

Using a Virtual Reality Headset to Decrease Pain Felt During a Venipuncture Procedure in Children

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Purpose: *This experimental study was conducted to determine the effect of using a virtual reality headset on decreasing the pain felt during a venipuncture procedure in children.*

Design: *This was a randomized controlled study.*

Methods: *The population included 120 children (experimental group = 60, control group = 60) aged 9–12 years who underwent blood collection at a children's hospital clinic. This study collected data using the information form regarding introductory characteristics of children and the venipuncture procedure, the Visual Analogue Scale, and the Wong-Baker Faces Pain Scale.*

Findings: *This study found that the levels of pain that experimental group children felt during the venipuncture procedure were lower than the levels of pain indicated by control group children ($P < .05$).*

Conclusions: *It was determined that using a virtual reality headset has an effect on decreasing the pain felt during the venipuncture procedure.*

Keywords: *children, pain, venipuncture procedure, virtual reality headset.*

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PAIN IS DEFINED as a complex personal experience.¹ Children experience it for multiple reasons in the health care setting. Procedures during diagnosis and treatment are the most common painful interventions and constitute the most frightening side of going to the hospital.^{2,3} Because these procedures create pain, anxiety, and stress, children have difficulty dealing with the intervention, and their recovery is negatively affected.⁴ Without effective management, acute pain could lead to negative outcomes on the cardiovascular and respiratory systems.^{5,6} Acute pain stimulates the reaction known as “general

adaptation syndrome.” The sympathetic nervous system is affected, which leads to physiological symptoms such as increased respiratory rate or blood pressure.⁶

The World Health Organization (WHO) recommends the use of practical alternatives to effectively control pain in the outpatient setting.⁷

Methods used for pain management in children can be pharmacological or nonpharmacological.⁸ Nonpharmacological methods are valuable alternatives for pain management, especially in slightly

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invasive procedures.^{9,10} The method of distraction, a nonpharmacological method, focuses the attention on a stimulus other than pain. This method is used to increase pain tolerance and to decrease pain sensitivity in patients.¹¹ Among methods used in clinical areas to distract the attention, virtual reality headsets have recently been used.^{12,13}

Virtual reality headsets have been used by children to reduce pain during painful procedures such as a venipuncture,^{14,15} burn injury treatment,¹⁶⁻¹⁸ dressing a chronic wound,¹⁹ and a lumbar puncture.²⁰ The use of nonpharmacological methods to reduce pain may allow nurses to play their independent roles.^{21,22} The purpose of this experimental study was to determine the effect of using a virtual reality headset on decreasing the pain felt during a venipuncture procedure in children.

Methods

Research Design

This was a prospective, randomized controlled experimental study.

Sample

This experimental study was conducted to determine the effect of using a virtual reality headset on decreasing the pain felt during a venipuncture procedure in children. The population of the study included children aged 9-12 years who underwent blood collection at a clinic of Bursa Dörtçelik Children's Hospital in Bursa, Turkey, between January and May 2017. A total of 120 children (experimental group = 60, control group = 60) who accepted to participate in the study and met the sample criteria were included in the study's sample. The sample selection criteria were being aged between 9 and 12 years, having no developmental problems that prevent communication, not wearing glasses, not suffering from pain before the intervention or having a chronic disease that causes pain, or having a venipuncture at the antecubital site. Therefore, 60 children were included in the experimental group (using virtual reality headset), and 60 children were in the control group.

Data Collection Tools

INFORMATION FORM REGARDING CHILDREN'S INTRODUCTORY CHARACTERISTICS AND THE VENIPUNCTURE PROCEDURE. This form was developed by the researcher in light of the literature. This form includes questions regarding the child's age, gender, latest venipuncture time, frequency of venipuncture, use of a virtual reality headset, whether or not the children liked using a virtual reality headset, and willingness to use a virtual reality headset during the next intervention.

THE VISUAL ANALOGUE SCALE. The Visual Analogue Scale (VAS) is a 10-cm straight line scale. A score of "0" shows "no pain" and "10" shows "intolerable pain."²³⁻²⁵ This scale is applicable for children older than the 7 years. The practitioner asked children to mark the place indicating the level of pain.²³

WONG-BAKER FACES PAIN SCALE. The Wong-Baker Faces Pain Scale (WBFPS) can be used for children as young as 3 years of age.²⁶ The possible minimum score on the scale is 0, and the maximum possible score is 10. There are 6 facial expressions that range from a smiling happy face to a crying face.²⁷

VIRTUAL REALITY HEADSET. A virtual reality headset was used in this study. The headset was tested on five children before being used. To test the headsets, verbal consent was obtained from the children and their parents. The headsets' appropriateness for faces and the visibility of the application used were also tested. The children who tested the headsets were not included in the study. No problems were observed in the system. The headset weighed 295 g and was padded where in contact with the face. It also had biconvex lenses with a diameter of 38 mm, a wide viewing angle, and an optical zoom button. The interocular distance can be adjusted for children.²⁸

THE APPLICATION OF "AQUARIUM VR". The virtual reality application simulates a submarine journey to discover things underlying the virtual aquarium. The aquarium features sharks, aquatic mammals, clown fish, and much more. It allows children to learn more about the sea life in the Pacific Ocean.²⁹

Procedure

Study data were collected from children who underwent blood collection at a clinic with their parents and met the sample collection criteria. The researcher informed these children and their parents about the study using the “informed consent form.” Verbal consent was obtained from children who wished to participate in the study, as well as their parents, and they were included in the study. The researcher collected study data using the face-to-face interview method.

Before the venipuncture procedure, children to be included in experimental and control groups and their parents were informed about the study. Children who accepted the invitation to participate in the study were divided into two groups according to the sequence number for the blood collection clinic; odd and even numbers were included among the experimental and control groups, respectively.

Before entering the intervention room, experimental group children were briefly informed about how to use a virtual reality headset. One minute before the venipuncture procedure, children started to watch the 3D “Aquarium VR” application via the virtual reality headset. The nurse performed the venipuncture at the patients’ antecubital site using a vacutainer. This procedure lasted about 2-3 minutes, during which time the children did not take off the virtual reality headset. At the end of the procedure, the virtual reality headset was taken off. The researcher administered a questionnaire to children and asked them to rate the level of their pain (WBFPS and VAS). No interventional procedure was used for children in the control group. The WBFPS and VAS were used to measure the pain level after the venipuncture procedure.

Evaluation of Data

To determine the needed sample size, this study performed a prior power analysis. A study by Güdücü Tüfekçi et al was taken as a reference, and the effect size was calculated to be 0.56.³⁰ For the relevant effect size value, the needed sample size was calculated for each experimental and control group to be 51 to obtain power in the significance level of $\alpha = .05$, at the level of 80%. This study used the “G*Power v 3.1.9.2” software to

calculate the sample size. Considering the possible losses in participant numbers, the sample size was set at 60 children in each group; a total of 120 children were included in the study. This study used the Shapiro-Wilk test to evaluate the convenience of normal distribution of continuous variables. Continuous variables were expressed as mean \pm standard deviation as well as median (minimum:maximum) values. Regarding normality test results, the Kruskal-Wallis and Mann-Whitney U tests were used for intergroup comparisons. Intergroup comparisons of categorical variables were made using the Pearson’s chi-squared test and the Fisher-Freeman-Halton or Fisher’s exact chi-squared test. For statistical analyses, this study used SPSS software (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0; IBM Corp., Armonk, NY); the value of $P < .05$ was accepted to be statistically significant.

Ethical Considerations

Before initiating the study, the researcher obtained written permission from the Uludağ University, Faculty of Medicine, Clinical Research Ethical Committee, and from the hospital in which the study was conducted (IRB no.: 00004769/decision no.: 2016-18/24). To use the “Aquarium VR” application, this study obtained approval from the relevant company (EON Reality). Before collecting study data, parents and children were informed about the purpose of this study and the manner of application using the “informed consent form.” Verbal consent was obtained from children who would participate in the study, as well as their parents.

Findings

Regarding the demographic characteristics of children included in the study (Table 1), the mean age of the children in the experimental group was 10.50 ± 1.14 years, and the mean age of the children in the control group was 10.30 ± 1.12 years. Of the children in the experimental group, 50% ($n = 30$) were female, and of the children in the control group, 51.7% ($n = 31$) were male. There was no significant difference in the distribution of control and experimental group children’s mean age and gender ($P > .05$).

The pain levels of the children were measured using the WBFPS and the VAS, and the mean pain

Table 1. The Comparison of Characteristics of Children Regarding the Venipuncture Procedure According to Experimental and Control Groups

	Experimental Group (n = 60)	Control Group (n = 60)	P value
Age (mean \pm standard deviation)	10.50 \pm 1.14	10.30 \pm 1.12	U = 1623.000, P = .337
Gender			$\chi^2 = 0.033$
Female	30 (50)	29 (48.3)	df = 1
Male	30 (50)	31 (51.7)	P = .855

U, Mann-Whitney U test; χ^2 , chi-squared (Pearson's chi-squared) test.

Data are expressed as n (%) unless otherwise noted.

levels of the 9-year-old children in the experimental group were found to be 2.13 ± 2.13 using the WBFPS and 2.75 ± 2.79 using the VAS. The mean pain levels of the 9-year-old children in the control group were found to be 4.32 ± 4.07 using the WBFPS and 4.53 ± 3.99 using the VAS. The study examined the pain levels of the children by gender and found that the mean WBFPS pain level of the females in the experimental group was 1.80 ± 1.42 , and the males' mean WBFPS pain level was 1.57 ± 1.61 . The mean WBFPS pain level of the females in the control group was 3.31 ± 3.17 , and the males' mean WBFPS pain level was 2.84 ± 2.57 (Table 2). The pain levels of children felt during the venipuncture procedure showed that there was no statistically significant difference between groups in terms of WBFPS and VAS pain scores according to their age groups and gender (Table 2; $P < .05$).

This study compared the pain levels of children felt during the procedure and found that the scores of the experimental group and control group children on the WBFPS were 1.68 ± 1.51 and 2.02 ± 1.96 , respectively. The pain levels on the WBFPS were higher in the control group ($P < .01$). The scores of the experimental group and control group children on the VAS pain scale were 3.07 ± 2.86 and 3.23 ± 3.05 , respectively. The pain levels on the VAS were higher in the control group (Table 3; $P < .05$).

Discussion

The purpose of this study was to determine the effect of using a virtual reality headset on decreasing the pain felt during a venipuncture procedure in children. The control group and the experimental group were compared in terms of the variables

Table 2. The Comparison of Pain Scores in the Experimental and Control Groups According to the Characteristics of Children

	Experimental Group (n = 60)		Control Group (n = 60)	
	WBFPS Pain	VAS Pain	WBFPS Pain	VAS Pain
Age Group				
9	2.13 \pm 2.13	2.75 \pm 2.79	4.32 \pm 4.07	4.53 \pm 3.99
10	1.85 \pm 1.28	2.31 \pm 2.18	3 \pm 2.07	3 \pm 2.78
11	1.63 \pm 1.09	1.69 \pm 1.01	2.15 \pm 1.28	2.62 \pm 1.80
12	1.33 \pm 1.25	1.33 \pm 1.18	2.17 \pm 2.17	2.17 \pm 2.25
P value	KW = 2.931, df = 3 P = .402	KW = 2.267, df = 3 P = .519	KW = 2.792, df = 3 P = .425	KW = 2.619, df = 3 P = .454
Gender				
Female	1.80 \pm 1.42	2.07 \pm 1.96	3.31 \pm 3.17	3.14 \pm 3.13
Male	1.57 \pm 1.61	1.97 \pm 1.99	2.84 \pm 2.57	3.32 \pm 3.02
P value	U = 399.500 .414	U = 419.000 .638	U = 419.500 .633	U = 424.500 .709

KW, Kruskal-Wallis test; U, Mann-Whitney U test; WBFPS, Wong-Baker Faces Pain Scale; VAS, Visual Analogue Scale.

Table 3. The Comparison of Pain Levels of Children Felt During the Procedure

	Experimental Group (n = 60)	Control Group (n = 60)	P value
WBFPS Pain	2 (0:6) 1.68 ± 1.51	2 (0:8) 2.02 ± 1.96	U = 1317.000, P = .006*
VAS Pain	2 (0:10) 3.07 ± 2.86	2 (0:10) 3.23 ± 3.05	U = 1413.000, P = .039†

Data were expressed as median (minimum:maximum), mean ± standard deviation, and n (%).

*P < .01.

†P < .05.

such as age, gender, and the characteristics about the venipuncture procedure. No statistically significant differences were found between the groups ($P < .05$), which means the groups were similar in terms of these variables (Table 1).

No statistically significant difference was found between the pain scores of the experimental and control groups based on their age (Table 2). Similar to the study finding, another study examined the effect of the distraction of attention by using a kaleidoscope to decrease the level of pain felt during the venipuncture procedure in school-age children. This study determined that the age of children had no effect on the level of pain felt during the venipuncture procedure.³¹ Various studies used colorful cards and kaleidoscopes, as well as virtual reality headsets, which were among the distraction tools used during venipuncture in the present study. It was determined that children's age had no effect on pain level.^{15,32} Among studies supporting that the age of children had an effect on the level of pain, in the study by Tüfekçi and Erci, the authors determined that the pain tolerance of children aged 6–11 years was lower than that of children aged 12–14 years.³³ A study by Moadad et al showed that the distraction method, using the “BUZZY”, was more effective for decreasing the pain in children aged 4–8 years than in children aged 8–12 years.³⁴ Contradictions in study results may stem from sociocultural differences and age groups which affect the perception of pain or from a variety of distraction methods used in studies to decrease pain.

This study examined the level of pain felt by participating children during the venipuncture procedure according to their gender and found

no statistically significant difference between the experimental and control groups (Table 2). An analysis of similar studies showed that Canbulat et al used kaleidoscopes and distraction cards, Karakaya and Gözen used kaleidoscopes, and Risaw et al only used distraction cards to reduce children's pain and found no significant difference between the groups' pain level based on their gender.^{31,32,35} These studies support the findings of the present study and show that gender has no effect on the level of pain felt during the procedure. In contrast to the findings of the present study, another study determined that the effect of the distraction method on decreasing the pain was greater in female children than in males.³⁴ A study by Tüfekçi and Erci found that the gender of children had an effect on pain tolerance, and female children felt greater pain than male children.³³ Differences in study results may be due to the variety of distraction methods or age groups. In conclusion, the relationship between gender and pain level should be discussed.

The present study determined that control group children felt more severe pain than experimental group children did during the venipuncture procedure, and the difference between groups was statistically significant (Table 3; $P < .05$). A similar study by Gold and Mahrer examined the effectiveness of using virtual reality headsets on decreasing the level of pain felt by children during the venipuncture procedure and revealed that the mean pain score of the experimental group children was lower than that of the control group children.¹⁴ Virtual reality technology, therefore, is effective in the treatment of acute pain. Piskorz and Czub carried out a study with children aged 7–17 years to examine the effect

of using virtual reality headsets on pain intensity during the venipuncture procedure, and the experimental group children reported lower pain intensity than the control group.¹⁵ This study found a significant difference between groups. Findings of the present study support the hypothesis that using virtual reality headsets has an effect on decreasing the level of pain felt by children during a venipuncture procedure. The virtual reality application is defined as an encouraging and interesting intervention which helps to decrease pain for children experiencing painful interventions.³⁶

Limitations of the Study

Including only the children aged 9 to 12 years and being conducted in a single center were the limitations of this study.

Conclusion

The venipuncture procedure in children is a painful, frequently used medical intervention. The present study revealed that using a virtual reality headset decreased the level of pain felt during the venipuncture procedure in children aged 9-12 years. A parallel relationship was determined in the pain assessment of the WBFPs and VAS pain scales. According to these results, virtual reality headsets can be used in children during the venipuncture procedure. More evidenced-based studies should be conducted on using new technological devices such as virtual reality headsets in clinical areas.

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