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Original Article

Paediatrics Section

Impact of Virtual Reality on Pain and Fear among Hospitalised Children Undergoing Venipuncture: A Quasi-experimental Study

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ABSTRACT

Introduction: Pain and worry during painful procedures like needle pricks are normal among children admitted in hospitals and can make their overall treatment harder. Virtual Reality (VR) is rapidly becoming a potent new tool that employs immersive play to divert youngsters from their pain and anxiety, while tried-and-true psychological techniques assist alleviate this suffering.

Aim: To assess the effectiveness of VR in mitigating pain and fear in children during venipuncture.

Materials and Methods: The present quasi-experimental study was conducted in the Paediatric Wards of Yenepoya Medical College Hospital, a tertiary care centre, from September 2024 to August 2025, with main data collection in January and March 2025. The children aged 8-12 years undergoing their first venipuncture after admission was included in the study. The study involved 82 school-age children, 41 each in intervention and control groups. The intervention group received VR during venipuncture and the control group received routine hospital care. Parameters assessed were pain and fear during venipuncture using the Numerical Pain Rating Scale (NPRS) and child fear scale. Statistical analysis was performed using frequencies, percentages, Mann-Whitney U, and Wilcoxon signed-rank tests for score comparisons. Karl Pearson's correlation was used to relate post-procedure pain and fear, while the chi-square test determined associations with demographic variables.

Results: The mean age of children was 10.05±1.57 years; majority was males (51.2% in the intervention group and 63.4% in the control group). The mean post-test pain score was less in the intervention group (2.05±0.74) compared to the control group (6.37±1.69). At the same time the mean post-test fear scores were less in the intervention group (0.20±0.40) compared to the control group (2.07±0.34). The study also found a very highly significant difference ($p<0.001$) in the mean post-test pain and fear scores between the groups. A strong positive correlation was found between pain and fear scores in children undergoing venipuncture ($r=0.82$; $p<0.001$).

Conclusion: The VR is found effective in reducing the pain and fear among children undergoing venipuncture.

Keywords: Needle prick, Pain management, Paediatric phlebotomy, Psychological distraction

INTRODUCTION

Around 24.7% of the population is of under 15 years of age [1]. The paediatric population in hospitals has changed significantly during the last 20 years. Even while shorter hospital stays are becoming more common, hospitalised children nowadays frequently have more complicated and serious problems than they did in the past [2].

Children often endure pain while in the hospital, particularly as a result of medical and diagnostic procedures [3]. The most frequent invasive procedures performed on children include phlebotomy, intravenous (i.v.) cannula insertions, and injections. For children in hospitals, invasive procedures can be a traumatic procedure. Invasive therapies often cause negative emotions including pain, fear, and anxiety. Depending on the age and developmental stage of the child, these feelings may impact therapy by forcing acceptance of less effective forms of care [4]. School-age children frequently clench their fists, tense their muscles, avoid painful stimuli, and put off getting shots because they can vocally express their suffering [5]. Studies have shown that children typically experience fear prior to seeing medical personnel and being admitted to the hospital according to empirical research. Children who experience fear and, pain may exhibit emotional distress, behavioural regression, hostility, disobedience, disengagement, non cooperation and trouble recuperating after procedures [6,7].

It should be emphasised that, if pain and fear are not adequately addressed, children may have needle phobia, increased pain perception during future procedure. This leads to challenges in the delivery of healthcare and can lead to parental frustration [8,9]. Global research, including studies from India, has shown that distraction techniques effectively minimise children's pain during medical procedures. Additionally, psychological interventions have been validated to reduce needle-related pain and discomfort [10,11]. According to the literature, use of VR technology in the field of medical setting, is a rapidly developing tool which has been shown to have promising prospects [11].

The VR, a computer-generated simulation, allows children to immerse themselves in a multisensory, three-dimensional environment, altering their sense of reality. These glasses can be connected to a computer or a telephone [12].

Numerous studies have assessed the use of VR as a diversion during invasive procedures like venipuncture [13,14], among paediatric patients where they have found that children embraced the VR distraction very willingly, and it had no negative side-effects. Paediatric populations have found success using VR to reduce pain associated with routine medical services and procedures [15]. While VR is a proven distraction tool, research lacks focusing on its efficacy during the initial venipuncture post-admission, a period of peak distress for the 8-12 year old children. The present study addresses that gap by leveraging this group's unique digital inclination and cognitive maturity to investigate the 'decoupling' of sensory pain from procedural fear.

Hence, the present study was conducted to assess the effectiveness of VR in mitigating pain and fear in children during venipuncture.

MATERIALS AND METHODS

The present quasi-experimental study with pre-test post-test control group was conducted in the paediatric wards of Yenepoya

Medical College Hospital, Mangaluru, Karnataka, India. The total duration of the study was around one year from September 2024 to August 2025, where the data for the main study was collected in the month of January 2025 and March 2025. Following ethical approval (YEC-2/2024/209) and the acquisition of parental consent and child assent, children were recruited via purposive sampling.

Inclusion criteria: School age children aged between group 8 to 12 years, venipunctured after admission were included in the study.

Exclusion criteria: School age children with intellectual or neurological disability, critically ill, having visual and hearing impairment and unable to communicate, on sedatives were excluded from the study.

Sample size calculation: Non-probability, purposive sampling technique with the inclusion criteria was used to select 41 children in each group undergoing venipuncture. The sample size was calculated using G* power software. The reference from literature taken where the mean difference was 2.2 and the pooled Standard Deviation (SD) was 1.065 [16].

Study Procedure

The demographic proforma, NPRS and child fear scale instruments were used for data collection, demographic proforma consisted of age, gender, class of study, birth order, previous hospitalisation of the child, previous visit to hospitalised friends or relatives, previous experience of witnessing venipuncture.

The NPRS [17] is a standardised scale to assess the level of pain among children. It is an 11-point numerical scale, Minimum score is 0, and Maximum is score is 10. The score interpretation was done based on the instructions in the scale; i.e., 0-None, 1 to 3-Mild, 4 to 6-Moderate, 7 to 10-Severe pain.

The Child Fear Scale is also a standardised scale used to assess the level of fear among children. It features five gender-neutral facial expressions, from fearless to extreme fear [18]. The score interpretation was done based on the instruction s in the scale; i.e., Minimum score is 0, and Maximum score is 4. The tool was validated be seven subject experts for applicability and appropriateness of tool.

In the demographic proforma, it was suggested to collect the details of age as-age in completed years; which was incorporated in the tool. The other two tools were accepted by the validators for the current study.

To ensure procedural integrity and prevent treatment contamination, a sequential recruitment strategy was employed, whereas the children getting admitted and having venipuncture performed were assigned to control group. Once the data collection in control group is completed, the next children were assigned to the intervention group. While the control group received routine hospital care, children in the intervention group were given to view a VR video of their choice in a supine position, with the device (manufactured by Shine Concept Limited, China, Imported by Reliance Retail Limited, Thane, India) applied five minutes prior to the procedure. This immersive experience continued throughout the venipuncture, (performed by a hospital nurse) and for an additional five minutes post-procedure. Pre-test fear was assessed before the intervention, while both pain and fear levels were evaluated in both groups five minutes after the venipuncture to determine the intervention's efficacy.

STATISTICAL ANALYSIS

The collected data were recorded systematically and analysed with descriptive and inferential statistics at a 5% level of significance. The demographic data were summarised with frequency, percentage, mean, median and SD. For statistical analysis, Mann-Whitney U test was used to compare pain and fear scores between the intervention and control groups at different time points. The Wilcoxon Signed-rank test was employed to compare fear scores within each group over time. To determine the relationship between post-test pain and fear scores, Karl Pearson's correlation coefficient was calculated. Lastly, the association of fear and pain scores with selected demographic variables was assessed using the chi-square or Fisher's exact test. Statistical Package for the Social Sciences (SPSS) version 24 is used for the data analysis.

RESULTS

The mean age of children was 10.05±1.57 years. The baseline demographic data were comparable across both groups, which were largely comprised of 12-year-old, first-born males. A significant majority of participants in both the intervention and control groups had prior medical exposure, characterised by previous hospitalisations clinical visits, or first-hand observation of venipuncture procedures [Table/Fig-1].

Demographic variables		Groups: Intervention n (%) n=41	Groups: Control n (%) n=41	×2 / Likelihood ratio#	p-value
Age (years)	8	10 (24.4)	12 (29.3)	5.30#	0.25
	9	5 (12.2)	5 (12.2)		
	10	9 (22.0)	2 (4.9)		
	11	5 (12.2)	7 (17.1)		
	12	12 (29.3)	15 (36.6)		
Gender	Male	21 (51.2)	26 (63.4)	1.25	0.26
	Female	20 (48.8)	15 (36.6)		
Birth order	1st	20 (48.8)	19 (46.3)	0.34#	0.95
	2nd	12 (29.3)	11 (26.8)		
	3rd	7 (17.1)	8 (19.5)		
	4th and above	2 (4.9)	3 (7.3)		
Class of study	2	8 (19.5)	4 (9.8)	5.12#	0.64
	3	6 (14.6)	9 (22.0)		
	4	6 (14.6)	7 (17.1)		
	5	4 (9.8)	5 (12.2)		
	6	8 (19.5)	10 (24.4)		
	7	9 (21.9)	6 (14.6)		
Previous hospitalisation of the child	No	22 (53.7)	21 (51.2)	0.05	0.82
	Yes	19 (46.3)	20 (48.8)		
Previous visit to hospitalised friends or relatives	No	26 (63.4)	21 (51.2)	1.25	0.26
	Yes	15 (36.6)	20 (48.8)		
Previous experiencing of witnessing venipuncture	No	27 (65.9)	23 (56.1)	0.82	0.36
	Yes	14 (34.1)	18 (43.9)		

[Table/Fig-1]: Distribution of study participants according to their demographic attribute (N=82).
% - percentage, Test for homogeneity: x2-chi square test/ LHR (#)-Liklihood ratio, p<0.05 was considered significant

The post-test pain scores were significantly lower in the intervention group (2.05±0.74) compared to the control group (6.37±1.69). The Mann-Whitney U test confirmed this difference was very highly significant (p<0.001), indicating a substantial reduction in pain levels following the VR [Table/Fig-2].

Groups	Mean±SD	Median	Range	Mann-Whitney U Test value	p-value
Intervention group	2.05±0.74	2	1-4	14	0.001***
Control group	6.37±1.69	6	3-10		

[Table/Fig-2]: Comparison of post pain test scores between intervention and control groups.
Maximum possible pain score 10, ***Very highly significant

There was very highly significant reduction in fear scores in both groups (p<0.001).

The intervention group demonstrated a near-total reduction in mean fear scores (from 2.34±0.65 to 0.20±0.40), while the control group showed a less pronounced decrease (from 3.22±0.52 to 2.07±0.34) [Table/Fig-3].

Groups	Observation	Mean±SD	Median	Range	Wilcoxon Signed-rank test	p-value
Intervention	Pre-test	2.34±0.65	2	1-4	861	0.001***
	Post-test	0.20±0.40	0	0-1		
Control	Pre-test	3.22±0.52	3	2-4	703	0.001***
	Post-test	2.07±0.34	2	1-3		

[Table/Fig-3]: Comparison of pre and post-test fear scores within intervention and control groups.
Maximum possible fear score is 4 ***Very highly significant

As shown in [Table/Fig-4] the comparison of pretest fear scores between the groups, where a statistically significant difference was found in the mean scores of fear between the group, hence the groups were not similar at baseline. At the same time, the post-test fear scores were significantly lower in the intervention group (0.20±0.40) compared to the control group (2.07±0.34). The Mann-Whitney U test confirmed a very highly significant difference between the cohorts (U=4, p<0.001), highlighting the efficacy of the intervention in reducing fear.

The present study results are also consistent with a randomised controlled trial by Tüfenk N and Tural Büyük E which demonstrated that both VR and kaleidoscopes successfully alleviated pain and fear during blood draws [22]. Furthermore, another study by Semerci R et al., showed that VR is efficacious (p<0.001) in minimising pain during venous port access among patients with paediatric oncology [23]. Additionally, a study by Atzori B et al., highlighted that VR elicits a strong sense of immersion and positive emotions, such as fun,significantly improving patients' ability to cope with medical procedures [24]. Jenabi E et al., reported that VR effectively reduces pain associated with i.v. injections in paediatric patients [25]. Studies conducted by Atzori B et al., Deepti D et al., and Wei Q et al., also reported that VR is an effective distraction technique to help control pain in children and adolescents with onco-haematological diseases undergoing venipuncture [24,26,27].

The present study revealed that there is a significant positive correlation between the pain and fear scores (p<0.001) of children undergoing venipuncture. These findings are supported by a study conducted by Taddio A et al., which showed a statistically significant strong positive correlation (p<0.001) between children's pain and fear scores in the intervention group [9] undergoing i.v. cannulation. Yet another study by Piquer RG et al., also found a significant correlation between pain and anxiety (p<0.001) among children undergoing venipuncture [28].

Groups	Comparison of pre-test fear scores between groups				Comparison of post-test fear scores between groups			
	Mean±SD	Median	IQR	Mann Whitney Utest value (p-value)	Mean ±SD	Median	IQR	Mann-Whitney U test value (p-value)
Intervention	2.34±0.65	2	2-3	288 (<0.001***)	0.2±0.40	0	0-1	4 (0.001***)
Control	3.22±0.52	3	3-4		2.07±0.34	2	1-3	

[Table/Fig-4]: Comparison of pre-test and post-test fear scores between intervention and control groups (n=41+41).
Maximum possible fear score is 4 ***very highly significant

The post-test pain and fear scores demonstrated a very highly significant, strong positive correlation (r=0.82, p<0.001) [Table/Fig-5]. This correlation indicates that lower pain levels were directly associated with a corresponding reduction in fear scores among the participants.

Variables	Mean±SD	r value	p-value
Pain	4.21±2.53	0.82	<0.001***
Fear	1.13±1.02		

[Table/Fig-5]: Post-test correlation between pain and fear scores among children (N=82).
r- Karl Pearson's correlation coefficient test ***very highly significant

DISCUSSION

The present study showed that majority study participants were males (63.4%) and 36.6% were females. The study also showed that 53.7% had no previous hospitalisation. These findings are consistent with a study conducted by Rao DG et al., to assess the efficacy of VR distraction reducing pain perception and anxiety in children during restorative treatment where it was found that 60% of the study participants were males and 40% were females [19]. Another study conducted by Amin GM and Abdalkhair SS on the effect of VR on alleviating children's fear and pain during painful procedures showed that majority (60%) had no previous admission [20]. The findings of the present study showed that VR was highly effective in reducing pain and fear among children undergoing venipuncture (p<0.001). A study demonstrates that VR is a highly effective, safe, non pharmacological tool for reducing pain, fear, and anxiety in children (typically aged 4-17) undergoing venipuncture. Wong CL and Choi KC reported that by providing immersive, interactive distraction, VR reduces pain intensity by up to 55%, decreases anxiety, increases cooperation, and boosts "fun" during procedures [21].

Limitation(s)

Previous experience of venipuncture was not studied among the study group. Present study was limited to the children admitted to a hospital at a single geographic unit, hence generalisation is not possible. The intervention and control groups showed a significant baseline difference in fear scores (p<0.001), indicating that the groups were not comparable before the intervention.

CONCLUSION(S)

The present study confirmed that VR is more than just a distraction; it is a powerful clinical tool that effectively bridges the gap between physical pain management andemotional well-being during paediatric venipuncture. By simultaneously stabilising a child's emotional state and physical comfort, this intervention offers a superior, high-tech alternative to traditional routine care. These findings champion the integration of immersive technology as a new standard for compassionate, fearless paediatric care in hospital settings.Future studies could replicate this investigation in a larger, multicentre sample and evaluate the effectiveness of VR during other invasive procedures across different age groups.

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