

Virtual Reality Headset Use During Venipuncture in Children: Impact on Fear and Pain Levels

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ABSTRACT

Background: Medical procedures, such as venipuncture, are among the most common causes of fear and pain in children. This study aimed to determine whether using a virtual reality (VR) headset during venipuncture reduces children's fear and pain.

Methods: This controlled experimental study included 70 children aged 5-12 years (VR group=35; control group=35). Before venipuncture, each child, their parent, and an observer completed an interview-observation form and a fear scale. Following the procedure, the same participants completed both the fear and pain scales. The Children's Fear Scale (CFS) was used to assess fear levels, while the Wong-Baker FACES Pain Rating Scale was used to evaluate pain levels. Statistical analyses were performed using SPSS v25 software.

Results: Analysis of preprocedure and postprocedure CFS scores showed a statistically significant reduction in fear in the VR group compared with the control group, as reported by the children ($P < .001$). Pain assessments indicated that the VR group had significantly lower pain scores than the control group in evaluations by children, parents, and observers ($P < .001$).

Conclusion: The findings demonstrate that VR headsets effectively reduce both fear and pain in children undergoing venipuncture. Therefore, their use should be encouraged in clinical practice to improve the patient experience during medical procedures.

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INTRODUCTION

Childhood is a critical stage in human development, which can be disrupted by negative experiences. Medically invasive procedures often cause pain, fear, and anxiety in pediatric patients, leading to emotional distress during both diagnosis and treatment.^{1,2} Effective management of pain and fear plays a crucial role in recovery³ and can reduce reluctance to undergo long-term treatment and care.⁴

Fear is a normal emotional response that alerts the body to real danger and triggers defensive action.⁵ Pain, as defined by the International Association for the Study of Pain (IASP), is "an unpleasant sensory and/or emotional experience associated with actual or potential tissue damage."⁶ Previous studies have shown that children experience both fear and pain during medical procedures.⁷ Painful procedures such as needle sticks, injections, and vaccinations are among children's most common fears. A joint statement by the World Health Organization, IASP, and the European Association for the Study of Pain recognizes the elimination of pain as a human right.⁸

Needle phobia in children can hinder necessary tests and delay treatment. Reducing pain and improving quality of life are therefore fundamental goals of healthcare.⁹ Both pharmacological and nonpharmacological approaches are used to reduce pain and fear during needle insertion procedures.¹⁰ Given the costs and side effects of pharmacological methods, nonpharmacological strategies are often preferred. These include supportive methods (e.g., parental presence during painful procedures), physical methods (e.g., touch, hot/cold application, and massage), and cognitive-behavioral methods (e.g., hypnosis and distraction).¹¹

Distraction techniques have been widely used by healthcare professionals to reduce procedure-related fear and pain, with proven effectiveness.¹² Directing children's attention toward enjoyable activities helps divert focus from distressing stimuli.¹³ Commonly used distraction methods include watching cartoons, blowing balloons, rhythmic breathing, hypnosis, listening to music, distraction cards, kaleidoscopes, and virtual reality (VR) devices.¹⁴ Virtual

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reality glasses immerse children in a 3-dimensional environment by projecting computer-generated images, creating the sensation of being transported to another world.¹⁵

This study aimed to evaluate the effect of using a VR headset during venipuncture on fear and pain levels in children aged 5-12 years.

MATERIALS AND METHODS

Study Design and Sample

This quasi-randomized controlled study included 70 children aged 5-12 years who attended the Doruk Nilüfer Hospital Paediatrics Clinic between April 2024 and 2025 and were scheduled for venipuncture by a physician (VR group=35; control group=35).

The inclusion criteria were as follows: children aged 5-12 years, conscious and without cognitive impairments, no visual or auditory impairments, no analgesic use in the preceding 6 hours, and a child fear score > 1. Informed consent was obtained from both the children and their parents. Participants were assigned to groups according to the order of venipuncture: children with odd-numbered turns were placed in the control group, and those with even-numbered turns were placed in the VR group. All venipuncture procedures were performed by the same nurse who had 10 years of clinical experience. Parents were present with their children during the procedure.

Children in the VR group were introduced to the headset immediately before the procedure. During venipuncture, the Meta Quest 3 128 GB Wireless VR Headset (Meta Platforms Technologies, LLC, USA) was used to display an underwater experience video (*Finding Nemo* VR-360 Video, <https://www.youtube.com/watch?v=NJURlqK-vnY>). In the control group, venipuncture was performed without distraction.

Before venipuncture, the Children's Fear Scale (CFS) was completed by the child, parent, and observer in both groups. After the procedure, both the CFS and the Wong-Baker FACES Pain Rating Scale (WBFPRS) were completed by the same respondents.

Data Collection Tools

Data were collected using interview and observation forms, the CFS, and the WBFPRS.

Interview and observation form: This form included questions regarding the child's sociodemographic characteristics and medical history.

Children's Fear Scale: Developed by McMurtry et al¹⁶ in 2011, this scale is widely used to assess children's fear levels. Its Turkish validity and reliability study was conducted by Gerçeker et al¹⁷. The CFS consists of 5 facial images scored from 0 (no fear) to 4 (the most fear). Higher scores indicate higher fear levels. Although named a fear scale, it can also be used to evaluate anxiety.¹⁸

Wong-Baker Facial Expression Pain Rating Scale: This scale evaluates pain in children aged 3-18 years based on facial expressions. It includes 6 facial expressions corresponding to pain levels from 0 to 10.¹⁹

Statistical Analysis

The normality of data distribution was assessed using the Shapiro-Wilk test. For normally distributed data, parametric tests were applied and results expressed as mean $\pm$ SD. For non-normally distributed data, non-parametric tests were applied and results expressed as median (min:max).

Between-group comparisons were performed using the independent-samples *t* test or the Mann-Whitney *U* test. Within-group pre-post comparisons were assessed using the Wilcoxon signed-rank test. To evaluate individual changes, difference scores (post-treatment - pre-treatment) were calculated and compared between groups. Categorical variables were analyzed using the Pearson chi-square test and presented as frequencies and percentages.

All statistical analyses were performed using SPSS version 25 (IBM SPSS Corp.; Armonk, NY, USA). A *P*-value of <.05 was considered statistically significant.

Ethical Considerations

Ethical approval was obtained from the Clinical Research Ethics Committee of Atlas University Faculty of Medicine and the hospital where the study was conducted (decision no. 10/46, dated December 24, 2024). Written informed consent was obtained from all participating children's parents.

RESULTS

The VR group and the control group were first compared for homogeneity in variables that could influence the study outcomes. Statistical analysis showed no significant differences between the groups in demographic variables, including gender, child's age, parental age, and education. Similarly, no significant differences were observed in clinical variables such as the presence of chronic diseases, history of blood transfusion, and number of transfusions

MAIN POINTS

- Childhood fears can influence long-term personality development, with painful medical procedures being a major contributing factor.
- Reducing fear and pain during such procedures protects children from trauma and enhances cooperation between children, families, and healthcare professionals.
- In this study, children who used a virtual reality (VR) headset during venipuncture experienced significantly less fear and pain.
- The use of VR headsets in other painful medical procedures, beyond venipuncture, may also help divert attention and protect children from fear and psychological trauma.

Table 1. Comparison of Homogeneity Between Virtual Reality and Control Groups

		VR (n = 35)	Control (n = 35)	P
Gender, n (%)	Male	17 (48.6)	20 (57.1)	.473
	Female	18 (51.4)	15 (42.9)	
Child's age, median (min:max)		8 (5-13)	7 (5-12)	.059
Mother's age (mean $\pm$ SD)		38.2 $\pm$ 4.46	39.22 $\pm$ 5.86	.413
Father's age (mean $\pm$ SD)		41.02 $\pm$ 4.14	42.02 $\pm$ 6.05	.425
Mother's education, n (%)	Primary	5 (14.3)	3 (8.6)	.634
	High school	10 (28.6)	8 (22.9)	
	University	20 (57.1)	24 (68.6)	
Father's education, n (%)	Primary	4 (11.4)	1 (2.9)	.310
	High school	12 (34.3)	10 (28.6)	
	University	19 (54.3)	24 (68.6)	
Venipuncture in last year, n (%)	Yes	34 (97.1)	35 (100)	1.000
	No	1 (2.9)	0 (0.0)	
Number of venipuncture, n (%)	1	2 (5.7)	0 (0.00)	.493
	≥ 1	33 (94.3)	35 (100)	
Chronic disease, n (%)	No	33 (94.3)	31 (88.6)	.673
	Yes	2 (5.7)	4 (11.4)	

VR, virtual reality.

in the past year. These results indicate that the VR and control groups were homogeneous with respect to factors that could potentially affect the study outcomes (Table 1).

Fear scores of children, parents, and observers were compared between the VR and control groups before and after the procedure (Table 2). Significant reductions in fear scores were observed in both groups following venipuncture. However, the reduction was significantly greater in the VR group than in the control group, as assessed by the children. In the VR group, fear scores decreased by 2-4 points, with a median reduction of 3 points. In contrast, in the control group, some scores remained unchanged, with a maximum reduction of 4 points and a median reduction of 2 points. Overall, the VR group demonstrated a greater

Table 2. Comparison of Fear Before and After Treatment in the Virtual Reality and Control Groups

Group		Before Procedure Median(min:max)	After Procedure Median(min:max)	P
VR (n = 35)	Child	3(2:4)	0(0:2)	<.001
	Parent	2(0:4)	0(0:1)	<.001
	Observer	4(1:4)	0(0:0)	<.001
Control (n = 35)	Child	3(2:4)	1(0:4)	<.001
	Parent	3(0:4)	0(0:2)	<.001
	Observer	4(1:4)	0(0:3)	<.001

VR, virtual reality.

Table 3. Comparison of Changes in Fear Between Groups Before and After Treatment

	Score Difference	VR (n = 35) Median(min:max)	Control (n = 35) Median(min:max)	P
Fear	Child	-3 (-2:-4)	-1 (0:-4)	<.001
	Parent	-2 (0:-4)	-1 (0:-4)	.804
	Observer	-4 (-1:-4)	-3 (0:-3)	.081

VR, virtual reality.

decline in fear levels compared with the control group (Table 3).

Regarding pain assessments, statistically significant differences were identified between the VR and control groups in evaluations conducted by children, parents, and observers. Across all assessments, children in the VR group reported lower pain levels compared with those in the control group (Table 4).

DISCUSSION

Fear is a natural emotion that arises when an individual perceives their safety to be under threat. To assess fear in children, it is essential to consider the source of fear from their perspective and empathize with them. As the intensity of the fearful stimulus decreases, the child's fear also diminishes. Among children, medical fears are particularly common. A study by Gündüz et al²⁰ identified exposure to invasive procedures as one of the most significant causes of hospital-related fear in children.

Many medical procedures performed on children are painful, and this pain can trigger both fear and anxiety. Fear, in turn, amplifies the perception of pain, thereby creating a vicious cycle. Pharmacological and nonpharmacological methods are employed to interrupt this cycle.²¹

Pharmacological methods involve the use of medications for pain control. These are often preferred due to their rapid onset of action and ease of administration. However, frequent or excessive use of analgesics can lead to adverse side effects and impose a considerable economic burden. In contrast, nonpharmacological methods offer several advantages, including ease of application, reduced reliance on analgesics, absence of side effects, and the potential for use alongside pharmacological approaches.

Table 4. Comparison of Virtual Reality and Control Groups in Terms of Pain

	VR (n = 35) Median (min:max)	Control (n = 35) Median (min:max)	P
Child	1(0:3)	2(0:5)	<.001
Parent	0(0:1)	1(0:3)	<.001
Observer	0(0:1)	1(0:2)	<.001

VR, virtual reality.

Moreover, encouraging the child's active participation in such interventions can decrease both fear and pain, thereby improving overall quality of life.²²

One of the most widely used nonpharmacological approaches is distraction through VR goggles.²³ Virtual reality is particularly effective because it simultaneously stimulates multiple senses, diverts attention from painful stimuli, and provides an escape from the "painful real world."²⁴

For instance, Akarsu et al²⁵ investigated anxiety and fear in children aged 7-12 years during venipuncture using a VR headset. Their findings revealed that children in the VR group reported lower levels of anxiety and fear compared with the control group. Similarly, another study examined distraction techniques among children aged 6-12 years undergoing intravenous catheterization and venipuncture.¹⁴ Whereas no distraction techniques were used in the control group, distraction cards and VR headsets were employed in the experimental group. The results indicated that both methods effectively reduced fear, anxiety, and pain.

Del Castillo et al²⁶ evaluated the effect of VR during invasive procedures among hospitalized children aged 4-15 years in an emergency department. Fear and anxiety were assessed using the CFS score before and after the procedure in both groups. The VR group demonstrated significantly lower fear and anxiety compared with controls.

Other distraction strategies have also proven effective. A study on children aged 6-10 years demonstrated that playing video games, watching cartoons, and parental distraction during venipuncture reduced fear and pain, with video games being the most effective.²⁷ Lange compared watching films with VR use among 88 children undergoing venipuncture, intravenous catheterization, and suturing in a pediatric emergency department.²⁸ The VR group reported lower fear and pain levels, suggesting greater efficacy of VR compared with films. Similarly, Erdoğan et al² compared distraction cards, Buzzy, and VR in 142 children aged 7-12 years. Pain levels were lower in the VR group than in controls. In another study, animations shown to children aged 3-6 years during venous access also reduced fear and pain.²⁹

Miguez-Navarro et al³⁰ studied 140 children aged 3-11 years undergoing venipuncture in a pediatric emergency department. Whereas 1 group received no intervention, the other watched a video during the procedure. Results confirmed that fear and pain were reduced in the video group.

Parents expect healthcare professionals to minimize their children's pain. A systematic review on VR applications in pediatric pain management reported higher patient and parent satisfaction in groups using VR, with the intervention also considered enjoyable by children.³¹ The

absence of any reported side effects of VR is also one of the reasons for its preference.³²

In the present study, CFS fear scores were assessed before and after venipuncture. The VR group demonstrated a significantly greater reduction in fear compared with the control group ($P < .001$), suggesting that VR headsets effectively distract children and reduce fear. Similarly, WBFPRS pain scores also showed a significant decrease in the VR group compared with controls ($P < .001$). These findings support the hypothesis that VR functions as a powerful distraction tool for children undergoing painful procedures.

The results of this study align with existing literature, confirming that VR use during venipuncture can effectively reduce fear and pain in pediatric patients. However, certain limitations should be acknowledged. The most important limitation is the small sample size, which restricts the generalizability of findings. Additionally, the study included only children aged 5-12 years and was conducted at a single center.

Fear associated with medical procedures can adversely affect a child's personality development and may create a lifelong fear of healthcare professionals and treatments. Evidence-based distraction techniques help reduce fear and pain during medical interventions, positively influencing the child's psychological state. These techniques also promote cooperation among children, parents, and healthcare professionals, thereby contributing to successful treatment outcomes.

In recent years, VR headsets have become more accessible and are now widely used in society. As VR is an effective and practical distraction method, its broader use should be encouraged to alleviate fear and pain in children undergoing medical procedures.

Data Availability Statement: The data that support the findings of this study are available on request from the corresponding author.

Ethics Committee Approval: Ethical committee approval was received from the Ethics Committee of Atlas University (Approval No.: 10/46; Date: December 24, 2024).

Informed Consent: Written informed consent was obtained from the children's parents who agreed to take part in the study.

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