IMMERSIVE VIRTUAL REALITY ON CHILDBIRTH EXPERIENCE WITHIN DIFFERENT PERSONALITY TRAITS

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IMMERSIVE VIRTUAL REALITY ON CHILDBIRTH EXPERIENCE WITHIN DIFFERENT PERSONALITY TRAITS

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All the material in this publication was acquired and presented according to academic and ethical standards. As required by these rules and standards of behavior, I confirm that I've appropriately cited any non-original resources and outcomes.

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ABSTRACT

IMMERSIVE VIRTUAL REALITY ON CHILDBIRTH EXPERIENCE WITHIN DIFFERENT PERSONALITY TRAITS

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Neuroscience Master Program

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The purpose of this research is to assess the efficacy of Oculus Quest All-in-one immersive virtual reality (VR) on patient satisfaction as a distractive aid and pain management in laboring women. In addition to pain relief effect, it was aimed to observe how various relaxing environment experiences watched with virtual reality glasses during the latent phase of normal vaginal birth affect the personality traits of individuals. Method: This was a randomized, controlled clinical trial in which 58 laboring women were randomly assigned to one of two groups: VR intervention or control. Patient satisfaction with the use of VR among women in the VR group was examined using a Virtual Reality Satisfaction Survey, scored using a Visual Analog Scale (VAS) score, and evaluated by asking them whether they would select VR in the future labor. The main result was an assessment of patient satisfaction levels for the overall childbirth experience between the two groups of women. In all groups, pain was measured using a visual pain rating scale throughout the early and active periods of labor. The Beck Anxiety and Depression Inventory, as well as the Montreal Cognitive Assessment Test, were used to obtain neuropsychiatric data from individuals in each group. The personality traits are determined by Big Five Personality Inventory. The environments in the Oculus Quest All-in-one virtual reality glasses are named as the blue ocean, blue deep, blue moon, green meadows, red savannah, red fall, orange sunset, white winter, and black beginning. To measure the relationship between the variables done with an independent t-test, linear regression analysis, logistic regression analysis, and descriptive statistics within the SPSS version 25.0. Results and Conclusion: We found that using immersive VR during labor resulted in a high degree of patient satisfaction. The mean satisfaction score on the VAS was 86.2± 12.4 out of a possible 100. Thirty-five of the 37 women in the VR group (94.5%) said they would want to use VR again in the future. Early in labor, virtual reality reduced pain levels and enhanced the entire childbirth experience. Pre-VR, the mean pain score was 2.4±1.0, but post-VR, it was 1.9±1.0 ($p<0.01$). Participants in the control group had considerably lower anxiety levels ($p=0.02$, respectively). An analysis of correlations indicated a link between openness to new experiences and virtual reality satisfaction. ($p=0.056$) According to the analyzes made, it was observed that the level of satisfaction with virtual reality was related to the selected environment image. Although this relationship is thought to depend on different personality inventories, a statistically significant result could not be reached due to the lack of sample.

Keywords: Big Five Personality Traits, Non-Pharmacological Treatment, Pain, Virtual Reality

ÖZET

SÜRÜKLEYİCİ SANAL GERÇEKLİK UYGULAMASININ, FARKLI KİŞİLİK YAPISINA SAHİP OLAN GEBELERİN DOĞUM DENEYİMLERİNDE KULLANILMASI

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Sinirbilim Yüksek Lisans Programı

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Amaç: Bu araştırmanın amacı, Oculus Quest Hepsi-Bir-arada sürükleyici sanal gerçekliğin (VR) doğum yapan kadınlarda dikkat dağıtıcı bir yardım ve ağrı yönetimi olarak hasta memnuniyeti üzerindeki etkinliğini değerlendirmektir. Ağrı kesici etkisinin yanı sıra normal vajinal doğumun latent ve aktif evresinde sanal gerçeklik gözlüğü ile izlenen çeşitli rahatlatıcı ortam deneyimlerinin bireylerin kişilik özelliklerini nasıl etkilediğinin gözlemlenmesi amaçlanmıştır.Yöntem: Bu randomize kontrollü klinik çalışma Kasım 2020 ve Haziran 2021 tarihleri arasında Acıbadem Maslak Hastanesi Kadın Doğum ve Perinatoloji birimine normal vajinal doğum sebebiyle yatan ve sanal gerçeklik grubu ve kontrol gruplarına ayrılan toplam 58 gebe kapsamında yapılmıştır. Gebelerin ağrı skorları latent fazda ve aktif fazda olmak üzere uygulama öncesi ve sonrası şeklinde Görsel Ağrı Skalası (GAS) ile ölçülmüştür. Beck Anksiyete Skalası ve Beck Depresyon Skalası ve montreal bilişsel değerlendirme testi, her iki grubu da dahil olma sırasında uygulanmıştır. Gebelerin sanal gerçeklik deneyimlerini değerlendirmek üzerine hazırlanan Sanal Gerçeklik Memnuniyet anketi uygulanmıştır. Kişilerin kişilik envanterleri ise Beş Faktörlü Kişilik Envanteri kullanılarak çıkarılmıştır. Oculus Quest sanal gerçeklik gözlüğünde bulunan ortamlar, mavi okyanus, mavi derinlik, mavi ay, yeşil çimenlik, kızıl ova, kızıl sonbahar, turuncu günbatımı, beyaz kış ve siyah başlangıç olarak isimlendirilmiştir. Veriler SPSS sürüm 25 istatistik program ile değişkenlerin arasındaki ilişkiyi ölçmek için doğrusal regresyon analizi, lojistik regresyon analizi ve bağımsız t testi, kişilik envanteri sonuçlarını da deskriptif analiz uygulanmıştır. Bulgular ve Sonuç: Doğumun latent fazı sırasında sürükleyici VR kullanımıyla yüksek düzeyde hasta memnuniyeti gözlemledik. VAS, maksimum 100 üzerinden 86.2± 12.4'lük bir ortalama memnuniyet skoru ortaya koydu. VR grubundaki 37 kadından 35'i (%94,5) VR'yi gelecekteki doğumda tekrar kullanmak istediklerini belirtti. VR, erken doğumda ağrı skorlarını iyileştirdi ve genel doğum deneyimine olumlu katkıda bulundu. VR öncesi ortalama ağrı skoru, VR sonrası 1.9±1.0'a kıyasla 2.4±1.0 idi ($p<0.01$). Kontrol grubuna kaydolanlarda anksiyete puanları anlamlı olarak daha düşüktü (sırasıyla, $p=0.02$). Yapılan doğrusal regresyon analizinde sanal gerçeklik memnuniyetini belirleyen faktörlerin en başında seçilen Beyaz Kış isimli sanal ortamın etkili olduğu görülmüştür. ($p=0.033$) ($\beta=8.61$)(SE=3.89). Sanal gerçeklik uygulaması sonrasında ölçülen ağrı düzeyi de istatistiksel olarak anlamsız çıkmıştır. ($P=0.065$). Kişilik envanterlerine yapılan Korelasyon analizi, deneyime açık olmanın sanal gerçeklik memnuniyeti ile az da olsa ilişkili olduğunu ortaya koydu. ($p=0.056$). Yapılan analizlere göre, sanal gerçeklikten memnun kalma düzeyi ile seçilen ortam görüntüsünün ilişkili olduğu gözlenmiştir. Bu ilişkinin de farklı kişilik envanterlerine bağlı olduğu düşünülmekle birlikte, örneklem yetersizliği nedeniyle istatistiksel olarak anlamlı bir sonuca ulaşılamamıştır.

Anahtar Kelimeler: Ağrı, Beş Faktörlü Kişilik Envanteri, Farmakolojik olmayan tedavi, Sürükleyici Sanal Gerçeklik

DEDICATION

As with everything I accomplish, dedicating my thesis to my parents would be an honor. Who taught me the skills and principles essential to getting where I am now,I am grateful to them for believing in me and allowing me to pursue a master's degree in health sciences at the university.

This research is the product of innumerable and arduous sacrifices. Through the Professor’s effort, this work is heartly and proudly dedicated to the individuals who serve as an inspiration. I am grateful to everyone who has offered support and encouragement during drafting this paper, from my parents and Professors to close friends. To the teachers and staff members of Bahcesehir University and Acibadem Maslak Hospital who awarded me their guidance and patience in the accomplishment of this work.

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LIST OF ABBREVIATIONS

E	Extraversion
A	Agreeableness
C	Conscientiousness
N	Neuroticism
O	Openness to Experience
VAS	Visual Analog Scale
VE	Virtual Environment
MOCA	Montreal Cognitive Assessment
TENS	Transcutaneous Electrical Nerve Stimulation
BDI	Beck Depression Inventory
BAI	Beck Anxiety Inventory
VR	Virtual Reality
IVR	Immersive Virtual Reality
AR	Augmented Reality
IAS-R	Revised Interpersonal Adjective Scale
BFI-10	Big-Five Inventory-10
FOC	Fear of Childbirth

MRI	Magnetic Resonance Imaging
fMRI	Functional Magnetic Resonance Imaging
WHO	World Health Organization
HMD	Head-mounted Display
MCI	Mild Cognitive Impairment
PUBG	PlayerUnknown's Battlegrounds

Chapter 1
Introduction

In the recent times, it has become more important to study how pleased women are when they are giving birth. This characteristic, particularly its origins, is essential to investigate since it may affect the mother's health and connection with the newborn, as well as the newborn's cognitive, social, and emotional health.(Goodman et al., 2004)

Studies on childbirth satisfaction have focused on the hospital environment and on aspects of labor itself, rather than the whole experience. The characteristics at the hospital that have the strongest links to mother satisfaction at the time of delivery include professional support, the information provided throughout birth and pregnancy.(Fleming et al., 2016), treatment provided by health professionals, and the quality and organization of care provided. According to birth situations, most research have focused on whether a vaginal birth or a Cesarean section is better than an instrumental delivery or natural birth. (Mei et al., 2016a)

1.1 Statement of The Problem and Purposes of Study

There has been a lack of research on the maternal personality characteristics that might influence a person's level of satisfaction throughout the labor and delivery process. According to the behavioristic theories, the satisfaction a woman feels during childbirth is a function of both her role as a mother and the circumstances surrounding her labor and delivery.(Redshaw, 2008a) Within the previously described maternal personality factors, the present research was particularly interested in measuring personality in terms of the Big Five (P. T. Costa & McCrae, 1992a), as well as coping and maternal childbirth expectations.

Subjective, psychological components of the experience, such as anxiety-relieving methods(“Oxford Textbook of Palliative Nursing,” 2015), enhanced engagement in decision-making, perception of more control over the pain process via non-pharmacologic treatment (Lundgren, 2005a), and positive perception of social support, also predict overall satisfaction with the birth experience. In addition, virtual reality (VR) has been proved to reduce pain and anxiety.(Morris et al., 2009a) in a variety of circumstances, including patients undergoing painful procedures in hospitals and those suffering from chronic pain.(Dascal et al., 2017a) Once the user puts on the virtual reality goggles, they are given the impression that they are entering the 3D computer-generated world and exploring new places. It is theorized that immersive virtual reality may alleviate pain via distraction, which is a non-pharmacologic attentional process. Because the user's brain is distracted by the flood of information provided by the immersive virtual reality experience, the mind's capacity to process pain signals is limited. In obstetric populations, two randomized studies have been carried out: one in women who are laboring and the other in episiotomy repair; the findings of both trials have shown that they are promising.(Frey et al., 2019a; Shourab et al., 2016a)

In this clinical trial, which was randomized, controlled, and conducted in a single site, we enrolled a total of 58 laboring women as participants. After receiving their agreement and written consent, we randomly assigned these laboring women to either an immersive virtual reality (VR) group or a control group. The research was filed with clinicaltrials.gov after receiving approval from the Institutional Ethics Committee at Acibadem Mehmet Ali Aydinlar University. The research was carried out at the Acibadem Maslak Hospital in Istanbul, Turkey. Completion of enrollment between the months of November 2020 and June 2021. Due of the Covid-19 pandemic epidemic, we could only enroll a small number of people in this trial. The study included primigravida or multigravida women in labor with no known vaginal delivery risk factors. Included were singleton pregnant women aged 18–42 years with no history of chronic medical conditions, no pregnancy complications and admission with confirmed labor by cervical exam and frequent uterine contractions. Women with a history of cesarean section or epilepsy were excluded.

The purpose of this research was to determine whether patient satisfaction might be increased via the use of immersive virtual reality in laboring women. As our primary objective, is to investigate the impact that exposure to several distinct relaxing environment experiences viewed through virtual reality glasses during the latent phase and active phase of a normal vaginal birth has on an individual's personality characteristics as well as their neuropsychological states. Our second goal was to determine whether VR was effective in relieving pain during either the latent or active phase of labor. In addition, we assessed the levels of cognition, anxiety, and depression that were present in both groups at admission as possible confounding factors.

Based on their individual features and preferred environment, we expected that laboring women would find immersive VR to be a useful aid for their entire delivery experience. Immersive VR may find a role in labor and delivery facilities to alleviate women's prolonged labor experiences. Larger sample size investigations are required to validate these results.

Chapter 2
Literature Review

2.1 Personality

The term "personality" derives from the Latin word persona, which refers to a theatrical mask used by players to present various characters or conceal their identity.

At its most fundamental level, personality refers to the distinctive patterns of thoughts, emotions, and actions that define an individual. It is believed that an individual's personality develops from the inside out and is relatively stable throughout their lives. In recent years, personality-related theories and models have become more prevalent. A person's personality is comprised of their attitudes, talents, interests, physical appearance, and interactions with their surroundings. It is critical to understand what type of person a person is and how she is classified because this provides important clues about his or her personality. People' personalities have an impact on their relationships, career choices, and sexual connections, to name a few things.

2.1.1 Theories of personality Numerous hypotheses have evolved to account for various characteristics of personality. Some are interested with clarifying how personality develops, while others are concerned with personality distinctions between individuals. Trait theories of personality believe that a person's personality is built up of a variety of distinct characteristics. Many hypotheses have been put out to discover which personality characteristics are most important and the overall number of components that make up a person. An individual's personality characteristics must be constant, stable, and unique to everyone.(Moberg, 2020) According to this concept, traits may be defined as stable characteristics that influence how people act. Personality characteristic theories are among the most influential in the field of personality research. According to trait theory, people's personalities are made up of a variety of distinct traits. Unlike other theories of personality, such as psychoanalytic or humanistic perspectives, the trait approach to personality focuses on the distinctions between individuals. Combining and combining a multitude of characteristics creates an individual's unique personality. Trait theory seeks to uncover and measure personality characteristics. (Fajkowska & Kreitler, 2018)

2.1.1.1 Allport's trait theory In 1936, psychologist Gordon Allport examined human behavior and established a theory of personality characteristics and how they affect an individual's conduct. It's hard to picture personality psychology without today's popular characteristic names, but Gordon Allport's lexical studies helped shape the discipline. Gordon Allport and Henry Odbert identified over 40,000 personality-descriptive terms from major dictionaries much of their time. The researchers chose adjectives from this list and identified over 4,000 words that fit. (Allport, 1936) Many personality researchers in the years to come would have been influenced by the findings of this study. Three categories of features were identified in Gordon Allport's theory: Cardinal Traits, Central Traits, and Secondary Traits, each of which had a distinct impact on the way people behave in public. These features are arranged in a hierarchy, with Cardinal Traits dominating Central Traits, which are then more strongly emphasized than Secondary Traits. Cardinal traits, according to Allport, are uncommon and develop later in life. Some examples include Machiavellian, narcissistic, Don Juan, and Christ-like. Personality is built on a foundation of Central Traits. Although core features aren't as dominant as cardinal traits, they reflect the most important aspects you may use to characterize someone. Intangible characteristics such as honesty, intelligence, and a lack of social comfort are also included in this list. Attitudes or preferences are often associated with Secondary Traits. They often do not appear in any other contexts or circumstances than those specified. One example of this is anxiety around public speaking, while another is impatience when waiting in line.(Fleeson & Jayawickreme, 2015)

2.1.1.2 Cattell's 16-factor personality model Raymond Cattell conducted an analysis of Allport's list and narrowed it down to 171 characteristics, mostly by excluding terms that were duplicated or unusual. He then utilized a statistical approach known as component analysis to determine the relationships between attributes. He reduced his list to 16 key personality qualities using this method. According to Cattell, these 16 traits comprise all human personalities. "16 Personality Factor Questionnaire" is one of the most widely used personality assessments.(A. F. Friedman et al., 1976)

2.1.1.3 Eysenck's 3 dimensions of personality Eysenck's theory of personality focused on personality types, which he thought were mostly controlled by genes. (Soliemanifar et al., 2018)He used a statistical method called factor analysis to figure out what he thought were the two main types of personality: extraversion and neuroticism. Psychoticism is another term for this third dimension. He later came up with a name for it. Each of Eysenck's components is a bipolar dimension, meaning it has a reverse. Introversion focuses emphasis on internal experiences, while extroversion directs attention outward, toward other people and the surroundings. A person with a high level of introversion may be quiet and reserved, while someone with a high level of extroversion may be friendly and outgoing. Emotional stability, or neuroticism, was also proposed by Hans Eysenck as a second component. Stress and anxiety are more common in those with a high neuroticism score. They are preoccupied with little concerns, overestimate their significance, and are unable to deal with pressures. Eysenck further expanded his trait theory by researching people with mental illness and inventing the term "psychoticism." A high level of this feature may lead to antisocial, aggressive, non-empathic, and manipulative behavior in those who have it.(Hampson, 2012)

2.1.1.4 The Big five Personality Traits Several studies have examined Cattell and Eysenck's hypotheses. This has led some theorists to conclude that Eysenck concentrated on too few features, whereas Cattell concentrated on an excessive number of attributes. Consequently, the "Big

Five" hypothesis of personality traits was born. It is vital to determine people's personalities to understand and lead them. It's hard to describe someone's personality in just one dimension. This five-factor personality model depicts the interplay between five fundamental characteristics that make up a person's unique personality.(McCrae & Sutin, 2018)

According to personality theories and experimental findings, there are five major qualities of personality. (Furnham et al., 2016; Goldberg, 1990, 1993; O. John et al., 2008) Goldberg (1981) came up with the term "Big Five" because of a study on the five aspects of personality. The results of McCrae and Costa's (2003) factor analysis back up Goldberg's (1981) five-factor personality model. This approach is regarded to be significant because it allows people to understand one another based on the five fundamental personality qualities, rather than on personality theories. The Big Five Personality Factor Theory splits personality into five primary aspects and explains personality using these five variables. Originally designed to detect personality traits, the five-component model has now been used to explain personality structure, and the model's five elements have been thoroughly described.((PDF) A Five-Factor Theory of Personality, n.d.)

2.1.1.4.1 Components of the big five theory Extraversion, agreeableness, conscientiousness, neuroticism, and openness are the five key elements that make up the Big Five Personality Factor Theory.

Extraversion (E) is a term that refers to a person's active attitude to the social and material environment, and it encompasses attributes like socializing, activity, assertiveness, and positive emotionality. Agreeableness (A) is a personality trait that contains attributes like benevolence, tendermindedness, trust, and modesty, and contrasts a prosocial and community attitude toward others with hostility. Conscientiousness (C) is socially defined impulse control that permits task- and goal-directed behavior, such as planning, organizing, and prioritizing tasks, as well as thinking before acting, planning, and conforming to norms and standards. Neuroticism (N) is a personality characteristic that contrasts emotional stability and even-temperedness with negative feelings including worry, anxiety, melancholy, and tension. Openness (O) refers to an individual's psychological and experiential life's breadth, depth, uniqueness, and complexity.(O. P. John et al., 2008) Relationships, work choices, and even one's whole life are all influenced by one's personality. Individuals can be better understood and led if their personality is defined. Personality assessments are vital for developing successful vocational, educational, and personal guidance curricula and counseling strategies. This requires reliable personality evaluation tools.

2.1.2 Personality traits and coping pain Chronic pain is a multi-dimensional phenomenon that is well acknowledged to include psychological as well as physical manifestations in most cases. The term "multi-dimensional" refers to the fact that it has components that include not just sensory components but also cognitive, emotive, and social components.(Turk & Okifuji, 2002) Research shows that people with different types of chronic pain (neuropathic, nociceptive, and inflammatory) have similar affective-motivational, cognitive-evaluative, and social pain experiences, even though they perceive pain differently.(Haythornthwaite & Benrud-Larson, 2000)Patients' psychological resources and personal perceptions are more important than objective indicators in determining their well-being. The patient's personality type is one of the most crucial psychological elements. The psychological categorization of persons into distinct groups based on their preferences, habits, and consistent actions is known as personality type. Personality characteristics are 'persistent patterns of seeing, connecting to, and thinking about one's surroundings and self that manifest themselves in a variety of social and personal circumstances.(American Psychiatric Association, 2013) According to a study, one's personality type can influence how one perceives pain, how long it lasts, and how one copes with unpleasant situations. It is possible that personality characteristics are relevant in the study and management of chronic pain because they may be connected to the development and modulation to chronic pain symptoms. (Gatchel et al., 2007) Pain-related attitudes and coping methods have been shown to predict chronic pain adjustment. (P. T. Costa &

McCrae, 1992c; Franklin et al., 2016; Hirschfeld et al., 1989; Schiphorst Preuper et al., 2008; Wettstein et al., 2019) Anecdotally, many doctors have noticed that patients with chronic pain often have personality or interpersonal disorders.(McGrath, 1999) Chronic pain patients have been shown to have higher degrees of anxiety, depression (M. A. Asghari & Nicholas, 1999), and personality disorders(Weisberg, 2000), according to research. People with chronic pain, according to the fear-avoidance paradigm, have a negative experience of pain, which leads to catastrophic thinking, pain-related anxiety, and avoidant behavior. The previous study has related acceptance and catastrophizing of chronic pain to personality traits.(Vlaeyen et al., 2016; W. S. Wong et al., 2015a) As suggested by the vulnerability-stress model, some personality characteristics that were present before to the start of chronic pain are activated and exacerbated when faced with psychosocial stressors such as chronic pain. The model suggests that some personality characteristics are activated and exacerbated when faced with psychosocial stressors such as chronic pain. This can contribute to psychopathology and pain catastrophizing, which can result in avoidant and debilitating behaviors.(Dersh et al., 2002) People with negative personality traits like neuroticism and negative feelings have more negative thoughts about pain, which leads to kinesiophobia, which in turn leads to poor pain adjustment, more pain, and depression.(Goubert et al., 2004a; W. S. Wong et al., 2015b) Patients with chronic low back pain may be more prone to experiencing central sensitization symptoms, which may lead to neuronal hyperexcitability in response to both noxious and non-noxious pain stimuli, depending on their personality factors.(J. R. Clark et al., 2019) Evidence on the association between personality and pain management is drawn from a broad range of chronic pain diseases including fibromyalgia and headache, migraine, trigeminal neuropathy, and musculoskeletal problems.(A. Asghari & Nicholas, 2006a; Naylor et al., 2017a; Poppe et al., 2011)

In a study with myofascial dysfunction pain patients, Harkins et al (H. J. Eysenck et al., 2013) discovered that, while neuroticism and extraversion, as measured by the Eysenck Personality Inventory (H. J. Eysenck et al., 2013), had no effect on pain intensity reports, high neuroticism significantly increased overall effective disruption and malady behavior related to chronic pain. Additionally, the same research discovered that greater extroversion, rather than greater introversion, was related to a higher rate of pain complaints. Similarly, Wade et al (Wade et al., 1992a) found that extroversion and neuroticism, as evaluated by the NEO-Personality Inventory (NEO-PI) (P. T. Costa & McCrae, 2012), influenced negative pain-related beliefs, emotional disturbance, and pain behavior in a study of diverse chronic pain patients.

In addition, previous research has focused on maladaptive personality traits or personality characteristics related with a mental diagnosis in chronic pain patients. (A. Asghari & Nicholas, 2006b; Naylor et al., 2017b)

Instead of taking a categorical approach to personality, trait models of personality such as the Five-Factor Model consider personality as a continuum rather than a categorical approach, and they do not distinguish between clinically significant personality maladaptation diagnosed as personality disorders and health conditions associated with personality. Among these five broad personality factors, most pain research focused on Neuroticism, which is known to enhance sensitivity to depression (H. J. (Hans J. Eysenck et al., n.d.; Wade et al., 1992b), anxiety(A. Asghari & Nicholas, 2006c; Hilbig et al., 2014), kinesiophobia (Goubert et al., 2004b), and pain catastrophizing(Naylor et al., 2017c; W. S. Wong et al., 2015c).

Most of the research emphasized the importance of personality characteristics as risk factors while overlooking their protective effect. Patients who have a high degree of agreeableness, on the other hand, depend on their social support network to help them cope with their emotional suffering. Furthermore, high levels of conscientiousness have been shown to be associated with greater acceptance of one's disease-related life(Janowski et al., 2010), whereas low levels of conscientiousness have been shown to be associated with difficulties in defining meaningful goals, low motivation, and difficulties with adaptive coping strategies. Cross-sectional research with chronic pain patients indicated that neuroticism and extroversion are correlated with pain's meanings and implications for a person's life.

2.1.3 Associations between personality traits and stress, anxiety, and depression Personality characteristics seem to have a significant impact in the development of psychological distress. People with more negative personalities have historically related to higher suffering, while people with more extroverted and cheerful personalities are more likely to have good psychological health overall.(Duggan et al., 1995; Magnus et al., 1993; Suls et al., 2016; Vollrath & Torgersen, 2000) Duggan et al.(Duggan et al., 1995) discovered that those with a family history of depression were more likely to develop depressive symptoms.

Individuals with a high level of neuroticism may be more prone to discomfort because they react adversely to everyday pressures and report experiencing more stressful situations. Suls et al.(Suls et al., 2016) established this conclusion via their research of participants. At a first session, participants took the NEO Personality Inventory and then filled diary entries over an eight-day period. Suls et al. discovered that all subjects exhibited a decrease in mood when confronted with a stressor. Individuals with a high level of neuroticism, on the other hand, responded more adversely to stresses and were more prone to recurrence of the same issues. Additionally, neurotic individuals reported encountering more stressful events.

Neuroticism, extraversion, and conscientiousness are also linked to psychological distress in students at college. As people who are more extraverted and conscientious are more social, positive, and goal-oriented, they are less likely to be stressed out than people who are more neurotic. There was a study done by Vollrath (Vollrath & Torgersen, 2000) that found that students with more adaptable personalities like high extraversion and conscientiousness were less likely to be stressed out every day. They were asked about their personality and stress levels three months after they started college, and then three years later. The study found that extraversion and conscientiousness were not linked to daily stress, but neuroticism was linked to daily stress.

The triad model of anxiety and depression has affected research on personality and Axis I psychopathology (L. A. Clark & Watson, 1991). Anxiety and depression are both described by significant negative affect. Positive affect, which is low in depression, which is widespread in anxiety, set them apart. Positive and negative affect are connected to neuroticism and extraversion. (L. A. Clark & Watson, 1991). The authors suggest that all anxiety and depressive problems are linked to neuroticism, but that depression is also linked to extraversion. (Watson et al., 1999). The discovery that low extraversion is linked to both depression and social anxiety is a major exception to the overall agreement. (L. A. Clark et al., 1994)(Brown et al., 1998; Kotov et al., 2007; Watson et al., 1988)

2.1.4 Personality and environmental preferences Colors have an essential role in both natural and artificial surroundings. As humans, we see the world as a spectrum of color. Color may be found in almost everything we see in our everyday lives, as well as in our subconscious minds. The color of our clothing, the color of our new vehicle or computer, and even the color of our, hair, or cosmetics all play a role in our decision-making and discourse. Many psychological processes are linked to color, which has been studied for over a century. For example, in 1893, Jastrow performed large-scale research of color preferences among visitors to Chicago's World's Columbian Exposition. (Elliot & Maier, 2014b)

In fact, several subsequent research have verified Jastrow's findings that blue is the most popular color choice.(A. Hurlbert & Owen, 2015) The reasons behind people's color choices, on the other hand, have long been debated. The factors that contribute to color preferences have been an important topic of discussion for some time. It has been shown in previous studies that color preference can vary depending on gender, seasonal changes, and cultural differences. Color perception may be affected by seasonal changes in winter, spring, summer, fall). Our eyes distinguish between different colours according on the wavelengths of light they receive. Those with shorter wavelengths seem blue or violet, whereas those with longer wavelengths appear reddish. Due to reflected greenish light in spring-summer, summer wavelengths are shorter than winter wavelengths.(Welbourne et al., 2015)

According to studies on color preferences on gender bias, it has been observed that women prefer colors in warmer tones (reds and oranges) compared to men.(Ellis & Ficek, 2001; A. C. Hurlbert & Ling, 2007) Colors are also related to emotions (Kaya, n.d.), behavior(Cuthill et al., 1997; Pryke, 2009), and physiology (Dreiskaemper et al., 2013) and this has been shown in several studies from a variety of other study traditions, as well. It's been hypothesized that various hues have distinct meanings. Red, for example, has been demonstrated to boost attractiveness, dominance, rage, and aggressiveness, among other things.(Elliot & Maier, 2014c; Elliot & Niesta, 2008a; Stephen et al., 2012; Wiedemann et al., 2015a) At the same time, red targets seem to be related with dominance and boldness, and red may therefore be interpreted as a signal of competitiveness and social dominance in evolutionary terms, presumably linked to underlying testosterone levels.(Little & Hill, 2007)

According to a marketing study, blue is more closely connected with trust than red (Su et al., 2019), and red is more closely associated with dominance.(Mentzel et al., 2017) Additionally, red is related to romantic sensations. Research has demonstrated that red not only influences men's perceptions of women as more beautiful and sexually appealing (Elliot & Niesta, 2008b) but also influences women's perceptions of men as more attractive. Likewise, red may have significant physiological arousal and motivational benefits, seeming to boost motor speed and strength.(Elliot & Aarts, 2011)

Furthermore, there has been various research conducted to determine the impact of the colors blue, green, and gray. (Fetterman et al., 2011; Lichtenfeld et al., 2012; Wiedemann et al., 2015b) Green is often selected because it is the color tone opposite to red in most color models and because it is related with cognitive restorative benefits (Berman et al., 2008), creativity (Lichtenfeld et al., 2012), and a sense of security(Pravossoudovitch et al., 2014). Gray is the most appropriate achromatic contrast for red, and it may be coupled with red to create chromatic color and lightness contrasts.(Kaya & Epps, 2004)

In moreover, blue relates to tranquility, serenity, and peace. Color has been connected to emotions and emotionality since the studies of Adams and Osgold (1973)(Adams & Osgood, 1973). (i.e., the observable behavioral and physiological component of emotion). In their research, they discovered that respondents perceive bright colors as "good" and dark hues as "bad." While there has been much study on the link between colors and emotions, only a small number of studies have focused on the direct relationship between personality and color preferences in recent years. However, a prior analysis published in 1963 found no evidence of a relationship between colors and personality traits such as impulsivity, suggestibility, and emotionality, but did find that sad people used colors less often. (Cerbus & Nichols, 1963) The lack of research on the relationship between colors and personality is unexpected, given that emotions are a basic component of the dispositional domain of personality. (Hughes et al., 2020; Tellegen, 1991)

Emotions aren't just temporary states. They also include emotional traits, patterns of emotional experiences, and consistent reactions that are common for people in a wide range of situations and are stable across many different situations.(de Raad & Kokkonen, n.d.) For example, unpleasant emotions are often associated with neuroticism, while happy emotions are associated with extraversion.(Longua et al., 2009; Ng & Diener, 2009)Methodologically, studies claiming connections between emotions and color preferences may be describing emotional qualities in the personality. So, it's worth investigating the link between color choices and personality traits. In terms of personality, previous research on color-evoked emotions is highly intriguing.(Elliot & Maier, 2014a; Gao & Xin, 2006) Wu and Lin (Wu & Lin, 2017), for illustration, demonstrated how single colors might elicit personality connections as revealed by short Big Five personality indicators.(Gosling et al., 2003) According to the research, colors in the blue-greenish region had a more pleasing influence on the viewer's mood than those in the yellow region. It is fascinating from a color science point of view, but a more rigorous scientific approach would be to undertake an evaluation of individual color preferences connected to personality factors in the same individual.

The authors explored the correlation between a single color-red and interpersonal hostility as measured by the warmth-coldness scale of the Revised Interpersonal Adjective Scale (IAS-R), which was developed in accordance with the circumplex personality model of personality. They found a positive relationship between red and interpersonal hostility.(Wiggins et al., 1988)

The limitations of Wiggins' circumplex model of personality, which is widely accepted, have been questioned for some time, particularly in reference to the relationships between emotions.(Larsen & Diener, 1992; Remington et al., 2000) As a result, evaluations based on the Big Five theory are both more relevant in terms of character profiles and more extensively employed than other types of assessments. A link between color preferences for basic colors such as black, white, blue, red, green, and yellow and personality characteristics measured using Big Five instruments has also yet to be explored in detail.

2.1.5 Birth experience and personality traits One of the most crucial consequences of childbirth is the woman's impression of her labor and delivery experience. For example, a pleasant delivery experience may help to strengthen the attachment between a mother and her child.(Mercer & Ferketich, 1994). The opposite is also true: high levels of prenatal anxiety, as well as stress and panic before and during birth, are connected with a larger risk of fetal distress and an increased requirement for medical intervention(Monk et al., n.d.; Nieminen et al., 2009; Ryding et al., 1998) In addition, women who have a bad birthing experience are more likely to put off having more babies in the future (Bahl et al., 2004; Gottvall & Waldenström, 2002) and more likely to ask for cesarean delivery in the future.(Hildingsson et al., 2002; Waldenström et al., 2006) Several factors have been shown to influence a woman's level of satisfaction with her labor and delivery. A shorter (Nystedt et al., 2005), more spontaneous vaginal birth (Hodnett et al., 2005) process with less medical interventions(Creedy et al., 2000; Waldenström et al., 2004a) is one of them. Subjective, psychological factors may also affect birth satisfaction. These include meeting expectations(Soet et al., 2003), having more voice in decisions(Waldenström et al., 2004b), having more control over the process(Lundgren, 2005b), and having a positive view of social support(Hallgren et al., 2005). Particularly interesting are the research that have been conducted on how a woman's fear of childbirth (FOC) relates to a bad experience throughout her pregnancy and delivery. (Elvander et al., 2013a; Handelzalts et al., 2015a; Spice et al., 2009) FOC features were associated with greater scores on a negative birth experience measure, including disappointment, discomfort, anxiety, hopelessness, and guilt.(Elvander et al., 2013b) Personality may also play a role in predicting whether a woman has a happy labor and delivery experience, according to some study. The Five-Factor Model is one of the most regularly used methods for analyzing stable personality features. The Big Five personality traits have been linked to certain parts of the labor and birthing process in previous studies, including FOC. Having a lot of trait anxiety, for example, has been found to be linked to FOC.(Spice et al., 2009) In 2015, Handelzalts and his colleagues (Handelzalts et al., 2015b) looked at how these personality traits, FOC, and the birthing process were linked. FOC was linked to higher levels of neuroticism and anxiety sensitivity, as well as lower levels of conscientiousness, in women who were pregnant before the study. It also indicated a negative delivery experience and a greater chance of birth difficulties and interventions, such as instrumental births and emergency C-sections. On the other hand, Johnston, and Brown (Johnston et al., 2013) looked examined the association between personality and objective variables of the birth experience, such as birth type, epidural usage, fetal distress, forceps use, and interventions to speed up delivery. Low extraversion and emotional stability mothers had higher c-sections and delivery problems.

There is a lack of data on the mother's subjective reactions to her labor and delivery experience, such as her emotions such as anxiety or a feeling of hopelessness, in the previous two studies. Only objective measurements of the delivery experience were considered by Johnston and Brown (2013). Mothers were asked to rate their overall satisfaction with their birthing experience on a Likert scale by Handelzalts et al. (2015). The mother's subjective delivery experience has been linked to her postpartum mood, her perceptions of her child's negativity(Green et al., 1998), her self-esteem, and her positive descriptions of her newborn, all of which have been shown to matter.(Reisz et al., 2015) Pain management during childbirth may also be influenced by personality factors. Subjective pain experiences are linked to one's personality, according to research. If a woman is more extroverted, she is more likely to report experiencing significant pain during childbirth.(EYSENCK, 1961)According to one research of Iranian women, higher levels of neuroticism and openness to experience correlated with higher levels of labor pain reactivity, pain tolerance, and pain depth.(Yadollahi et al., 2014)Pain treatment may be more popular among women who have more severe symptoms. The epidural is the most often utilized technique of pain control during childbirth in the United States, with around six out of ten women relying on this anesthetic.(Osterman & Martin, 2011) In certain cases, a woman's personality attributes may play a role in her decision to forego an epidural and choose other kinds of pain relief. Epidurals seem to increase passive compliance, external locus of control in labor (ie. the tendency to rely more on the instruction of physicians and nurses), and FOC in childbirth, according to one research. When it comes to pain management, women's opinions about delivery and their preferences for epidural anesthetic are linked. There has been little research on mother personality characteristics that might impact pleasure at the time of delivery. According to interactionist theories, the mother's involvement, coupled with external conditions, would explain birthing happiness(Redshaw, 2008b)

Among the maternal personality factors, the present research focused on the Big Five, (P. T. Costa & McCrae, 1992b) coping, and mother birth expectations. The Big Five model is a good way to figure out how people are, but it hasn't been used very often in the field of pregnancy and birth satisfaction. Studies about pregnant women's ways of dealing with stress have also been very few. Even though different studies say that the stress of pregnancy can make childbirth more difficult and less satisfying(D. da Costa et al., 2000), very few studies have found any coping strategies that work better than others to avoid this problem. The use of positive reappraisal and satisfaction with social support have been shown to be strongly linked to mother satisfaction at the time of delivery.(Essex & Pickett, 2008) Different studies have found that having a higher number of requests fulfilled is linked to a higher level of birth satisfaction.(Mei et al., 2016b; Soliday et al., 2013a) Expectations about personal control, social support, and suffering have all been explored in previous research, with the study focused on these three areas of expectation.(Gutman & Tabak, 2011; Meyer, 2013; Soliday et al., 2013b)

2.1.2 Labor Childbirth is the time between regular uterine contractions and placental ejection. Labor is the phrase used in obstetrics to describe this procedure. As defined by the New Shorter Oxford English Dictionary (1993), labor is characterized by physical effort, particularly when unpleasant, and a product of labor. They are all suitable in our opinion and underline the necessity for all attendants to assist the laboring woman's requirements, especially good pain treatment.

2.2.1 Labor and childbirth Labor natural process of fetus' migration from the uterus to the outside of vagina within the existence contractions of uterine and continuous cervical effacement and dilatation. There must be uterine contractions and cervical dilatation and effacement for labor to be classified as a process of birth. The initiation of labor is preceded by a few physiological changes in the last month of pregnancy. Braxton Hicks contractions are becoming more common among patients. The occurrence and strength of these are often unpredictable. The patient may feel the fetus descending into her pelvis as her contractions rise in frequency. That's why it's called "lightning." Contraction frequency and intensity will cause an increase in the lower uterine segment, which will cause this process to occur.(Harrington, 2009) With the progressing of dilation, cervix becomes thinner and shorter and more affected through time. The clinicians usually use their index fingers for the measurement of dilation size. While the one index finger refers to 1 cm, two index fingers' equals 3 cm of dilation. Fully dilation refers to 10 cm which can not be palpated by the index finger. There are three stages that labor appears.

2.2.1.1. First stage of labor The following describes the first stage of labor and delivery: The size of the cervix now of conception determines the division into two subgroups.

2.1.2.1.1 The latent phase of labor The latent phase, which may last up to twenty hours, is the most time-consuming aspect of the work. The early or latent phase of labor is the period immediately before the onset of labor. The latent phase begins with moderate, irregular, and painful contractions of the uterus that occur within a small amount of opening cervix and ends when the cervical contractions become more frequent and more severe in nature. (McGowan, 1967) Of late, as reported by the National Institute of Clinical Excellence UK, the dilation of the cervix initiates from 0 cm up to 3-4 cm followed by painful stimulus.(Nunes et al., 2014) Depending upon the acceleration of cervical dilatation, the active phase starts cooperatively.

*2.2.1.1.2 Active phase of labor*In the active phase of labor, a large percentage of cervical dilatation occurs, which is followed by intense contractions.(Steven G. Gabbe, 2017) The term of active phase requires a cervical dilation rate of 4 cm or above, as well as subsequent effacement, according to Friedman's studies on progression labor. (E. A. Friedman, 1955) The cervix undergoes rapid changes, which include increased pain and a significant number of contractions. This phase lasts until the cervical dilatation have reached 10 cm and the thinning has been completed. (Liao et al., 2005)

2.2.1.2 Second stage of labor Pelvic division, according to Friedman's definition, is the second stage of the process. This stage begins with the termination of dilatation of the cervix (10 cm) and concludes with the expulsion of the fetus from the body. At this point, the signs of initiation include the reaction to rectum pressure that results in defecation, maternal craving for bear down in terms of uterine contractions, and the onset of nausea that results in vomiting. (Liao et al., 2005)

2.2.1.3 Third stage of labor Finally, the third stage of labor is the baby's dissociation and eloignment from the placenta.

2.2.1.3.1 Normal vaginal delivery Between 37 and 42 weeks of gestation, a vaginal delivery offers the best chance of a healthy outcome for both the baby and the mother. Given the higher morbidity and mortality associated with surgical cesarean deliveries, vaginal delivery is recommended. About eighty percent of all singleton babies born by vaginal delivery are full-term, whereas eleven percent are born prematurely, and ten percent are born post-maturely. (Lagrew et al., 2018)

2.2.1.3.2 Cesarean section Cesarean section is a medical technique that involves the birth of one or more infants via an incision in the mother's abdomen. It is often used when vaginal delivery may damage the baby or mother. Obstructed labor, twin pregnancy, maternal hypertension, breech delivery, and placental or umbilical cord issues are all reasons for the procedure. A cesarean birth may be necessary due to the structure of the mother's pelvis or prior C-section history.(Gregory et al., 2012)

2.2.2 Pain management in labor Labor pain is a complicated, multidimensional phenomenon that each person experiences in a unique way, but some physiologic aspects are the same for everyone. First, during the first stage of labor, the lower uterine segment is stretched, and the cervix is dilated. Mechanoreceptors, which send pain signals, are stimulated by these actions, which cause them to transition. During the spinal cord, they travel through visceral sympathetic nerves at T10 through L1 to reach the brain. Perineal stretching activates somatic nerves, which deliver impulses to the spinal cord at S2 through S4. These nerves send signals to the spinal cord. Even though a woman's emotions, motivations, cognitive, social, and cultural factors all play a role in her experience of labor pain and how she responds to it, fear and anxiety can change her perception of pain and how well she can deal with it.(Cunningham & Gary, 2014)

The use of obstetric analgesia, anesthesia, and non-pharmacologic methods may lessen labor pains. Neuraxial blockades such as epidurals are the most effective methods of giving labor analgesia among the various pharmacological and non-pharmacological choices available. These are the benchmark against which all other modalities are compared. Using contemporary neuraxial methods for both the induction and maintenance of analgesia in the labor room, it is feasible to successfully deliver labor analgesia with excellent maternal and fetal/neonatal safety profiles. Therefore, neuraxial analgesia is a highly sought-after method of labor pain management when it is available. (Traynor et al., 2016) However, improving the whole delivery experience for women is a more difficult task that requires specialized care and the use of alternative medicines. The World Health Organization (WHO) advises epidural analgesia, systemic opioids, relaxation methods, and manual treatments (like as massage) as pain reduction choices for women in labor, depending on the woman's unique preferences. (World Health Organization, 2018) In order to avoid these adverse effects, many pregnant women opt to experience labor pain themselves rather than having epidural analgesia for pain management. Non-pharmacological labor pain treatment includes relaxation and breathing methods, prenatal education, TENS, acupressure/acupuncture, aromatherapy, and hypnosis.(Simkin & Bolding, 2004)

In the words of the American Aromatherapy Association, aromatherapy is "the science of employing highly concentrated essential oils or essences produced from plants to exploit their therapeutic characteristics." Additionally, aromatherapy is utilized during labor for the goal of lowering anxiety and fear, in addition to its primary function of pain reduction.(E. Burns et al., 2007) According to one large prospective cohort research, more than half of the 8058 women believed that aromatherapy was a good alternative for pain reduction during childbirth, owing to its non-invasiveness, simplicity of access, and the possibility that it may be used as a supplementary treatment for pain management.(E. E.

Burns et al., 2000) However, subsequent systematic reviews have concluded that there is insufficient evidence to support the usefulness of aromatherapy for pain management during childbirth, despite a large number of research demonstrating its advantages.(Arendt & Tessmer-Tuck, 2013; Jones et al., 2012; Wray, 2011) Touch and massage treatment are two manual healing modalities that are now in use during childbirth. The application of pressure with the hands on a woman's lower back, hips, thighs, and sacrum might alleviate the discomfort of painful uterine contractions. Massage treatment may help to minimize the need of pharmaceutical management during the early stage of labor, resulting in less unfavorable effects on both the fetus and the mother during this time.(Smith et al., 2012) Massage reduces the feelings of pain, helps to release spasms, and gives overall relief throughout the laboring process. (Field, 2010) There are two main ways to use hypnosis for childbirth interventions: having the practitioner deliver the treatment in person or teaching the mother how to induce "a state of consciousness similar to meditation that results in failure of naturally perceived experiences reaching conscious awareness." (Cyna et al., 2013) Individual or group instruction in self-hypnosis for women is an option, as is the use of self-hypnosis audio recordings in the comfort of one's own home. Pregnant women in one US study were given one-hour training sessions in the hospital every week for six weeks.(Harmon et al., 1990) Hypnotic induction tapes for daily practice were also supplied to all the ladies to prepare them for the delivery. (Harmon et al., 1990) The training of self-hypnosis to pregnant women before they go into labor promotes their active involvement and feeling of control in dealing with their pain and worry.

The use of immersive virtual reality (IVR) distraction to treat acute pain is one non-pharmacologic technique that has been shown to be beneficial in a broad range of clinical situations to manage acute pain.(Li et al., 2011a) According to Frey et al., it is possible to construct a VR experience utilizing low-cost, consumer-ready goods to reduce pain and anxiety during the early stage of labor without increasing nausea. Compared to the control condition, the VR condition had considerably decreased worst pain intensity (sensory pain) ratings, with the equivalent reduction seen in the secondary outcomes of reported emotional and cognitive pain scores. (Frey et al., 2019b)

2.2 Immersive Virtual Reality

Immersive virtual reality (VR) is the display of a variety of environments that properly match the user's real-world surroundings, enabling the user to actively engage in the created environment. Immersion is fundamental in virtual reality applications like gaming and therapy. It's a cutting-edge device that transports users to a 'virtual world'. Virtual reality (VR) uses a head-mounted display (HMD), headphones with sound, a joystick, or another device to control and navigate the virtual world (VE). Additionally, virtual reality includes head-tracking sensors, which are often incorporated into the head-mounted display (HMD). They provide the sense that the user is completely immersed in a virtual world because these systems monitor the movement of the user's head. Immersion in a virtual environment is achieved by the use of multimodal stimuli (such as visual, auditory, tactile, and olfactory stimulation), which distinguishes the VR experience from passively viewing television or movies and playing a 2D portable video game or game console.

From low-tech 2D VR systems that don't need a headset to fully immersive VR systems that use multimodal stimuli, there have been a variety of VR systems that have been tested and shown to be successful.

2.2.1 Types of virtual reality

2.3.1.1 Non-immersive virtual reality Virtual reality technology includes non-immersive desktop virtual reality. It delivers a computer-generated world but not virtual immersion. Users keep control while being aware of their surroundings. In non-immersive virtual reality systems, a computer or video game console, monitor, and input devices like keyboards, mouse and controllers are all that is required. In contrast to semi-immersive VR based on hard simulations, gaming non-immersive VR systems may also employ racing wheels, pedals, and speed shifters to improve the gaming experience. Users may interact with digital material shown on a screen by using a variety of input devices. In terms of immersive technology, non-immersive virtual reality is the least immersive and engaging variety. Instead of virtual reality goggles, it employs a single monitor to show computer-generated material. First-person video games allow players to identify more closely with their character and immerse themselves in the experience. Dota 2 is a non-immersive VR game. Your character's actions affect the game's virtual world. You engage with a virtual world indirectly. That's what your character does.

Full-immersion and non-immersion VR systems vary significantly in how users perceive digital material. Non-immersive VR, in contrast to fully immersive VR, delivers the same picture to both users' eyes simultaneously. As a result, this picture can only be seen in two dimensions: height and width, while truly immersive VR technology gives a three-dimensional digital image.

2.3.1.2 Fully immersive virtual reality Through fully immersive virtual reality, users can feel as if they are in the actual world by immersing themselves completely in a digital simulation. In other words, the senses of sight, sound, and touch all play a role in how people experience a computer-generated environment. Ultimately, the goal of this technology is to make it hard for users to tell that they're in a virtual environment rather than a real-world one. One example of this would be a Virtual Gaming Zone, where you and other players can use special gear to interact with the virtual environment at the same time and play with or against each other.

It's a dramatic difference to semi-immersive virtual reality, where there is still a strong link to real life, which is entirely removed in a fully immersive virtual environment. They are unable to interact with real-world items or navigate appropriately. Instead, users may explore digital 3D settings and interact with computer-generated material by donning a head-mounted display (HMD) and utilizing wireless controllers.(Patel et al., n.d.)

2.3.1.3 Semi-immersive virtual reality Semi-immersive virtual reality allows customers to engage with virtual 3-D settings while keeping connected to real-world visual, auditory, olfactory, and tactile cues and controlling actual items. Semi-immersive VR allows you see what's happening and interact with objects. Focus on a digital image for maximum immersion. One of the most significant issues affecting this technology is the amount of realism produced by 3D graphics, a word that is also used to refer to virtual reality depth. The higher the level of detail in the images, the more engrossed the user feels. When it comes to the breadth of the digital environment or the number of human senses stimulated during the immersion, semi-immersive virtual reality devices, like fully immersive VR, stimulate users' vision, hearing, and haptics. Flight simulators are semi-immersive VR. This comprises of a big, concave screen, projection equipment, and monitor, like IMAX theatres. High-end visuals are used. High-resolution screens in cockpit simulators enable pilots to enhance their abilities without utilizing actual aircraft.

2.3.1.4 Augmented reality (AR) Augmented reality (AR) integrates computer-generated perceptual information to real-world items for an interactive experience. Visual, auditory, haptic, tactile, and olfactory elements are available. AR is a system that has three main features: real-time interaction, accurate 3D registration of virtual and real objects, and a mix of real and virtual worlds. These three main features make up the system. Overlaid sensory information can be beneficial (i.e., add to the natural environment) or harmful (i.e. take away from it) (i.e. masking the natural environment).This experience is so seamlessly integrated with the real world that it is thought of as a part of the real world. AR does not provide a totally immersive experience in the same way that virtual reality does (VR). In contrast to virtual reality, which requires users to put on a special headset and be pulled into a totally digital environment, augmented reality allows them to continue engaging with the actual world around them.

2.3.1.5 Collaborative VR In this kind of virtual reality, individuals from all over the globe may come together in a virtual environment as 3D projected figures and interact. Collaborative VR may be seen in a mobile game like PlayerUnknown's Battlegrounds (PUBG), where virtual 3D avatars communicate with one other.

2.3.2 Virtual reality usage in medical conditions Initially intended for entertainment, virtual reality technology has recently been applied in a variety of therapeutic fields, including pain treatment, physical therapies, and mental health care (e.g., phobias, post-traumatic stress disorder, and anxiety disorder).(Powers & Emmelkamp, 2008; Rizzo et al., 2009; Rothbaum & Hodges, 1999).

Studies in medical settings have shown that it may help patients cope better with painful treatments like wound care and chemotherapy. It has also been shown to help patients cope better with dental surgery and other types of medical operations.(Furman et al., 2009; Gold et al., 2005, 2006; Morris et al., 2009b; Schneider et al., 2011)

2.3.2.1 Virtual reality distraction There has been a significant rise in the amount of interest shown in the use of virtual reality (VR) as a treatment for pain. Virtual reality (VR) is an experience that completely submerges the user in a multi-dimensional environment created by computer technology. In virtual reality, users enhance their experience with a head-mounted display helmet, headphones, and either a joystick or wand. The head-mounted helmet obscures the user's vision of the real world, and in its place, visual stimulation from the virtual world is presented to the user's eyes. In a similar manner, headphones replace the external auditory inputs with the sounds of the virtual world. The user can stare around the virtual environment due to a motion tracker that is included inside the head-mounted display helmet. This enables the user to reproduce real-world head movements within the virtual world. Furthermore, the use of a joystick or wand allows the user to navigate the virtual environment and interact with virtual things inside it. VR experiences range from riding down a snow hill and tossing snowballs at snowmen to engaging with gorillas in their natural habitat. (Kenney & Milling, 2016)

Distraction via the use of virtual reality technology has shown promising potential in the management of acute and chronic pain. Malloy and colleagues discovered that VR distraction was helpful for lowering experimental pain, burn wound suffering, and needle-related pain in 11 controlled experiments. More advanced computer technology is capable of fully immersing the user in the virtual environment related to greater pain alleviation. (Malloy & Milling, 2010). They concluded from their review of available controlled research that virtual reality distraction is a beneficial tool for physicians who deal with pain patients.

2.3.3 Pain perception and virtual reality According to The International Society for the Study of Pain, pain is undesirable because both emotional and sensory involvement cooperates with potential damage of tissue. Early-stage labor pain is described as cramping contractions that emerge from the uterus. In the second stage of labor, it involves the visceral pain caused by contractions of the uterine and somatic pain formed by vaginal distension.(McGurk, 2010) In addition to this, women in labor experience this pain excruciatingly both in physiological and psychosocial processes.(Lowe, 2002)

2.3.3.1 The gate control theory As it is understood from these explanations, the pain comes to existence against the painful stimuli which are under the controlled mechanism. For that reason, for the inhibition of this perception of pain, tasks could be done which include cognitive sources. This mechanism in our body is called “Gate-Control Theory”. According to this theory (Melzack & Wall 1965), each dorsal horn has a 'gate' that inhibits or facilitates afferent impulses. This "gate" is controlled by the amount of activity in large-diameter (A-beta) and small-diameter (A-delta and C-) fibers. Large-diameter fiber activity closes the "gate," while small-diameter fiber activity opens it. The gate is also shut by pathways in the brain which go down. The gate is physically located in the dorsal horn's Lamina II, which contains numerous inhibitory neurons. Inhibitory interneurons are activated by large-diameter myelinated fibers, which diminish presynaptic input to transmission cells and hence suppress pain. Pain is caused by activity in small-diameter unmyelinated A-delta and C-fibres, which block inhibitory neurons and enhance the passage of noxious impulses to transmission cells. This theory explains why pressing an injured region helps to relieve pain and why transcutaneous electrical nerve stimulation (TENS) is effective in lowering pain. Both substances activate A-beta fibers and block nociceptive information from being transmitted.(Shaikh et al., 2010)

Massage and kneading techniques during childbirth are based on the gate control principle. The purpose of these techniques is to distract the brain's attention away from the pain signals that are being processed. (“Western Approach to Labour,” 2010) This gate could be affected by behavioral and psychological factors associated with an experience like attention and emotion. Based on this gate control, the concept of neuromatrix is psychologically suggested for experiencing pain perception. The neuromatrix refers to a biopsychosocial system that is a combination of sensation, cognition, and emotion.(Katz & Melzack, 1990; Li et al., 2011b; Melzack, 1989, 1999) To perceive the pain, cognitive resources must be directed toward the painful stimulus. At this point, attention is essential for the detection of pain. This idea was sponsored by McCaul and Malott who have expanded Melzack and Wall’s “Gate-Control Theory” by describing the human’s limited capacity for attention.(McCaul & Malott, 1984) Thus, as we are distracted from the stimulus, the perception of pain will be lessened. Another theory proposed by Wickens suggested the Multiple Resources Theory based on the sources in sensory systems processed individually. This agrees also with the nature of virtual reality technology, which relies on the integration of sensory distractions across several modes (visual, aural, tactile, and olfactory). As mentioned about affecting the pain perception by distraction and psychological ways, these techniques used during medical procedures focus on diminishing pain.(Montgomery et al., 2000a; Wickens, 2008)

2.3.3.2 Pain management within distractive tools To give an example for distraction techniques that are supported by research are relaxation, hypnosis(Finlayson et al., 2015; Montgomery et al., 2000b), cognitive tasks(Buhle et al., 2012; Valet et al., 2004), watching movies and hydrotherapy. In addition, research on the benefits of music therapy have shown encouraging outcomes in reducing anxiety and stress levels in laboring women.(García González et al., 2017; Hepp et al., 2018) Virtual reality technology was recently added to the analgesic effect based on intercortical manipulation of the pain matrix via attention, emotion, memory, and other senses (e.g., touch, auditory and visual).(Gold et al., 2007) Pain management during both acute (such as venipuncture) and invasive (such as chemotherapy, burn wound care) medical operations has gained substantial attention due to the effectiveness of distraction as a pain management technique. Traditional methods of pain treatment, such as distraction, are still beneficial, but new breakthroughs in virtual reality (VR) technology have opened the door to more engaging alternatives. Through a combination of visual, aural, and tactile signals, immersive virtual reality (VR) enables users to fully immerse themselves in a virtual world. By redirecting attention away from a painful medical environment and into a pleasant and engrossing virtual world, while simultaneously activating the nervous system's higher cognitive and emotional centers, virtual reality may significantly reduce a patient's subjective pain experience.

In comparison to other types of distraction (e.g., cognitive exercises, movies), VR is a very efficient method of pain reduction because of its extremely immersive character. By restricting the user's ability to see and hear things that aren't directly relevant to the virtual world, a virtual reality headset limits the user from engaging with the real world. Because of this, virtual reality may offer a sensation of "presence," a perception that the user is there in the virtual environment, which further improves the immersive experience.

Even though virtual reality pain therapy is still in its infancy, an increasing number of clinical case studies and randomized controlled trials show that VR is effective and feasible in medical situations.

2.3.3.3 Initiation of virtual reality as a therapeutic tool It was Ramachandran and Rogers-Ramachandran (Ramachandran & Rodgers-Ramachandran, 1996) who initiated the application of virtual reality in a therapeutic environment when they developed a "virtual reality mirror box" to study the effects of visual input on phantom limb experiences in patients. In this paradigm, a patient's undamaged hand or arm movement created a picture that looked to the subject as movement of the phantom limb. Six of the ten patients enrolled for the research reported experiencing kinesthetic feelings in their phantom limb after observation of a mirror image of movement in their unaffected hand. Additionally, when the mirror box was utilized to aid the "opening" of the phantom hand, five patients who often had severe "clenching spasms" were able to decrease their pain. These early results provided the framework for future research into the effect of visual perception and virtual reality on pain feeling. Hoffman et al. found in a wound care experiment in two teenage burn patients that visiting an immersive virtual environment may have remarkable analgesic benefits without medications.(Hoffman et al., 2000). Despite the intense pain involved with burn wound care, both individuals reported substantial pain reductions when utilizing VR over a less immersive video game distraction paradigm. Many other case studies give additional evidence that VR may significantly decrease pain in burn sufferers during daily wound care and physical rehabilitation.(Hoffman et al., 2004; Patterson et al., 2004) VR has also been researched to reduce pain during unpleasant stimulation. For this research individuals were given either VR or no VR while suffering experimentally produced thermal discomfort in a functional MRI (fMRI). VR not only lowered subjective pain but also reduced pain-related brain activity in five pain-related areas. VR has also been shown to improve pain tolerance lower self-reported pain intensity, reduce emotional unpleasantness, and reduce time spent thinking about pain in healthy people.(Hoffman et al., 2003) Despite strong evidence from case studies and randomized trials that VR is a useful therapeutic tool, it is unclear how VR affects pain perception.

2.3.4 Immersive virtual reality and labor Virtual reality (VR) may help ease labor pain. VR uses close-proximity stereoscopic screens to give the illusion of being transported into realistic three-dimensional environments. VR alters nociceptive processing by activating the visual brain while engaging other senses. VR has comparable effects on the sensory and insular cortex as opioids, and head-to-head experiments suggest VR delivers similar or higher analgesia than hydromorphone. VR has now been shown to reduce pain in contexts such as pediatric burn patients, physical therapy, hospitalized patients with discomfort, and chronic pain sufferers.(Dascal et al., 2017b; Tashjian et al., 2017)These two randomized studies in obstetric populations (laboring women and episiotomy repair) had excellent outcomes.(Frey et al., 2019c; Shourab et al., 2016b)

Chapter 3

Materials and Methods

3.1 General Selection

3.1.1 Data collection This was a single-center, randomized clinical study with 58 laboring women. After their permission and written agreement, we randomized the women to VR or a control group. The VR group has 37 laboring women while the control group has 21. The research was authorized by Acibadem Mehmet Ali Aydinlar University (IRB protocol number. 2020-18/07) and filed with clinicaltrials.gov (NCT05032456). Acibadem Maslak Hospital in Istanbul, Turkey, conducted the research. Between November 2020 and June 2021, enrollment ended.

3.1.2 Diagnostics of general health The selected participants were subjected to take a test called Montreal Cognitive Assessment (MoCA) as shown in Figure 3.1 to assess their cognitive well-being.

3.1.2.1 Montreal cognitive assessment test (moca) Nasreddine and colleagues developed the MoCA to test cognitive processes (Nasreddine et al., 2005a). The exam takes around ten minutes to complete and assesses eight areas of cognitive function, including visuospatial and executive functioning, name, memory, attention, language, abstraction, and orientation. This exam consists of 30 points and lasts ten minutes.

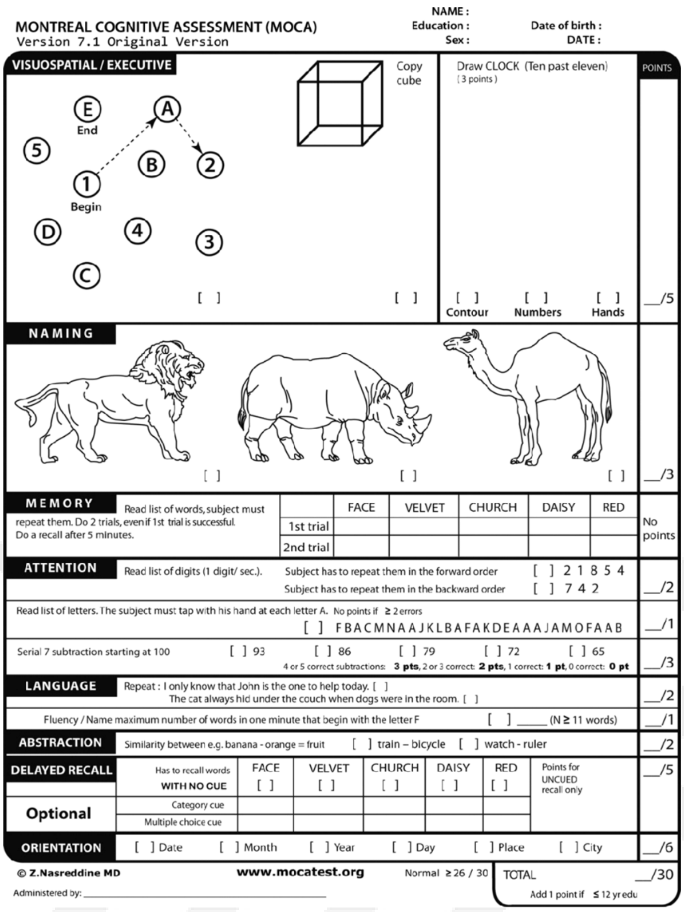

Figure 1. Montreal Cognitive Assessment Test

3.1.3 Inclusion and exclusion criteria

Inclusion Criteria:

a. 18-42 years of age at 37-41 weeks gestation with a singleton pregnancy
b. Vertex Presentation
c. Turkish as first language
d. No history of chronic medical conditions
e. Absence of pregnancy complications
f. Admission with documented labor by cervical exam and regular uterine contractions

Exclusion Criteria:

a. Diagnosis of migraine
b. Diagnosis of headache
c. Diagnosis of dizziness
d. Diagnosis of motion sickness
e. Diagnosis of epilepsy
f. Diagnosis of psychiatric disorders
g. Having visual or auditory disabilities
h. History of cesarean section

3.2 Neuropsychological Tests and Pain Assessment

On admission, the Beck Anxiety Scale, Beck Depression Scale, Monteral Cognitive Assessment Test, and The Big Five Personality Test were applied in each group.

3.2.1 Beck depression inventory The Beck Depression Inventory (BDI) was used to determine the prevalence of depression in each of the groups. The examination has 21 questions, is a multiple-choice test, and may award a score anywhere from 0 to 63 points. A number between 0 and 3 is assigned to each response on the scale. A individual is not depressed whether they have a score of 0–9, mild-to-moderate depression if they have a score of 10–18, moderate-to-severe depression if they have a score of 19–29, and severe depression if they have a score of 30–63. The symptoms of depression, such as pessimism, feelings of failure, self-dissatisfaction, guilt, crying hysterically, and sleeplessness, may be evaluated via the use of this self-rated exam. (Beck, Steer, et al., 1988)

3.2.2 Beck Anxiety Inventory The Beck Anxiety Inventory was used to evaluate the individuals in the research to determine their degrees of anxiety (BAI). There are a total of 21 things in this inventory, and each one receives a score between 0 and 3. This is a self-report questionnaire addressing both the physical and mental aspects of anxiety. Finding the sum of all 21 points contributes to the calculation of the overall score. A score ranging from 0 to 7 suggests minor anxiety, 8 to 15 shows mild anxiety, 16 to 25 indicates moderate anxiety, and 30 to 63 indicates severe anxiety, according to the scale. (Beck, Epstein, et al., 1988)

3.2.3. Wong-baker faces pain scale The Wong-Baker Faces Pain Rating Scale was used to measure pain in both early and active labor for each group. The scale consists of a sequence of six faces ranging from a joyful face at 0, which symbolizes "no suffering," to a crying face at 5, which indicates "pain as bad as you can possibly imagine." (Figure 3.2).(D. L. Wong & Baker, 1988)

Figure 2. *Wong-Baker Faces Pain Scale*[1]

3.2.4 The big five inventory-10 (BFI-10) As the Five-Factor Model becomes more widely accepted as the standard model for defining personality, there is a growing need for measuring the Big Five characteristics of personality in situations outside of psychology. In such situations, known Big Five instruments are often excessively long. The ultra-short BFI-10 analyzes the five dimensions with ten items and an average length of about one minute. Its is the shortest version Big Five Inventory (BFI-44) with 10-item .(Rammstedt et al., 2013) (Rammstedt & John, 2007) It consist of 10 statements that are describing your personality

[1] (Hockenberry et al., n.d.)

by rating them 1 (disagree strongy) to 5 (agree strongy). In our study, we used the Turkish version of the inventory.(Barış HORZUM & Ali PADIR, n.d.)

I see myself as someone who..	Disagree strongly	Disagree a little	Neither agree nor disagree	Agree a little	Agree strongly
1. ...is reserved	(1)	(2)	(3)	(4)	(5)
2. ...is generally trusting	(1)	(2)	(3)	(4)	(5)
3. ...tends to be lazy	(1)	(2)	(3)	(4)	(5)
4. ...is relaxed, handles stress well	(1)	(2)	(3)	(4)	(5)
5. ...has few artistic interests	(1)	(2)	(3)	(4)	(5)
6. ...is outgoing, sociable	(1)	(2)	(3)	(4)	(5)
7. ...tends to find fault with others	(1)	(2)	(3)	(4)	(5)
8. ...does a thorough job	(1)	(2)	(3)	(4)	(5)
9. ...gets nervous easily	(1)	(2)	(3)	(4)	(5)
10. ...has an active imagination	(1)	(2)	(3)	(4)	(5)

Figure 3 The Big Five-Inventory-10 (BFI-10) used in the questionnaire

3.2.5. Virtual reality satisfaction survey Using the "Virtual Reality Satisfaction Survey," a 10-question survey developed by our team and evaluated using a visual analog scale (VAS), we were able to determine whether patients were satisfied with their VR experience. The Virtual Reality (VR) satisfaction score may range from 0 to 100, with 0 being the lowest and 100 being the greatest. We also inquired as to whether these women would be interested in using VR throughout their following labors

Please indicate your views on the following statements by ticking the appropriate box (✓)

NAME/SURNAME :

		I strongly disagree (1)	I slightly agree (2)	I agree moderately (3)	I strongly agree (4)	I totally agree (5)
1	I felt like I was in a different environment.					
2	I enjoyed it / I felt relaxed.					
3	I did not have a headache.					
4	I did not experience any balance problems.					
5	I did not have any dizziness.					
6	I did not experience any blurry vision.					
7	I did not experience any burning/irritation in my eyes.					
8	I did not experience claustrophobia.					
9	I did not feel any discomfort in my ears.					
10	I did not feel VR experience was too long.					

Please rate your satisfaction with the VR use. "0" being the lowest "100"being the highest possible VR satisfaction score ****Mark and write the number****	Satisfaction visual analog scale (VAS) 0 10 20 30 40 50 60 70 80 90 100 Not satisfied Most satisfied
Would you like to use VR in your future labor ?	YES ☐ NO ☐

Figure 4. Virtual Reality Satisfaction Survey

3.2.6 Montreal cognitive assessment test (MoCA) The Montreal Cognitive Assessment (Nasreddine et al., 2005b) was created first to aid in the detection of Mild Cognitive Impairment (MCI). It requires little training and may be used by any physician for around ten minutes. It measures attention/concentration, executive functioning, conceptual thinking, memory, language, numerical skills, and orientation. A score of 25 or below (out of a possible maximum of 30) is assessed to indicate substantial cognitive impairment. The MoCA evaluates a variety of cognitive domains: The short-term memory recall test (5 points) consists of two 5-word learning trials and a 5-minute recall. Attention, focus, and working memory are measured by sustained attention, serial subtraction, and digits forward and backward (1 point each). An activity in compareand-contrast measures abstract thinking. Time and place orientation is tested by asking the responder the exam date and city (6 points).

3.3. Oculus Quest All-in-One VR Device

The virtual reality stand-alone headset used in the study was the 128 GB Oculus Quest® (Facebook Inc. USA). The Quest is the first virtual reality headset with great visual quality (i.e., up to 72 frames per second) that does not need a pricey desktop gaming computer or game console to be connected to the Internet. Increasing the frame rate of a virtual environment's visual display (also known as immersion) may improve the overall experience(Meehan et al., 2002), but decreasing the frame rate can cause motion sickness and nausea(M. B. Jones et al., 2004). A high-quality, immersive, pleasurable, and socially linked virtual reality experience can be prescribed in the comfort of one's own home with the Quest, the first off-the-shelf, all-in-one headset available. The Oculus Touch controllers accurately and intuitively translate your hands, movements, and interactions into virtual reality. The device was loaded with the application 'Nature Treks' and then properly adjusted around the patient's head and in front of her eyes.

Figure 5. Oculus Quest VR headset with the Oculus Touch Controllers[2]

[2] (*VR Review: Oculus Quest — Apps and All*, n.d.)

Figure 6. Nature Treks Game Screenshot of Green Meadows[3]

Figure 7. Nature Treks Game Screenshot of Blue Deep[4]

Figure 8. Nature Treks Game Screenshot of Blue Ocean[5]

[3] (*Nature Treks VR on Twitter: "Nature Treks VR out Now for #oculus GO and Gear VR. Https://T.Co/U22WUtWSTo" / Twitter*, n.d.)

[4] (*VR Movement Experiences: (A) Ocean Rift (Whales) 3 (b) Nature Treks VR... | Download Scientific Diagram*, n.d.)

[5] (*VR Review: Oculus Quest — Apps and All*, n.d.)

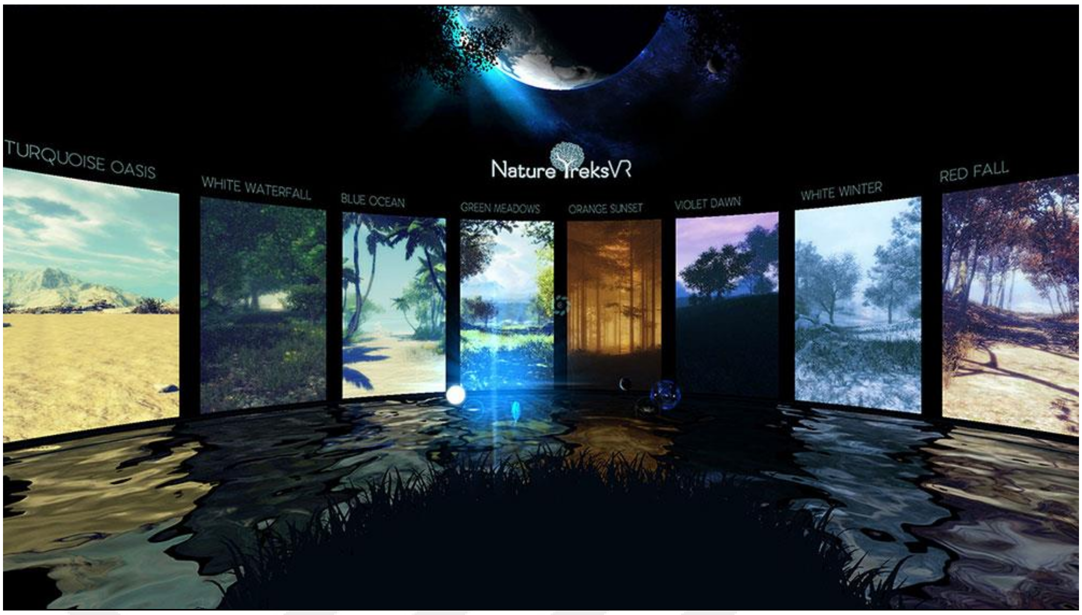

Figure 9. Nature Treks Environments

3.3.1 Oculus quest all-in-one vr gaming headset and application Before the intervention, Oculus Quest headsets trained participants on how to wear and activate them and asked them to rate their pain using the Wong-Baker Faces Pain Scale. The laboring women enrolled in the VR group first wore the headsets in the latent phase of labor (cervical dilation 3 cm) for 20 minutes. The patients were offered to choose among several environments including orange sunset, red savannah, blue ocean, blue deep, blue moon, White winter, green meadows, red fall, and black beginning. (Figure 9). Cards printed out from the screenshots of the Nature Treks application representing these novel immersion options were provided to the patients to help them pick up their preferred environment in advance. End of the first session of VR exposure, the pain score was noted again by using Wong-Baker Faces Pain scale. The second implementation of VR headsets was after epidural analgesia was administered in the active phase of labor (cervical dilation 6-7 cm); this implementation was also for 20 minutes. After the second intervention, the "Virtual Reality Satisfaction Survey" was applied by the authors. Patients were asked to fill out a visual pain rating scale immediately before and after VR use in early and active labor. Control group participants didn't utilize VR headsets and received regular labor care. On admission, everyone was assessed on anxiety, cognitive, and depressive measures.

3.3 Statistical Analysis

3.3.1 Sample size calculation and randomization An a priori power analysis was carried out to determine the sample size using the following parameters: a significance level of 0.05, a power of 80 percent (1-), and an allocation ratio of 1. Assuming a neutral satisfaction score of 50 out of 100 (standard deviation = 12.5) for the control group, we projected a 25 percent increase in satisfaction ratings with the usage of virtual reality technology. To notice this difference, a sample size of 17 people was determined for each of the groups. G*Power software was utilized to conduct this research.

3.3.2 Data analysis All the statistical work was carried out using the most recent version of IBM SPSS Statistics for Windows, which is 25.0. IBM Corporation is based in Armonk, New York. The mean score, the standard deviation, and the absolute frequency are reported as the descriptive statistics for each group, respectively. Normality test Shapiro–Wilk and Kolmogorov–Smirnov were utilized. Using Kolmogorov-Smirnov tests whether N is 30 or more. Kolmogorov-Smirnov significance is 0.060. SPSS tests with 95% confidence. Since our result is over 0.05, the data are near to normal. Normal distribution was determined by using the Kolmogorov-Smirnov test to determine whether the continuous variables were normal. Since our result is over 0.05, the data are near to normal. A p-value of less than 0.05 indicates that the two groups' variances are not equal (i.e., the "Equal variances not assumed" row must be used). An independent t-test or a Mann–Whitney U test was used, depending on the circumstances, to do a head-to-head comparison between the two groups in terms of the mean overall birthing satisfaction ratings, as well as anxiety and depression, cognitive scores. For comparing pain levels before and after the VR experience in early and active labor, we utilized a paired-samples t-test or a Wilcoxon t-test, depending on which was more suitable. A linear regression analysis was utilized to identify relationships between virtual reality satisfaction scores among the variables: beck anxiety score, beck depression score, big five items (O, C, E, A, N), all the environments of nature treks application, age, gestational week, pain level before virtual reality on latent phase and pain level after virtual reality on latent phase. A p-value of less than 0.05 was considered statistically significant.(di Leo & Sardanelli, 2020) Logistic regression analyses were performed to examine associations between anxiety level and beck depression score, big five items (O, C, E, A, N), virtual reality experience, age, gestational week, cognitive assessment score.

Chapter 4

Findings

4.1 Demographics

Women who were admitted to labor and were eligible for participation in the research numbered 58 out of 130. Immersive VR or control group laboring women's demographics are shown in the table (Table 1). These fundamental characteristics were the same in both groups.

Table 1

Characteristics of Each Group

	VR GROUP (n=37)	***CONTROL GROUP (n=21)***
Age, Mean ± SD	31.5 ± 2.7	31.8 ± 3.6
Gestational age, Mean ± SD	39.7 ± 0.7	39.0 ± 1.0
Body Mass Index (BMI), Mean ± SD	26.9±3.4	26.7 ± 3.1
Parity		
Primiparous (n) (%)	32(86.5%)	17(81%)
Multiparous (n) (%)	5(13.5%)	4(19%)
Delivery Type		
Vaginal Birth (n) (%)	33(89.2%)	18(86%)
Cesarean Section (n) (%)	4(10.8%)	3(14%)

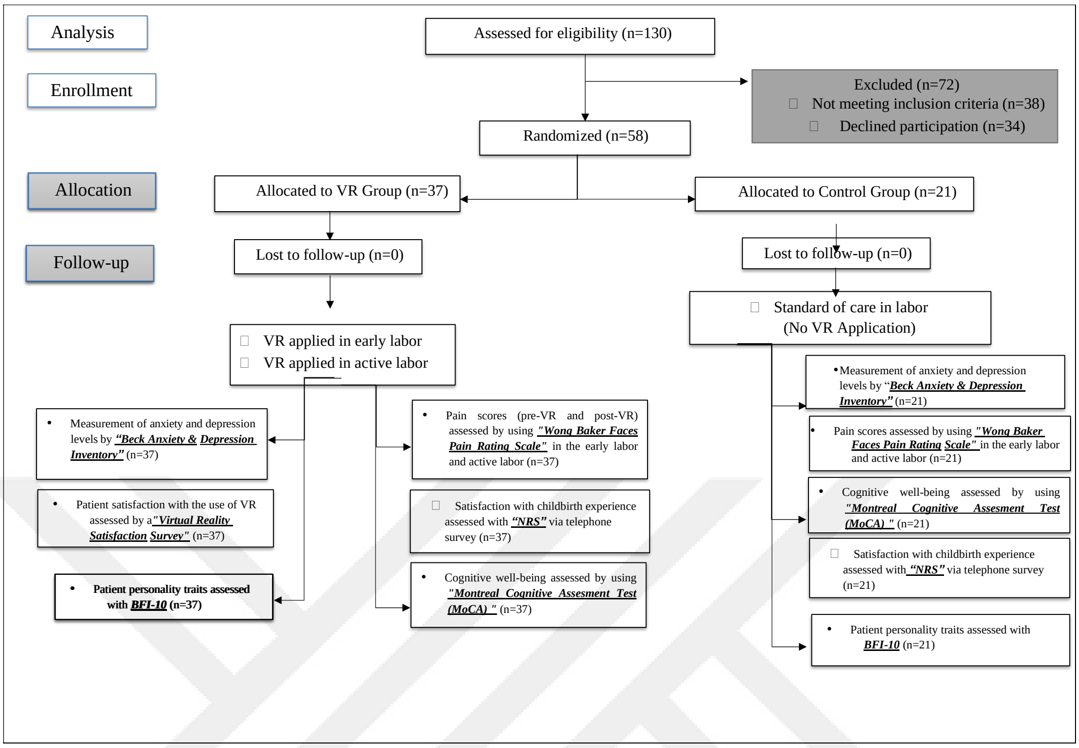

Figure 10. Flowchart of Study

4.2 Neuropsychological and Cognitive Assessments Results

Descriptive analysis of results for Montreal Cognitive Assesment Test (MoCA), Beck's Depression Inventory (BDI) and Beck's Anxiety Inventory (BAI) are given in (Table 3) The Beck Anxiety Inventory revealed similar anxiety scores in the VR (12.7±9.7) and control groups (7.5±6.6). The Beck Depression Inventory also revealed similar depression scores in women in the VR (7.6 ±5.8) and control groups (5.0±5.0). MOCA results are also revealed similar scores in VR (27 ±2.2) and control groups (26.8±2.5). It can be seen from (Table 5). that P-value significance < 0.05 can be observed in the t-test equality of means. It can be concluded that group differences in Beck Anxiety score results are significant for the VR group, who demonstrated a higher level of anxiety than the Control group. ($p=0.020$). Norm test Shapiro–Wilk and Kolmogorov–Smirnov were utilized. Since our result is over 0.05, the data are near to normal. A p-value of less than 0.05 indicates that the two groups' variances are not equal (i.e., the "Equal variances not assumed" row must be used). (Table 2)

Table 2

Normality Test Results for Neuropsychological Assessments

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Beck Anxiety Score	0,125	57	**0,027**	0,912	57	0,001
Beck Depression Score	0,150	57	**0,003**	0,931	57	0,003
Cognitive Assesment Score	0,128	57	**0,021**	0,952	57	0,024

Table 3

Descriptives Scores of Psychological Assessments Results

Grouping (VR Group=A), (Control Group=B)		N	Mean	Std. Deviation	Std. Error Mean
Beck Anxiety Score	***A***	37	12.7	9.7	1.6
	B	21	7.5	6.6	1.4
Beck Depression Score	***A***	37	6.9	5.0	0.7
	B	21	4.9	4.7	1.0
Montreal Cognitive Assesment Score	***A***	37	27.0	2.2	0.3
	B	21	26.8	2.5	0.5

Table 4

Psychological Assessments Group Differences Between VR Group and Control Group

	N	*Mean*	*Minimum*	*Maximum*	*Std. Deviation*
Beck Anxiety Score	58	10.8	0	36	9.0
Beck Depression Score	58	6.2	0	18	4.9
Montreal Cognitive Assesment Score	58	27	21	30	2.2

Table 5

Independent Sample t-test Results for Neuropsychological Tests

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower	Upper
Beck Anxiety Score	Equal variances assumed	2,279	0,137	-2,162	56	0,035	-5,17889	2,39493	-9,97652	-0,38126
	Equal variances not assumed			-2,394	53,871	**0,020**	-5,17889	2,16335	-9,51639	-0,84140
Beck Depression Score	Equal variances assumed	0,942	0,336	-1,482	56	0,144	-1,96654	1,32733	-4,62549	0,69241
	Equal variances not assumed			-1,460	39,845	0,152	-1,96654	1,34739	-4,69004	0,75696
MoCA	Equal variances assumed	1,043	0,312	-0,390	55	0,698	-0,25405	0,65152	-1,55973	1,05162
	Equal variances not assumed			-0,376	35,334	0,709	-0,25405	0,67491	-1,62373	1,11562

4.3 Virtual Reality Satisfaction Survey Results

The Virtual Reality satisfaction questionnaire reveals that all women in the VR group appreciated their VR experience. The normality test also applied with the Satisfaction score. (Table 6) The survey revealed a mean satisfaction score of 86.2± 12.4 out of a maximum of 100 (Table 7). Thirty-five out of 37 (94.5%) women in the VR group stated that they would like to use VR again in future labor. The independent t-test was used to analyze satisfaction level changes due to the virtual reality environment choices. The t-test results revealed that the women who prefer the blue moon environment have a higher score of satisfaction (p=0.001) (Table 8)

Table 6

The Normality Test for Virtual Reality Satisfaction Survey

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Virtual Reality Satisfaction Survey Scores	0,214	37	**0,000**	0,875	37	0,001

Table 7

Virtual Reality Satisfaction Survey Results

	N	Minimum	Maximum	Mean	Std. Deviation
Virtual Reality Satisfaction Survey Score	37	56.36	100.0	86.20	12.44

Table 8

Independent Sample t-test Results for Blue Moon Environment

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Virtual Reality Satisfaction Survey	Equal variances assumed	6,840	0,013	-1,218	35	0,231	-9,06735	7,44642	-24,18440	6,04969
	Equal variances not assumed			-3,744	26,539	**0,001**	-9,06735	2,42210	-14,04115	-4,09356

4.4 The Big Five Inventory Results

Descriptive analysis of results for the BFI-10 scores for each item (O, C, E, A, N) are given in Table 4.8. Bivariate correlation analysis was utilized to investigate the correlation between Big five items and virtual reality satisfaction score. An independent t test was used to determine whether there was a significant difference between the personality traits of those who used virtual reality glasses and those who did not. However, the two groups found no significant difference between the big five items. (Table 10) As a result of the correlation analysis between the satisfaction score and the big five items, no value was found significant. However, it was noteworthy that the openness to experience score and the p score were close to significant. (p=0.056) (Table 11)

Table 9

BFI-10 scores Descriptives for Both Groups

Grouping (VR Group=A)(Control Group=B)		*N*	*Mean*	*Std. Deviation*	*Std. Error Mean*	*P Value*
Extraversion	***B***	21	2,5	1,5	0,33	0,836
	A	37	2,4	1,4	0,23	
Agreeableness	***B***	21	2,4	1,4	0,30	0,91
	A	37	2,3	1,2	0,20	
Conscientiousness	***B***	21	2,7	1,4	0,30	0,217
	A	37	2,2	1,4	0,24	
Neuroticism	***B***	21	-0,9	1,8	0,40	0,807
	A	37	-0,7	1,6	0,27	
Openness to Experience	***B***	21	1,6	1,6	0,36	0,523
	A	37	1,3	1,5	0,25	

Table 10

Independent Sample t-test Results for Using the Virtual Reality Glasses

		Levene's Test for Equality of Variances		*t-test for Equality of Means*						
		F	Sig.	t	df	**Sig. (2-tailed)**	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Extraversion	Equal variances assumed	0,271	0,604	0,214	56	0,831	0,08494	0,39725	-0,71084	0,88072
	Equal variances not assumed			0,209	38,718	0,836	0,08494	0,40710	-0,73869	0,90857
Agreeableness	Equal variances assumed	0,551	0,461	0,276	56	0,783	0,09781	0,35386	-0,61106	0,80669
	Equal variances not assumed			0,267	37,430	0,791	0,09781	0,36673	-0,64497	0,84059
Conscientiousness	Equal variances assumed	0,044	0,835	1,234	56	0,222	0,49163	0,39845	-0,30656	1,28983
	Equal variances not assumed			1,252	43,483	0,217	0,49163	0,39283	-0,30033	1,28360
Neuroticism	Equal variances assumed	0,356	0,553	-0,253	56	0,802	-0,12098	0,47893	-1,08040	0,83844
	Equal variances not assumed			-0,245	38,215	0,807	-0,12098	0,49294	-1,11870	0,87675
Openness	Equal variances assumed	0,507	0,480	0,659	56	0,512	0,28829	0,43716	-0,58744	1,16402
	Equal variances not assumed			0,645	38,920	0,523	0,28829	0,44723	-0,61637	1,19295

Table 11

The Bivariate Correlation Analysis of VR Satisfaction Scores With O, C, E, A, N Continuos Scores

Correlations

		Virtual Reality Satisfaction Survey	Agreeableness	Conscientiousness	Neuroticism	Openness	Extraversion
Virtual Reality Satisfaction Survey	Pearson Correlation	1	-0,087	0,186	0,086	0,317	-0,066
	Sig. (2-tailed)		0,609	0,271	0,612	**0,056**	0,697
	N	37	37	37	37	37	37
Agreeableness	Pearson Correlation	-0,087	1	-0,149	-,655**	-0,019	0,099
	Sig. (2-tailed)	0,609		0,380	0,000	0,912	0,559
	N	37	37	37	37	37	37
Conscientiousness	Pearson Correlation	0,186	-0,149	1	-0,080	0,208	0,188
	Sig. (2-tailed)	0,271	0,380		0,640	0,218	0,265
	N	37	37	37	37	37	37
Neuroticism	Pearson Correlation	0,086	-,655**	-0,080	1	-0,191	-0,069
	Sig. (2-tailed)	0,612	0,000	0,640		0,256	0,685
	N	37	37	37	37	37	37
Openness	Pearson Correlation	0,317	-0,019	0,208	-0,191	1	0,053
	Sig. (2-tailed)	**0,056**	0,912	0,218	0,256		0,754
	N	37	37	37	37	37	37
Extraversion	Pearson Correlation	-0,066	0,099	0,188	-0,069	0,053	1
	Sig. (2-tailed)	0,697	0,559	0,265	0,685	0,754	
	N	37	37	37	37	37	37

4.5 Nature Treks Environment Preferences Results

Considering the results of the descriptive statistics (Table 12), the most preferred first environment was the blue ocean, and the second and third most preferred environments were blue deep and white winter environments, respectively. Descriptive analysis of results for the Big Five Item score for two groups separated by whether they prefer the blue ocean or not are given in Table 4.11. According to the results of (Table 13) which is the independent sample t-test, the laboring women who prefer the blue ocean environment have higher scores of agreeableness score (P=0,03) and also have higher neuroticism level (P=0,04), respectively.

Table 12

Frequency of Virtual Reality Environment

	Blue Ocean	Blue Deep	White Winter	Green Meadows	Red Savannah	Red Fall	Blue Moon	Black Beginning	Orange Sunset
Frequency	**28**	**15**	**14**	**10**	**6**	**5**	**3**	**2**	**0**

Table 13

O, C, E, A, N Scores Descriptives for Both Groups Which Are Separated by Whether They Prefer the Blue Ocean Or Not

Grouping depending on the watching Blue Ocean Environment (Have = 1 , Not Have = 0)		N	Mean	Std. Deviation	Std. Error Mean
Extraversion	.00	9	2,1111	1,53659	0,51220
	1.00	28	2,6071	1,37003	0,25891
Agreeableness	.00	9	1,2222	1,09291	0,36430
	1.00	28	2,7500	1,04083	0,19670
Conscientiousness	.00	9	2,3333	1,65831	0,55277
	1.00	28	2,2500	1,45615	0,27519
Neuroticism	.00	9	0,5556	1,33333	0,44444
	1.00	28	-1,2143	1,57191	0,29706
Openness	.00	9	2,1111	1,45297	0,48432
	1.00	28	1,1429	1,53271	0,28966

Table 14

Independent Sample t-test Results for Blue Ocean Environment

		Levene's Test for Equality of Variances		*t-test for Equality of Means*						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Extraversion	Equal variances assumed	0,067	0,797	-0,918	35	0,365	-0,49603	0,54022	-1,59273	0,60067
	Equal variances not assumed			-0,864	12,371	0,404	-0,49603	0,57392	-1,74234	0,75028
Aggreeableness	Equal variances assumed	0,001	0,975	-3,787	35	0,001	-1,52778	0,40347	-2,34687	-0,70869
	Equal variances not assumed			**-3,690**	**13,017**	**0,003**	**-1,52778**	**0,41401**	**-2,42208**	**-0,63347**
Conscientiousness	Equal variances assumed	0,998	0,325	0,145	35	0,886	0,08333	0,57659	-1,08720	1,25387
	Equal variances not assumed			0,135	12,234	0,895	0,08333	0,61748	-1,25919	1,42586
Neuroticism	Equal variances assumed	0,220	0,642	3,037	35	0,004	1,76984	0,58269	0,58691	2,95277
	Equal variances not assumed			**3,311**	**15,810**	**0,004**	**1,76984**	**0,53458**	**0,63547**	**2,90421**
Openness	Equal variances assumed	0,023	0,881	1,668	35	0,104	0,96825	0,58046	-0,21014	2,14665
	Equal variances not assumed			1,716	14,208	0,108	0,96825	0,56433	-0,24045	2,17696

4.6 Visual Pain Scale Results (VAS)

According to the results of the paired sample t-test, the virtual reality intervention reduced pain ratings in early labor before administering an epidural analgesia. ($p=0.00$) The mean pain score before VR was 2.4±1.0, but the mean pain score post-VR was 1.9±1.0 ($p<0.01$). After receiving epidural analgesia, patients reported much less pain, with a mean pain score of 0.8±0.6; this level remained the same (0.8±0.6) after VR treatment.

Table 15

Pain Scores Descriptives on Both Phases

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	***Pain Level Before VR on Latent Phase***	2,40	37	1,01	0,16
	Pain Level After VR on Latent Phase	1,94	37	1,07	0,17
Pair 2	***Pain Level Before VR on Active Phase***	0,78	37	0,62	0,10
	Pain Level After VR on Active Phase	0,81	37	0,61	0,10

Table 16

Paired Sample T-Test Results for VAS Scores

		Paired Differences					*t*	*df*	*Sig. (2-tailed)*
		Mean	*Std. Deviation*	*Std. Error Mean*	*95% Confidence Interval of the Difference*				
					Lower	*Upper*			
Pair 1	***Pain Level Before VR on Latent Phase – Pain Level After VR on Latent Phase***	0,45	0,55	0,09	0,27	0,64	5,01	36	**0,000**
Pair 2	***Pain Level Before VR on Active Phase – Pain Level After VR on Active Phase***	-0,02	0,16	0,02	-0,08	0,02	-1,00	36	**0,324**

4.7 Simple Linear Regression Analysis for Virtual Reality Satisfaction Survey Results

To assess the relationship between the satisfaction score and beck anxiety score, beck depression score, big five items (O, C, E, A, N), all the environments of nature treks application, age, gestational week, pain level before virtual reality on latent phase and pain level after virtual reality on latent phase Linear regression was used (Table 17). The white winter environment formed the model of satisfaction level in linear regression analysis. (P = 0.033).

This means that the laboring women who have chosen the White winter environment, are more satisfied. (B=8,681)

Table 17

Linear Regression Statistics for The Model of Satisfaction Score

Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Pain Level after Virtual Reality on Latent Phase	-3,424	1,794	-0,297	-1,909	0,065
Openness to Experience	2,509	1,246	0,313	2,014	0,052
White Winter	***8,681***	***3,897***	***0,343***	***2,228***	***0,033***

4.7 Logistic Regression Analysis for Beck Anxiety Inventory

Logistic regression analyses were performed to examine associations between anxiety level and beck depression score, big five items (O, C, E, A, N), virtual reality experience, age, gestational week, cognitive assessment score beck depression score which as dichotomized as “0-9” level of depression as “no depression”, “10-18” level of depression as “have depression”. Table 18 shows results from the binomial logistic regression analyses. Beck Anxiety score was dichotomized as “0-7” level of anxiety as “no anxiety”, “8-63” level of anxiety as “have anxiety”. The variables that were statistically related to anxiety, at a level of $p<0.05$ were embodied in a logistic regression analysis model. The significant features in the logistic regression model of anxiety level were age (p=0028), taking virtual reality technology (p=0.008), and cognitive assessment test score (p=0.035). Findings can be interpreted as follows, with a significant P-value. There is an inverse relationship between age and anxiety level. As the age decreases, the level of anxiety increases. (B=-0,244) In conclusion, it has been found that those who score lower on cognitive tests tend to have higher levels of anxiety. (B=-0,345)

Table 18

Logistic Regression Statistics for The Relationships Among Anxiety Level and Multiple Factors

	B	S.E.	Wald	df	**Sig.**	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
Age	-0,244	0,111	4,831	1	**0,028**	0,784	0,630	0,974
VR intervention	1,841	0,693	7,057	1	**0,008**	6,306	1,621	24,533
Neurotism	-0,323	0,193	2,812	1	0,094	0,724	0,496	1,056
MOCA	-0,345	0,163	4,465	1	**0,035**	0,708	0,514	0,975
Constant	16,040	6,021	7,097	1	0,008	9252684,309		

4.8 Logistic Regression Analysis for Beck Depression Inventory

Logistic regression analyses were performed to examine associations between anxiety level and beck depression score, big five items (O, C, E, A, N), virtual reality experience, age, gestational week, cognitive assessment score beck anxiety score which as dichotomized “0-7” level of anxiety as “no anxiety”, “8-63” level of anxiety as “have anxiety” .Table 4.20 shows results from the bivariate logistic regression analyses. Beck Depression score was dichotomized as “0-9” level of depression as “no depression”, “10-18” level of depression as “have depression”. The significant feature in the logistic regression model of depression level was neuroticism (p=008). Those who scored low on the depression scale are more neurotical, in accordance with the results of the logistic regression analysis. (B=0,587)

Table 19

Logistic Regression Statistics for The Relationships Among Depression Level and Multiple Factors

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 11[a]	**Neuroticism**	,587	,222	6,986	1	**,008**	1,799	1,164	2,782
	Constant	-3,345	,953	12,330	1	,000	,035		

Chapter 5
Discussions and Conclusions

5.1 Virtual Reality and Anxiety

Even though the advantages of virtual reality are widely acknowledged in the scientific literature, there is a lack of information on the local, regional, national, and international levels regarding how the use of VR technology can influence levels of discomfort and anxiety in laboring women. We believe that Chirico et al. (Chirico et al., 2016) are correct when they state that experiencing pain requires conscious attention, which is why VR was successful. Virtual reality (VR) allows the patient to be transported to another world, which captures their focus and leaves them with less attention available to process pain signals. We are assuming that the patient in our research was concentrating on the selected virtual environment, which resulted in emotions of satisfaction for them. According to the results of our research, exposure to a virtual reality environment increased the level of anxiety. This can also be interpreted as the opposite. There is a direct relationship between experiencing virtual reality and anxiety. (B=1,84). This indicates that being exposed to a virtual reality environment can make you feel more anxious, and vice versa. It was thought that there could be another explanation for this. Most of the control group of our study consisted of those who did not want to try virtual reality glasses. People with low anxiety levels are more willing to try something new, such as virtual reality glasses. Therefore, we automatically included these laboring women in the VR group. In other words, individuals with low anxiety levels may not have preferred to use the virtual reality device to compensate for the pain level experienced at birth. Considering that the anxiety levels of the pregnant women in the control group were low, it was assumed that they did not need an extra therapy method to compensate for their pain. Although there is not much research that supports this theory, certain studies have indicated that a person's level of anxiety increases in proportion to the degree to which they feel a feeling of immersion when engaging in virtual reality. (Ling et al., 2014)

5.2 Color Preferences

We noticed a considerable variation in people's preferences for blue based on their personality types. Those laboring women who preferred blue had greater agreeableness and neuroticism scores than those who didn't prefer it. There were no significant differences in color preferences for openness, and conscientiousness**.** Why is it that people with high levels of agreeableness and neuroticism like blue? Individual variations in attitudes toward interpersonal interactions are partly reflected in levels of agreeableness. People who score high on the agreeableness scale are seen to be cooperative, forgiving, prefer social harmony, exhibiting positive affectivity, and having good capacities to empathize with others.(Furnham, 2017) According to Valdez and Mehrabian, who used the Munsell color system, colors in the blue spectrum were ranked as the most pleasurable, whereas purple-blue hues were rated as the least so.(Valdez & Mehrabian, 1994)

5.3 Virtual Reality and Personality

Women with high neuroticism report greater levels of pregnancy anxiety, dread of vaginal delivery (Handelzalts et al., 2016), poor birth experiences, and depressive symptoms. However, research on neuroticism with obstetric and neonatal problems is lacking. High neuroticism or related measurements may be linked to preterm birth (Handelzalts et al., 2016), fetal growth limitation, and fetal discomfort. Neuroticism was linked to epidural analgesia, prolonged delivery, birth canal tears, assisted vaginal delivery, and urgent cesarean section. In all the studies mentioned above, the level of anxiety was measured after VR was applied. In our study, all psychological tests were performed before the women exposed VR technology.

5.4 Painless Delivery Experience

We discovered that the use of immersive VR in laboring women was related to excellent patient satisfaction and likely worked as a distraction strategy. There are relatively little statistics on the usage of VR in laboring women. Previous research evaluating the use of VR during episiotomy healing found that the intervention group had reduced anxiety.(Shourab et al., 2016c) Two recent research found that the usage of VR decreased labor pain and anxiety.(Frey et al., 2019d; M. S. Wong et al., 2021) Kist and colleagues demonstrated that virtual reality (VR) gave anxiolysis to laboring women during epidural placement. Hajesmeel-Gohari et al. presented a scoping review in which they included a total of nine virtual reality research on pregnant women and delivery, with the great majority of the studies showing VR to be beneficial in lowering anxiety and discomfort.(Hajesmaeel-Gohari et al., 2021) Due to the above mentioned, applying immersive virtual reality to pregnant women may have made them even more neurotic and anxious.

In our study, the use of VR during early labor prior to the administration of an epidural reduced pain ratings. Clearly, epidural injection afterwards provided substantial pain relief, as the pain levels of both groups decreased significantly. Importantly, we did not evaluate VR as epidural analgesia treatment. In accordance with our standard of care, women in labor in both the intervention and control groups received epidural analgesia upon request. Our research is the first to evaluate whether virtual reality may be used as a supplement to enhance the delivery experience for women. Our awareness of the significance of a positive childbirth experience and its effect on women's physical, psychological, and social well-being has gradually increased.(Attanasio et al., 2014; Dencker et al., 2020; Karlström et al., 2015) In addition to making sure that mothers and babies are healthy and safe, improving patient satisfaction during childbirth has become a key part of high-quality care, as the WHO has also pointed out. (Tunçalp et al., 2015)

The quality of the caregiver-patient connection and the quantity of assistance provided are critical to patient satisfaction during delivery.(M et al., 2020) As a result, many labor and delivery facilities provide laboring women the option of receiving one-on-one nurse care whenever feasible. They want to be engaged in care decisions and insist that their feedback be taken into consideration. Attending prenatal courses and making a birth plan may help ensure a happy experience for the mother and baby.(Jolles et al., 2019) Poor delivery experience, on the other hand, is a complicated problem that is more often reported in primiparous women, in instances of induced labor, surgical delivery, emergency cesarean, postpartum hemorrhage, poor Apgar score, shoulder dystocia, sphincter damage, and maternal infection.(Adler et al., 2020) According to our findings, the VAS is appropriate for assessing poor delivery experiences(Larsson et al., 2011), and our research suggests that it may also be appropriate for assessing pleasant birthing experiences. For most women, childbirth is accompanied by excruciating agony, making pain management a top priority for healthcare providers.(Ashagrie et al., 2020; Hawkins, 2010)

Labor analgesia is currently known as epidural analgesia because to its ability to effectively reduce pain during childbirth.(Fyneface-Ogan et al., 2009; Tulp & Paech, 2014) In contrast, many women who had healthy pregnancies want to avoid medical intervention and look for non-pharmaceutical methods of coping with labor pain. Also, they want to be calm and active at the same time during labor. A lot of labor and delivery units have warm showers and birth balls for people who are in labor. Warm showers during labor were linked to less pain and helped make the whole experience better.(Lee et al., 2013) Birth ball exercises also helped a lot with self-efficacy and pain during childbirth.(Gau et al., 2011) Some labor and delivery units employ professional therapists and provide massage therapy. The use of massage treatment during childbirth related to pain alleviation, less anxiety, and a shorter length of labor.(Smith et al., 2018)

Increasing rates of cesareans at the request of the mother are a result(Eyi & Mollamahmutoglu, 2021) of widespread fear of delivery, which has a negative impact on nations like Turkey, where already high cesarean rates exist.(Eyi & Mollamahmutoglu, 2021)

Given our high cesarean rates despite 24-hour epidural analgesia, it is evident that we must improve the whole birth process, not just pain management. Our results of great patient satisfaction with VR in labor, as well as regular epidural administration on demand, back up this assertion. Warm showers, birth ball exercises, yoga, massage, and other choices should be presented to laboring women in a variety of ways, sometimes rotating. Our research suggests that immersive VR might be a useful tool for distracting and entertaining women throughout extended periods of labor. When most of the following activities are not possible during intermittent fetal monitoring sessions, VR may be extremely useful. Headaches, dizziness, motion sickness, and impaired vision are all possible side effects of virtual reality. It's possible that VR immersion will have a detrimental impact on static equilibrium as well.(Moro et al., 2017; Park & Lee, 2020)

The women who participated in our research did not report any serious negative effects. This might be due to the limited sample size of our research, as well as the exclusion of all patients with a diagnosis of migraine, headache, dizziness, motion sickness, or epilepsy from participation. Furthermore, before this research, we ran a survey among numerous volunteer pregnant women, and the great majority responded that they chose immersion in nature (Nature Treks environment) over other alternatives, such as playing video games, compared to the other options. Our research has some advantages, but it also has several drawbacks, including the fact that it was not blinded to the level of care in either group of laboring women. There is a need for further research to corroborate our results since the sample size is so tiny. Also worth noting is that this research was conducted in a single premium health facility that serves an affluent demographic that may be more receptive to the use of modern technologies like virtual reality.

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APPENDICIES