

## Cope children's anxious behavior and pain with virtual reality during venipuncture procedure in emergency department

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### Article Info

#### Article history:

Received Nov 17, 2022

Revised Aug 15, 2023

Accepted Sep 8, 2023

#### Keywords:

Anxiety behavior

Children in emergency department

Dorothy's behavioral theory

Pain

Virtual reality

### ABSTRACT

Venipuncture procedures undeniably increase anxiety behavior and pain while children are in the emergency department. This study aimed to analyze the effectiveness of virtual reality (VR) on anxiety behavior and pain with the Dorothy-behavior theory during the venipuncture procedures procedure in the emergency department. The research used a quasi-experimental two-group pretest-posttest design with a control group design with 42 respondents in the yellow zone of the emergency department of RSPUN Cipto Mangunkusumo. Data analysis used the Wilcoxon test, Mann-Whitney, and ordinal regression. There were significant differences and comparisons between anxiety behavior (p-value <0.001) and pain (p-value <0.001) when the venipuncture procedure was performed in the experimental group. School-age children (p-value 0.026; OR=4.958) affect pain. This study recommends that nurses in emergency departments provide VR during venipuncture procedures to address anxiety and pain behaviors. In addition, Dorothy's behavioral theory in the vein puncture procedure has become an innovation in nursing care. Provide aspects of protection based on the age, gender, and experience of the child; maintenance aspects by looking at VR effects; and aspects of stimulation as reference materials or recommendations for further research on VR to overcome anxiety and painful behavior in children during venipuncture procedures.

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## 1. INTRODUCTION

The emergency department is a health service divided into several emergency-level classifications to preserve the patient's life and develop all analytical models for patient satisfaction and recovery, even in a crowded situation [1]. It is common for pediatric patients in the emergency department to experience significant anxiety phenomena, such as fear of being hurt, fear of hearing bad news, fear of hospitalization, fear of separation from parents and siblings, fear of strange procedures, and fear of loss of control and autonomy [2], [3]. The pain due to the illness must worsen because the child is undergoing an intravenous catheter procedure. The intravenous catheter procedure is the most common medical intervention encountered during treatment in the emergency department because it is the medium for blood laboratory tests and immediate medical therapy [4]. The pain felt by the child during the intravenous catheter procedure is an unpleasant sensory feeling due to the injured tissue [5]. As a result, children feel emotional, so anxiety arises as a warning signal originating

from the cerebral cortex affecting somatic and psychiatric conditions. In addition, anxiety can occur if the child sees a sharp object that will injure him or if the child has had an unpleasant experience from the procedure [6].

Not surprisingly, children experience changes in psychological behavior that increase before the procedure, such as panic, tension, screaming, confusion, crying, rebellion, grimacing, and anger [5], [7]. In the field, 70% of children experience pain, 87% experience increased anxiety, and 10% experience phobias [8]. By nature, this invasive procedure is considered the most dreaded, distressing, and painful, thus becoming a phobia. As a result of this act of inserting an intravenous catheter, children perceive the nurse as the party who injured them by 40% because the majority of nurses carry out collaborative instructions for the procedure for placing an intravenous catheter, and the nurse does not explain or contract the child regarding this action, so the child is shocked. While children fear doctors by 27% [6], [9]. Another fact that this procedure causes trauma to the child during hospitalization is the failure of the intravenous catheter procedure. The internal cause is the anatomy of the blood vessels. The younger the child, the harder it is. External factors result from the disease process, conditions of systemic circulation disorders that cause blood vessels to constrict so that the success rate of the procedure is lower, even though nurses and doctors are present to help children overcome their illness [10].

Nurses' sensitivity to the condition of patients who experience increased pain and anxiety due to this procedure is very important [11]. While undergoing pediatric emergency clinical practice at the emergency room at Cipto Mangunkusumo Hospital, a distraction technique was developed, namely venous puncture using cold compresses, but this has not been done for a long time because there were no special facilities for preparing cold compresses, and this action was not entirely successful. After discussing with the nursing team, the researcher turned all the children's views using virtual reality (VR). The VR distraction technique is a simple non-pharmacological intervention adapted to technological advances [12]. It distracts attention as if it were present in the real world, so the child stays focused. The tool is easy for the nurse, so no training is required. In addition, VR tools are inexpensive and prevent infection using VR, and it is enough to clean them with antiseptic gauze [13].

Providing VR to children in Italy is proven to reduce pain and provide pleasure [14]; Canadian children are satisfied [15]; children in Türkiye feel less afraid [16]; children in Colombia experience no side effects [17]; reduce pain from their illness [18]; as a new intervention in service satisfaction [19], and children with chronic pain in Indonesia experience a reduction in anxiety over and over due to the same procedure. However, this article only proves the pain response of intravenous catheter procedures in chronically ill children without describing the child's anxiety which can result in hospitalization and trauma, including previous research in Indonesia [20]. In addition, the measurement tool used is not suitable for assessing the child's pain response due to the procedure but rather a measuring scale of pain from the disease process [21]. Therefore, in this study, we investigated the impact of VR in reducing anxiety and pain behavior in children in the yellow zone of the hospital emergency room during venipuncture procedures using Dorothy's behavioral theory approach with protective, maintenance, and stimulation [11]. For this reason, researchers used an anxiety measurement tool, the child fear scale (CFS) [16]. To measure pain, researchers used the faces pain scale-revised (FPS-R) [15].

This article aimed to determine the effectiveness of VR in dealing with anxiety behavior and pain during venipuncture procedures using the Dorothy-behavior theory approach at the yellow zone emergency department of RSUPN Dr. Cipto Mangun Kusumo. The specific objective of this study was to analyze the characteristics of the respondents based on age, gender, and experience of venipuncture procedures and to analyze whether there were differences in pre-post-test child anxiety and pain behavior in the experimental and control groups; analyze whether there is a comparison between pre-post child anxiety and pain behavior in the experimental group and the control group, and analyze whether there is an effect of the intervention given to each group. The provision of VR is the first intervention and has never been developed and implemented in the emergency department of RSUPN Dr. Cipto Mangun Kusumo.

## 2. RESEARCH METHOD

### 2.1. Study design

This research is quantitative research. The researcher used a quasi-experimental method of pretest-posttest groups with a control group design [22]. This research design is the research team's decision because it considers time efficiency, minimal budget, does not require a large sample of respondents, and the time given by Dr. Cipto Mangun Kusumo Hospital is limited. The control group only received standard vein puncture procedure intervention. The experimental group got the VR distraction technique by providing a cartoon video of the underwater world with a 360° view, medium lens resolution, and safe for the eyes during the vein puncture procedure.

## 2.2. Sample

Purposive sampling method to recruit children in the yellow zone of the emergency department of RSUPN Cipto Mangunkusumo. The pediatric yellow zone is the zone of the minimal threat of death but can cause disability due to impaired consciousness, metabolism, and neurological. In this study, the control group did not receive treatment, while the experimental group was given treatment with VR. Researchers used G\*Power to use a "large" size to measure effect sizes in calculating statistical test samples based on Cohen's suggestion. 0.8 with tolerance  $\alpha=0.05$ , power 0.761, and allocation ratio  $n_2/n_1$  is 1 [23]. As for the G\*power test measurement, the researcher clicked "test" followed by "means" by selecting two independent groups: Wilcoxon (non-parametric) [24]. Researchers get a minimum total sample. The sample size obtained by the researcher added 10% to prevent dropout, so the number of corrected samples became 42 or 21 respondents in each group. Inclusion criteria: children aged 3 to 15 years, agreed to be given VR intervention, fully conscious, able to speak and hear, difficult intravenous access (DIVA) score <3, and accompanied by parents or guardians. Exclusion criteria: blindness, cancer (retinoblastoma), congenital cataracts, facial trauma, facial anomalies, and psychiatric disorders.

## 2.3. Research instruments

The instrument for measuring anxious behavior researchers used the CFS [16]. The CFS is a measuring scale that makes it easier for children who can already express the anxiety they feel as a result of the procedure to be given by selecting the facial expression they are currently feeling [16]. CSF measurements taken by parents to assess anxiety behavior on a child's face can be seen by wrinkling the limbs on a frightened face. It is known that facial expressions score 1=not afraid at all, 2=a little scared, 3=a little scared, 4=scared, and 5=very scared [16]. The results of Indonesia's validity and reliability tests have a Cronbach's alpha value of 0.722 [25]. The instrument for measuring pain in children uses the FPS-R. The FPS-R measurement tool is used to assess the pain felt by the patient, not due to the disease process but the actions given to the patient [15]. This measuring tool can be used by children who can already assess the expression of pain from the actions taken. Parents use it as a measuring tool to assess children's facial expressions during invasive procedures. It is known that the assessment of pain expression makes it easier for parents to see all parts of the face that are wrinkled in pain in children [15]. Pain scale score 0=no pain, 1=mild pain, 2=slight pain, 3=pain, 4=distant pain, 5=severe/uninterrupted pain. The results of Indonesia's validity and reliability tests have a Cronbach's alpha value of 0.761 [26]. Parents were directed to assess the child's facial expressions before and after the intravenous catheter procedure.

## 2.4. Tools and materials

The tool used in this study is the G10 VR glasses—a 3D sensation through a smartphone with moderate resolution and safe for the eyes. Cleaning the G10VR glasses with a 3D sensation is enough to use an alcohol swab. Respondents who use the G10 VR glasses are always cleaned before use. This cleaning is important to minimize the risk of infection for each user. This tool is light and easy to carry anywhere. Researchers present VR in the underwater world to respondents (Figure 1).



Figure 1. Examples VR in the undersea world

## 2.5. Research procedure

The VR distraction technique goes through the following two phases: First, we observe the phenomenon of children in the yellow zone receiving intravenous catheter procedures. All the patients we treat cry, struggle, scream, and utter harsh words. The yellow zone emergency department nurse agrees with innovations to overcome this. Even though the child is directed to watch videos, storybooks, and sing during the procedure, the child's view is focused on seeing the procedure that will take place. In the second stage, the researcher submits an innovation proposal to be tested on research ethics. After obtaining approval, the researcher contacted and met directly with

the respondent's parents according to the inclusion criteria. Researchers introduce themselves, build a relationship of mutual trust, and explain the aims and objectives of the research. The researcher asked the parents or guardians of the respondents and their children to sign a consent form to become respondents. This research was not forced or voluntary and signed informed consent. The respondent's data is kept confidential, and parents always accompany the respondent.

We divided the respondents into two groups: the experimental group was given VR during the intravenous catheter procedure, and the control group was given the intravenous catheter procedure only (Figure 2). Before inserting the infusion, the researcher directed all the respondent's parents to fill out a measuring scale for anxious behavior using FPS-R and pain using CFS in children by selecting facial expressions according to the respondent for two minutes. Then the experimental group was directed to use VR for 3 minutes before performing an intravenous catheter procedure cleaned with antiseptic gauze. The control group only received standard procedures. The intravenous catheter procedure lasts a maximum of 10 minutes. After the intravenous catheter procedure was successful, the respondent continued to use VR until it was finished. Next, the researcher directed the respondent's parents to fill in the post-test assessment for 2 minutes. When finished, the researcher thanked the parents and respondents for their willingness to participate.

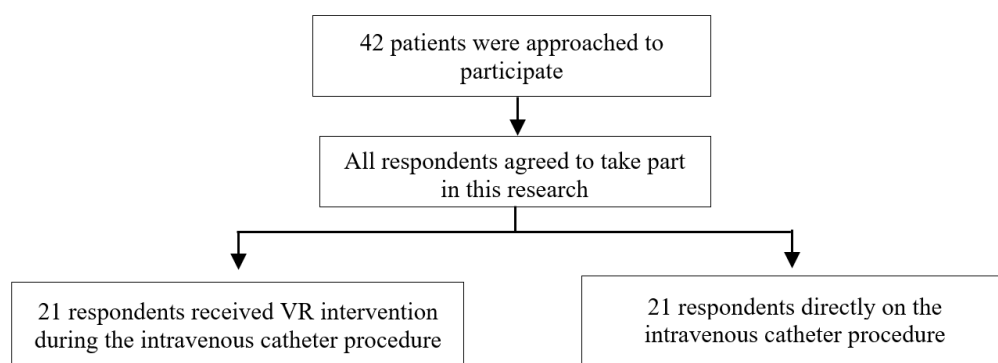


Figure 2. The study flowchart illustrates the number of participants who participated in the study

## 2.6. Data collection

This research was carried out after passing the research ethics test from the Faculty of Medicine, University of Indonesia–RSPUN Dr. Cipto Mangunkusumo. Data collection took 22 days, from 06 June 2022 to 30 June 2022. The time used to implement the research intervention was in less than 20 minutes.

## 2.7. Data analysis

SPSS version 24.0 was used for data analysis, with a statistical significance set at  $<0.05$ . In this study, there is all the data. Demographic and relevant study factors are summarized using descriptive statistics. Wilcoxon test analysis was used to see differences between research variables, the Mann-Whitney test was used to see comparisons, and multiple regression analysis was used to determine the factors influencing venipuncture procedures.

## 2.8. Ethical considerations

Ethical approval was approved by the ethics committee of the Faculty of Medicine, University of Indonesia–RSPUN Dr. Cipto Mangunkusumo, Indonesia, on July 4, 2022 (registration number KET-677/UN2.F1/ETIK/PPM.00.02/2022), and protocol number (22-06-0612). In addition, the consent form was signed by the patient's parents or guardian of the respondent who agreed, and the confidentiality of the respondent's data was maintained.

# 3. RESULTS AND DISCUSSION

## 3.1. Results

### 3.1.1. General characteristics

School-age children dominated the characteristics of respondents in this study. It is known that the age range of children participating in the study is six years to 12 years of, 40.5%. Respondents of the male sex participated more, with 52.7% and 85.7% of children in this study having previous experience with the vein puncture procedure (Table 1).

Table 1. Characteristics of respondents

Variable		Respondent	
		n	%
Age	Pre School (3-6 years old)	10	23.8
	School (6-12 years old)	17	40.5
	Teenager (13-15 years old)	15	35.7
Sex	Boy	22	52.4
	Girl	20	47.6
Vein puncture experience	No	6	14.3
	Yes	36	85.7

### 3.1.2. Differences in behavior anxiety and pain in children during the venipuncture procedure

Table 2 with the Wilcoxon test shows significant differences in anxiety behavior before and after inserting an intravenous catheter in each group ( $p < 0.001$ ). The control group showed that respondents experienced an increase in anxious behavior of 95.2% and persistent anxious behavior of 4.8%. Meanwhile, in the experimental group, it was revealed that all respondents experienced decreased anxiety behavior.

In addition, the researchers found significant differences in pain in children before and after intravenous catheter insertion ( $p < 0.001$ ) in each group. The control group experienced an increase in pain of 71.4%, and some children experienced persistent pain of 28.6% as shown in Figure 3 (a). While the pain felt by the experimental group as a whole experienced a decrease in pain as shown in Figure 3 (b).

Table 2. Differences in anxiety behavior and pain in each group

Variable	Group	Pre-post changes; n (%)			
		Control (n=21)		Experiment (n=21)	
		n	%	n	%
Anxious behavior	Decrease	0	0	21	100
	Increase	20	95.2	0	0
	Stay	1	4.8	0	0
	p-value	<0.001		<0.001	
Pain	Decrease	0	0	21	100
	Increase	15	71.4	0	0
	Stay	6	28.6	0	0
	p-value	<0.001		<0.001	

\*Wilcoxon test



Figure 3. Difference in the expression of the treatment of the (a) control group and (b) experimental group

### 3.1.3. Comparison of anxiety behavior and pain in children during venipuncture procedures

Table 3, with the Mann-Whitney test, significantly compares anxiety and pain behavior in each group ( $p < 0.001$ ). The control group experienced increased pressure and pain behavior, while the experimental group experienced the opposite. We can see this comparison in Figures 4 (a) and (b).

Table 3. Comparison of anxiety behavior and pain changes in each group

Variable	Group	Mean ranks	Difference	p-value
The difference in anxiety behavior scores pre-post	Control	32.00	21.00	<0.001
	Experiment	11.00		
Pre-post pain score difference	Control	32.00	21.00	<0.001
	Experiment	11.00		

\*Mann Whitney test

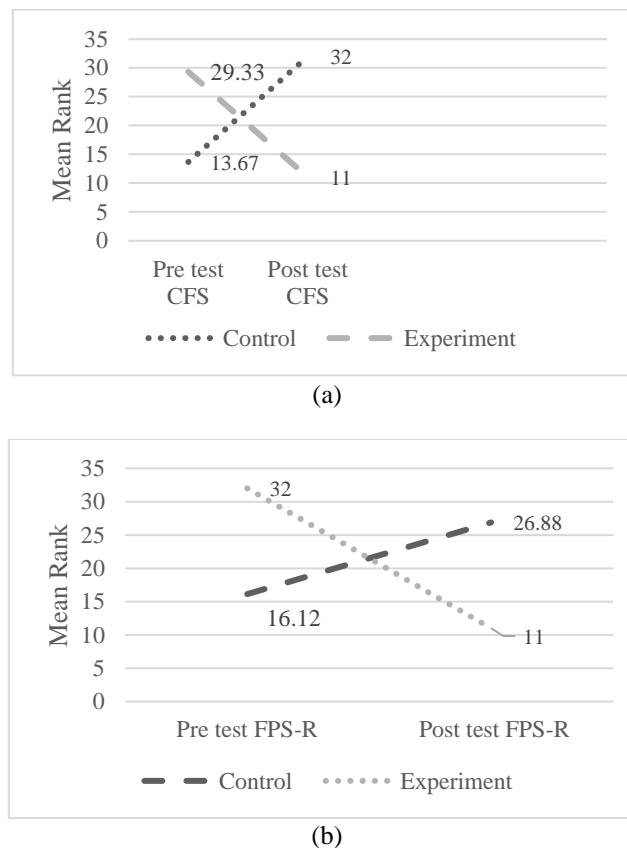


Figure 4. Comparison of children's anxiety before and after (a) and pain (b) between groups during the venipuncture procedure at the emergency department

### 3.1.4. Factors influencing venipuncture procedures in children

Table 4, with the ordinal regression test, shows the VR distraction assessment related to CFS and FPS-R recommended using female adolescents experienced with intravenous catheter procedures and feeling very scared and in unbearable pain before the procedure is given. In addition, the researcher found there are factors that influence pain (FPS-R) that are significant during the vein puncture procedure in school-aged children (p-value 0.026) with an estimated value of -2.564 and odds ratio (OR) = 4.958, meaning that school-age children experience lower pain than pre-school age children and adolescents with 4.958 times lower feeling of pain using FPS-R.

## 3.2. Discussion

The results showed that VR was proven to reduce anxiety and pain behavior in children during intravenous catheter procedures in the emergency department. The ability of VR is also proven to reduce pain using the same measuring instrument, even in an inpatient room [20]. VR confirms the decrease in anxious behavior with the same measuring instrument [5], [15]. Increased anxious behavior and pain in children before the intravenous catheter intravenous must be addressed immediately [2]. Nurses' sensitivity is needed to think critically and innovate [11]. This behavior change reinforces the importance of Dorothy's behavioral theory to be developed as nursing care for the sake of equivalence behavior.

Behavioral theory-Dorothy is divided into three aspects: protection, maintenance, and stimulation. Protection is a preventive (immediate) action given to patients to prevent more serious problems. In the context of this study, protection for dealing with anxiety and pain during illness and the ability to solve problems encountered [5]. Maintenance is the steps taken to stabilize the nursing problems experienced by patients, namely the impact of giving VR to children to overcome anxious behavior and pain during intravenous catheter procedures [16], [27]. Stimulation is a recommendation for the next step to see feedback from the interventions delivered so that it becomes better and develops [11], [27].

Table 4. The effect of VR distraction techniques in overcoming children's anxiety and pain behavior

Table 7: The effect of VR distraction techniques in overcoming children's anxiety and pain behavior								
Variable		Factor affecting	Estimate	Wald	CI (95%)		p-value*	
					Low	Upper		
Pre-post anxiety behavior	Age	Pre-school	-0.051	0.001	-3.00	2.897	0.973	
		School	-32.425	0.000	-5842.9	5758.1	0.991	
		Teenager	Reference					
	Sex	Boy	0.321	0.063	-2.31	2.755	0.802	
		Girl	Reference					
	Vein puncture experience	No	-52.845	0.000	-20870.6	20764.9	0.996	
		Yes	Reference					
	Pre-anxiety	Not afraid at all	5.28	0.000	-13109.4	13120.0	0.999	
		A little bit afraid	36.3	0.000	-11720.9	11793.7	0.995	
		A little more afraid	18.741	0.000	-8783.7	8821.2	0.997	
		Afraid	-13.14	0.000	-10560.4	10534.1	0.998	
	Pain-pre	Very afraid	Reference					
		No pain	36.84	0.000	-19266.7	19340.4	0.997	
		A little more pain	23.81	0.000	-23.5	21.83	0.998	
		More pain,	17.1	0.000	-3852.0	3888.6	0.993	
		Much more painful	-30.48	0.000	-5841.0	5780.0	0.992	
		Worst pain/unbearable	Reference					
Pre-post pain	Age	Pre-school	-3.75	0.109	-2.603	1.852	0.741	
		School	-2.564	4.958	-4.821	-0.307	0.026*	
		Teenager	Reference					
	Sex	Boy	-1.88	0.037	-2.107	1.731	0.848	
		Girl	Reference					
	Vein puncture experience	No	-1.432	0.343	-6.224	3.360	0.558	
		Yes	Reference					
	Pre-anxiety	Not afraid at all	-0.831	0.000	-8924.4	8922.7	1.0	
		A little bit afraid	19.4	0.000	-8904.1	8942.9	0.997	
		A little more afraid	18.8	0.000	-8904.7	8942.4	0.997	
		Afraid	16.7	0.000	-8906.8	8940.3	0.997	
	Pain-pre	Very afraid	Reference					
		No pain	20.66	0.000	-8907.9	8939.2	0.998	
		A little more pain	18.65	0.000	-8907.4	8939.8	0.998	
		More pain	0.466	0.1	-2.422	3.354	0.75	
		Much more painful	-2.384	3.64	-4.831	0.062	0.056	
		Worst pain/unbearable	Reference					

\*Ordinal regression test

### 3.2.1. Protection mechanisms based on aspects of Dorothy's behavioral theory

VR reduces anxious behavior and pain. Respondents at the preschool age stage (3 to 6 years) lack interest in participating. This is because children aged 2 to 6 years perceive VR mirrors as frightening objects and consider them as medical procedure that injures them [19]. Another argument is that they have never seen and used it, so they are afraid and prefer to know the process even though it hurts [18]. Another reason, the anatomy of blood vessels at that age is complex, and the risk of failure is high, so VR is not meaningful [15].

In contrast, school-age children and adolescents find the VR distraction technique interesting and feel its presence in the environment. This is because brain development in children of this age is characterized by increased neuroplasticity, emotional intensity, reactivity, and improved learning abilities [6]. Experiences like this provide special and fresh moments for school-age children and adolescents because they can be actively carried away by the virtual atmosphere and stimulate their curiosity. Their interest in this can overcome the painful problems of their age [9].

The participation of boys dominates. This is because boys use realism, play, and curiosity more in VR [10]. Besides, boys are better at thinking and challenging games. Children are easier to get involved because they are less skeptical. In contrast, girls are more sensitive [18]. However, other studies state that nothing affects gender because it is not a barrier to experiencing the VR sensation [15].

Children who had undergone intravenous catheter procedures predominated in this study. The experience of the intravenous catheter procedure caused them to remember the pain. The reason is that most respondents had failed intravenous catheter procedures and had multiple responses due to the administration of concentrated drugs [19]. As a result, it has an impact on the mental health of children [15], [18]. In addition, this procedure is an intentional act. It is natural for children with intravenous catheter experiences to be worried because of the unpleasant experience. Children who have these experiences prefer to be given a distraction to reduce fear and pain rather than not at all [10].

### 3.2.2. Maintenance mechanism based on aspects of Dorothy's behavioral theory

VR has been shown to reduce anxiety and pain behaviors. But it's different for children without VR. There was a difference in the control group, which experienced increased anxiety and pain behavior due to nociceptive, emotional, and cognitive stimuli, which appeared automatically. This response is a negative impact on emotional and situational factors. Situational factors occur due to the experience of pain (trauma), thus requiring pharmacological methods to treat pain [15]. Emotional aspects can be seen in their behavior verbally and non-verbally [5], [11].

This is the first study to report the effect of VR distraction techniques on anxiety and pain behavior in children at the yellow zone emergency department of Cipto Mangunkusumo General Hospital. Provision of VR in the emergency department to provide artificial stimulation (visual images and spatial sounds) and feel a presence in the virtual world so that children are focused and not distracted when using the VR box [4]. Therefore, VR becomes a distraction technique for focus and stimulus in nursing care plans [11], [27].

### 3.2.3. Stimulus mechanisms based on aspects of Dorothy's behavioral theory

The results of the ordinal regression test showed that VR disturbance feedback on anxiety assessment with CSF and pain with FPS-R assessment. The results of the study referred to adolescents, female sex, who had experienced, felt very scared, and felt unbearable pain before an intravenous catheter was performed. The reference criteria for the results of the ordinal regression test are directed at adolescents because adolescents are considered a phase that can experience emotional and sensory pain, especially if adolescents have chronic illnesses such as cancer, human immunodeficiency virus (HIV), and kidney failure [20]. They experience severe discomfort from having to receive medication continuously. Ordinal regression tests direct girls. Girls have metacognitive amygdala sensitivity because it leads to maladaptive attitudes such as unfounded fears and increases crying [16], [18]. These negative beliefs correlate with worry about the consequences of the disease, which adds to the pain and disturbs the emotions [5], [11].

School-age children experience less pain during intravenous catheter procedures than preschoolers because, at this age, they can focus and can imagine dynamically, aesthetically, and creatively. In addition, children can divert the causes of stress and pain because endorphins are produced by the pituitary gland and are channeled directly from the brain's nerves [28]. In addition, childhood pain tolerance has been shown to increase with age [12]. Therefore, the VR distraction technique can be used as a psychological stimulation and social attitude. Children in our study enjoyed brief VR exposures with minimal physical and emotional stress [5], [18].

The application of Dorothy's behavioral-approach theory with VR has great potential to be a non-pharmacological analgesic therapy for other invasive procedures [11], [27]. So that the image of the nurse is expected to gradually change into a helper figure to deal with medical problems and be used as an atraumatic treatment program in hospitals because it can reduce perceptions and negative behavior of children [15], [27]. The effectiveness of VR that has been proven in reducing anxious behavior and pain in children during intravenous catheter insertion procedures in the emergency department. So that further research can be developed by testing the effectiveness of VR for teenage girls, having intravenous catheter experience, experiencing very anxious behavior, and feeling extreme pain in the emergency department.

The limitations found in this study were that some prospective respondents considered VR glass as a medical device that had never been seen before, so they were hesitant to participate. In addition, this study only lasted for 22 days, so the number of respondents who participated was in accordance with the sample calculation. The age range of the respondents is not homogeneous because the age gap is too large (3-15 years), and children aged three years are assumed to be more anxious than those aged 15 years.

## 4. CONCLUSION

The VR distraction technique provides a practical impression of supporting technological advances in dealing with anxious behavior and pain in children during vein procedures. Using Dorothy's behavioral theory approach, giving VR during a venipuncture procedure is an innovation in nursing care. Provide aspects of protection based on the age, gender, and experience of the child; maintenance aspects by looking at VR effects; and aspects of stimulation as reference material or recommendations for further research on VR to overcome anxiety and pain behavior in children during venipuncture procedures. In addition, VR can reduce trauma in children and increase satisfaction for providers and users of services in the emergency department.

## ACKNOWLEDGMENT

We thank all the child participants, parents, and professionals who participated in the research and advised on this project and their members for participating in the surveys and discussion groups. The author thanks the reviewer for the feedback provided. All authors declare no conflict of interest regarding this research or its funding.






## REFERENCES




- [1] S. Alharethi, A. Gani, and M. K. Othman, "Emergency departments," in *Advances in Information and Communication Networks: Proceedings of the 2018 Future of Information and Communication Conference (FICC)*, 2019, pp. 341–358, doi: 10.1007/978-3-030-03405-4\_23.
- [2] H. Embong, C. Y. Ting, M. S. Ramli, and H. Harunarashid, "Heightened anxiety state among parents of sick children attending emergency department using State-Trait Anxiety Inventory," *Hong Kong Journal of Emergency Medicine*, vol. 27, no. 2, pp. 65–70, Mar. 2020, doi: 10.1177/1024907918807384.
- [3] Y. Rustina, A. Y. Nursasi, T. Budiati, E. Syahreni, and P. Fitriyani, "The influence of family empowerment on the health status of low birth weight infant in Jakarta," *Makara Journal of Health Research*, vol. 18, no. 1, pp. 19–24, Sep. 2014, doi: 10.7454/msk.v18i1.3089.
- [4] P. A. Gheshlaghi, Z. B. Farahani, S. Z. Anboohi, M. Nasiri, A. Ziapour, and V. H. Garosi, "Effect of family presence on pain and anxiety levels among patients during invasive nursing procedures in an emergency department at a public hospital in Western Iran," *African Journal of Emergency Medicine*, vol. 11, no. 1, pp. 31–36, Mar. 2021, doi: 10.1016/j.afjem.2020.11.003.
- [5] C. P. Rochat, N. Gaucher, and B. Bailey, "Measuring anxiety in the pediatric emergency department," *Pediatric Emergency Care*, vol. 34, no. 8, pp. 558–563, Aug. 2018, doi: 10.1097/PEC.0000000000001568.
- [6] H. Howe-Davies, C. Hobson, C. Waters, and S. H. M. van Goozen, "Emotional and socio-cognitive processing in young children with symptoms of anxiety," *European Child & Adolescent Psychiatry*, pp. 1–12, Jul. 2022, doi: 10.1007/s00787-022-02050-2.
- [7] E. Osmanliu *et al.*, "Distraction in the emergency department using virtual reality for intravenous procedures in children to improve comfort (DEVINCI): a pilot pragmatic randomized controlled trial," *Canadian Journal of Emergency Medicine*, vol. 23, no. 1, pp. 94–102, Jan. 2021, doi: 10.1007/s43678-020-00006-6.
- [8] M. Cooke, A. J. Ullman, G. Ray-Barruel, M. Wallis, A. Corley, and C. M. Rickard, "Not 'just' an intravenous line: consumer perspectives on peripheral intravenous cannulation (PIVC). An international cross-sectional survey of 25 countries," *PLOS ONE*, vol. 13, no. 2, pp. 1–18, Feb. 2018, doi: 10.1371/journal.pone.0193436.
- [9] S. J. Friedrichsdorf and L. Goubert, "Pediatric pain treatment and prevention for hospitalized children," *PAIN Reports*, vol. 5, no. 1, pp. 1–13, Jan. 2020, doi: 10.1097/PR9.0000000000000804.
- [10] G. Ö. Gerçek, D. Ayar, E. Z. Özdemir, and M. Bektaş, "The impact of the difficult vascular access, fear, and anxiety level in children on the success of first-time phlebotomy," *The Journal of Vascular Access*, vol. 19, no. 6, pp. 620–625, Nov. 2018, doi: 10.1177/1129729818765598.
- [11] T. Linh, Y. Cheng, and Y.-W. Luo, "The application progress of Johnson's behavior system model," *Journal of Engineering Research and Application*, vol. 10, no. 3, pp. 39–42, 2020, doi: 10.9790/9622-1003053942.
- [12] R. Havale *et al.*, "Assessment of efficacy of virtual reality distraction in reducing pain perception and anxiety in children aged 6–10 years: a behavioral interventional study," *International Journal of Clinical Pediatric Dentistry*, vol. 12, no. 6, pp. 510–513, Dec. 2019, doi: 10.5005/jp-journals-10005-1694.
- [13] A. Janssen *et al.*, "Experiences of patients undergoing chemotherapy with virtual reality: mixed methods feasibility study," *JMIR Serious Games*, vol. 10, no. 1, pp. 1–15, Feb. 2022, doi: 10.2196/29579.
- [14] B. Atzori *et al.*, "An exploratory study on the effectiveness of virtual reality analgesia for children and adolescents with kidney diseases undergoing venipuncture," *International Journal of Environmental Research and Public Health*, vol. 19, no. 4, pp. 1–12, Feb. 2022, doi: 10.3390/ijerph19042291.
- [15] R. D. Goldman and A. Behboudi, "Virtual reality for intravenous placement in the emergency department—a randomized controlled trial," *European Journal of Pediatrics*, vol. 180, no. 3, pp. 725–731, Mar. 2021, doi: 10.1007/s00431-020-03771-9.
- [16] D. S. Düzakaya, G. Bozkurt, S. Ulupinar, G. Uysal, S. Uçar, and M. Uysalol, "The effect of a cartoon and an information video about intravenous insertion on pain and fear in children aged 6 to 12 years in the pediatric emergency unit: a randomized controlled trial," *Journal of Emergency Nursing*, vol. 47, no. 1, pp. 76–87, Jan. 2021, doi: 10.1016/j.jen.2020.04.011.
- [17] E. H. Au and J. J. Lee, "Virtual reality in education: a tool for learning in the experience age," *International Journal of Innovation in Education*, vol. 4, no. 4, pp. 215–226, 2017, doi: 10.1504/IJIE.2017.10012691.
- [18] J. Piskorz and M. Czub, "Effectiveness of a virtual reality intervention to minimize pediatric stress and pain intensity during venipuncture," *Journal for Specialists in Pediatric Nursing*, vol. 23, no. 1, pp. 1–6, Jan. 2018, doi: 10.1111/jspn.12201.
- [19] C. L. Wong, M. M. W. Lui, and K. C. Choi, "Effects of immersive virtual reality intervention on pain and anxiety among pediatric patients undergoing venipuncture: a study protocol for a randomized controlled trial," *Trials*, vol. 20, no. 1, pp. 1–10, Dec. 2019, doi: 10.1186/s13063-019-3443-z.
- [20] J. O. Karundeng, N. Nurhaeni, and D. Wanda, "The effect of virtual reality on the pain level of a child who will be introduced in the infection room of RSUPN Dr Cipto Mangunkusumo," *Nveo-Natural Volatiles & Essential Oils Journal*, vol. 8, no. 6, pp. 284–293.
- [21] A. A. Mohammed, S. Abdel, F. Abou, and Z. Abdel, "The effectiveness of distraction techniques on minimizing pain and anxiety for cancer children undergoing venipuncture," *Journal of Nursing and Health Science*, vol. 6, no. 6, pp. 35–43, 2017, doi: 10.9790/1959-0606053543.
- [22] G. Valentelyte, C. Keegan, and J. Sorensen, "A comparison of four quasi-experimental methods: an analysis of the introduction of activity-based funding in Ireland," *BMC Health Services Research*, vol. 22, no. 1, pp. 1–12, Nov. 2022, doi: 10.1186/s12913-022-08657-0.
- [23] H. Kang, "Sample size determination and power analysis using the G\*Power software," *Journal of Educational Evaluation for Health Professions*, vol. 18, no. 17, pp. 1–12, Jul. 2021, doi: 10.3352/jeehp.2021.18.17.
- [24] L.-T. Chen and L. Liu, "Content analysis of statistical power in educational technology research: sample size matters," *International Journal of Technology in Teaching and Learning*, vol. 15, no. 1, pp. 49–75, 2019, doi: 10.37120/ijttl.2019.15.1.04.
- [25] L. M. Octovia, B. Somantri, and R. R. Barokah, "Therapeutic puzzle play affects anxiety levels in preschool-aged children preschool children (3-6 years) before intravenous drug administration (bolus) (in Indonesian: Permainan puzzle terapeutik mempengaruhi tingkat kecemasan pada anak usia prasekolah (3-6 tahun) sebelum pemberian obat intravena (bolus))," *Care: Jurnal Ilmiah Ilmu Kesehatan*, vol. 6, no. 3, pp. 239–252, 2018.
- [26] D. Renaldi, R. Novayelinda, and S. R. Hd, "Comparison of the validity of pain measurement tools between self-report pain scale and observational pain scale in acute pain of children aged 3-7 years old (in Indonesian: Perbandingan validitas alat ukur nyeri antara skala nyeri self-report dan skala nyeri observasional pada nyeri akut anak usia 3-7 tahun)," *Jurnal Online Mahasiswa Program Studi Ilmu Keperawatan Universitas Riau*, vol. 1, no. 2, pp. 1–10, 2014.
- [27] B. Rahmani, N. Aghebati, H. Esmaily, and K. L. Florczak, "Nurse-led care program with patients with heart failure using Johnson's behavioral system model: a randomized controlled trial," *Nursing Science Quarterly*, vol. 33, no. 3, pp. 204–214, Jul. 2020, doi: 10.1177/0894318420932102.
- [28] D. Karaman, "Virtual reality and pain management," *International Journal of Health Sciences & Research*, vol. 6, no. 12, pp. 288–291, 2016.

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