JBACHS
Journal of Basic and Clinical Health Sciences

J Basic Clin Health Sci 2025; 9: 429-436
https://doi.org/10.30621/jbachs.1568230
RESEARCH ARTICLE

THE EFFECT OF VIRTUAL REALITY APPLIED DURING BLOOD DRAW ON PAIN AND ANXIETY IN ADULTS: A RANDOMIZED CONTROLLED STUDY

Magbül Ahmet Çoban[1], Serap Sayar[2]

[1] Necmettin Erbakan University, Medicine Faculty Hospital, Blood Collection Unit, , Konya, Türkiye
[2] KTO Karatay University, Faculty of Health Sciences, Department of Nursing, Konya, Türkiye

ORCID: M.A.C 0000-0003-4496-1201; S.S. 0000-0003-4195-0320

Corresponding author: Serap Sayar, **E-mail:** oranserap@gmail.com
Received: 16.10.2024; **Accepted:** 28.08.2025; **Available Online Date:** 30.09.2025

Cite this article as: Çoban MA, Sayar S. The Effect of Virtual Reality Applied During Blood Draw on Pain And Anxiety in Adults: A Randomized Controlled Study. J Basic Clin Health Sci 2025; 9: 429-436.

ABSTRACT

Purpose: The purpose of this study is to determine the effect of using virtual reality (VR) during blood draw on pain and anxiety levels in adults.
Material and Methods: This study was conducted at the blood collection unit of a medicine faculty hospital in central of Anatolia in Türkiye using a randomized controlled experimental design. The study sample consisted of a total of 76 adult patients, with 38 in the VR group and 38 in the control group. The patients were assigned to groups using block randomization method. Data were collected using the Visual Analog Scale (VAS) and State-Trait Anxiety Inventory (STAI). While patients in VR group watched with nature images through VR googles during the blood draw, the control group received only the routine blood draw procedure. STAI scores of patients in both groups were measured before and after the procedure, along with VAS scores during the procedure.
Results: It was found that the VR group had statistically significantly lower mean VAS and STAI scores compared to the control group ($p<0.05$).
Conclusion: In line with these results, it can be said that the use of virtual reality during blood draw is effective in reducing pain and anxiety levels in adult patients.

Keywords: Virtual reality, adults, pain, anxiety, nursing, blood draw

INTRODUCTION

Blood draw is an invasive procedure that causes the patient to experience pain, anxiety and aversive reactions (1,2). The severity of fear of needle during procedures such as blood draw may cause delay in treatment and avoidance of treatment (3). It is reported that 30% of adults experience fear of needles (4). Although the experience of feeling pain often seems to be the cause of anxiety during the blood draw, patients may experience fear and anxiety not only due to pain but also due to the sight of blood, and they also worry that blood-borne diseases may be transmitted (5). Individuals are at high risk of dizziness or syncope because of the anxiety associated with fear of exposure to blood or needles. Syncope causes temporary loss of consciousness and increases the risk of physical injury due to falls (6). The management of pain and anxiety during the procedure will increase the satisfaction of patients by reducing the level of pain and anxiety, and will allow

patients to experience less pain, fear and anxiety during future procedures, as they experience the blood draw experience positively (7).

Nurses can have a significant impact in alleviating pain and anxiety during invasive procedures through pharmacological, non-pharmacological techniques, or by redirecting attention (4, 8). The literature highlights that nurses utilize local anesthetic creams and oral medications as pharmacological interventions during invasive procedures. Additionally, non-pharmacological approaches such as music therapy, vibrating tourniquets, buzzy devices, various palpation techniques, and therapeutic touch are employed especially in children (9,10,11). Virtual reality (VR) are also employed as part of these non-pharmacological interventions (11). VR involves the creation of an artificial and immersive environment in three dimensions using computers and various tools, making it possible for individuals to experience it as if it were real. With the VR application that appeals to multiple senses, the person feels as if the person really exists in the created world (12). When the literature is examined, the effect of virtual reality on pain and anxiety as a distraction technique during invasive procedures such as blood sampling is widely used in children (11, 13, 14, 15, 16). In the literature, studies on the subject for adults during the invasive procedures are limited. It was stated that the application of VR during peripheral intravenous catheter insertion in adults is an effective method to reduce pain (17). In the study by Yılmaz Koçak and Kaya (7), which evaluated the effect of coughing application and VR application on pain and anxiety during blood draw in adults, it was shown that the pain and anxiety levels of the intervention group decreased and satisfaction levels increased. In patients with breast cancer, it was stated that VR s were more effective than morphine alone in relieving pain and anxiety and VR were more reliable than pharmacological methods (18). The compatibility of VR googles with modern technology, their easy accessibility, portability, cost-effectiveness, applicability to various patient groups, effectiveness in alleviating pain and anxiety based on numerous studies, and their non-invasive nature collectively render their utilization appealing. Although it is seen that VR are frequently used in children due to distraction, it is important to expand their use in adult patient groups. For this, more studies are needed in the literature to prove the positive effects of using VR goggles during invasive procedures such as blood sampling in adults. Therefore, this study was conducted to determine the effect of VR goggles on pain and anxiety during blood collection in adults.

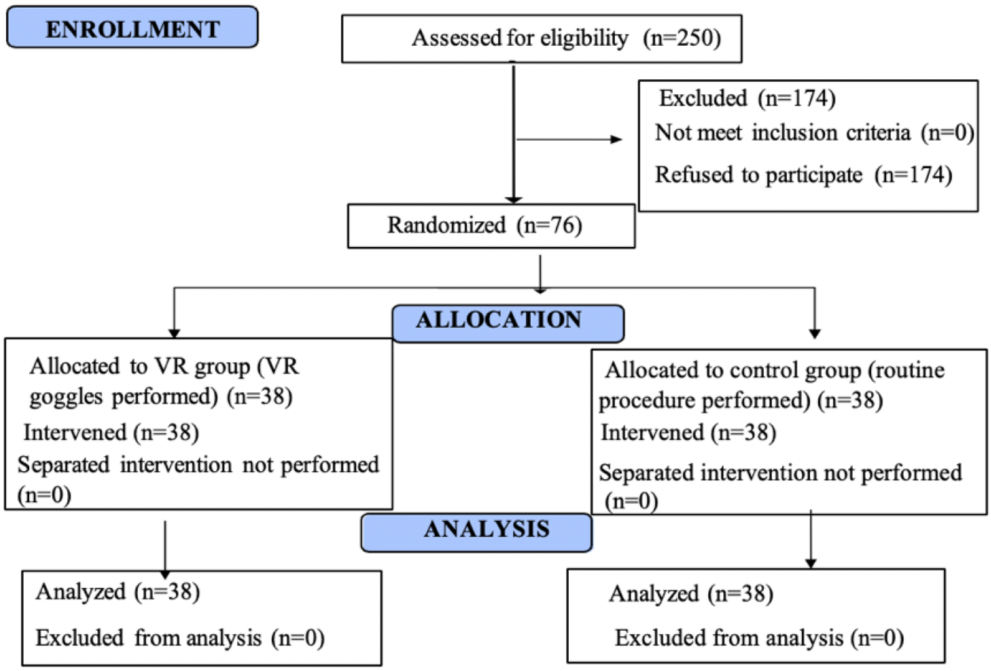

Figure 1. Consort flow diagram

Hypotheses of the Study

H_1: The pain levels of the VR group during blood draw in adult patients are lower than the pain levels of the control group.

H_2: The anxiety levels of the VR group during blood draw in adult patients are lower than the anxiety levels of the control group.

MATERIAL AND METHODS

This study was a randomized controlled experimental design. This study is registered in the Clinical Trials database (NCT05366556).

Ethical Considerations

Ethics committee permission was obtained from KTO Karatay University Faculty of Medicine, Ethics Committee for Research Other Than Drugs and Medical Devices (Date: 17.02.2022, Decision number 2022/09). Institutional permission numbered E-14567952-900-164653 was obtained from Medical Faculty Hospital where the study was conducted. Verbal and written informed consent was obtained from the patients who would participate in the study. The present study followed the principles outlined in the Declaration of Helsinki for Human Studies.

Study Sample

The study population consisted of adults who applied to Necmettin Erbakan Unversity Medical Faculty Hospital blood draw unit to give blood between February 2022 and June 2022 in Konya Province. The sample size of the study was determined based on a study using G*Power 3.1.9.7 program with α= 0.05, d=0.3332287 and 80% power (11). The sample size was calculated as 76 participants, 38 in each group. The targeted sample size was reached (Figure 1 Consort Flow Diagram). The study included patients aged 18 and above, without visual and hearing impairments, not using glasses, and without psychiatric and cognitive disorders. Patients with chronic pain, those unable to provide a blood sample in one attempt, and those experiencing fainting or syncope during blood draw were excluded from the study.

Randomization

A block randomization method was used to create four-letter combinations. In this study with 76 participants, a total of 19 blocks were obtained through blocked randomization. By drawing lots, it was determined whether the letters in the blocks were assigned to VR group or control group.

Blinding

Patients could not be blinded during the application since the patients knew which application group they were in by wearing the VR glasses. Therefore participant blinding and blinding of the researcher who will apply VR could not be applied due to the nature of the study.

Measuring Methods

Sociodemographic and Descriptive Characteristics Questionnaire Form, Visual Anolog Scale and State-Trait Anxiety Inventory were used as data collection tools in the study.

Sociodemographic and Descriptive Characteristics Questionnaire Form

This form was developed by the researchers following a review of the literature and includes questions related to sociodemographic and descriptive characteristics of the patients, such as age, gender, education level, marital status, occupation, fear of venipuncture, and previous experience with virtual reality goggles (7,8, 11,16,17).

Visual Analog Scale (VAS)

The scale was developed by Price et al. in 1983 to assess subjectively perceived pain (19). In her study, Eti Aslan indicated that VAS is sensitive and provides better description in the assessment of acute pain (20). The VAS is a scale of 10 cm lines (0-10 cm) used to assess pain. 0 means "no pain" and 10 means "unbearable pain". In this method, the patient is told that there are two endpoints and asked to mark the number expressing the degree of pain between these two points (19,20).

State-Trait Anxiety Inventory (STAI)

Developed in 1970 by Spielberger, the scale was adapted and validated in Turkish by Öner and Le Compte in 1982. It is used to determine how an individual feels at a certain moment and under certain conditions. It can be applied to the same individuals at different times to detect changes in the level of anxiety, fear and severity. The scale is a four-point Likert-type scale and it consists of 20 items. The total score obtained from the scale is between 20-80. A high score indicates a high level of anxiety. The Cronbach's alpha value of the Turkish validity and

reliability of the scale was found to be 0.94 (21). In our study, the Cronbach alpha value of the scale was found to be 0.92.

Data Collection Process

Patients who applied to the blood collection unit and met the sample selection criteria were informed about the study and included in the study after verbal and written informed consent was obtained. Patients were assigned to the VR and control groups by randomization.

VR Group

Subjects in the intervention group were provided with information regarding the study and the utilization of VR goggles. The informed subjects were then requested to fill out the questionnaire pertaining to sociodemographic and descriptive characteristics, as well as the State-Trait Anxiety Inventory. Participants who had completed the questionnaire and STAI were informed about VAS and were instructed to use their individual statements when questioned about the level of pain during the blood draw process. After taking a seat in the blood draw chair, participants were asked to put on the VR goggles. The Shinecon G07E 3D model VR goggles utilized in the study are compatible with smartphones ranging from 4.7 to 6.3 inches. Approximately one or two minutes before the blood draw, the video named Nature Walk included a relaxing music (Travel and Relax in Nature in 3D-Relaxing Forest and Bird Sounds) began to be shown to the patients through the VR goggles. The blood draw procedure lasted approximately two minutes. The patients' right or left arm was used for blood draw. Throughout this duration, the application of the VR goggles continued. During the VR application, patients listened to relaxing music with headphones and the music level was adjusted so that they could hear the researcher's voice.

Table 1. Comparison of the groups according to sociodemographic and descriptive characteristics

	Group		Test statistics	
	VR Group (n=38)	**Control Group (n=38)**	**Test value**	**p**
Age				
$\bar{x} \pm$SD	31.29±8.29	28.50±6.15	-1.322 ‡	0.186
	VR Group n (%)	**Control Group n (%)**	**Test value**	**p**
Gender			1.317 †	0.251
Female	17 (44.7)	22 (57.9)		
Male	21 (55.3)	16 (42.1)		
Marital status			3.742 †	0.053
Married	21 (55.3)	29 (76.3)		
Single	17 (44.7)	9 (23.7)		
Education status			3.194 †	0.363
Primary school	3 (7.9)	8 (21.1)		
High school	13 (34.2)	11 (28.9)		
University	22 (55.3)	19 (44.7)		
Master's Degree/PhD	1 (2.6)	2 (5.3)		
Occupation			4.528 †	0.339
Jobless	7 (18.4)	12 (31.6)		
Student	7 (18.4)	5 (13.2)		
Officer	4 (10.5)	8 (21.1)		
Worker	13 (34.2)	9 (23.7)		
Other (self-employed)	7 (18.4)	4 (10.5)		
Previous use of VR			0.106 †	0.744
Yes	6 (15.8)	5 (13.2)		
No	32 (84.2)	33 (86.8)		
Fear of bloodletting			2.581 †	0.108
Yes	23 (60.5)	16 (42.1)		
No	15 (39.5)	22 (57.9)		

VR: Virtual Reality; ‡: Mann Whitney U Test (z); †: Chi-Square Test (X^2); Summary statistics are given as mean ± standard for numerical data and Number (Percentage) for categorical data

The patient's level of pain was assessed and marked on the VAS during the blood draw process. Following the completion of the blood draw procedure, the VR goggles were removed. The patient was escorted to the waiting area and instructed to complete the STAI. The cleanliness of the virtual reality goggles was maintained using protective disposable hygienic eye bands. There were no patients who fainted during blood drawn or who could not be drawn even once. Therefore, no patient was excluded from the study.

Control Group

No intervention procedures were administered to the subjects in the control group. The standard blood draw procedure was performed. Blood was collected from the antecubital region using a vacutainer by the researcher. Prior to the procedure, the STAI and the questionnaire were administered; during the procedure, VAS was used; and after the procedure, STAI was completed. There were no patients who fainted during blood drawn or who could not be drawn even once. Therefore, no patient was excluded from the study.

Statistical Analyses

Data were analyzed using the statistical package program IBM SPSS Statistics Standard Concurrent User V 26 (IBM Corp., Armonk, New York, USA). The normal distribution of the data of the numerical variables was evaluated by Shapiro Wilk normality test. The data did not have a normal distribution. The Mann-Whitney U test was used to compare two groups for numerical variables. Chi-square tests (Pearson chi-square/Fisher exact test) were used to compare the groups with categorical variables. Measurements taken at two different times, intra-group and inter-group evaluations of the VR and control groups were performed using mixed design analysis of variance and Bonferroni-Dunn test, one of the multiple comparison tests. $p<0.05$ level was considered statistically significant.

RESULTS

The comparison of the VR and control groups according to sociodemographic and descriptive characteristics is given in Table 1.

Table 2. Comparison of the mean VAS scores of the groups during blood draw

	Group		**Test statistics**	
	VR Group n=38	**Control Group n=38**	**Test value**	**P**
VAS				
$\bar{x} \pm$**SD**	1.13±0.96	3.87±2.18	-5.333 ‡	**0.001**
***M* (*min-max*)**	1 (0-3)	4 (0-8)		

VAS: Visual Anolog Scale; VR: Virtual Reality; ‡: Mann Whitney U Test (z); Summary statistics are given as mean ± standard and Median (minimum, maximum) values for numerical data. Bolded sections are statistically significant ($p<0.05$).

Table 3. Comparison of pre-test and post-test STAI scores of the groups

	Group		**Test Statistics****		
	VR Group (n=38)	**Control Group (n=38)**	***F***	***p***	***η²***
STAI					
Pre-test	47.61±15.21	40.66±13.88	4.327	0.081	0.035
Post-test	28.79±6.82	37.55±12.72	14.008	**0.001**[&]	0.159
Test statistics*	F=72.333 ***p*=0.001**[&] η^2=0.494	F=1.970 p=0.165 η^2=0.026			

Group effect: F=0.140 p=0.709 η^2=0.002 **Time Effect:** F=49.089 p<0.001 η^2=0.399
Group x Time Effect: F=25.214 p<0.001 η^2=0.254

VR: Virtual Reality; STAI: State-Trait Anxiety Inventory; *F:* Mixed order analysis of variance, Effect Size (η2), *Inter-group comparison, **Intragroup comparison, Summary statistics are given as mean ± standard deviation [&]Bolded sections are statistically significant ($p<0.05$)

There was no statistically significant difference between the distribution of gender, marital status, educational status, occupation, previous use of virtual reality goggles, and fear of bloodletting. VR and control groups showed homogeneous distribution ($p > 0.05$; Table 1).

The comparisons of the mean VAS scores between the VR and control groups during blood draw are presented in Table 2. The median VAS score was one point in the VR group and four points in the control group. Accordingly, the mean VAS scores of the patients in the VR group were significantly lower than those in the control group ($p < 0.05$;Table 2).

The comparison of the mean STAI scores of the VR and control groups before (pre-test) and after (post-test) intervention and the changes in mean scores are given in Table 3. The mean post-test STAI scores of the patients show a statistically significant difference between the VR and control groups. While there was no difference between the groups in pre-test, the mean STAI scores of the VR group were statistically lower than the control group in post-test (F=14.008; p=0.001). Furthermore, within the control group, there was no statistically significant difference between the mean pre-test and post-test STAI scores (F=1.970 p=0.165). However, within the VR group, it was observed that the mean post-test STAI scores were statistically significantly lower than the mean pre-test STAI scores (F=72.333 p=0.001) (Table 3).

DISCUSSION

In this study, when the pain level during blood draw in adults was evaluated, it was determined that the VAS pain score of the patients in the VR group was lower than the patients in the control group, and there was a statistically significant difference between the VR group and the control group. There are different study results on the subject in the literature. Unlike the results of the current study, in some studies evaluating the effect of the use of VR goggles on pain level, it was stated that VR application had no effect on pain (22-26). VR had no effect on pain during colonoscopy, bone marrow aspiration and biopsy, and cystoscopy procedures (23, 24, 26). Similar to current study results, some other studies which were conducted during peripheral intravenous catheter placement (7), during blood sampling (17), intramuscular penicillin injection (27), port catheter implantation (28) in adults reported positive conclusions in terms of decreased pain level. In adition, in a meta-analysis investigating the impact of VR application on acute and chronic pain reduction in adults, VR goggles were identified as an effective method for alleviating acute pain (29). It is seen that the results of some studies in the literature are similar to the results of the present study and some of them are different. It is thought that the perception of diagnostic methods such as colonoscopy, cystoscopy, bone marrow aspiration as larger procedures by patients compared to procedures such as blood draw and the idea that these interventions can be used in the diagnosis of diseases such as cancer cause patients to feel more fear and anxiety and this situation indirectly affects pain. Therefore, it is estimated that VR does not affect the pain level during procedures such as colonoscopy, cystoscopy, but may be effective during small procedures such as blood draw, by diverting attention. Apart from this, these results may also be due to the different images and durations shown in virtual reality.

In this study, it was determined that the anxiety levels of adult patients in the VR group during blood draw decreased compared to patients in the control group. In the study by Koçak and Kaya (7), pain, anxiety and satisfaction levels of the patients were evaluated by using virtual reality application and cough technique during blood drawing in adults. As a result of the study, it was determined that the anxiety scores of the patients in the VR group decreased and their satisfaction levels increased. In a systematic review investigating the effect of VR on anxiety in hospitalized patients, it was found that 44% of the studies included in the review evaluated the anxiety levels of the patients and 50% of these studies found that VR application was effective in reducing the anxiety levels of the patients (30). In a study by Cheruvatoor et al. (31), it was reported that during dental procedure, a video with underwater environment and relaxing music shown to adult patients with virtual reality reduced their anxiety. In a systematic review in which Gilbertson et al. (32) examined the effect of virtual reality application on the management of needle phobia during medical procedures in adult patients, they found very little research on virtual reality as a distraction method with adult patients, so they did not comment on the effect of virtual reality and emphasised the need for further studies on the subject. The results obtained from the study are consistent with the limited literature and possess a supporting nature towards the literature's conclusions. It can be said that VR, which activates multiple senses and has the potential to pacify stimuli

from environmental factors, enables the individual to feel shorter long-lasting procedures and reduces anxiety by removing the individual from the hospital environment.

Limitations of the Study

One of the most important strengths of this study is that it has a randomized controlled design. In addition, the standardized execution of the application and comparative analysis with the control group strengthens the reliability of the results obtained. However, the study has two limitations. Firstly, blinding was not implemented in the research. Secondly, since the study was conducted in a single hospital, the results cannot be generalized to the entire population.

CONCLUSION

In line with these results; it was found that the use of VR during blood draw in adults reduces the level of pain and anxiety. It may be recommended to expand the use of VR goggles in hospitals during invasive procedures, to raise awareness of nurses working in clinics about the use of easy and effective distraction methods during anxiety-increasing and painful procedures, and to conduct more comprehensive studies on VR goggles in different sample groups of adults.

Acknowledgement: We would like to thank all participants who participated in the study. This study was presented as an absract oral presentation at the ''Innovative Healthcare Education Through Virtual Reality Congress'' in Karabük/Türkiye on 06-07 December 2023 and this abstract was awarded the first prize for oral presentation.

Author contribution: Conceptualization: SS, MAC. Data collection: MAC. Formal analysis: SS. Investigation: SS, MAC. Methodology: SS, MAC. Writing–original draft: SS, MAC.

Conflict of interests: There are no conflicts of interest. This study is a master's thesis project.

Ethical approval: Ethics committee permission was obtained from KTO Karatay University Faculty of Medicine, Ethics Committee for Research Other Than Drugs and Medical Devices (Date: 17.02.2022, Decision number 2022/09). Institutional permission numbered E-14567952-900-164653 was obtained from Medical Faculty Hospital where the study was conducted. Verbal and written informed consent was obtained from the patients who would participate in the study.

Funding No financial support was received for this study. The expenses associated with the virtual reality goggles have been funded by the researcher (first author) within the scope of the article.

Peer-review: Externally peer-reviewed.

REFERENCES

1. Hassan AM, Mohammed GT, Hefnawy GR, et al. Effects of nursing guidance about venipuncture versus ordinary syringe, a comparative study on rates of phlebotomy hematoma. International Journal of Membrane Science and Technology 2023;10(2):3426-3438.
2. Perdue MJ, Umar MA, Walker JD, et al. Immersive virtual reality for pain control and anxiolysis during IV blood draws in adults: a randomized controlled trial. Military Medicine 2023;188(7-8):e2467-e2471.
3. Alsbrooks K, Hoerauf K. Prevalence, causes, ımpacts, and management of needle phobia: an ınternational survey of a general adult population. Plos One 2022;17(11):e0276814.
4. McLenon J, Rogers MAM. The fear of needles: a systematic review and meta-analysis. J Adv Nurs 2019;75(1):30-42.
5. Birgili F, Aydın S. Examination of negative sign symptoms seen during bloodletting and the level of anxiety from ındividuals which are donating blood. Hacettepe University Faculty of Health Sciences Nursing Journal 2011;18(2):17–26.
6. Trost Z, Jones A, Guck A, et al. Initial validation of a virtual blood draw exposure paradigm for fear of blood and needles. J Anxiety Disord 2017;51:65-71.
7. Yılmaz Koçak M, Kaya H. Kan alma işlemi sırasında uygulanan dikkati başka yöne çekme yöntemlerinin ağrı, anksiyete ve memnuniyet üzerine etkisi (The effect of distraction methods applied during blood collection on pain, anxiety and satisfaction). Fırat University Health Sciences Medical Journal *2022;*36(2):84-91.
8. Kaplan A, Kaplan Ö. Analysis of nursing thesis using complementary therapies and supportive care applications during drug applications and blood collection, Ordu University Journal of Nursing Studies 2022;5 (1):84–92.
9. Davas S, Kürtüncü M. The effect of three different methods during blood collection on pain level and parental satisfaction in children. Archives of Health Science and Research 2021;8(1):60–68.
10. İnal S, Canbulat N. Using of Distraction Methods on Procedural Pain Management of Pediatric Patients. Arch Health Sci Res 2015;2(3):372-378,

11. Özalp Gerçeker G, Ayar D, Özdemir EZ, et al. Effects of virtual reality on pain, fear and anxiety during blood draw in children aged 5–12 years old: a randomised controlled study. Journal of Clinical Nursing 2020;29(7-8):1151–1161.
12. Şekerci C. History of the virtual reality concept. Journal of International Social Research 2017;10(54):1126–1133.
13. Piskorz J, Czub M. Effectiveness of a virtual reality intervention to minimize pediatric stress and pain intensity during venipuncture, Journal for Specialists in Pediatric Nursing 2018;23 (1):1–6.
14. Koç Özkan T, Polat F. The effect of virtual reality and kaleidoscope on pain and anxiety levels during venipuncture in children. Journal of PeriAnesthesia Nursing 2020;35(2):206–211.
15. Ayran G, Köse G, Çelebioğlu A. The effect of virtual reality on pain and anxiety during blood draw in children: a randomized controlled study. Gevher Nesibe Journal of Medical And Health Sciences 2023;*8*(3):469-477.
16. Akarsu Ö, Us MC, Semerci R, et al. The effect of two different virtual reality videos on pain, fear, and anxiety during a venous blood draw in children: a randomized controlled study. Pediatric Practice and Research 2023;11(3):164-170.
17. Başak T, Duman S, Demirtaş A. Distraction-based relief of pain associated with peripheral ıntravenous catheterisation in adults: a randomised controlled trial, Journal of Clinical Nursing 2020;29(5-6):770–777.
18. Mohammad EB, Ahmad M. Virtual reality as a distraction technique for pain and anxiety among patients with breast cancer: a randomized control trial. Palliat Support Care 2019;17(1):29–34.
19. Price DD, McGrath PA, Rafii A, et al. The validation of visual analogue scales as ratio scale measures for chronic and experimental pain, Pain 1983;17;45–56.
20. Eti Aslan F. The assessment methods of pain, Cumhuriyet Nursing Journal 2002;6(1):9–16,
21. Öner N, Le Compte A. Durumluk-Sürekli kaygı envanteri el kitabı, 1983. İstanbul, Boğaziçi Üniversitesi Yayınları.
22. Eijlers R, Dierckx B, Staals LM, et al. Virtual reality exposure before elective day care surgery to reduce anxiety and pain in children. European Journal of Anaesthesiology 2019;36(10):728–737.
23. Glennon C, Mcelroy SF, Connelly LM, et al. Use of virtual reality to distract from pain and anxiety. Oncology Nursing Forum 2018; 45(4):545–552
24. Umezawa S, Higurashi T, Uchiyama S, et al. Visual distraction alone for the ımprovement of colonoscopy-related pain and satisfaction. World Journal of Gastroenterology 2015;21(15):4707–4714.
25. Veldhuijzen G, Klaassen NJM, Van Wezel RJA, et al. Virtual reality distraction for patients to relieve pain and discomfort during colonoscopy. Endoscopy International Open 2020;8(7):E959–E966.
26. Walker MR, Kallingal GJS, Musser JE, et al. Treatment efficacy of virtual reality distraction in the reduction of pain and anxiety during cystoscopy. Military Medicine 2014;179(8):891–896.
27. Başak T, Demirtaş A, Yörübulut SM. Virtual reality and distraction cards to reduce pain during ıntramuscular benzathine penicillin ınjection procedure in adults: a randomized controlled trial. Journal of Advanced Nursing 2021;77(5):2511–2518.
28. Menekli T, Yaprak B, Doğan R. The effect of virtual reality distraction ıntervention on pain, anxiety, and vital signs of oncology patients undergoing port catheter ımplantation: a randomized controlled study. Pain Management Nursing 2022;23(5):585–590.
29. Mallari B, Spaeth EK, Goh H, et al. Virtual reality as an analgesic for acute and chronic pain in adults: a systematic review and meta-analysis, Journal of Pain Research 2019;12:2053–2085.
30. Smith V, Warty RR, Sursas JA, et al. The effectiveness of virtual reality in managing acute pain and anxiety for medical ınpatients: systematic review. Journal of Medical Internet Research 2020;22(11):e17980.
31. Cheruvatoor JJ, Kaini L, Hanafiah MABMA, et al. Use of virtual reality (vr) as an audio-visual distraction tool in the reduction of dental anxiety during local anesthesia. Journal of Pharmaceutical Research International 2021;*33*(31B):102-108.
32. Gilbertson CJ, Rasekaba T, Blackberry I. Effect of using virtual reality to manage needle phobia in adults undergoing medical procedures: a rapid review. Journal of Perioperative Nursing 2024; 37(1):29-40.