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Effect of Virtual Reality on Pain and Anxiety among School Age Children during Vein Puncture

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Abstract: Background: Virtual Reality (VR) play an integral role as a promising distraction technique for children's pain and anxiety management. **Purpose:** To assess the effect of virtual reality on pain and anxiety among school age children during vein puncture. **Design** A quasi-experimental design (study and control groups) was utilized. **Setting** The study was conducted in the pediatric department at Menoufia University Hospital, Shebin El-Kom City. **Sample** A purposive sample of 50 school age children who used the virtual reality goggle during vein puncture and 50 school age children who received only routine hospital care during the vein puncture. **Instruments** Four instruments used for data collection: A structured interviewing questionnaire for school age children, Wong–Baker Faces Pain Rating Scale, Facial Affective Scale (FAS)-Three Faces Facial Affective Scale and Feasibility assessment sheet. **Results** showed that there were highly statistical significant differences between levels of pain and anxiety on posttest compared to pretest (3.72 ± 2.86 Vs 7.32 ± 2.67 respectively) & (43.0 ± 33.52 Vs 78.0 ± 32.20 respectively). Also, children who received virtual reality distraction had less pain and anxiety than children who received routine hospital care (3.72 ± 2.86 Vs 6.80 ± 3.16 respectively) & (43.0 ± 33.52 Vs 64.0 ± 35.05 respectively). **Conclusion:** the application of virtual reality distraction had appositive effect on reducing pain and anxiety during the vein puncture among school age children. So, it was recommended that applying virtual reality goggle during the vein puncture in clinical setting to reduce pain intensity and anxiety level.

Key words: *Anxiety, Pain, School age children, Vein puncture, Virtual Reality*

Introduction

Vein puncture is a recurrently performed needle-related procedure. It is one of the most alarming experiences and a common source of moderate to severe pain among children. Vein puncture is a devastating medical, emotional and physical problem for both pediatric patients and their families (Czech et al., 2021). It is a painful, invasive

procedures that are disturbing many children, worse than the disease itself and frequently accompanied by anxiety or fear. Frequent stress and anxiety associated with needle-related procedures may lead to needle phobia (Sayed et al., 2020).

Pain is a personal, subjective experience influenced by one's emotions, body, mind, society and culture (Chen et al., 2020). Self-reporting is considered to be the most valuable because it directly reflects the degree and nature of child pain. Measures for self-reported were preferred as pain and anxiety are subjective and private experiences (Nordgård & Låg, 2021).

Anxiety is a feeling of apprehension caused by the anticipation of internal or external danger, with physiological and psychological characteristics, such as fear, insecurity, tension, muscle pain, tremors, sweating, tachycardia and tachypnea. Anxiety usually arises in situations of a sense of threat and imminent but nonspecific danger (DE Campos et al., 2020).

Pain and anxiety can be prevented, treated, or at least reduced using pharmacological and non-pharmacological approaches. Non pharmacological approaches are considered to be desirable (Sayed et al., 2020).

One of non-pharmacological techniques is distraction technique. Distraction involves a process by which the child senses become disconnected from the nociceptive stimulus and leads to a reduction in stress symptoms during painful procedures. Research shows that combining visual and audio distraction stimuli is more effective than using visual stimuli alone. An example of this distractor is virtual reality which was effective with school age children as, they were open to co-operation and more curious about technology (Czech et al., 2021).

Virtual reality (VR) is a new distractor tool that presents virtual objects and environments using computer technology and generally does so in three-dimensional environments by stimulating users' auditory, visual, tactile senses and using head-mounted displays. (Chen et al.,2020).

VR provides settings (e.g., peaceful scenes or gaming scenarios) where the child can assume an interactive avatar to experience presence in the environment. These interactive and immersive VR techniques could be effective in reducing pain and anxiety as interacting with immersive VR might divert attention, leading to a slower response to incoming pain signals (Arane et al., 2017).

Significance of the study

Vein puncture is a common source of moderate to severe pain for pediatric patients. Approximately 51% of children aged 6–12 years undergoing vein puncture reported high levels of distress during the procedure (Wong et al., 2019). Vein puncture has been reported to be the most common painful event for a hospitalized child. About 28% to 83% of pediatric patients are diagnosed with acute behavioral distress while routine vein puncture test (Singh et al., 2017).Various studies have suggested

non-pharmacological interventions, such as distraction as a most effective non-pharmacological intervention for mitigating pain and anxiety experienced by pediatric patients undergoing needle-related procedures particularly in children aged < 12 years (Wong et al.,2019). Virtual reality technology has been explored in the health sector as a distraction novel tool for supporting and monitoring treatment (Ahmadpour et al., 2020). So, using virtual reality as a distraction method of intervention may help school age children to reduce pain and anxiety during vein puncture, as immersive virtual reality (IVR) can simultaneously provide complete distraction and procedural information to the children. For this reason this study will be conducted to assess the effect of virtual reality on pain and anxiety among school age children during vein puncture.

Definition of variables

Virtual reality:

It is theoretically defined as a new effective tool for pain distraction in children undergoing medical procedures. It surrounds the users with cool, fantasy-like three dimensional virtual environments in which they can interact with virtual objects by stimulating users' auditory, visual and tactile senses by using a head-mounted displays (Chen et al., 2020).While in the current study, it is operationally defined as a new way which will be used to distract the child's attention during vein puncture.

Pain:

Is theoretically defined as unpleasant sensory emotional experience associated with actual or potential tissue damage resulting from vein puncture. Pain is a complex perception that has profound affective & cognitive feature damage (Meha, 2020).While in the current study; it is operationally defined as series of hurts that starts from little to severe that the child feels during the vein puncture. It will be assessed through using Wong baker scale (instrument two).

Anxiety:

Is theoretically defined as internal emotion characterized by feelings of tension, worry, and activation of the autonomic nervous system before medical procedures (Nunns et al., 2018). While in the current study, it is operationally defined as internal feeling that the child feels when a painful procedure occurs such as vein puncture. It will be assessed through using Facial Affective Scale (FAS) - Three Faces Facial Scale (instrument three).

Methods

The purpose of the study:

The purpose of the study was to assess the effect of virtual reality on pain and anxiety among school age children during vein puncture.

Research Hypotheses:

1) Children who engage in virtual reality session (study group) will exhibit less pain on post intervention than on pre intervention.

2) Children who engage in virtual reality session (study group) will exhibit less anxiety on post intervention than on pre intervention.
3) Children who engage in virtual reality session (study group) will exhibit fewer anxiety on post intervention than children who do not (control group).
4) Children who engage in virtual reality session (study group) will exhibit fewer pain on post intervention than children who do not (control group).

Research Design:

A quasi experimental design (study and control groups) was used to fulfill the purpose of the study.

Research Setting:

The study was conducted in the pediatric department at Menoufia University Hospital, Shebin El-Kom City.

Sampling:

A purposive sample of 100 school age children ranged from 6-12 years old was selected from the previously mentioned setting. A simple random sample was used to assign children into study and control groups.

Study group:

It involved 50 school age child, they used the virtual reality goggle during vein puncture.

Control study:

It involved 50 school age child, they used the virtual reality goggle during vein puncture. They received only routine hospital care during the vein puncture.

The sample size was calculated according to this equitation.

$$n = \frac{z^2 \times p(1-p)}{\epsilon^2}$$

Instruments:

Four instruments were used and developed for data collection.

<u>Instrument one:</u> A structured interviewing questionnaire for school age children.

It was developed by the researcher to collect data about school age children. It was divided into two parts:

- **Part one:** Characteristics of studied sample. It included questions about age and gender.
- **Part two:** Medical data, it included questions about diagnosis, duration of hospitalization, last vein puncture and indication for vein puncture.

<u>Instrument two:</u> Wong–Baker Faces Pain Rating Scale.

It was adopted from Wong & Baker (1983) to assess pain severity for school age children (figure1). The scale showed a series of hurts like the worst pain imaginable. Based on the faces and written descriptions, the child chose the face that best describes his/her level of pain. However, it can be used with all children (3 and above). It is useful for school age children to assess pain severity because they may not understand rating their pain on a scale of 0-10, but are able to understand the cartoon faces and the emotions they represent. Then, the child was asked to point to the face that best match his/her level of pain.

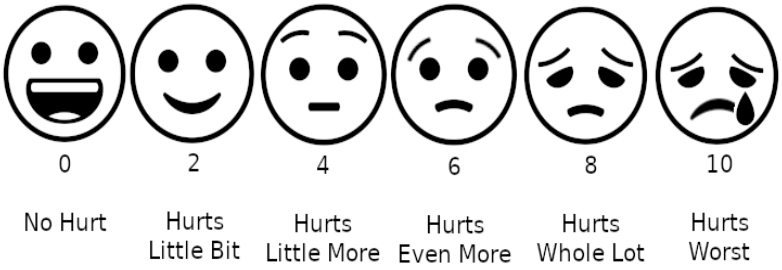

Figure1. An emoji representation of the Wong–Baker Faces Pain Rating Scale

Scoring system for pain:

Scoring items	Score
No Hurt	Zero
Hurts little bit	2
Hurts little more	4
Hurts even more	6
Hurts whole lot	8
Hurts worst	10

Total Scoring system:

Scoring items	Total Score
No pain	Zero
Mild pain	1-4
Moderate pain	5-7
Severe pain	8-10

<u>Instrument three:</u> Facial Affective Scale (FAS) - Three Faces Facial Affective Scale.

It was adopted from McGrath et al., (1996) to assess the level of anxiety in school age children. It was known as Facial Affective Scale (FAS). The FAS contains nine drawings of children's faces whose expressions vary according to the level of anxiety (figure2). The original order of the nine faces ranges from a smiling face to a frowning one with eyes closed and mouth turned down. Then, it was modified by Quiles et al., (2013) using 5 and 3 faces and their corresponding descriptors (figure 3).Three of these faces were chosen for this study (figure 4). These would fulfill the criteria of equidistant progression in the expressive elements of eyebrows, eyelids, tears and smile, so respecting the degree of emotional intensity.

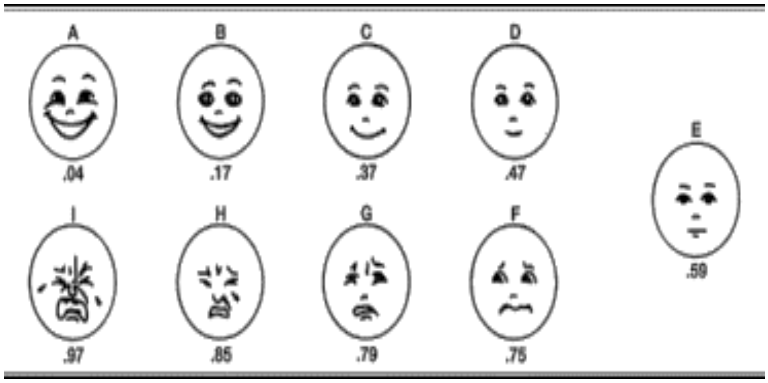

Figure 2. Original nine-face FAS

Figure 3. Modified FAS using 5 and 3 faces and their corresponding descriptions

No anxiety Some anxiety High anxiety

Figure 4. Modified Facial Affective Scale Using 3 Faces

Scoring system for anxiety:

Scoring items	Score
No anxiety	Zero
Some anxiety	1
Very high anxiety	2

Total scoring system:

Scoring items	Score
Mild anxiety	**<60%**
Moderate anxiety	**60-80%**
Severe anxiety	**>80%**

Instrument four: Feasibility assessment sheet.

It was developed by the researcher guided by Gold et al., (2021) to assess the Feasibility of virtual reality experience after using the virtual reality goggle during the vein puncture. It contained 7 questions such as did you get used to the game quickly?, did the things you saw look real?, was the virtual reality goggle comfortable?, Were you worried about putting on the virtual reality goggle?, did it feel like you were in control?, did your play look real?, do you prefer to use the virtual reality goggle during any future vein puncture?.

Scoring system:

Scoring items	Score
Agree a lot	**2**
Agree a Little	**1**
Disagree	**0**

Total score:

Scoring items	Score
Feasible	60%- ≥80%
Not feasible	<60%

Reliability:

The reliability of the instruments was tested to determine the extent to which items in the instruments were related to each other by Cronbach's Co-efficiency Alpha. It was 0.92 ,0.87, 0.76 for instrument two, three and four respectively which indicates that the instruments was high reliable to meet the objectives of the study. Pearson correlation co-efficiency was done to test the internal consistency (r=0.62, 0.77, 0.64) in instrument two, three and four respectively of all items of the tool.

Validity

For validity assurance purposes, the four instruments were submitted to a jury of five experts in the pediatrics field (three professors and two assistant professors in the pediatric nursing field). The necessary modifications were done to ascertain their relevance and completeness.

Pilot study

A pilot study was carried out on 10 children (10% of the sample) after developing the instruments and before starting the data collection to test the practicability, applicability, consistency, clarity and the feasibility of the study instruments to estimate the needed time to fill the instruments. No modifications were done. The sample of the pilot study was included in the total sample.

Ethical considerations

A written approval was obtained from ethical and research committee of the Faculty of Nursing, Menoufia University. For protection of human rights, written consent was obtained from parents' of school age children. An initial interview was done to inform parents and their children about the purpose of the study, its importance, safety, duration, program and confidentiality. Parents were informed that their participation was voluntary and they had the right to participate or withdraw at any time. Parents were assured that confidentiality and anonymity was respected through coding all data and putting it in a closed cabinet.

Procedure:

- An official permission to carry out the study was obtained from the director of the setting after submitting an official letter from the Dean of the Faculty of Nursing explaining the purpose of the study and methods of data collection.
- At the beginning of the study, the researcher introduced herself and explained the purpose and nature of the study to nurses, parents and their children.
- Characteristics of children in the study and control group were assessed using instrument one (pre-test).
- Children were selected according to their inclusion and exclusion criteria. Then were they sent to the nursing room for starting the vein puncture procedure as requested.
- The nurse started the vein puncture procedure as requested. After the procedure, each child was asked to point to the face that indicated pain intensity and anxiety he/she felt

during the procedure (both study and control groups) using instruments two and three (pre-test).

- Children in the control group received only routine hospital care during vein puncture procedure without any distraction.
- The researcher prepared the needed VR equipment (Samsung Gear headset, VR selected video and Samsung smartphone with VR support system) for children in the study group.
- The researcher performed hand hygiene and wore appropriate personal protective equipment (gloves & mask).
- The researcher wiped the lens and removed any foam areas from the headset with a dry microfiber cloth.
- The researcher cleaned the VR face plate with alcohol swabs and make sure that the residue from alcohol swaps completely dries as it can be a bit harsh on some children's skin.
- The researcher put cover over child's hair (eg, bouffant cloth surgical cap).
- The researcher operated the supported mobile with VR video, placed it in the VR goggle and the goggle was put on the child eyes and secured around the child's head.
- The researcher trained each child individually for 5-7 minutes on utilization of VR goggle and playing games through it before starting the study.
- Children started playing with VR goggle just one minute before the vein puncture procedure to be immersed in the VR game.
- The nurse was asked to start the vein puncture procedure while the child was using the VR goggle.
- The researcher removed the VR goggle after finishing the procedure and placed on a clean disposable pad.
- The researcher cleaned all visibly soiled areas with disposable wipes or paper towels.
- The researcher disinfected the VR headset and allowed it to dry.
- The researcher stored the device in a dry space physically separated from non-disinfected devices.
- The researcher removed personal protective equipment and performed hand hygiene.
- The child was asked to re- point to the face that best indicated how much pain and anxiety he/she felt during the vein puncture for both study and control groups using instruments two and three (posttest).
- The researcher assessed the feasibility of the VR experience after using the virtual reality goggle during the vein puncture for the study group by using instrument four (post-test).

Statistical Analysis:

Data was coded and transformed into specially designed form to be suitable for computer entry process. Data was entered and analyzed by using SPSS (Statistical Package for Social Science) statistical package version 23. Graphics were done using Excel program.

Quantitative data were expressed as mean & standard deviation (X ±SD) and analyzed by using Chi-square test

for categorical variables, to compare between different groups. Also, Monte Carlo correction used for chi-square when more than 20% of the cells have expected count less than 5. Furthermore, Student t-test for normally distributed quantitative variables, to compare between two studied groups. And Spearman coefficient used to correlate between two distributed abnormally quantitative variables

Results:

Table (1): Characteristics of studied children in the study and control group. Regarding age, it was found that more than half of studied children in the study and control groups were 6<9 years old (54 % & 56% respectively).

Regarding gender, it was found that more than half of them in the study and control groups were females (52% & 56% respectively).

Regarding diagnosis, twenty percent of the studied children in the study and control groups had gastroenteritis and dehydration. Concerning duration of hospitalization, about two thirds of children in the study and control group were hospitalized from 1 to 6 days (66 % & 64 % respectively).

Regarding last vein puncture, it was found that less than half of studied children in the study group (42%) and more than half (54%) in the control group had vein puncture from 3weeks ago.

Regarding indications of vein puncture, it was found that more than two thirds of studied children in the study group (70%) and less than two thirds (64%) in the control group had vein puncture for cannulation. So, there was no statistical significance difference between study and control group

Table (2): Level of pain among children in the study and control group during the vein puncture on pre and post intervention. It was obvious from this table that 40.0% & 32.0% of studied children in the study and control groups respectively pointed hurts worst during the vein puncture on pre intervention. So, there was no statistical significant difference between the two groups.

Meanwhile more than one quarter (28.0%) of children in the study group selected no hurt compared to only 2% of children in the control group post intervention. So, there were very highly statistical significance differences at 1%0 level of statistical significance between the study and control groups post intervention.

Table (3): Level of anxiety among children in the study and control group during the vein puncture on pre and post intervention. It was obvious from this table that about two thirds of children in the study group (64%) and half of them in the control group (50%) had very high anxiety on pre intervention. So, there were no statistical significance differences between the two studied groups on pre intervention. On the other hand 54% of children in the study group showed no anxiety post intervention compared to only 14.0% in the control group. So, there was a statistical significant difference between the two groups post intervention (p<0,05).

Table (4): Correlation between age and level of pain among children in the study and control group on pre and post intervention. It was obvious from this table that there were negative correlations between age and level of pain on pre and post intervention for the study and control groups. So, there were highly statistical significant correlations ($p<.01$) and very highly statistical significant correlations ($p<.0001$) between age and level of pain among children in the study and control.

Figure (5): Spearman Correlation between age and level of anxiety post intervention according to child selection It was obvious from this figure that there were negative correlations between age and level of anxiety on post intervention as anxiety level increase with the younger age.

Table (5): Effect Size of virtual reality intervention vs routine hospital care on levels of pain and anxiety among children during the vein puncture. It was obvious from this table that the effect size of virtual reality intervention (VRI) for children in the study group was higher than the effect size of the routine hospital care for children in the control group. Moreover, the effect size of VRI was moderate on the level of pain (0.700) and high on the level of anxiety (0.826).

Figure (6): Distribution of children in the study group according to their opinions about the feasibility of virtual reality goggle post intervention The figure revealed that most of children in the study group (80%) strongly agreed that virtual reality goggle was feasible.

Table (1): Characteristics of studied children in the study and control group (n=100).

Characteristics of children	Study group (n = 50)		Control group (n = 50)		χ^2	P
	No.	%	No.	%		
Age / years						
6<9	27	54.0	28	56.0	0.040	0.841
9≤12	23	46.0	22	44.0		
Gender						
Male	24	48.0	22	44.0	0.161^{ns}	0.688
Female	26	52.0	28	56.0		
Diagnosis:						
A) Blood diseases:					11.393^{ns}	0.508
▪ Sickle cell anemia.	5	10	4	8.0		
▪ Thalassemia.	8	16	6	12.0		
▪ Acute hemolytic Anemia.	2	4	4	8.0		
▪ G6PD deficiency.	3	6	4	8.0		
B) Immunity diseases:						
▪ Arthritis.	5	10	5	10.0		
▪ Diabetes mellitus type1.	3	6	7	14.0		
C) Respiratory diseases:						
▪ Respiratory distress.	2	4	5	10.0		
▪ Pneumonia.	3	6	0	0.0		
D) Other diseases:						
▪ Hypertension.	3	6	0	0.0		
▪ Renal Failure.	4	8	5	10.0		
▪ Gastroenteritis& dehydration.	10	20	10	20.0		
▪ Febrile convulsion.	2	4	0	0.0		
Duration of hospitalization:						
(1-6) days.	33	66	32	64.0	0.151^{ns}	1.000
(7-21) days.	14	28	15	30.0		
(30) days.	3	6	3	6.0		
Last vein puncture:						
30 days.	9	18	6	12.0	9.181^{*}	0.027
21 days.	21	42	27	54.0		
2 days.	13	26	17	34.0		
1 day.	7	14	0	0.0		
Indication of vein puncture						
▪ Blood draw.	15	30	18	36.0	0.407^{ns}	0.523
▪ Cannula insertion.	35	70	32	64.0		

NB ^{ns}: not significance p>0.05 *: Statistically significant at p ≤ 0.05

Table (2): Level of pain among children in the study and control groups during the vein puncture on pre and post intervention (n = 100).

Level of pain	Study Group (n = 50)		Control Group (n = 50)		χ^2	P
	No.	%	No.	%		
Pre Intervention Child selection						
No hurt	0	0.0	1	2.0	6.305^{ns}	0.249
Hurts little bit	2	4.0	4	8.0		
Hurts little more	12	24.0	6	12.0		
Hurts even more	7	14.0	14	28.0		
Hurts whole lot	9	18.0	9	18.0		
Hurts worst	20	40.0	16	32.0		
Post intervention child selection						
No hurt	14	28.0	1	2.0	26.127^{***}	<0.001
Hurts little bit	13	26.0	7	14.0		
Hurts little more	9	18.0	8	16.0		
Hurts even more	7	14.0	9	18.0		
Hurts whole lot	5	10.0	5	10.0		
Hurts worst	2	4.0	20	40.0		

NB ***: very highly statistical significance p<0.001 ^{ns}: not significance p>0.05

Table (3): Level of anxiety among children in the study and control groups during the vein puncture on pre and post intervention (n = 100)

Level of anxiety	Study Group (n = 50)		Control Group (n = 50)		χ^2	P
	No.	%	No.	%		
Pre intervention						
No anxiety	4	8.0	6	12.0	2.017^{ns}	0.365
Some anxiety	14	28.0	19	38.0		
Very high anxiety	32	64.0	25	50.0		
Post intervention						
No anxiety	27	54.0	7	14.0	9.247^{*}	0.010
Some anxiety	15	30.0	22	44.0		
Very high anxiety	8	16.0	21	42.0		

NB *:statistically significant at $p \leq 0.05$ ^{ns}: not significance p>0.05

Table (4): Correlation between age and level of pain in children in the study and control groups on pre and post intervention.

Level of pain	Age			
	Study Group		Control Group	
	r_s	P	r_s	P
Pre intervention	-0.316^{*}	0.026	-0.392^{**}	0.005
Post intervention	-0.292^{*}	0.040	-0.494^{***}	<0.001

NB r_s: Spearman coefficient *:statistically significant at $p \leq 0.05$
**:highly Statistical significant at $p \leq 0.01$ ***:very highly statistical significance p<0.001

Table (5): Effect Size of virtual reality intervention Vs routine hospital care on levels of pain and anxiety among children during the vein puncture (n=100).

	Effect size	
Scales	**Study Group(n=50)**	**Control Group(n=50)**
Level of pain	0.700 (moderate)	0.071 (Mild)
Level of anxiety	0.826 (high)	0.626 (moderate)

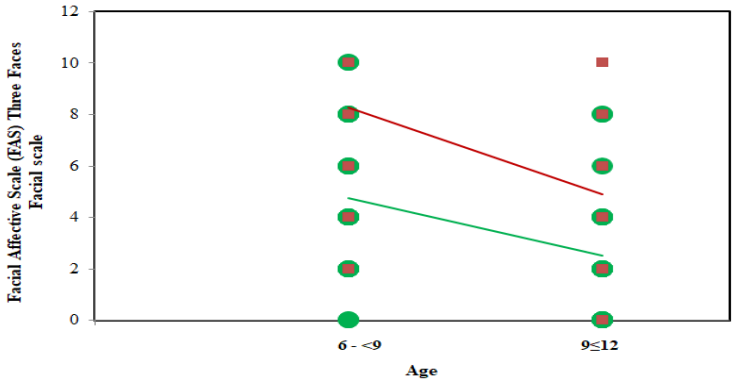

Figure (5): Spearman Correlation between age and level of anxiety post intervention according to child selection(n=50)

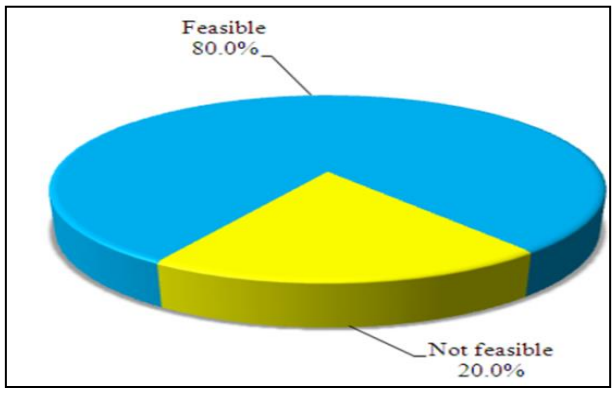

Figure (6): Distribution of children in the study group according to their opinions about the feasibility of virtual reality goggle post intervention (n = 50).

Discussion

Hospitalized children experience pain and anxiety from invasive procedures and/or their underlying diseases. Vein puncture, a frequently performed needle-related procedure, is one of the most frightening experiences and a common source of moderate to severe pain for pediatric patients.

It was reported that more than three quarters of children (2.5–6 yrs) and about half of children (7-12yrs) who underwent vein puncture developed distress. Therefore, pain management was often required. (Atzori et al., 2022).

For this reason, it was hypothesized (hypothesis one) that children who engaged in virtual reality session would exhibit less pain on post intervention than on pre intervention.

The study revealed that more than one third (40%) of children in the study group had hurts worst pain on pre intervention compared to only 4% of children on post intervention. From the researcher's perspective, this could be attributed to the positive effect of virtual reality application on reducing pain during vein puncture.

This result was consistent with Goldman and Behboudi, (2021). The study showed that VR group reported that pain was slightly lower after the procedure than before the procedure. Besides, this finding was consistent with Gerçeker et al., (2018). The study concluded that VR reduced pain during blood draw experienced by the 7–12 years old children.

Furthermore, this result came in agreement with Liuesma et al., (2022). The study indicated that using VR as a distraction measure had a significant reduction in children pain post procedure in the experimental groups.

On the other hand this study contradicted with Caruso et al., (2020). They study didn't show any significant difference in feelings of pain post procedure with the use of VR goggle. From the researcher's perspective this difference may be due to using large sample (106 child in the virtual reality group and 114 in the control group).

Another study conducted by Lambert et al., (2020). They concluded that virtual reality goggle have no beneficial effect on pain. This discrepancy may be due to the different age groups and developmental stages of their studied sample.

In relation to hypothesis two: Children who engage in virtual reality session would exhibit less anxiety on post intervention than on pre intervention. The findings of the current study showed that although about two thirds of children in the study group (64%) had severe anxiety on pre intervention compared to none on post intervention. From the researcher's perceptiveness, this could be attributed to the positive effect of virtual reality application in reducing anxiety during the vein puncture.

The study findings came in agreement with Han et al., (2019). The study reported that VR education reduced peri procedural anxiety in children after the intervention ($p < 0.001$) which is consistent with our results. In addition, these results were in harmony with Gold and Mahrer, (2018). They found that VR reduced pain and anxiety in children aged from 6–21 years old during blood draw, which supports the present research.

In contrast, a study conducted by Yıldırım and Gerçeker, (2023). The study showed that there was no difference in post procedural anxiety scores ($P > .05$). This difference may be due to using different tools.

In relation to hypothesis three: Children who engaged in virtual reality session (study group) would exhibit less anxiety on post intervention than children who didn't (control group). The findings of the current study showed that no one in the study group had severe anxiety compared to 42% in the control group post intervention.

This result was consistent with Erdogan and Ozdemir, (2021). It was found that there was a significant difference in anxiety scores between the study and control groups ($p < 0.05$). Furthermore, this result was consistent with Goldman and Behboudi (2021). It was reported by children in the study group (virtual reality) that Level of anxiety from IV management was lower after utilization than before.

Moreover, this result was in line with Mohanasundari et al., (2021).The study found that children who received VRT and Flippit therapy perceived less anxiety compared to control group.

This result was also consistent with Gerçeker et al., (2021). It was reported that children in the study group had less anxiety than children in the control group.

In relation to hypothesis four: Children who engaged in virtual reality session (study group) would exhibit less pain on post intervention than children who didn't (control group). The study revealed that more than one quarter (28.0%) of children in the study group had no hurt compared to only 2% of children in the control group.

This result was consistent with Gerçeker et al., (2021). It was reported that pain scores among children in the virtual reality group (2.4 ± 1.8) were lower than pain scores of children in the control group (5.3 ± 1.8).

Also, This result was in line with Erdogan and Ozdemir, (2021). It was reported that children in the study group had less pain than children in the control group.

Moreover, this result was consistent with Semerci et al., (2021). They found that children who used VR (study group) had lower pain scores than children who didn't (control group) (VR group = 2.34 ± 3.2.7 & control group= 5.02 ± 3.35). Furthermore, this result came in agreement with Tashjian et al., (2017). They found that VR significantly reduced pain more than other distraction methods.

In addition, these results were in harmony with Elsharkawy and Abouheiba, (2022)who observed that the severity of pain was zero in VR group. While eighty percent in the control groups showed severe pain and discomfort during peripheral cannulation. Regarding perceived pain intensity, none of children in VR group felt that it hurts worst compared to about one third (32 %) of children in the control during peripheral cannulation.

Moreover, this result was in line with Mohanasundari et al., (2021). It was found that pain scores of VRT and flippit groups were less than the control group. Also, this result was consistent with Özalp et al., (2018). They demonstrated that pain scores were lower in the VR Rollercoaster group and VR-Ocean Rift group than the control group.

On the contrary, these results were in contrast with Osmanlliu et al., (2021) who reported that the median level of pain during the procedure was not statistically different between the intervention and control groups ($p = 0.75$). This difference in the research findings may be due to depending more on passive distraction through the video game in the VR goggle.

Also, these results were in contrast with Walther et al., (2019) who found that no significant statistical difference in pain scores between the study and control groups. The VAS scores for the procedural pain between the two groups (study Vs control) were 27 of 100 Vs 15 of 100. This result may be due to inadequate training on playing the game in the VR goggle.

Regarding the correlation between age and level of pain and anxiety in children, it was obvious from the study that young age were more sensitive to vein puncture than older age as they had high level of pain and anxiety than older age. So, there were negative correlations between age, level of pain and anxiety on pre and post intervention among the study and control groups.

This result was consistent with Kaluza et al., (2021). It was clarified that younger children reported more anxiety and pain. In total, 89% of children aged 4–7 years, and 54% of children aged 8–18 years reported that there ere anxious. Furthermore, 92% of

children aged 4–7 years, and 68% of children aged 8–18 years reported pain. This could reflect that there were negative correlations between age, level of pain and anxiety (p = 0.001).

Also, this study was in line with Satchi and Sankar, (2017) who reported that there was a negative correlation between age of children and pain perception. In other words, the older the child the lower his|her pain intensity.

Furthermore, this study was consistent with Sikorova and Hrazdilova, (2011). It was reported the younger the age group the higher intensity of pain.

It was also cosistent with Sayed et al., (2020) who found that there were statistically significant negative correlations between children's age and pain.

Also, the study was in line with Özalp et al., (2020). It was reported that young children are at greater risk for being more distressed and anxious with needle-related procedure.

The study was in contrast with Ferraz et al., (2021). They reported that the increase in stress and anxiety is directly related to the older age (>6 years old) of children. This could be attributed to the difficulty in distracting older children.

Regarding the effect size of virtual reality intervention Vs routine hospital care on levels of pain and anxiety among children during vein puncture, it was obvious from this study that the effect size of virtual reality intervention (VRI) for children in the study group was higher than children in the control group receiving routine hospital care. Moreover, the effect size of VRI was moderate on the level of pain (0.700) and high on the axiety level (0.826).

This result was consistent with Semerci et al., (2021). They reported that the effect size of virtual reality intervention (d = 0.80) was calculated using Cohen's indicating a large effect size.

Furthermore, this result was consistent with Nordgård and Låg, (2021). It was found that the overall mean effect of pain was estimated to 0.72, which may be considered a large effect size. Also, the mean effect size for anxiety was estimated to 0.90, which may be considered a large effect size.

This study was in contrast with Caruso et al., (2020). They noted a small effect size of VR intervention (0,40). From the researcher's perceptiveness this difference may be due to training and explaining utilization of VR in a group rather than individually.

The study also was in contrast with Erdogan and Ozdemir, (2021). They reported that the effect sizes of pain self-report was 0.215 which mean small effect size. From the researcher point of view this difference may be due to small sample size of their VR group as well as control group. Also, the effect size of anxiety self-report was 0.255 which mean moderate effect size. From the researcher perceptiveness this difference may be due to using different instrument for anxiety (children's fear scale).

Regarding feasibility of virtual reality intervention, it was obvious from the study that about two third (62%) used the game quickly, more than half (58%) perceived things look like real. Besides, two thirds (66%) identified that virtual reality goggle was comfortable for them, more than two thirds (70%) felt like they were in control of game, about half (44%) played as if they were in real situation and about three quarters (72%) prefered to use VR goggle during any future venous puncture. This revealed that most of children in the study group (80%) strongly agreed that virtual reality goggle was feasible.

This result was consistent with Osmanlliu et al., (2021). It was found that using virtual reality-based distraction to standard of care was feasible and acceptable intervention during IV procedure for children in the emergency department.

Also, this result was consistent with Gold and Mahrer, (2018). They reported that all children in the VR group felt high levels of immersion and recognized the value of VR. They recommend using VR again and try it by other children.

Furthermore, it was in the line with Goldman and Behboudi, (2021). They found that children liked the VR experience, as they rated it "much more fun" compared with other activities in the control group. The "fun" aspect of VR was believed to influence VR analgesic effects. Children reported much more "fun" with the VR intervention.

To capitulate, pain and anxiety levels during the vein puncture was reduced after applying the VR distraction technique for school age children.

Conclusion

Based on the findings of the present study, it was concluded that Virtual reality distraction had a positive effect on reducing pain and anxiety during vein puncture among school age children. Children who engaged in virtual reality session (study group) exhibited less pain and anxiety on post intervention than on pre intervention. Furthermore, Children who engaged in virtual reality session (study group) exhibited less pain and anxiety on post intervention than children who didn't (control group).

Recommendation

This study recommended that an educational training program is mandatory for pediatric nurses about pain, anxiety assessment and management strategy during vein puncture and other painful procedures. In addition to ongoing in-service education programs for pediatric nurses about standardized guidelines for disinfection of virtual reality device. Also, Illustrated Arabic booklet about pain assessment and management in children should be available in every pediatric health care unit. Furthermore, New distraction methods should be applied in every pediatric health care unit.

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