Effect of Applying Virtual Reality Glasses on Reducing Pain and Anxiety of Children Undergoing Chemotherapy

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Abstract

Background: Virtual reality technology is a remarkably effective method to distract attention from painful stimuli. It is a promising and attractive intervention to help reduce anxiety and pain of children undergoing painful procedures. **Aim**: to evaluate the effect of applying virtual reality glasses on reducing pain and anxiety of children undergoing chemotherapy. Method: A quasi-experimental research design was used to conduct the study at the Oncology Department of the Specialized Children's Hospital in Benha, affiliated with the Ministry of Health and Population, Egypt. A purposive sample of 50 children undergoing chemotherapy was included. Four tools were used for data collection: A structured interviewing questionnaire, pain rating scale, Beck anxiety inventory scale, and Physiological assessment of children. **Results:** The results of the study revealed that more than half (52.0%) of the children experienced severe pain before the intervention, while less than two-thirds (60.0%) of the children reported no pain after the intervention. Furthermore, less than two-thirds (60.0%) of the studied children had a high anxiety level before the virtual reality glasses intervention. However, during the intervention, less than half (46.0%) of the studied children had a low anxiety level **Conclusion:** Children who received the virtual reality glasses exhibited less pain and anxiety score compared to children who did not receive them Recommendations: Virtual reality should be used as a technology to reduce pain and anxiety during painful procedures of children admitted in pediatric oncology departments.

Keywords: Anxiety, Chemotherapy, Children, Pain, Virtual reality glasses.

Introduction

Virtual reality (VR) is a relatively new technique that provides distraction and is more effective than traditional methods. It involves a computer-generated environment that allows for orientation and three-dimensional interaction. This environment is projected directly in front of the user's eyes through advanced head-mounted displays (HMDs), which include wide fields of view and motion tracking systems. (1)

Virtual reality provides complete immersion and permits users to feel as if they are in a virtual environment. This immersion is very important as it is directly concerned with pain relief, with less attention given to pain perception. VR is an especially exciting method for children who are interested in imaginative play. Additionally, VR makes children feel comfortable, helps familiarize them with medical procedures, and environments, and reduces pain as well as anxiety. (2)

Virtual reality technology creates an immersive experience in a virtual environment that closely resembles the

real world. VR-based interventions distract children's attention from active cognitive processing, which may result in higher pain thresholds and tolerance. [2] Additionally; these interventions allow children to interact with simulated computing environments. The human brain has a limited ability to process details, so more complex VR programs tend to be more effective in reducing pain. [3]

Pain is an unpleasant sensory and emotional experience associated with tissue damage. Children undergoing medical procedures often experience higher levels of anxiety, and distress, and display various signs of discomfort compared to adults. Their experience and memory of pain serve as strong predictors of future pain responses. Repetitive procedures can lead to conditioned distress and fear, posing concerns for medical professionals and parents, [4] Children may develop anticipatory anxiety responses, including physical symptoms and behavioral changes. Virtual reality has emerged as a promising tool in pediatric healthcare, offering immersive and interactive environments that effectively distract children during medical interventions. It helps reduce anxiety and pain, providing a smoother and less traumatic experience for children, especially those with chronic illnesses requiring frequent procedures. [5]

With the increasing number of childhood cancer survivors, it is crucial to examine the psychosocial consequences of surviving cancer diagnosed during childhood. [6] Understanding the psychosocial needs of these survivors is particularly important. Pain, anxiety, and depression are highly prevalent among children with cancer, posing significant challenges for healthcare professionals. [7]

Medical procedures often elicit pain, distress, and anxiety in children, which not only greatly impact their comfort during the procedures but are also associated with adverse consequences such as attempts to escape, improper recovery, disturbances in the pattern of sleep & feeding, and posttraumatic stress symptoms. Addressing pain and anxiety in children is essential as these experiences can lead to avoidance of necessary healthcare interventions. [8]

Pain associated with the oncological process in childhood is often accompanied by anxiety related to medical procedures, hospitalization, treatment side effects, separation anxiety, and psychological stress. [9] Cancer treatment is a significant anxiety source among children because it is often invasive, painful, and results in major side effects. These treatments disrupt children's lives, altering routines and relationships with family and peers. [10]

Significance of the study

Approximately 400,000 children are diagnosed with cancer each year. Children with cancer undergo numerous painful medical procedures, usually inducing pain and anxiety. Pain experienced by children is often linked to anxiety because young children may lack the cognitive development to understand that subsequent procedures can be less painful with appropriate analgesic medication. [4] The application of VR can significantly impact nursing practice by offering a non-pharmacological strategy to reduce pain and anxiety commonly associated with painful medical procedures, [11] Therefore, this study was conducted to evaluate the effect of applying virtual reality glasses on reducing pain and anxiety of children undergoing chemotherapy.

Aim of the study

The aim of this study was to evaluate the effect of applying virtual reality glasses on reducing the pain and anxiety of children undergoing chemotherapy. This is accomplished through the following:

- Assessing the pain intensity of children undergoing chemotherapy.
- Assessing the physiological parameters of children undergoing chemotherapy.
- Assessing the level of anxiety of children undergoing chemotherapy.
- Evaluating the effect of applying virtual reality glasses on reducing pain and anxiety of children undergoing chemotherapy

Research Hypothesis

Children who receive virtual reality glasses may exhibit less pain and anxiety compared to children who do not receive them .

Research design

A quasi-experimental research design was utilized to conduct this study .

Setting

The study was carried out at the Oncology Department located on the fourth floor of the Specialized Children's Hospital in Benha City, which is affiliated with the Ministry of Health and Population, Egypt. The department comprises five rooms, with each room accommodating four beds .

Subject:

The study included a purposive sample of 50 children undergoing chemotherapy within 6 months in the previously mentioned setting. The inclusion criteria for selecting the study participants were as follows: Children in the age group of 6-12 years who were undergoing chemotherapy, both gender, and children agreed to participate in the study.

On the other hand, the following exclusion criteria were applied: Children who were clinically unstable and unfit to participate. Children with cognitive impairments that may hinder their ability to comprehend and engage in the study procedures. Children with visual or hearing impairments could potentially affect their experience with virtual reality glasses. Children with craniofacial abnormalities might impede the proper use and fit of virtual reality glasses.

Tools of data collection

There were four tools utilized to collect the required data. Those tools as the following :

Tool I: A structured interviewing questionnaire was developed by the researchers after reviewing related literature. It was written in the Arabic language to suit the study sample. The questionnaire is composed of two parts:

Part 1: Characteristics of the child, such as age, gender, child ranking, and educational level.

Part 2: Medical history of the children. This tool was designed by the researchers after reviewing literature and children's hospital sheets to collect data about each child, including medical diagnosis and clinical manifestations.

Tool II: Pain rating Scale: It included two parts:

Part 1: Use Wong-Baker Faces pain rating scale

This scale was adopted from **Wong, Lau & Campbell (2016)** [(12)] to assess the intensity of pain in children. It consisted of 6 line-drawn faces ranging from "no hurt" to "hurts worst." A scoring system was used to categorize pain into four levels: no pain (score of zero), mild pain (scores 1-2), moderate pain (scores 4-6), and severe pain (scores 8-10.(

Part 2: Behavioral rating scale

This scale was adopted from **Hjermstad etal,(2011)** [(13)] The behavioral rating scale

included four pain behaviors: crying, movement, agitation, and verbalization. Each behavior category was scored from 0 to 2. The total pain score ranged from 0 to 10. Mean scores were calculated for different levels of pain: no pain (score of 0), mild pain (scores 1-3)

Tool III: Beck Anxiety Inventory (BAI) scale: Adapted from **Beck etal, (1988)** [14] **.** It was used to assess Children's anxiety levels during chemotherapy with moderate pain (scores 4-6), and severe pain (scores 7-10). The Beck Anxiety Inventory (BAI) scale was utilized to measure children's anxiety levels with a total score of 60. The mean scores for different levels of anxiety were calculated as follows: not at all (score of 0), mild (score of 1), moderate (score of 2), and severe (score of 3). The total anxiety score was then classified into the following categories:

Scoring system: No anxiety: Scores ranging from 0 to 20, low anxiety: Scores ranging from 20 to 40, moderate anxiety: Scores ranging from 40 to 60, and high anxiety: Scores above 60.

Tool IV Physiological assessment: Adapted from **Walco etal, (2005)** [15] this component involved monitoring vital signs (pulse, and respiration) before, during, and immediately after the intervention of virtual reality glasses during chemotherapy.

Validity and reliability

The validity of the tools was assessed by a jury of three experts: professors of pediatric nursing from the Faculty of Nursing at Benha University and El-Menofia University, and a professor of oncology medicine from the Faculty of Medicine at Benha University. They evaluated the content validity of the tools and judged their clarity, comprehensiveness, relevance, simplicity, and accuracy. All of their remarks were taken into consideration, and some items were rephrased to finalize the tools. The experts deemed the tools to be valid. The reliability for the pain rating scale showed a coefficient alpha of 0.89, and the anxiety scale yielded a coefficient alpha of 0.82 .

Ethical Considerations

The study received approval from the Ethics Committee at the Faculty of Nursing, Mansoura University. The researchers explained the purpose of the study and the anticipated results to all participating children during the initial interview. Oral approval was obtained from parents of children to participate in the study. The children were assured that all information would be kept confidential. Furthermore, they were informed that they could withdraw from the study at any time without needing to provide a reason.

Pilot Study

A pilot study was conducted on 10% of the total study sample, consisting of 5 children. The purpose of the pilot study was to assess the feasibility of the research process and the reliability, clarity, and applicability of the tools. No significant modifications were made to the study tools, which allowed for the inclusion of the study subjects in the final sample. Additionally, the pilot study helped estimate the time required for data collection, which was determined to be approximately 20-30 minutes.

Field of work

To achieve the aim of the current study, the following stages were followed: the pre-intervention stage, during the intervention stage, and the immediately after intervention stage. These stages were accomplished within six months, starting from July 2022 and concluding in December 2022

Stage one: Pre-intervention stage :

At the beginning of the study, the researchers conducted individual interviews with each child, introducing themselves and explaining the purpose and duration of the study. Oral approval was obtained from the parent and child before data collection. The researchers visited the study settings on a rotational basis, twice a week (Sunday and Wednesday) during the morning shift, to collect data using the established data collection tools.

During data collection, the researchers gathered information from the child's medical assessment sheet, including age, gender, diagnosis, disease onset, cancer therapy details, chemotherapy administration route, duration, and chemotherapy side effects. Additionally, the researchers measured the child's physiological parameters (temperature, pulse, and respiration) using a thermometer and a watch (tool I). The average interview duration for each child ranged between 20-25 minutes.

After the initial assessments, the researchers observed each child while they received chemotherapy, using subjective and objective pain rating scales as well as physiological pain measurements (tool II). The average time required for completing these assessments ranged between 15-20 minutes. Furthermore, the researchers evaluated each child's anxiety level using tool III, with an average completion time of 15-20 minutes. This phase of data collection spanned the month of July 2022, starting at the beginning of the month and concluding at the end.

Stage two: Intervention Stage (Implementation): - it included :

-1Prepare the needed equipment: (Virtual reality (VR) 3D glasses).

The researchers prepare the videos and games according to the studied children's needs using the following steps: Preparation and organization of the content videos and games according to children's age and ability. Selecting the videos and games. Using virtual reality glasses methods

Preparation and organization of the content of videos and games: The content of videos and games were prepared and organized under various headings according to aim, objectives, and principles.

Selecting the videos and games: The videos selected by the researchers to the following criteria: Videos and games should meet children's needs and interests. Videos and games should include section breaks. Videos and games should have acceptable technical quality. The length and pace of each video and game are appropriate to children's age and gender. Videos and games manipulating and rearranging create a flow add effects, graphics, and music, alter the style, pace, or mood of the video and games to adjust angle then watch it and take notes. Music, sound, color correction, and effects were added. The prepared videos and games were edited by a video expert.

-3Using virtual reality glasses methods

Methods involving virtual reality glasses are used to minimize pain & anxiety in children during and after chemotherapy. Each child should receive psychological preparation, which involves explaining the effects and importance of virtual reality glasses on their body muscles. Physical preparation includes helping the child assume relaxing positions, such as sitting with their entire back resting against the back of a chair, placing their feet flat on the floor with legs separated, or lying supine with a pillow under their head. Virtual reality glasses (VRE) are connected to a mobile device, and children

use them during chemotherapy administration. The virtual reality glasses intervention, which involves adjusting the lenses to match the interpupillary distance, is fitted with a mobile device and headphones, providing children with an opportunity to listen to and watch VR videos. They are allowed to choose from different videos that were previously reviewed based on their age and preferences. Virtual reality headsets are devices that help reduce pain and anxiety. This phase lasted for three months, from August to October 2022

Virtual reality headset

The researchers considered the use of the Arabic language when explaining the intervention to children in order to enhance their engagement in the study. The total number of children who participated in the study was 45, with 5 of them not being excluded from the pilot study. Therefore, the final study sample consisted of 50 children who agreed to participate. The study group was divided into 9 groups, with each group consisting of 5 to 6 children.

Initially, the researchers explained the objectives of the intervention and the expected outcomes to the children. The researchers visited the Oncology Department at the Specialized Children's Hospital three days a week on a rotational basis (Saturday, Monday, and Thursday) from 9 am to 1 pm. During these visits, when the nurses performed needle punctures for children receiving chemotherapy through IV injections, the researchers assessed the children's pain sensations and anxiety. They used tools II and III to determine objective pain scores.

After using the virtual reality glasses, each child was asked to indicate their level of pain and anxiety during chemotherapy administration by ticking on a numeric pain rating and anxiety scale. Additionally, the researchers monitored and recorded physiological measures such as temperature, pulse, and respiration for each child during chemotherapy administration.

Stage three: Post-intervention stage

During this stage, the researchers conducted a reassessment of pain and anxiety after half an hour of using virtual reality glasses for each child. They used pain and anxiety tools II and III for the assessment, which took approximately 15-20 minutes per child. The post-test tools were similar to the pretest. This phase of the study lasted for two months, from November to December 2022.

Statistical analysis

The collected data were organized, tabulated, and analyzed using the statistical software SPSS version 20. Descriptive statistics were calculated, including the mean and standard deviation for quantitative data, and frequency and distribution for quantitative data. In analytical statistics, inter-group comparisons of categorical data were performed using the chi-square test (X2 value). Additionally, the Pearson correlation coefficient test was used. A p-value of less than 0.05 was considered statistically significant (*), while a p-value greater than 0.05 was considered statistically insignificant. A p-value of less than 0.001 was considered highly significant (**), indicating strong statistical evidence in all analyses.

Results

Table (1): Illustrates that less than two-thirds (60.0%) of the studied children aged 6 to <8 years old, with a mean age of (6.760±.846). Regarding the level of education, less than two-thirds (98.0%) of the studied children had primary

education. Additionally, more than half (54.0%) of them live in rural areas.

Fig (1): Shows that less than two-thirds (64.0%) of the studied children were diagnosed with leukemia, while less than one-fifth (18.0%) were diagnosed with lymphoma.

Fig (2): Explains that more than half (58.0%) of the studied children suffered from weight loss, while less than one-quarter experienced insomnia. Additionally, a change in the skin was found in 4.0% of them.

Table (2): displays the mean scores of physiological measurements for children before, during, and after the application of virtual reality glasses. The results indicate that the mean pulse before, during, and after the application of virtual reality glasses was 112.080 ± 6.043 beats/minute, 81.920 ± 1.998 beats/minute, and 74.440 ± 3.928 beats/minute, respectively. Furthermore, the mean respiration rate for children before, during, and after the virtual reality glasses intervention was 31.880 ± 1.493, 20.640 ± .851, and 20.720 ± .858, respectively.

Table (3): Shows that more than half (56.0%) of the children experienced pain as a side effect of cancer medication. In terms of the behavior of the child during pain, less than half (48.0%) experienced anorexia. Furthermore, less than one-third (38.0%) of the children watched cartoons to reduce the sensation of pain during chemotherapy.

Table (4): Illustrates that there were highly statistically significant differences between the pre and during-virtual reality glasses intervention. The results indicate that in the pre-intervention phase, (68.0%, 80.0%, 74.0%, and 52.0%) of children responded to pain by crying, not responding to tender loving care, being fully bent with finger flexion, and being able to be comforted to reduce agitation, or localizing verbally or by pointing, respectively. However, after the virtual reality glasses intervention, (52.0%, 54.0%, 40.0%, and 60.0%) of children showed no crying, no movement, calmness, and stated no pain, respectively.

Fig (3): Clarifies that more than half (52.0%) of the children experienced severe pain before the intervention. However, after the intervention, less than two-thirds (60.0%) of the children reported no pain .

Table (5): indicates highly statistically significant differences in the anxiety levels of the studied children during the virtual reality glasses intervention compared to the pre-intervention phase (P=<0.001). However, there were no significant differences in the mean scores of the studied children during and immediately after the intervention (P= >0.05 .(

Table (5): Shows that there was a highly statistically significant difference between the studied children regarding anxiety levels during virtual reality glasses compared to pre-virtual reality glasses intervention (P=<0.001). While there were no significant differences in the mean score of the studied children during and immediately after intervention (P>0.05.(

Fig (4): Illustrates that less than two-thirds (60.0%) of the studied children had a high anxiety level before the virtual reality glasses intervention. However, during the virtual reality glasses intervention, less than half (46.0%) had a low anxiety level during the intervention, and more than half (58.0%) of them had a low anxiety level after the intervention.

Table (1): Percentage distribution of children according to their demographic characteristics (n=50).

Demographic characteristics	N.	%
Age in years		
6 <8 years	30	**60.0**
8 <10 years	18	36.0
10-12 years	2	4.0
Mean ±SD 6.760±.846		
Child education		
- Primary school	**49**	98.0
- Secondary school	1	2.0
Child's rank		
- First	11	22.0
- Middle	28	**56.0**
- Last	7	14.0
- Alone child	4	8.0
Residence of children		
- Urban	23	46.0
- Rural	27	**54.0**

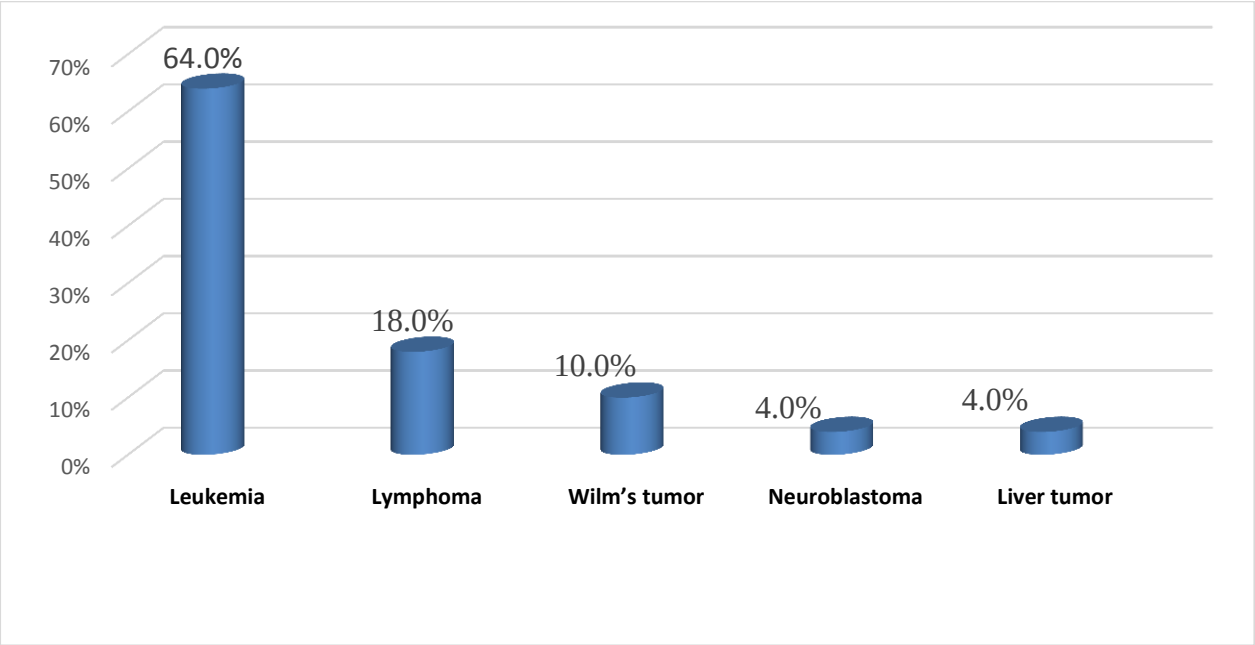

Figure (1): Distribution of children undergoing chemotherapy according to medical diagnosis (n=50).

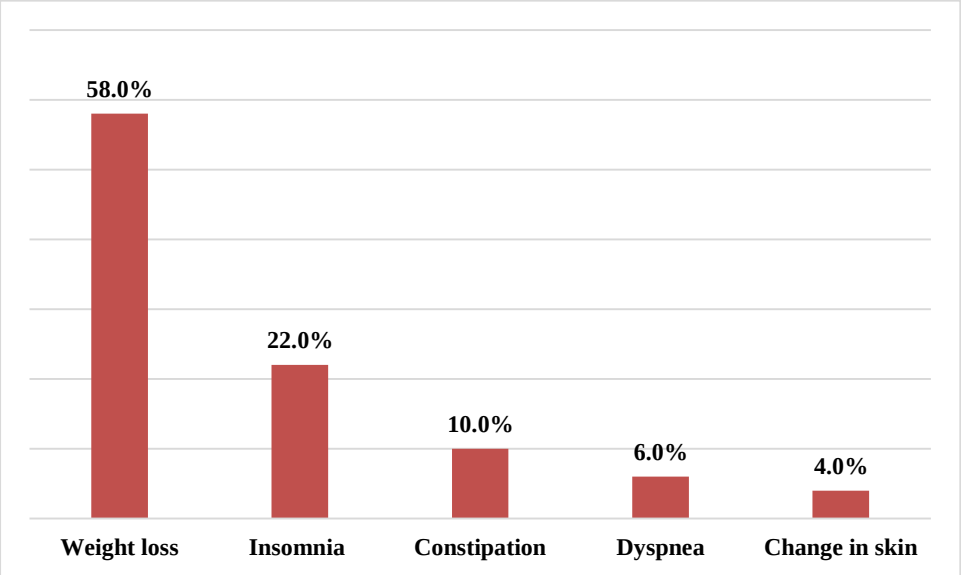

Figure (2): Distribution of children undergoing chemotherapy according to clinical manifestation (n=50).

Table (2): Total means score of children's pulse and respiration pre, during, and after intervention (n=50).

Items	Children's vital signs through three phases of intervention (n=50)			t	p. value
	Pre-intervention	During intervention	Immediately after intervention		
	Mean ± SD	Mean ± SD	Mean ± SD		
Pulse	112.080 ± 6.043	81.920 ± 1.998	74.440 ± 3.928	6.224	<0.01
Respiration	31.880 ±. 1.493	20.640 ± .851	20.720 ± .858	5.999	<0.01

Table (3): Distribution of the children's according to their pain (n=50)

Items	Children (n=50)	
	N.	%
Feeling pain due to		
- Cancer disease	22	44.0
- Adverse reaction from cancer medication	28	**56.0**
The behavior of children during pain		
- Anorexia	24	**48.0**
- Sleep disturbance	12	24.0
- Attachment to a parent	4	8.0
- Unable to make any activity	10	20.0
Action is taken to reduce children's pain sensation during chemotherapy		
Cartoon	17	38.0
Drugs	19	34.0
Mobile	14	28.0

Table (4): Distribution of the children according to their pain assessment using a behavioral rating scale through three stages of intervention (n=50).

Children's Response to Pain	Studied children during three phases of implementation (n=50)								
	Pre-intervention		During intervention		X^2	P value	Immediately after intervention		X^2	P value
	N.	%	N.	%			N.	%		
Crying										
Not crying	7	14.0%	26	52.0	16.83	0.00	27	54.0	1.183	P>0.05
Crying but the response to tender loving care (TLC).	9	18.0%	13	26.0			11	22.0		
Crying and does not respond to TLC	34	68.0%	11	22.0			12	24.0		
Moving of limbs during chemotherapy										
No movement	0	0.0%	25	50.0	19.04	0.00	32	64.0	1.837	P>0.05
Partially bent	10	20.0%	11	22.0			15	30.0		
Fully bent with finger flexion	40	80.0%	14	28.0			3	6.0		
Agitation										
Child calm	0	0.0%	23	46.0	28.35	0.00	30	60.0	2.455	P>0.05
Can be comforted to lessen the agitation (mild).	13	26.0%	14	28.0			13	26.0		
Cannot be comforted.	37	74.0%	13	26.0			7	14.0		
Verbal evaluation or body language										
No pain	0	0.0%	20	40.0	12.90	0.00	30	60.0	2.826	P>0.05
Mild pain (cannot localize)	6	12.0%	15	30.0			9	18.0		
Moderate pain (can localize	18	36.0%	10	20.0			6	12.0		
Severe pain	26	52.0%	5	10.0			5	10.0		

Highly significant (P<0.001) no significant difference (P= >0.05) X^2= chi-square**

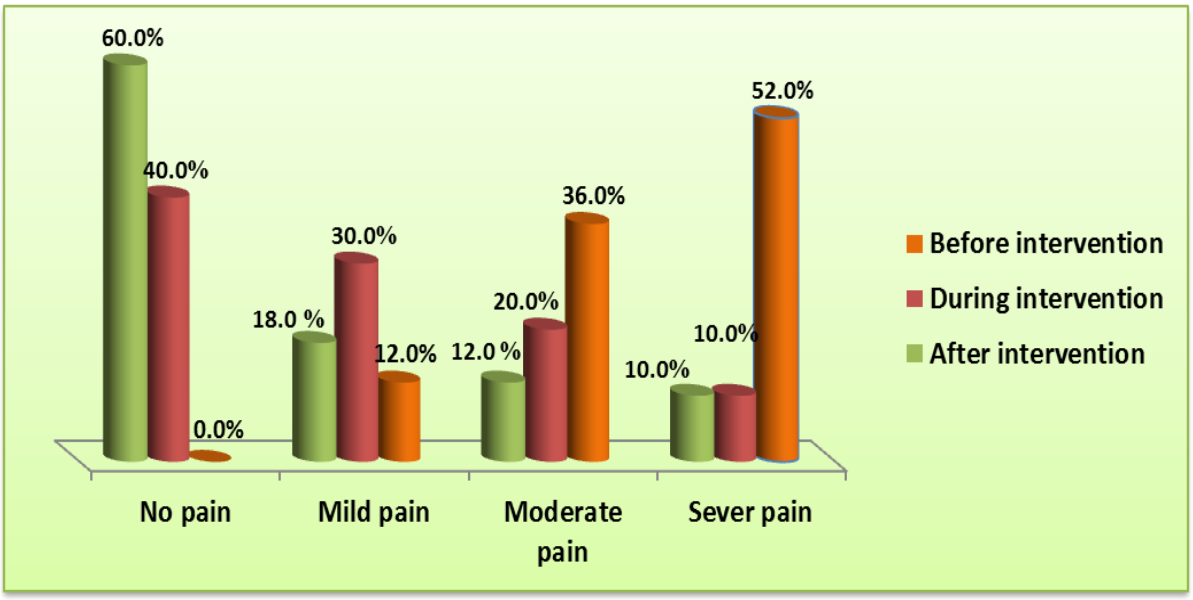

Figure (3): Distribution of the children according to their pain assessment using the Wong-Baker Faces pain rating scale through three stages of intervention (n=50).

Table (5): Mean and standard deviation of the studied children's anxiety undergoing chemotherapy through three stages of virtual reality glasses intervention (n=50).

	Studied children's anxiety during three phases of intervention						
	Pre-intervention	During intervention	t test	P	Immediately after intervention	t test	P
	Mean ± SD	Mean ± SD			Mean ± SD		
Numbness or tingling	2.440±.704	720±.809.1	5.054	0.00**	1.500±.614	1.585	P>0.05
Feeling hot	2.40±.638	1.720±.757	5.116	0.00**	1.620±.725	1.018	P>0.05
Wobbliness in legs	2.40±.699	1.860±.808	5.837	0.00**	1.700±.735	1.471	P>0.05
Unable to relax	2.40±.677	1.720±.833	5.157	0.00**	1.540±.761	1.231	P>0.05
Fear of the worst happening	2.50±.707	1.780±.815	5.563	0.00**	1.620±.725	1.125	P>0.05
Dizzy or lightheaded	2.50±.674	1.860±.808	6.279	0.00**	1.500±.735	0.495	P>0.05

Heart pounding / racing	2.320±.620	700±.788.1	4.732	0.00**	1.400±.670	2.966	P>0.05
Unsteady	2.280±.729	760±.796.1	4.826	0.00**	1.380±.666	2.010	P>0.05
Terrified or afraid	2.300±.614	1.720±.833	4.732	0.00**	1.500±.735	1.485	P>0.05
Nervous	2.400±.638	640±.270.1	4.521	0.00**	1.480±.762	1.798	P>0.05

Highly significant difference (P<0.001) no significant difference (P >0.05) T= Independent t test**

Continue (5): Mean and standard deviation of the studied children's anxiety undergoing chemotherapy at pre, during, and after virtual reality intervention (n=50).

Items	**Studied children anxiety during three stages of intervention**						
	Pre-Intervention	**During intervention**	**Paired t-test**	**P**	**Immediately after intervention**	**T-test**	**P**
	Mean ± SD	**Mean ± SD**			**Mean ± SD**		
Feeling of choking	**2.340±.688**	**1.520±.677**	**4.601**	**0.00****	**1.420±.641**	**1.774**	**P>0.05**
Hands trembling	**2.480±.677**	**1.720±.809**	**4.222**	**0.00****	**1.440±.674**	**2.196**	**P>0.05**
Shaky /unsteady	**2.500±.707**	**1.580±.758**	**3.933**	**0.00****	**1.360±.631**	**1.464**	**P>0.05**
Fear of losin control	**2.320±.620**	**1.580±.784**	**5.634**	**0.00****	**1.440±.760**	**1.009**	**P>0.05**
Difficulty in breathing	**2.280±.729**	**1.560±.704**	**4.482**	**0.00****	**1.380±.635**	**0.747**	**P>0.05**
Fear of dyin	**2.340±.626**	**1.720±.833**	**6.918**	**0.00****	**1.360±.631**	**1.836**	**P>0.05**
Scared	**2.440±.704**	**1.640±.827**	**5.671**	**0.00****	**1.440±.760**	**2.560**	**P>0.05**
Indigestion	**2.480±.677**	**1.520±.677**	**4.586**	**0.00****	**1.380±.635**	**2.190**	**P>0.05**
Face flushed	**2.510±.710**	**1.7200±.83**	**4.683**	**0.00****	**1.440±.760**	**2.088**	**P>0.05**
Hot/cold sweats	**2.400±.638**	**1.780±.815**	**6.038**	**0.00****	**1.380±.635**	**2.400**	**P>0.05**

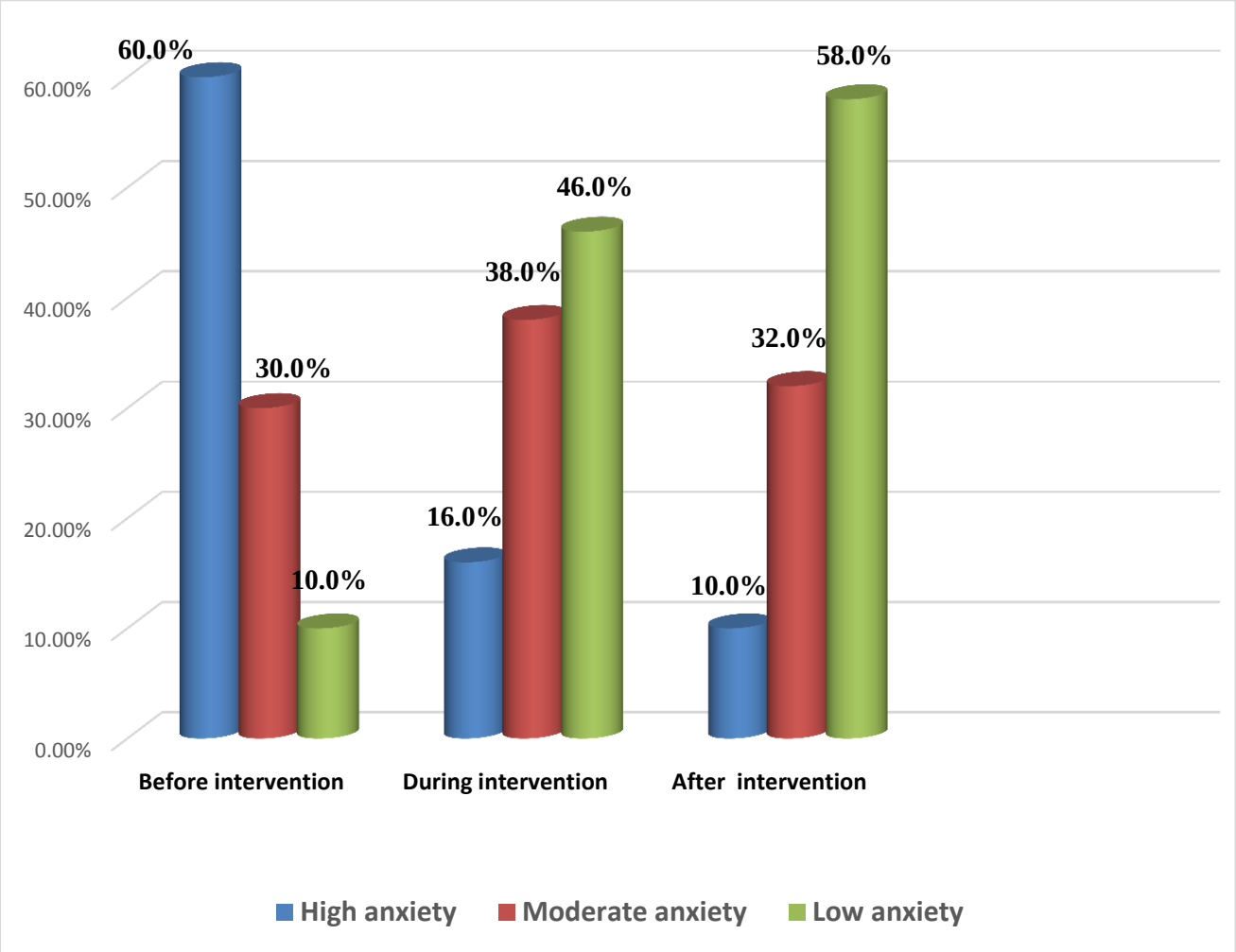

Figure (4): Percentage distribution of total anxiety score among children undergoing chemotherapy through three stages of intervention. (n=50).

Discussion

Cancer and its treatment can have significant emotional and psychological effects on children. Managing chronic cancer pain is a complex process that involves various pharmacological and non-pharmacological approaches. Pain and anxiety can negatively impact the treatment of children with cancer **(Longkuan et al., 2021)** [16]. Thus, this study aimed to evaluate the effect of applying virtual reality glasses on reducing pain and anxiety of children undergoing chemotherapy. Regarding the characteristics of the studied children, the current study revealed that less than two-thirds of the children were between the ages of 6 to <8 years, and slightly less than two-thirds were males. These findings are consistent with the study by **Semerci et al. (2021)** [17]**,** which also found that more than two-thirds of children with cancer were between the ages of 6-10 years, and more than half were males. Additionally, this study aligns with the findings of **Aydin & Ozyazicioglu (2019)** [18], who reported that 80% of children in their study were between the ages of 6 to 10 years. However, this study disagrees with the findings of **Tennant et al.**

(2020) [19]**,** who observed that nearly half of the studied children in both groups were between the ages of 6 to ≤10 years old, and more than half of them were boys.

Regarding the medical diagnosis of the studied children, the findings of the present study highlight that less than two-thirds of them were diagnosed with leukemia. This finding is consistent with **Wong et al. (2020)** [20]**,** who stated that leukemia is considered the most common type of cancer in childhood, Similarly, the study findings align with **Yang & Cho (2019)** [21]**,** who reported that nearly two-thirds of pediatric cancer patients suffer from hematologic malignancies. Additionally, the findings agree with **Fooladi et al. (2019)** [22], who found that more than two-thirds of pediatric patients were affected by acute lymphoblastic leukemia (ALL).

Regarding the clinical manifestations experienced by the studied children receiving chemotherapy, the current study highlights that more than half of them suffered from weight loss, and less than one-quarter experienced insomnia. This finding is in agreement with **Ibrahim et al. (2021)** [25], who reported that weakness/tiredness, fever, and paleness are classic symptoms observed in cases of pediatric cancer. It is also consistent with **Wong et al. (2022)** [26], who found that pain and weight loss were frequently reported manifestations in children undergoing chemotherapy. However, this finding contradicts the findings of **Tanriverdi et al. (2020)** [27], who documented changes in weight in more than two-thirds of cases. On the other hand, it aligns with **Diakatou & Vassilakou (2020)** [28], who found a significant positive correlation between children's self-reported total fatigue score and play activity. Additionally, it corresponds with **Pelangi & Allenidekania (2020)** [29], who found a significant relationship between types of cancer and fatigue. Furthermore, **Sheikh et al. (2021)** [30] stated that children with cancer often experience higher levels of fatigue and sleep disturbances, with insomnia being the most prevalent symptom.

Regarding the mean score of children's pulse and respiration pre, during, and after virtual reality glasses intervention, the current study showed a decline in mean pulse and respiration rates during and immediately after the intervention. This finding is in accordance with **Helmy et al. (2022)** [23], who found that there were declines in mean pulse and respiration rates in the virtual reality group compared to the control group, with statistically significant differences observed before and after the virtual reality intervention. These findings are also supported by **Fralish (2017)** [24], who observed a decrease in mean heart rate after virtual reality glasses intervention. Furthermore, the mean pain intensity after the intervention was significantly lower in the intervention group compared to the control group. These changes in vital signs and pain intensity may be attributed to the fear and anxiety experienced by children during chemotherapy administration.

Regarding the level of pain, the findings of the current study indicate that more than half of the studied children experienced severe pain before the virtual reality intervention, while less than two-thirds of them reported no pain after the intervention. This can be attributed to the effectiveness of the virtual reality distraction experienced during the procedure. These findings are supported by **Hoffman et al. (2020)** [31], who reported that the pain score in the intervention group was lower than the comparison group after the intervention. Additionally, **Gerçeker et al. (2021)** [1], found that the use of virtual reality in the intervention group significantly reduced pain compared to the control group receiving pharmacological intervention alone.

Nordgard & Lag (2021) [32], also reported significantly lower pain levels during virtual reality compared to non-virtual reality conditions. Overall, these findings highlight the effectiveness of virtual reality glasses in reducing pain levels.

Regarding anxiety levels, the current study revealed that less than two-thirds of the studied children had severe anxiety levels pre-VR intervention. While less than half of them had low anxiety levels during and after the intervention. These results are in line with **Wong et al. (2022)** [26], who found that the use of virtual reality reduced needle-related anxiety compared to the control intervention. Similarly, **Smith et al. (2022)** [33], reported reduced levels of pain and anxiety in the active virtual reality group compared to the standard care group, with significant differences observed in pain intensity and distress behaviors. The findings of **Hashimoto et al. (2020)[34],** also support these results, as they found significantly lower pain and anxiety scores during procedures in the virtual reality group compared to the control group. These findings suggest that virtual reality glasses have a strong and positive effect on reducing anxiety levels in children.

In conclusion, the use of virtual reality glasses has demonstrated effectiveness in reducing both pain and anxiety levels in children undergoing Chemotherapy. These findings are consistent with previous studies and highlight the potential of virtual reality as a non-pharmacological intervention for managing pain and anxiety in pediatric patients.

Conclusion

Children who received virtual reality glasses exhibited less pain and anxiety compared to children who did not receive them

Recommendation

-Hospitals and healthcare facilities should consider integrating VR technology into their pediatric oncology departments to provide an additional pain and anxiety management tool

-Healthcare professionals, particularly nurses, should receive comprehensive training on the proper utilization of VR technology for pain and anxiety management in pediatric patients. Evidence-based guidelines and protocols should be developed to ensure the safe and effective use of VR interventions.

-Further research and development should focus on customizing VR experiences to cater to the individual preferences and needs of children undergoing chemotherapy.

-Future studies should investigate the long-term effects of VR interventions on pain and anxiety levels, as well as explore potential psychological and physiological benefits

References

1. Gerçeker G. O., Bektas M., Aydınok Y., Oren, H., Ellidokuz H. & Olgun N. The effect of virtual reality on pain, fear and anxiety during access of a port with huber needle in pediatric hematology-oncology patients: Randomized controlled trial. Eur. Journal Oncology Nurse, 2021; 50, (1). Available on: http://doi 101886.
2. Ahmadpour N., Keep M., Janssen A., Rouf A.S. & Marthick M. Design strategies for virtual reality interventions for managing pain and anxiety in children and adolescents: scoping review. JMIR Serious Games, 2020 ; 8 (5).pp 66-95.
3. Lopez-Rodriguez M. M., Fernández-Millan A. & Fernández-Medina I. M.: New technologies to improve pain, anxiety and depression in children and adolescents with cancer: A systematic review, International Journal of Environmental Research

and Public Health, May, 2020; 17(10).pp 3563-3577.

4. Czech O., Wrzeciono A., Rutkowska A., Guzik A., Kiper P., Rutkowski S. & Czech O. Virtual reality interventions for needle-related procedural pain, fear and anxiety-A systematic review and meta-analysis. J Clin Med. 2021; 10(15).Available on :http://doi:3248.
5. Chen Y. J., Cheng S. F., Lee P. C., Lai C. H., Hou I. C. & Chen C. W. Distraction using virtual reality for children during intravenous injections in an emergency department: A randomized trial. J. Clin. Nurs. 2020; 29 (4).p 50-53
6. Loeffen E.A., Knops R.G., Boerhof J., Feijen E.A., Merks J., Reedijk A., Lieverst J.A., Pieter R., Boezene H.M., Kremer L. &Tissing W. Treatment-related mortality in children with cancer: Prevalence and risk factors, European Journal of Cancer, 2019; 121, pp 113-122. Available at, https://doi.org/10.1016/j.ejca.2019.08.008.
7. Ozalp G. G., Ayar D., Özdemir E.Z. & Bektas M. Effects of virtual reality on pain, fear and anxiety during blood draw in children aged 5-12 years old: A randomized controlled study. J Clin Nurs. 2020; 29 (7).pp51-61.
8. Tychsen L. and Foeller P. Effects of immersive virtual reality headset viewing on young children: vasomotor function, postural stability, and motion sickness. American Journal Oncology.2020; 8(2). Available on: http://doi: 151 1002.1026.
9. Goldman R. D. & Behboudi A. Virtual Reality for Intravenous Placement in the Emergency Department-A Randomized Controlled Trial. Eur. J. Pediatr,2020; 18(7).pp15-17
10. Friedrichsdorf S. J. & Goubert L. Pediatric pain treatment and prevention for hospitalized children. J Pediatr Oncol Nurs. 2020; 10(3).pp16-19
11. **World Health Organization,** Childhood cancer, available at, **https://www.who.int/news-room/fact-2021;sheets/detail/cancer-in-children.**
12. Wong C., Lau E. & Campbell F. Pain management in children, Part 1 , Pain assessment tools and a brief review of non pharmacological and pharmacological treatment options, springer, 2016;Pp1159-1160
13. Hjermstad M.J., Fayers P.M., Haugen D.F. , Caraceni A, Geoffrey W.H , Loge J.H., Fainsinger R, Aass N.& Stein Kaasa S. Studies comparing numerical rating scales,verbal rating scales, and visual analogue scales for assessment of pain intensity in adults. Journal of Pain and Symptom Management. 2011; 41(6). pp 73-75
14. Beck A.T., Epstein N., Brown G. & Steer R.A. An inventory for measuring clinical anxiety:Psychometric properties. Journal of Consulting and Clinical Psychology. 1988; 56(8).
15. Walco G.A., P Conte A. M., Labay L. E ., Engel R. and Zeltzer L. KProcedural

distress in children with cancer: self-report, behavioral observations, and physiological parameters. 2005; *Clinical Journal Pain, 21*(6),48-50. http:// doi: 10.1097/01.ajp.0000146166.15529.8b.

16. Longkuan R., Nan Z., Lin F., Pinping Z., Chao Z. & Cong Y. Application of virtual reality on non-drug behavioral management of short-term dental procedure in children. J. Clin. Nurs. 2021; 8(2). pp52-54
17. Semerci R., Akgün Kostak, M., Eren T., Avci G. & Semerci E. Effects of Virtual reality on pain during venous port access in pediatric oncology patients: A randomized controlled study. J Pediatr Oncol Nurs. 2021; 38(2).pp14-17
18. Aydin A. I. & Ozyazicioglu N. Using a virtual reality headset to decrease pain felt during a venipuncture procedure in children, J. Perianesthesia Nurs. 2019; 34 (6).pp1215–1221.
19. Tennant M., Youssef G., McGillivray J., Clark T., McMillan L. & McCarthy M. Exploring the use of Immersive Virtual Reality to enhance psychological wellbeing in pediatric oncology: A pilot randomized controlled trial .European Journal of Oncology Nursing. 2020; 15 (9).Available on: http://doi 13:101804.
20. Wong C. L., Li C. K., Chan C. H., Choi K. C., Chen J. & Yeung M. T. Virtual reality intervention targeting pain and anxiety among pediatric cancer patients undergoing peripheral intravenous cannulation. J Pediatr Oncol Nurs. 2020; 7(4). Available on: http://doi 10.5: 1080.1097
21. Yang H. & Choi H. A prospective study on changes in body composition and fat percentage during the first year of cancer treatment in children. Nutrition Research Practice. 2019; 13(3).Available on: http: doi: 10.4162 /nrp. 2019,1 3.3.214.
22. Fooladi S., Ghaljaei F., Keikhaei A. & Aliabad G. Effect of distraction therapy on physiological indices and pain intensity caused by intra-spinal injection of chemotherapy drugs in cancerous children: A clinical trial. Medical - Surgical Nursing Journal. 2019; 8(1).Available at: http: doi: 10.5812/msnj.90409.
23. Helmy A. A., Mansour H. E., Ahmed M.M. & Abd- El aziz E. Effect of virtual reality technology on sleeping pattern and its effect on physiological parameters among critical ill children. Egyptian Journal of Health Care. 2022; 13 (2).
24. Fralish B. Improved physiology and psychosocial well-being for children with physical disabilities through virtual reality immersion. Master Thesis. University of Central Florida. 2017; Available on: doi: 10. 90/children4040022
25. Ibrahim F. E. Elsayed N. A. M. & Zayed H. H. A survey on the effectiveness of virtual reality-based therapy and pain management,international Journal of Advanced Computer Science

and Applications (IJACSA). 2021; 12(7).Available on: http: www.ijacsa.thesai.org.

26. Wong Y., Guo L., Xiong X. & Wang Y. Effects of virtual reality-based distraction of pain, fear and anxiety during needle-related procedures in children and adolescents. J Front Psychol.2022; 19(8).pp13-15
27. Tanrıverdia M., Vuralb M. & Çakır F. The effects of treatment on nutrition in children with cancer. Experience Clinical Medical Journal. 2020; 37(3).Available on: http: doi:10.5835/jecm.omu.
28. Diakatou V. & Vassilakou T. Nutritional status of pediatric cancer patients at diagnosis and correlations with treatment, clinical outcome and the long-term growth and health of survivors. Children. 2020; *7*(11).Available at: https://doi.org/10.3390/children7110218.
29. Pelangi J. & Allenidekania A. Relationship between depression and fatigue in children with cancer undergoing chemotherapy. Enfermería Clínica. 2020; 31(2).Available on: https://doi.org/10.1016/j.enfcli.2020.12.027
30. Sheikh I. M., Roth M. & Stavinoha P. L Prevalence of sleep disturbances in pediatric cancer patients and their diagnosis and management. Children (Basel), 2021; 8(12).Available on: http: doi: 10.3390/children8121100.
31. Hoffman H. G., Vagnoli L., Patterson D. R. Alhalabi, W. & Messeri, A. venipuncture in pediatric patients with oncology-hematological diseases. Front. Psychol. 2020; Vol 20(6). Available on: https: //doi.org/10.33 89/ fpsyg.2020.02508
32. Nordgard R & Lag T. The effects of virtual reality on procedural pain and anxiety in pediatrics: A systematic review and meta-analysis. Systematic Review Article. 2021; 7(3). Available at: https:// doi.org /10.3 389/ frvir. 2021.699383.
33. Smith K. L., Wang Y. & Colloca L. Impact of virtual reality technology on pain and anxiety in pediatric burn patients: A systematic review and meta-analysis. Front Virtual Reality. 2022; 6(2). Available on: https:// doi.org/ 10.3389 / frvir. 2022.751735
34. Hashimoto Y., Chaki T., Hirata N., Tokinaga Y., Yoshikawa Y. & Yamakage M. Video glasses reduce preoperative anxiety compared with portable multimedia player in children: A randomized controlled trial. J. Perianesthesia Nurs. 2020; 35 (3) pp 321–325.