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The Effect of Virtual Reality on Pain During Blood Draw in Children Aged 6-10 Years

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ABSTRACT
Objective: This was study that was performed to determine the effect of distraction technique which was applied by a virtual reality for decreasing the pain of the child during blood draw. **Methods:** In this randomized controlled experimental study, venous blood samples were taken from children aged 6–10 years. In order to evaluate the level of pain that the children felt during the procedure, the Faces Comparative Pain Scale and Visual Comparative Pain Scale were used. Children in the experimental group were shown video with virtual reality glasses during the blood collection process. **Results:** It was found that mean score of the children in the experimental group from "Faces Pain Scale" was 1.02±1.12 following the procedure and their mean score from "Visual Comparative Pain Scale" was 1.87±1.97. For the children in control group, mean score from "Faces Comparative Pain Scale was 2.47±1.83 and mean score from "Visual Comparative Pain Scale" was 4.17±3.16; and also, a statistically significant difference was found between two groups (p=0.0001 and p=0.001). **Conclusion:** Virtual reality glasses, that are used during venous blood collection, are an effective instrument which draw the attention of the children, do not require no prior preparation, can be applied easily and decrease pain.
Key words: Blood Drawal, Distraction, Nonpharmacological Method, Pain, Virtual Reality.

Kan Alımı Sırasında Kullanılan Sanal Gerçekliğin Çocukların Hissettikleri Ağrıya Etkisi: Randomize Kontrollü Bir Çalışma

Amaç: Sanal gerçeklik gözlüğü ile uygulanan dikkati dağıtma tekniğinin çocuğun kan alımı sırasında ağrısını azaltmak için etkisini belirlemek amacıyla yapılmış bir çalışmadır. **Yöntem:** Bu randomize kontrollü deneysel çalışmada, 6–10 yaş arası çocuklardan venöz kan örnekleri alındı. Çocukların işlem sırasında hissettikleri ağrı düzeyini değerlendirmek için Yüzler Karşılaştırmalı Ağrı Ölçeği ve Görsel Karşılaştırmalı Ağrı Ölçeği kullanıldı. Deney grubundaki çocuklara kan alma işlemi sırasında sanal gerçeklik gözlüğü ile video izletildi. **Bulgular:** Deney grubu çocukların işlem sonrası "Yüzler Ağrı Kıyaslama Ölçeğine" verdikleri puanın ortalamasının 1.02±1.12, "Görsel Ağrı Kıyaslama Ölçeğine" verdikleri puanın ortalaması 1.87±1.97, kontrol grubu çocukların ise "Yüzler Ağrı Kıyaslama Ölçeğine" verdikleri puanın ortalamasının 2.47±1.83, "Görsel Ağrı Kıyaslama Ölçeğine" verdikleri puanın ortalaması 4.17±3.16 olduğu belirlenmiş, iki grup arasında ileri düzeyde anlamlı fark olduğu saptanmıştır (p=0.0001 ve p=0.001). **Sonuç:** Venöz kan alımı sırasında kullanılan sanal gerçeklik gözlüğü çocukların dikkatini çeken, ön hazırlık gerektirmeyen, kolay uygulanabilen ve ağrıyı azaltan etkili bir araçtır.

Anahtar kelimeler: Kan Alma, Dikkat Dağıtma, Nonfarmakolojik Yöntem, Ağrı, Sanal Gerçeklik.

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INTRODUCTION

Individuals face with pain due to any trauma, disease or various medical interventions during childhood period at the first time (Cohen et al., 2008; Dinçer et al., 2011). Although pain is considered as one ofthe important factors throughout one's life, the needs of children during painful procedures have not gained enough importance (Tüfekci & Erci, 2007). According to American Academy of Pediatrics and American Pain Society, pain is evaluated and treated inadequately for children (Conk et al., 2013; American Academy of Pediatrics, 2001).

Painful medical procedures such as blood drawing, injection and vaccine application are among the fears of children. These fears may lead to frustration in children and parents most of the time; and it affects subsequent treatment and care process of the child negatively. If the child has undergone a painful procedure previously, this experience may cause anxiety in children during later procedures; and this condition significantly affects the degree of the pain felt (İnal & Canbulat, 2015).

Physiologically, pain causes tachycardia, an increase in the oxygenation of myocardium, an increase in cardiac output, respiratory alkalosis, tachypnea, a decrease in lung ventilation, hypoxia, nausea and vomiting; and psychologically, it causes problems such as an increase in stress and anxiety levels, behavioral disorders, sleeping problems, disappointment and guilt among parents (Yılmaz & Atay, 2014; Conk et al., 2013; Törüner & Büyükgönenç, 2011).

Provision of effective pain control during painful interventions applied to children will increase tolerance against pain during further interventions (Mutlu & Balcı, 2015). Successful pain management increases life quality of the child, provides early mobilization and decreases hospital costs by shortening the duration of hospitalization (Conk et al., 2013; Akatın, & Kocaman, 2018).

A multidisciplinary team approach is required to achieve the desired success in pain management among children (Mutlu & Balcı, 2015). Nurses have a central position within this team due to their roles such as spending a long time with the patient, learning previous pain history and pain coping style of the patient, and also, benefiting from these methods when necessary, nurses teach patients how to cope with the pain, guide the patients, perform the planned treatment and follow up its outcomes (Cohen et al., 2008).

Pharmacological and nonpharmacological methods are used in pain management (Conk et al., 2013; Törüner & Büyükgönenç, 2011). Nonpharmacological methods are the independent practices conducted by nurses. At the same time, these methods are inexpensive, reliable, non-invasive, easy to apply, cost-effective and has no side effects (Mutlu & Balcı, 2015; Akatın, & Kocaman, 2018).

Distraction is a nonpharmacological nursing intervention that provides better pain management by drawing patient's attention to another direction. Some of the methods used for distraction are watching cartoon movies (Erbay, 2016), balloon inflation, cough trick (Mutlu & Balcı, 2015), kaleidoscope (Kunjumon, & Upendrababu, 2018), virtual reality (Ustuner Top & Kuzlu Ayyıldız 2021), buzzy® and distraction cards (Erdogan, & Ozdemir, 2021).

The aim of this study was to determine the effect of distraction technique, that is applied during blood collection, on the pain of children aged between 6–10 years old. The hypothesis of the study was indicated as "There is a difference between the pain felt, the pulse measured and the saturation values of the children in the study and control groups."

MATERIALS AND METHODS

Design

The present study was a prospective, randomized, controlled study.

Place and time of research

The study was carried out in the pediatric blood collection unit of a university hospital between May and September 2016.

The study population and sample of the research

The children who not between 6 and 10 years of age, who had pain at admission, who had a disease causing a chronic pain, who used a medication that might cause an analgesic effect within the last 24 hours before the admission, who were not willing to participate in the study, who had a mental and neurological disability, who could not speak Turkish, who had a chronic disease requiring frequent blood collection (such as renal failure or diabetes), who were experiencing a fever disease during admission and who had a history of faint during blood collection were excluded from the study. Children whose parents provided consent and who did not have pain at admission were enrolled (n=106). Among these, 16 children gave up blood collection with virtual reality glasses during the procedure. Ten children did not fill the pain scale following the procedure. Therefore, the study was carried out by assigning 80 children to experimental and control groups as 40 per each. The study adhered to the CONSORT guidelines (Figure 1) (Schulz, Altman, Moher, & CONSORT Group, 2010). Randomization was performed using a computer program.

The number of the universe could not be calculated since registration process did not take place in a blood collection clinic. The calculation of the sample size was performed by G-power 3.1 package program. Minimum number of patients per group was calculated as 30 with an effect size of 0.8 and power of 0.80. Considering that there may be case losses and that there may be cases that disrupt homogeneity in terms of variables affecting pain and that they may be removed from the study groups, 40 people were included in each group.

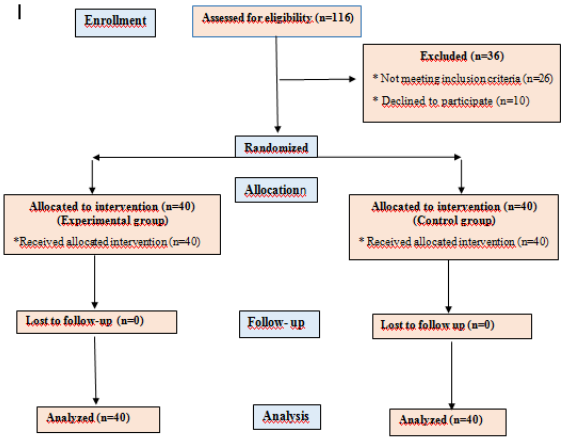

Figure 1. Consort diagram of the study

Variables

The dependent variable of the study;

- Faces Pain Scale-Revised
- Visual Analog Scale
- Heart rate,
- Oxygen saturation values.

The independent variables of the study

- Watching video with virtual reality glasses

Data collection tools

The data were collected by using the Descriptive Information Form, Faces Pain Scale and Visual Analog Scale.

Descriptive Information Form

There were 33 questions in the form including sociodemographic characteristics of the children, the person accompanying the child during the procedure and experiences, feelings, thoughts and responses of the child during previous blood collection.

Faces Pain Scale-Revised (FPS-R)

There were 6 facial expressions which were scored between 0 and 5 in the scale that was used for children who were older than 3 years old, who were conscious and who had ability to communicate. The severity of the pain increased as the score increased (Cohen et al., 2008; Conk et al., 2013; Törüner & Büyükgönenç, 2011).

Visual Analog Scale (VAS)

The children were asked to show pain they felt on a 10-cm ruler within an interval from "no pain" to "the most severe pain"(Conk et al., 2013; Törüner & Büyükgönenç, 2011).

Virtual Reality Glasses

Virtual reality glasses are a technological product that are used to watch displays prepared as 360 degrees and that can show the display greater and clearer due to the special lenses inside it. In this study, "VR BOX 3.0" virtual reality glasses that were white in color were used. The distance between the cell phone and objective can be adjusted personally. It has air outlets that might dissipate the heat transmitted by the phones. While using the product, there is no need for any power or connection unit except the phone. The weight of the product was 0.414 kg. The dimensions (height x depth x length) were 19.5x14x11 cm/7.66x5.50x4.32 inches.

Ethical considerations

Written consents for the study were taken from Zonguldak Bulent Ecevit University (BEU) Clinical Research Ethics Committee and from Head Physician of Zonguldak BEU Health Practice and Research Center. Parents were informed about the aim and research plan of the study before the treatment. Informed Consents were taken from the parents who accepted to participate in the study. Verbal consents were taken from the children who accepted to be included in the study.

Intervention

Before the venipuncture procedure

Children in experimental and control groups and their parents filled "Descriptive Information Form" just 30 minutes before the procedure. Oxygen saturation and the heart rates of the children participating in the study, were measured before the procedure, and they were recorded into "Application Registration Form". Children were reminded that one of their parents would be with them during the procedure.

Venipuncture procedure

Blood was collected from the children in experimental and control groups by a pediatric nurse using a 21 guage + 1.5 inch vacutainer. Blood was collected from all children at the first trial. Their parents were besides their children during the procedure.

Control group

A pain-decreasing intervention was not applied to the children in the control group. Their blood was collected by the nurses working in the pediatric clinic through routine nursing care. Parents were allowed to stay besides their children during the procedure but they did not perform any pain-decreasing intervention.

Experimental group

Virtual reality glasses were introduced to the children in the experimental group before the procedure and children who were willing to wear were made to try glasses, and their consent for blood collection was taken with these devices on. The child was made to watch a two to three minutes long video with virtual reality glasses before starting the procedure; and it continued until the end of the blood drawing procedure (an average of five minutes). Each child was made to watch "Aquarium-VRA" video.

After the venipuncture procedure

Just after the procedure, oxygen saturation and heart rates were measured again. The score of pain felt during blood collection was asked to the child second minutes after the procedure; and it was marked on Visual Analog Scale (VAS) and Faces Pain Scale. The children in the experimental group and their parents were asked their opinions about virtual reality glasses after the procedure.

Data analysis

Statistical analyses of the study were done by Statistical Package for the Social Sciences (SPSS Inc., Chicago, IL, USA), Version 19.0 package program. Descriptive statistics for continuous variables in the study were presented with mean, standard deviation, minimum and maximum values; and they were given with frequency

and percentages for categorical variables. Compliance with normal distribution of continuous variables was evaluated by Shapiro Wilk test. Pearson chi-square test was used to compare groups of categorical variables. Independent-samples ttest was used to compare variables showing normal distribution while Mann Whitney U test was used to compare variables that did not show normal distribution. Paired-tamples t test was used to compare variables in dependent groups showing normal distribution; and two-related-samples test was used to compare variables which did not present normal distribution. P value below 0.05 was found to be statistically significant for all statistical analyses in the study.

RESULTS

It was detected that 45.0% (n=18) of the children in each group were females, and 55.0% (n=22) were males; and mean age was found to be 7.65±1.30 (6-10) years old. Based on the ranking of the child among his/her siblings, it was determined that 57.5% (n=23) in experimental group and 62.5% (n=25) in the control group were the oldest children within their families (Table 1).

When children in experimental and control groups were examined based on their age, sex and ranking between the siblings, no statistically significant differences were found between the groups (p>0.05).

Table 1. Comparison of sociodemographic characteristics of the children based on groups.

Variables	Experimental Group Ort±*SS* Median (Min–Max)		Control Group Ort±*SS* Median (Min–Max)		Total Ort±*SS* Median (Min–Max)		p
Age	7.4+2.46 (6–10)		7.4+2.46 (6–10)		7.4+2.46 (6–10)		1.000[a]
Child's sex	**n**	**%**	**n**	**%**	**n**	**%**	
Boys	18	45.0	18	45.0	36	45.0	1.000[b]
Girls	22	55.0	22	55.0	44	55.0	
Enumeration between siblings							
1st Child	23	57.5	25	62.5	48	60.0	0.74[b]
2nd Child	12	30.0	12	30.0	24	30.0	
3rd and over	5	12.5	3	7.5	8	10.0	
Total	**40**	**100.0**	**40**	**100.0**	**80**	**100.0**	

[a]Mann Whitney U Test [b]PearsonChi-Square Test

When children in experimental and control groups were compared based on the causes for admission to hospital and their states of having a companion, no statistically significant differences were found (p>0.05(Table 2).

Table 2. Comparison of the children in experimental and control groups based on the reason for their admission to hospital and their status of attendant.

Variables	Experimental Group		Control Group		Total		p
	n	%	n	%	n	%	
The reason for their admission to hospital							
Thyroid gland diseases	5	12.5	5	12.5	10	12.5	0.39[b]
Allergy	6	15.0	4	10.0	10	12.5	
Respiratory system diseases	6	15.0	3	7.5	9	11.1	
GİS* diseases	8	20.0	7	17.5	15	18.8	
Circumcision	5	12.5	2	5.0	7	8.8	
Other**	10	25.0	19	47.5	29	36.3	
Attendant							
Mother	28	70.0	31	77.5	59	73.8	0.77 [b]
Father	10	25.0	7	7.5	17	21.2	
Other	2	5.0	2	5.0	4	5.0	
Total	**40**	**100.0**	**40**	**100.0**	**80**	**100.0**	

[b]PearsonChi-Square Test*Gastrointestinal System

**Control, vertigo, developmental disorder, early puberty, weight gain, anemia, perspiration, nose bleeding, urinary incontinence, swelling around, sebaceous gland, tick

It was found that the mean score of the children in the experimental group from "Faces Pain Scale" was 1.02±1.12 following the procedure and their mean score from "Visual Comparative Pain Scale" was 1.87±1.97. For the children in the control group, the mean score from "Faces Comparative Pain Scale was 2.47±1.83 and the mean score from "Visual Comparative Pain Scale" was 4.17±3.16; and also, a statistically significant difference

was found between two groups (p=0.0001 and p=0.001) (Table 3).

Table 3. Comparison of the levels of pain felt by children during blood collection.

Pain Scales	Experimental Group Ort±ss Min–Max	Control Group Ort±ss Min–Max	p
FPS-R	1.02±1.12 (0.00–3.0)	2.47±1.83 (0.00–5.0)	**0.001**[a]
VAS	1.87±1.97 (0.00–6.0)	4.17±3.16 (0.00–10.0)	**0.001**[a]

[a]Mann Whitney U Test

When the levels of pain felt by the participants were compared, it was found that significantly less pain was felt by the children in the experimental group compared to the children in the control group.When physiological changes of the participants before and after the tretment were examined, a statistically significant difference was observed between both groups about their pulse values before and after the treatment (p=0.046 and p=0.033) whereas no statistically significant difference was observed between groups before and after the treatment in terms of saturation values (p=0.676 and p=0.479) (Table.4).

Table 4. Comparison of pulse and SPO_2 values of the children before and after the procedure.

Physiological changes		Before Procedure X±SS (Min–Max)	After Procedure X±SS (Min–Max)	p
Pulse	Experimental Group Control Group	106.12±16.90 (63–151) 105.07±15.53 (77–153)	102.57±19.85 (60–149) 108.70±18.03 (80–155)	**0.04**[c] **0.03**[c]
p		0.28 0.77	-1.44 0.15	
Saturation	Experimental Group Control Group	98.12±1.01 (94–100) 98±01.81 (95–100)	98.20±1.32 (92–100) 98.10±0.81 (96–100)	0.67[c] 0.47[c]
p		0.35[a]	0.32 [a]	

[a]Mann Whitney U Test [c]Wilcoxon Signed Ranks Test

DISCUSSION

Pain may cause children to get scared of procedures such as blood collection and injections, and may lead to unwillingness for these, and even neglection or delay of the treatment. One of the non-pharmacological methods used in pain management is distraction. The method of distraction is a nursing intervention that provides better control and a decrease in pain by drawing attention of the patient away from the procedure (Conk et al., 2013; Törüner & Büyükgönenç, 2011; Inal & Canbulat, 2015). After having compared the individual and familial characteristics of the children in experimental and control groups, the causes for their admission to hospital, their states of having a companion at hospital, their experiences regarding blood collection, their states of fear and emotions before blood collection and their less favorite procedure, no significant differences were found. This situation showed that experimental and control groups were homogenous.

When levels of pain felt by the participants were compared, it was found that children in experimental group felt significantly less pain during blood collection compared to the children in the control group. This situation was thought to stem from the fact that the children in the experimental group felt less pain due to the ability of virtual reality glasses applied to the experimental group to draw the attention of children to another direction. The findings obtained from the study show similarities with the other studies. Some studies are reporting that distraction during procedures such as establishing vascular access or drawing blood decreased the pain felt among children of different age groups (Canbulat et al., 2014; Inal & Canbulat, 2015; Erbay 2016; Mutlu & Balcı, 2015; Kunjumon, & Upendrababu, 2018; Ustuner Top & Kuzlu Ayyıldız, 2021; Erdogan, & Ozdemir, 2021; Şahin & Ayyıldız, 2022).

There are some studies reporting that distraction during the procedures such as establishing vascular access or drawing blood decreased the pain felt among children of different age groups. Many researchers have reported that several techniques helped to decrease pain among children of different ages such as distraction cards, virtual reality, and buzzy® among 7-12 age group (Erdogan, & Ozdemir, 2021); blowing soap foam among 3-6 age group (Caprilli et al., 2012); balloon inflation and coughing exercises among 6–12 age group (Mutlu & Balcı, 2015); watching to virtual reality among 4–6 age group, (Ustuner Top & Kuzlu Ayyıldız, 2021) and using colorful cards and kaleidoscope among 7–11 age group (Canbulat et al., 2014).

In the study, physiological changes in both groups were evaluated before and after blood collection. In terms of pulse values, pulse rate decreased after the treatment in the experimental group whereas it showed an increase in

the control group (p=0.046 and p=0.033). For $SP0_2$ values, there was not a statistically significant difference between both groups in terms of saturation values before and after the treatment (p>0.05).

The most reliable source in pain evaluation is the self pain expression of the patient. However, it is required to transform this subjective statement into objective to make it measurable. Perception of pain is accompanied with significant physiological changes such as heart rate, blood pressure, electrodermal activity and electromyography especially in case of acute pain (Demir, 2012). Heart rate, respiration rate and blood pressure may increase and oxygen saturation may decrease in children during pain (Törüner & Büyükgönenç, 2011).

According to the measurement results of our study, it was detected that there was not a significant difference in oxygen saturation values before and after the procedure; but there was a significant difference in pulse values between both groups. It is thought that this condition might be due to the shortness of the procedure. It has been reported that it was difficult to detect changes showing autonomic stimulation during short painful procedures, physiological changes turned into normal rapidly due to the shortness of the duration of the procedure and adaptation and harmony occurred in a short time (Oakes, 2011; Rostami et al., 2006).

In the previous studies relevant with this topic, different results were found about the changes in vital findings of children during painful procedures. In their study evaluating the effect of making 2–7 year old children to watch cartoons during establishing peripheric vascular access on the pain felt, Erbay et al. (2016) have found that there were not significant differences between average pulse, respiration and oxygen saturation before and after the procedure. In the study by Mutlu et al (2015) that aims to decrease pain during blood drawal among 9–12 year old children, it was found that there was not a significant difference in oxygen saturation before and after the procedure in balloon and coughing groups, but average pulse value following the procedure was found to be significantly higher compared to the value before the procedure in coughing group. Rostami et al (2006) applied local cooling to the children of 6–12 years old during establishing venous vascular access in order to decrease pain in their study; and did not detect a statistically significant difference in pulse values.

In this study, it was observed that application of virtual reality glasses was effective for decreasing pain of 6–10 year old children during blood collection. The efficiency of the use of virtual reality glasses is recommended to be supported by evidence-based studies that will be performed with distinct age groups and for distinct painful procedures.

Research Strengths

- The study is a randomized controlled trial.
- It is the first study in which virtual glasses were used during blood collection in children in Turkey.

Limitations

This study has some limitations. Some children did not want to continue the study since they felt too much pain. Some of the children, who provided consent for blood collection by using virtual reality glasses before the procedure, declared that they did not want to wear glasses when they entered the blood collection room. The families who wanted to spendless time in the hospital did not want to participate in the study. For these reasons, there were case losses.

CONCLUSION

Virtual reality glasses, that are used during venous blood collection, are an effective instrument which draw the attention of the children, do not require no prior preparation, can be applied easily and decrease pain.

Conflict of Interest

The author declare no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

Author Contributions

Plan, design: FG, TKA; **Material, methods and data collection:** FG, TKA; **Data analysis and comments:** FG, TKA; **Writing and corrections:** FG, TKA.

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