate pain. As for the degree of pain unpleasantness, the question was asked “How unpleasant and unbearable was pain during contractions?” with response options from 0 “no pain” to 10 “the worst pain imaginable”.

According to the same scheme, a questionnaire for parturient women, which comprised thirteen questions on an 11-point scale of answers, was constructed. It contained four content blocks relating to: a) the psychological state which preceded childbirth; b) pain sense, the ability to relax during contractions c) the run of the second stage of labor (pushing and delivery); d) the final impressions of labor. A grid question touched upon the experience of using VR glasses with a relaxation program.

The survey of parturient women was carried out between 24 and 48 hours after labor. The women filled out a paper or electronic form of the questionnaire. A total of 110 forms were received (55 participants in the control and experimental group, respectively). At the stage of data processing, women who gave birth to a second or third child and patients who had to undergo caesarean during childbirth were excluded from the sample. Thus, the final sample included 92 expectant mothers aged 25-43 years with a gestation period of 37-41 weeks who gave birth for the first time. Participation in the program was free and voluntary. The experimental group (EG) consisted of 49 parturient women who used the relaxation program in the VR space during contractions. The control group (CG) included 43 women who had natural childbirth and did not use VR glasses during labor.

In addition, to assess the effectiveness of the developed method, parturient women’s medical records were employed: anesthesia frequency, the total duration of childbirth.

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and a newborn’s condition were recorded following the Apgar scale.

Comparative analysis of data from control and experimental groups was carried out using different criteria depending on the type of empirical data. Student’s t-test was used to compare the averages in the groups, and the Mann-Whitney U-test and Pearson’s chi-squared test – to compare the distributions.

Results

Regarding the objective assessment of the labor process, there were significant benefits of using VR glasses in the experimental group.

1. Anesthesia frequency. Among the CG participants, 29 persons (i.e., 67.44%) resorted to anesthetics, mainly epidural analgesia, during childbirth. In EG, only 15 parturient women (30.61%) were administered medical analgesia, i.e., almost half as much. Pearson’s chi-squared test contributed to the verification of the statistical significance of the percentage difference. The calculated value is 12.45, which corresponds to the level of significance $p \leq .001$. Consequently, CG and EG differ reliably in the frequency of pharmacological anesthesia use, which favors VR relaxation during contractions.

2. The duration of childbirth in CG is $627.9 \pm 163.1$ min. (minimum was six hours, maximum – just over fifteen) on average. The duration of labor with VR glasses was substantially shorter – $372.8 \pm 182.3$ min. (from 2.5 to 17.5 hours). A comparative analysis of the mean values of the two groups showed a significant difference: $t = -7.032$ at $p = .000$. Therefore, the use of VR glasses at the stage of contractions contributes to a substantial reduction in the total duration of childbirth.

3. The Apgar scores of newborns in the experimental group are also higher: $8.90 \pm 0.56$ compared to $8.12 \pm 1.03$ in CG (frequency analysis in Table 1). The calculated indicator under Student’s t-test is 4.624, which confirms a significant difference in groups ($p = .000$). Thus, facilitation and acceleration of the labor process using VR relaxation have a positive influence on the health of a newborn.
Table 1. Distribution of newborn health indicators

<table>
<thead>
<tr>
<th>Apgar Score</th>
<th>CG (43 women)</th>
<th>EG (49 women)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number кількість</td>
<td>%</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>4.6</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
<td>18.6</td>
</tr>
<tr>
<td>8</td>
<td>19</td>
<td>44.2</td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td>23.3</td>
</tr>
<tr>
<td>10</td>
<td>4</td>
<td>9.3</td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td>100.0</td>
</tr>
</tbody>
</table>

4. The subjective perception of childbirth was analyzed through a postnatal survey of the parturient women. Comparative analysis of the average indicators of the two groups (Table 2) showed that CG and EG did not differ significantly in terms of preliminary psychological readiness for childbirth. However, indicators of the two groups are reliably different in all questions directly related to the labor process.

The distribution of answers to the survey questions concerning women’s experiences and feelings at the first and second stages of the labor process was analyzed.

Four questionnaire items examine women’s experiences during contractions. It was the period when the experimental group employed VR relaxation.

A. Perception of the duration of contractions. It is known that the perception of time depends on many situational and neuropsychological factors; subjective time can last several times longer or shorter than objectively measured. The survey showed that the CG parturient women felt the duration of contractions differently, from instantaneous to very long. Instead, the EG women predominantly regarded contractions as fast – more than half of scores range from 1 to 4 points (Fig. 1). The experimental groups are drastically distinct in estimates of how long contractions lasted, and this difference is significant (U=344 at p=.000).

B. As for the assessment of pain intensity during contractions, there is a pronounced difference between CG and EG (U=203 at p=.000). Almost half of the parturient women in CG (44.2%) gave labor
### Table 2. Comparison of the average indicators of childbirth perception in the control and experimental groups

<table>
<thead>
<tr>
<th>Postnatal survey questions</th>
<th>CG (N=43)</th>
<th>EG (N=49)</th>
<th>(t_{\text{emp.}})</th>
<th>Difference significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What was your psychological readiness for the childbirth process?</td>
<td>7.39</td>
<td>7.41</td>
<td>-.04</td>
<td>.971</td>
</tr>
<tr>
<td>2. How did you experience worries (anxiety, fear) about future labor?</td>
<td>4.58</td>
<td>4.84</td>
<td>-.48</td>
<td>.635</td>
</tr>
<tr>
<td>3. How confident were you about a positive childbirth experience for you and your baby?</td>
<td>8.07</td>
<td>6.84</td>
<td>3.27</td>
<td>.002</td>
</tr>
<tr>
<td>4. To what extent did the childbirth process meet your expectations and perceptions?</td>
<td>6.12</td>
<td>6.86</td>
<td>-1.80</td>
<td>.076</td>
</tr>
<tr>
<td>5. How long did contractions last, according to your feelings?</td>
<td>6.86</td>
<td>3.73</td>
<td>6.55</td>
<td>.000</td>
</tr>
<tr>
<td>6. How painful were contractions?</td>
<td>8.26</td>
<td>3.96</td>
<td>9.54</td>
<td>.000</td>
</tr>
<tr>
<td>7. How satisfied are you with the childbirth process?</td>
<td>6.77</td>
<td>4.02</td>
<td>7.34</td>
<td>.000</td>
</tr>
<tr>
<td>8. How painful was the period of pushing, according to your feelings?</td>
<td>4.49</td>
<td>6.14</td>
<td>-3.65</td>
<td>.000</td>
</tr>
<tr>
<td>9. How long did the second stage of labor (pushing and delivery) last, according to your feelings?</td>
<td>4.42</td>
<td>3.12</td>
<td>3.01</td>
<td>.003</td>
</tr>
<tr>
<td>10. How satisfied are you with the childbirth process?</td>
<td>5.07</td>
<td>6.16</td>
<td>-1.92</td>
<td>.057</td>
</tr>
<tr>
<td>11. How satisfied are you with the childbirth process?</td>
<td>7.05</td>
<td>8.49</td>
<td>-3.53</td>
<td>.001</td>
</tr>
<tr>
<td>12. Do you plan to have another child in the future, considering the childbirth course?</td>
<td>5.72</td>
<td>8.43</td>
<td>-6.19</td>
<td>.000</td>
</tr>
</tbody>
</table>
pain 10 points “the worst pain imaginable”. These feelings urgent the use of anesthesia as early as the first stage of childbirth. In EG, there were no maximum pain intensity scores in any of the cases, and 8-9 points are found in 8.1% of the participants. Most parturient women reported moderate or slight pain. Consequently, the use of VR glasses effectively influenced the experience of labor pain and crucially alleviated the course of contractions in women who gave birth for the first time.

C. The analgesic effect of VR relaxation is confirmed by answers to the question about the nature of the pain experienced – its unpleasantness and intolerance. No woman in EG felt pain as unpleasant and unbearable as much as possible. Thus, most scores varied from 2 to 5 points. The difference between the groups in pain unpleasantness during contractions is statistically significant (U=276 at p=.000).

D. An important effect of VR technology is to ensure rest between contractions. The possibility of relaxation is distinctly evident in the experimental group as opposed to CG (U=606 at p=.000). In free comments, the parturient women wrote that VR glasses helped them distract themselves and even fall asleep at night during contractions. Unlike EG, in the control group, no woman marked the successful relaxation between contractions – see Fig. 1.

Two other questionnaire items relate to the duration and painfulness of the second stage of labor, when the fetus is actively pushed through the birth canals. At this stage, VR glasses were not used, but a survey of the parturient women proved a lasting positive effect of the previous relaxation. The control and experimental groups significantly differ in assessment of the subjective duration of the pushing process (U=672.5 at p=.003); the same applies to pain perception, although the difference is less significant (U=801 at p=.047). Since the EG participants were much less likely to use anesthetics and resorted to them at a later stage of labor. Low pain intensity scores are not found in this group. At the same time, EG has much fewer maximum scores of 10 points compared to CG, which demonstrated 20.9% of such scores. Most participants who used VR glasses with a relaxation program felt pain during the active phase of childbirth as more or less moderate – see Fig. 2.
The use of virtual reality technologies for the relaxation of pregnant and parturient women: the results of a pilot study

Fig. 1. Histogram of the distribution of parturient women’s answers about the subjective perception of contractions

Рис. 1. Гістограма розподілу відповідей породіль про суб'єктивне сприйняття перейм
The concluding part of the questionnaire was designed to study the general impressions of childbirth. Most parturient women from both groups indicated sufficiently high satisfaction with childbirth (Fig. 3). Such an assessment was based on many factors: the joy of meeting the child, the general psychological and physical state after delivery, the availability of social support, etc. Scores of labor satisfaction in EG are reliably higher than in CG (U=688 at p=.004). To a large extent, such an outcome was affected by the reduction of painful experiences and the employment of innovative technologies – women mentioned it in the questionnaire's grid question: "I liked it. It is рідше використовували фармакологічні засоби знищення болю і вдавалися до них на більш пізньому етапі пологів. У цій групі не зустрічаються низькі оцінки інтенсивності болю. Водночас, в ЕГ значно менше максимальних оцінок в 10 балів, на відміну від КР, де таких з’ясовано 20.9 %. Більшість учасниць, які використовували ВР-окуляри з програмою релаксації, сприймали біль в активній фазі пологів як більш-менш помірний – див рис. 2.

Заключна частина анкети була спрямована на вивчення загальних вражень від пологів. Більшість породіл в обох групах вказали на достатньо високу задоволеність пологами.

Fig. 2. Histogram of the distribution of parturient women’s answers about the subjective perception of the second stage of labor
Рис. 2. Гістограма розподілу відповідей породіл про суб’єктивне сприйняття потуг
modern", "I am happy that I live in a contemporary country", "Thank you for the opportunity to give birth in such a modern way".

Another question clarified a woman’s desire to retry the experience of labor and give birth to another child. In this respect, the experimental group also significantly advanced the control group (U= 426.5 at p=.004). About a quarter of women in CG indicated that they no longer wish to give birth, and the EG scores are exceptionally positive – from 5 points and above. Even if a woman stated labor was painful, she did not lose the desire to give birth one more time.

Discussion
The conducted study confirms and specifies the available research findings, which demonstrated the effectiveness of relaxation therapy in the psychological support of pregnant women. It is known that the introduction of relaxation sessions in prenatal training essentially reduces the level of anxiety and stress in pregnant women (Bastani et al., 2005). Progressive muscle relaxation combined with guided visualization can relieve the levels of stress, anxiety and depression of pregnant women in six sessions (Nasiri et al., 2018). As our study has shown, relaxation is also an accessible method of assistance directly in childbirth. The positive effect of relaxation is based on the interrelation between psyche and body. Under stress, the muscle tone of a person increases, but there is also feedback: with

Fig. 3. Histogram of the distribution of scores for childbirth satisfaction
Рис. 3. Гістограма розподілу оцінок задоволеності пологами
a decrease in muscle tone and deep relaxation, mental tension decreases. It is particularly beneficial in the psychogenic theory of labor pain caused by muscle tension due to fear, anxiety, and uncertainty (Dick-Read, 1933; Velovsky et al., 2002; Lowe, 2002; Mongan, 2005).

VR technologies greatly enhance the potential of guided relaxation in promoting natural childbirth. Previous studies demonstrated the benefits of VR glasses during childbirth. In the work by D. Frey et al., the head-mounted display showed 14 women a scene from a scuba diving simulator during contractions that allowed them to considerably reduce the intensity and unpleasantness of pain and be less anxious and concerned with pain (Frey et al., 2019). Using VR for 30 minutes significantly reduced the subjective assessment of pain and heart rate in 40 parturient women with regular contractions (Wong et al., 2021). Infant images were the most effective among the different types of distraction content (Gür & Apay, 2020). Thus, the demonstration to 50 parturient women of ultrasound images of their children via VR glasses decreased the pain scores under cervical dilatation by 9 cm; reduced anxiety scores and improved the perception of therapeutic support (Akin et al., 2021). Parturient women subject to VR immersion had lower pain scores and higher satisfaction with the childbirth experience (Carus et al., 2022). A systematic review of eight randomized control studies with a total of 466 patients showed that VR performs well in pain relief, anxiety reduction, and increasing satisfaction during natural childbirth (Baradwan et al., 2022). At the same time, the convenience of the headset and the content of the offered videos produce a positive effect. Most researchers use relaxation videos of beaches, forests, rocks, dolphin swimming, etc., distracting women from current events. Specially developed professional programs are used only in some cases. It is the undeniable advantage of the proposed method adapted to pregnant women's psychophysiological features and needs.

The survey showed that VR relaxation during contractions cut the intensity and unpleasantness of pain and allowed women to relax in the intervals between contractions. The result is expected: it is due to the effect of distraction and entertainment in complex with visualization of zatnad hroms hryvned prief rehur, trivy no dreeess vategtnih wrapped sheti seans noh (Nasiri et al., 2018). Як показало наше дослідження, релаксація також є доступним методом допомоги безпосередньо в процесі пологів. Позитивний вплив релаксації базується на взаємозв'язку психіки та тіла. У стані стресу тонус м'язів людини підвищується, але існує і зворотний зв'язок: при зниженні тонусу м'язів, їх глибокому розслабленні відповідно знижується психічна напруга. Цей ефект особливо корисний в світлі психогенної теорії пологового болю як наслідку напруження м'язів, викликаного страхом, тривогою та невпевненістю (Dick-Read, 1933; Velovsky et al., 2002; Lowe, 2002; Mongan, 2005).

Потенціал керованої релаксації у спрямованій природних пологах значно посилюється завдяки використанню BP-технології. У попередніх дослідженнях вже була показана користь використання BP-окулярів у пологах. У роботі D. Frey з колегами наголівний дисплей демонстрував 14 жінкам сцену з симулятора підводного плавання під час перейм, що дозволило суттєво знизити інтенсивність та неприємність болю, менше тривожитися та думати про біль (Frey et al., 2019). Використання BP впродовж 30 хвилин суттєво знизило суб'єктивну оцінку болю та частоту серцевих скорочень у 40 породіль з регулярними переймами (Wong et al., 2021). Серед різних видів контенту для відволікання найбільшу ефективність мали зображення немовлят (Gür & Apay, 2020). Так, демонстрація 50 породіллям ультразвукового зображення власної дитини за допомогою BP-окулярів суттєво зменшила оцінки болю при розкритті шийки на 9 см; знизила показники тривоги та покращила сприйняття терапевтичної підтримки (Akin et al., 2021). Породіллі, що отримували імерсійну BP, мали нижні показники болю та вищу задоволеність досвідом пологів (Carus et al., 2022). Системний огляд восьми рандомізованих контролних досліджень із загальною кількістю 466 пацієнтів показав, що BP – ефективний метод зниження інтенсивності та викликуваного страху, зниження занепокоєння та підвищення задоволеності під час природних пологів (Baradwan et al., 2022). При цьому на позитивний ефект впливає заручність гарнітури та зміст пропонованих відеороликів.
typical of immersion in virtual space. Moreover, the "relaxed" experience of the first stage contributed to easing the pushing and delivery phase in EG. Data on the subjective perception of childbirth by parturient women are confirmed by the objective data of medical records.

It is worthwhile to refer to the experience of implementing virtual reality hypnosis in justifying the effects obtained (Askay et al., 2009). VR guides patients following the same steps as in direct interaction with the doctor, and the illusion of presence and immersion effect even can enhance the suggestive response in persons with low susceptibility to suggestion. VR technology conveys compelling incentives for concentration, and thus it has potential advantages over standard hypnosis when a person imagines stimuli with a verbal prompt. In addition, it is a fully standardized procedure which does not depend on the therapist’s experience and competencies. The latter is relevant to further scientific research.

The outcome which indicates the general satisfaction of women with childbirth and the desire to give birth again is emphasized separately. The good experience of childbirth determines the formation of motherhood in the long term. In the context of the current demographic crisis in Ukraine, such an effect also has social utility. The involvement of innovative technologies and the provision of a wide range of psychological services in the maternity ward contribute to the formation of positive maternal attitudes in women who give birth for the first time.

Restrictions
The presented analysis of the results of the postnatal survey of parturient women does not consider the use of pharmacological anesthesia during childbirth. This fact requires additional differentiation of control and experimental groups. The impact of the participation of pregnant women in prenatal training programs, previous experience of relaxation, meditation, and other bodily and mental practices needs to be clarified.

Conclusions
In the practice of assistance to parturient women, there is an urgent request for non-pharmacological anesthetics, which have
an effect through understanding the physiology of obstetric pain and optimal use of the woman's neurophysiological resources. The psychological support of labor relies on the principle that labor pain occurs mainly due to fear and stress, which causes muscle tension. Therefore, it is necessary: a) to relieve women of anxiety and stress; b) to ensure control over the body, which will contribute to deep and stable muscle relaxation. Virtual reality technologies combined with guided relaxation practices give unique opportunities for relieving anxious tension during contractions. The deep illusion of presence in the artificially created virtual world distracts women from adverse stimuli (labor pain), immerses them in rich sensory stimuli, and results in a positive experience.

The data of medical records of parturient women confirmed the benefits of using VR glasses at the stage of contractions: reduction of childbirth duration, decreased frequency of pharmacological anesthesia use, and improvement of the physical condition of newborns.

The postnatal survey of parturient women proved that the employment of VR relaxation in the maternity ward effectively influences the experience of labor pain and significantly facilitates the course of contractions in women who give birth for the first time, encouraging a feeling of its diminished duration, intensity and unpleasantness. An important effect involves the opportunity to relax between contractions that allows the parturient woman to keep strength and recover. Thus, the positive effect of labor pain alleviation is maintained at the second stage of labor, when the relevant technology is no longer used. Compared to the control group, women who used VR glasses demonstrated greater satisfaction with labor and declared intentions to give birth in the future.

The obtained results present considerable and convincing advantages of using VR glasses with a guided relaxation program during childbirth. This work will be advanced in the future. It is envisaged to expand the sample to clarify the characteristic differences in the effect of technology in different clinical groups, including women with various types of gestational dominance. Further research is required to establish prognostic factors for selecting individuals who may benefit most from VR.
The use of virtual reality technologies for the relaxation of pregnant and parturient women: the results of a pilot study

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