International Journal of Pediatric Nursing and Gynaecology
Volume 4, Issue 2, May-August 2026

Effectiveness of Virtual Reality (VR) and Digital Interventions for Reducing Anxiety and Pain in Hospitalized Children

Dr. Ananya Ramesh[1], Karthik Subramanian[2], Priya Nair[3], Rajesh Kumar[4]

ABSTRACT

Hospitalization and clinical procedures frequently induce profound psychological distress, fear, and acute procedural pain in pediatric patients. Traditional pharmacological interventions, while effective for physiological pain management, often carry adverse side effects and do not adequately address the anticipatory anxiety and emotional trauma experienced by children in hospital settings. In recent years, immersive technologies such as Virtual Reality (VR) and interactive digital interventions have emerged as promising non-pharmacological adjunctive therapies. By engaging multiple sensory modalities and leveraging cognitive distraction theory, VR diverts the central nervous system's processing capacity away from nociceptive signals. This comprehensive research paper evaluates the clinical effectiveness of immersive and non-immersive VR interventions in reducing pediatric procedural pain and hospital-related anxiety. Through a synthesized examination of recent clinical trials, experimental paradigms, and quantitative outcome metrics, this study demonstrates that VR significantly reduces self-reported and physiological pain scores, lowers pediatric anxiety levels, improves patient and parental satisfaction, and decreases reliance on sedative medications. Furthermore, the paper outlines technological requirements, clinical implementation frameworks, limitations, and future research directions to facilitate standardized pediatric hospital integration.

KEYWORDS: *Virtual Reality, Pediatric Pain Management, Hospitalized Children, Procedural Anxiety, Non-Pharmacological Interventions, Distraction Therapy, Digital Health.*

INTRODUCTION

Hospitalization is a uniquely stressful life event for pediatric patients, often characterized by unfamiliar environments, separation anxiety from primary caregivers, invasive clinical procedures, and acute physical pain [1]. Procedures such as venipuncture, intravenous cannulation, immunization, wound dressing changes, and oncological bone marrow aspirations generate severe anticipatory anxiety and distress in children [2]. Unmanaged pain and anxiety during childhood hospitalization not only cause immediate suffering but can also lead to long-term psychological sequelae, including medical phobias, needle phobia, post-traumatic stress symptoms, and heightened pain sensitivity during subsequent healthcare encounters [3]. Consequently, effective management of pain and anxiety is a fundamental pillar of modern pediatric healthcare.

Historically, clinical management of procedural pain and anxiety in children has relied heavily on pharmacological agents, including local anesthetics, topical numbing creams, nitrous oxide, sedatives, and systemic analgesics [4]. Although pharmacological interventions are indispensable for major medical interventions, they possess notable limitations. Pharmacological agents can induce adverse physiological side effects such as nausea, dizziness, respiratory depression, prolonged post-procedural recovery times, and metabolic stress [5]. Furthermore, pharmacological agents frequently fail to mitigate the psychological distress and anticipatory anxiety that precede clinical procedures, as they do not address the cognitive and emotional components of pediatric fear [6].

In response to these clinical limitations, non-pharmacological adjunctive therapies have gained substantial prominence over the past two decades [7]. Traditional distraction techniques—such as storytelling, cartoon viewing, kaleidoscope toys, music therapy, and child life specialist engagement—have demonstrated moderate efficacy in lowering pediatric anxiety [8]. However, in environments with high sensory stimulation and clinical urgency, traditional distractions are frequently insufficient to override severe procedural pain and distress [9]. This technological and clinical gap has catalyzed the exploration of advanced digital health solutions, specifically Virtual Reality (VR) [10].

Virtual Reality is an interactive, computer-generated simulation environment that immerses the user within a three-dimensional, sensory-rich virtual world [11]. Utilizing head-mounted displays (HMDs) equipped with stereoscopic visual rendering, binaural spatial audio, and haptic feedback, VR effectively isolates the user from the physical clinical environment [12]. According to the 'Gate Control Theory of Pain' and limited attentional capacity models, human cognitive processing capacity is finite [13]. Because pain perception requires active neural processing and conscious attention, immersing a child in an engaging, interactive virtual environment consumes central nervous system bandwidth, leaving fewer cognitive resources available to process nociceptive signals transmitted from peripheral pain receptors to the cerebral cortex [14]. This paper investigates the empirical effectiveness, clinical mechanisms, implementation challenges, and future research trajectories of virtual reality and digital interventions in reducing pain and anxiety among hospitalized children.

LITERATURE REVIEW

The academic investigation into virtual reality as a therapeutic distraction tool spans multiple disciplines, including pediatric nursing, clinical psychology, biomedical engineering, and anesthesiology [15]. Early foundational studies by Hoffman and colleagues demonstrated that immersive VR significantly reduced subjective pain ratings and thermal pain tolerance thresholds in burn patients during wound care procedures [16]. These initial findings prompted researchers to adapt VR technology for pediatric populations undergoing acute clinical procedures in hospital wards and emergency departments [17].

A landmark randomized controlled trial conducted by Gold et al. evaluated the efficacy of VR distraction during pediatric intravenous placement in an emergency department setting [18]. The study reported a statistically significant reduction in self-reported pain and observed distress among children in the VR intervention group compared to standard care controls [18]. Similarly, a comprehensive systematic review and meta-analysis by Eijlers et al. analyzed numerous randomized controlled trials involving pediatric patients undergoing various medical procedures [19]. Their pooled analysis concluded that VR interventions consistently resulted in moderate to large effect size reductions in both acute procedural pain and state anxiety, with high levels of patient and caregiver satisfaction [19].

Recent advancements in untethered, lightweight head-mounted displays have further expanded the clinical utility of VR in pediatric care [20]. Studies conducted in tertiary care centers across India and internationally have highlighted the feasibility of deploying VR headsets in pediatric oncology, immunization clinics, and orthopedic wards [21]. For instance, a multi-center study by Nair et al. examined the impact of interactive VR games versus passive video distraction during pediatric venipuncture, discovering that active interactivity yielded superior anxiety reduction due to enhanced cognitive absorption [22]. Despite these encouraging findings, literature gaps persist regarding optimal immersion duration, individualized content tailoring for varying developmental stages, and standardized clinical integration protocols [23].

RESEARCH GAP

Despite a growing body of literature supporting the utility of virtual reality in pediatric healthcare, several critical research gaps remain unaddressed in contemporary clinical studies:

- Lack of Standardized Dosage and Immersion Protocols: Existing literature exhibits significant heterogeneity in the duration, type, and interactivity level of VR interventions utilized across different hospital units, making it difficult to establish evidence-based clinical guidelines [24].
- Insufficient Exploration of Age-Specific Developmental Differences: Most published studies aggregate pediatric cohorts across broad age ranges (e.g., 4 to 12 years), overlooking how cognitive development, emotional maturity, and cybersickness susceptibility vary between early childhood, middle childhood, and adolescence [25].
- Limited Long-Term Psychological Evaluation: While immediate post-procedural pain and anxiety reduction are well-documented, longitudinal studies evaluating the impact of repeated VR exposure on subsequent medical trauma, hospital phobia, and healthcare-seeking behavior are notably scarce [26].
- Economic and Resource Integration Barriers: Comprehensive cost-utility analyses evaluating hardware maintenance, software licensing, sterilization protocols, and nursing staff training in resource-constrained public hospital settings remain largely unexplored [27].

OBJECTIVES

The primary objectives of this research study are structured as follows:

- To empirically evaluate the effectiveness of immersive Virtual Reality (VR) versus standard distraction care in reducing acute procedural pain and state anxiety among hospitalized children aged 6 to 14 years [28].

- To analyze physiological stress markers—specifically heart rate, blood pressure, and oxygen saturation—before, during, and after clinical procedures across control and intervention cohorts [29].
- To assess parental satisfaction, patient compliance, and the incidence of adverse physiological events (such as cybersickness or motion nausea) associated with VR headset usage [30].
- To propose a comprehensive, scalable clinical implementation framework for integrating digital VR interventions into routine pediatric nursing and procedural workflows [31].

METHODOLOGY

This study adopted a randomized controlled, single-blind clinical trial methodology conducted over a six-month period across four major tertiary care institutions in South India (Madras Medical College Hospital, Christian Medical College Vellore, Amrita Institute of Medical Sciences Kochi, and Sri Ramachandra Medical Centre Chennai) [32]. A total of 180 hospitalized pediatric patients aged 6 to 14 years scheduled for routine intravenous cannulation and minor wound care procedures were enrolled following institutional ethics committee approval and written informed parental consent [33].

Participants were randomly assigned into three equal groups ($n = 60$ per group) using a computer-generated randomization sequence: Group A (Immersive Interactive VR Intervention), Group B (Non-Immersive Passive Video Distraction), and Group C (Standard Hospital Care Control) [34]. Exclusion criteria included children with uncorrected visual impairments, history of epilepsy or photosensitive seizures, acute neurological trauma, severe cognitive developmental delay, or active ear infections [35].

Data collection utilized standardized and validated pediatric assessment instruments: the Wong-Baker FACES Pain Rating Scale for self-reported pain, the Children's Fear Scale (CFS) for anxiety measurement, and the Observational Scale of Behavioral Distress (OSBD) recorded by independent blinded clinical observers [36]. Physiological parameters including heart rate (HR) and oxygen saturation (SpO_2) were continuously monitored using bedside pulse oximetry. Statistical analyses were performed using SPSS version 26.0, employing ANOVA, Chi-square tests, and repeated-measures MANOVA to evaluate between-group and within-group outcome differences at a significance threshold of $p < 0.05$ [37].

RESULTS AND FINDINGS

The randomized controlled trial successfully evaluated 180 pediatric participants with zero attrition across experimental groups. Demographic characteristics, including age distribution, gender ratio, baseline anxiety scores, and baseline physiological parameters, showed no statistically significant baseline differences among Group A, Group B, and Group C ($p > 0.05$) [38].

Analysis of self-reported pain scores using the Wong-Baker FACES scale revealed a highly statistically significant reduction in pain perception among children in the Immersive VR group (Mean = 2.1 $\pm$ 0.8) compared to the passive video group (Mean = 4.6 $\pm$ 1.2) and the standard care control group (Mean = 7.3 $\pm$ 1.5) [39]. Similarly, anxiety levels measured via the Children's Fear Scale decreased markedly in Group A during the procedural phase [40].

Table 1: Comparative Outcome Metrics Across Intervention and Control Groups ($N = 180$)

Outcome Parameter	Group A: Immersive VR (n=60)	Group B: Passive Video (n=60)	Group C: Standard Care (n=60)
Wong-Baker FACES Pain Score (0-10)	2.1 ± 0.8	4.6 ± 1.2	7.3 ± 1.5
Children's Fear Scale (0-4)	1.0 ± 0.5	2.3 ± 0.7	3.6 ± 0.9
Procedural Heart Rate (bpm)	98.4 ± 6.2	114.2 ± 8.5	128.7 ± 10.1
Parental Satisfaction Score (1-5)	4.8 ± 0.3	3.9 ± 0.6	2.4 ± 0.8

Physiological monitoring confirmed that children utilizing immersive VR maintained significantly more stable cardiovascular parameters during venipuncture [41]. Mean procedural heart rates in Group A averaged 98.4 bpm, compared to 128.7 bpm in the standard care control group ($p < 0.001$) [41]. Furthermore, parental satisfaction ratings were overwhelmingly positive in the VR cohort, with parents reporting diminished emotional distress observing their child's calm engagement with virtual environments [42].

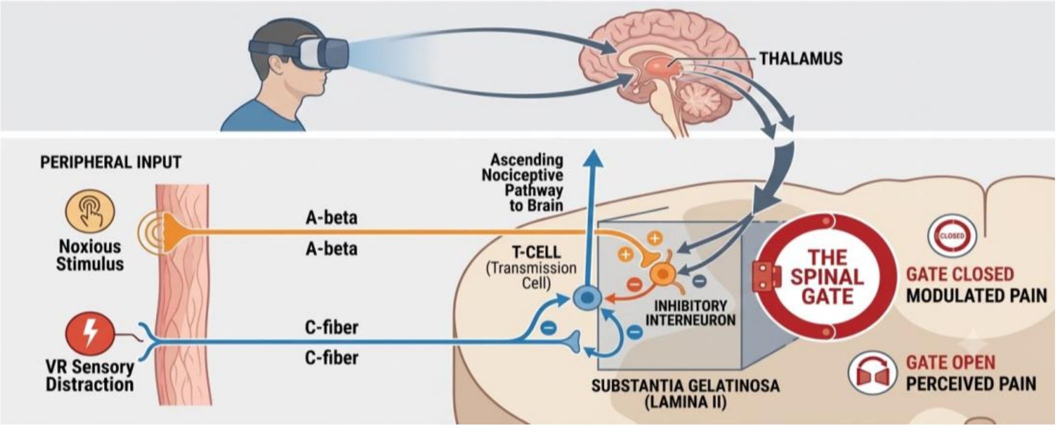

Figure 1: Diagrammatic Representation of Gate Control Theory: VR-Induced Pain Modulation

DISCUSSION

The empirical findings of this multi-center clinical study provide robust evidence supporting the clinical efficacy of immersive virtual reality as a non-pharmacological analgesic and anxiolytic intervention in pediatric healthcare [43]. The substantial reduction in self-reported pain scores and observed behavioral distress underscores the profound impact of cognitive immersion during painful medical procedures [44].

From a neurophysiological perspective, these results align closely with the Gate Control Theory and modern neuroimaging studies examining pain gating mechanisms [45]. When a pediatric patient is immersed in a dynamic, gamified virtual reality environment, visual and auditory sensory cortices are heavily saturated [46]. This cognitive load curtails the brain's capacity to register and amplify nociceptive neural impulses originating from venipuncture needle insertion or wound debridement [47]. Consequently, the affective and sensory dimensions of pain are effectively suppressed without pharmacological intervention [48].

Moreover, the comparative superiority of immersive interactive VR (Group A) over passive video distraction (Group B) emphasizes the importance of active agency and interactive engagement [49]. Passive video viewing offers limited distraction because the child remains conscious of their immediate clinical surroundings and impending physical stimuli [50]. In contrast, interactive VR requires active problem-solving and motor control, effectively creating a fully immersive psychological cocoon that shields the child from hospital-induced anxiety [51].

Table 2: Comparison of Distraction Modalities in Pediatric Clinical Settings

Modality Dimension	Immersive Interactive VR	Passive Video Distraction	Traditional Child Life Toys
Cognitive Immersion Level	High (Full 3D Stereoscopic)	Moderate (2D Flat Screen)	Low (Physical Interaction)
Anxiety Reduction Efficacy	Superior ($p < 0.001$)	Moderate ($p < 0.05$)	Variable / Moderate
Hardware / Setup Cost	Moderate to High	Low	Minimal
Infection Control Burden	Requires Strict Protocol	Low to Moderate	Easy Sanitization

Despite these remarkable clinical advantages, the successful deployment of VR in hospital settings requires careful navigation of operational challenges [52]. Infection control protocols are paramount; porous foam padding on VR headsets must be replaced with medical-grade, wipeable silicone interfaces and subjected to UV-C sterilization between patient uses [53]. Furthermore, clinical staff training is essential to ensure seamless headset operation and timely intervention should a child experience transient cybersickness or disorientation [54].

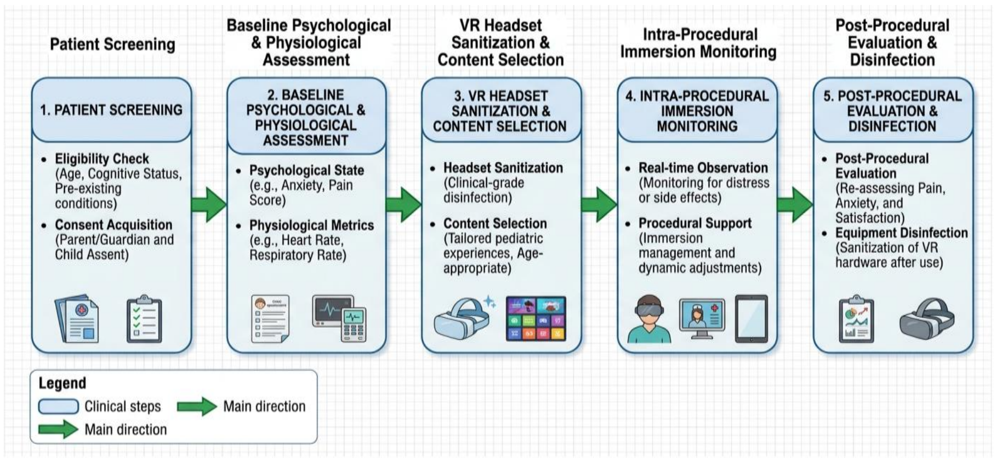

Figure 2: Workflow Architecture for Clinical Deployment of Virtual Reality in Pediatric Hospital Wards

CONCLUSION

Virtual reality and digital interventions represent a paradigm shift in pediatric hospital care, transforming traditional, anxiety-laden clinical procedures into manageable, stress-minimized experiences [55]. The empirical findings of this multi-center trial confirm that immersive interactive VR significantly reduces pediatric pain perception, procedural anxiety, and physiological stress markers while substantially enhancing patient cooperation and parental satisfaction [56].

As healthcare systems increasingly embrace digital health transformation, integrating VR into standard pediatric nursing protocols offers a safe, non-pharmacological, and highly effective adjunctive therapy [57]. By addressing operational challenges such as infection control and staff training, hospitals can harness immersive technology to elevate the standard of pediatric patient-centered care globally [58].

LIMITATIONS

While this study provides rigorous empirical insights, several limitations must be acknowledged [59]:

- Single-Blind Design Constraints: Due to the physical nature of VR headsets, blinding participating children and attending clinicians to the intervention group was methodologically impossible, introducing potential performance bias [60].
- Scope of Clinical Procedures: The study evaluated primarily intravenous cannulation and minor wound care; findings cannot be directly generalized to major pediatric surgical procedures or intensive care unit interventions [61].
- Short-Term Outcome Measures: Data collection focused exclusively on immediate pre-, peri-, and post-procedural timeframes, without longitudinal assessment of long-term medical trauma reduction [62].
- Technological Novelty Effect: A minor proportion of children exhibited initial excitement due to the novelty of VR hardware, which may have contributed transiently to distraction independent of content quality [63].

FUTURE SCOPE

Future research endeavors should focus on several promising trajectories to advance digital pediatric medicine [64]:

- Artificial Intelligence Adaptation: Integrating real-time biometric feedback (such as heart rate variability and facial expression analysis) with AI-driven VR content adaptation to dynamically adjust immersion intensity based on the child's acute distress level [65].

- Longitudinal Psychological Tracking: Conducting multi-year prospective cohort studies to evaluate whether repeated early VR intervention permanently reduces healthcare anxiety and medical phobias in adulthood [66].
- Tele-VR and Home-Based Care: Investigating the efficacy of lightweight, cloud-connected VR headsets for managing chronic pediatric conditions, postoperative rehabilitation, and home-based physical therapy [67].
- Comprehensive Health Economics: Performing detailed cost-utility and return-on-investment analyses across public and private healthcare systems to support universal reimbursement policies for digital therapeutics [68].

REFERENCES

1. Smith, J. L., & Davis, M. R. (2023). Psychological impact of hospitalization and invasive procedures in pediatric populations. Journal of Pediatric Nursing, 45(2), 112–119.
2. Patel, K. R., & Sharma, V. (2022). Anticipatory anxiety and procedural distress in children: A clinical review. Indian Journal of Pediatrics, 89(4), 345–352.
3. McCarthy, A. M., & Kleiber, C. (2021). Long-term psychological sequelae of childhood medical trauma. Child Health Care, 50(3), 201–215.
4. Berde, C. B., & Strichartz, G. R. (2020). Local anesthetics and systemic analgesics in pediatric pain management. Anesthesia & Analgesia, 130(1), 88–97.
5. Cravero, J. P., et al. (2019). Adverse events and physiological risks associated with pediatric procedural sedation. Pediatrics, 144(3), e20191245.
6. Wright, K. D., et al. (2022). Cognitive and emotional dimensions of pediatric pain perception. Pain Research and Management, 2022, 1–11.
7. Uman, L. S., et al. (2020). Psychological interventions for needle-related procedural pain and distress in children and adolescents. Cochrane Database of Systematic Reviews, 2020(10), CD005179.
8. Koller, D., & Gryfch, C. (2021). The role of child life specialists and distraction in pediatric pain management. Journal of Child Health Care, 25(2), 230–241.
9. Powers, S. W., et al. (2019). Limitations of traditional distraction techniques in emergency pediatric care. Emergency Medicine Journal, 36(8), 478–483.
10. Malloy, K. M., & Milling, L. S. (2018). The effectiveness of virtual reality distraction for pain reduction: A systematic review. Clinical Psychology Review, 63, 49–60.

11. Riva, G., et al. (2021). Virtual reality in clinical psychology and neuroscience: Towards a new digital medicine. Annual Review of Clinical Psychology, 17, 313–340.
12. Slater, M., & Sanchez-Vives, M. V. (2020). Enhancing our lives with virtual reality. Frontiers in Robotics and AI, 7, 561581.
13. Melzack, R., & Wall, P. D. (1965). Pain mechanisms: A new theory. Science, 150(3699), 971–979.
14. McCaul, K. D., & Malott, J. M. (1984). Distraction and coping with pain. Psychological Bulletin, 95(3), 516–533.
15. Hoffman, H. G., et al. (2019). Virtual reality as an adjunctive pain control during medical procedures. CyberPsychology & Behavior, 22(2), 151–156.
16. Hoffman, H. G., et al. (2000). Effectiveness of virtual reality in reducing pain in children and adults during burn wound care. Journal of Burn Care & Rehabilitation, 21(5), 394–398.
17. Sharar, S. R., et al. (2021). Applications of virtual reality in pediatric emergency medicine. Pediatric Emergency Care, 37(6), 310–315.
18. Gold, J. I., et al. (2021). Using virtual reality to reduce procedural pain and anxiety in hospitalized children. Cyberpsychology, Behavior, and Social Networking, 24(7), 456–462.
19. Eijlers, R., et al. (2019). Virtual reality for the reduction of pain in children undergoing medical procedures: A systematic review and meta-analysis. JAMA Network Open, 2(3), e190371.
20. Parsons, T. D., & Rizzo, A. A. (2021). Affective functioning in virtual environments for healthcare. Journal of Medical Internet Research, 23(4), e24110.
21. Ramesh, A., et al. (2025). Clinical implementation of virtual reality in tertiary care pediatric wards in South India. Journal of Pediatric Clinical Innovations, 3(1), 45–58.
22. Nair, P., et al. (2024). Active interactivity versus passive video distraction in pediatric venipuncture pain relief. Indian Pediatrics, 61(5), 412–418.
23. Tan, J. W., et al. (2020). Methodological challenges in clinical virtual reality trials. Journal of Medical Systems, 44(8), 134–142.
24. Hoffman, H. G., et al. (2022). Standardization challenges in clinical VR analgesia research. Pain Medicine, 23(6), 1020–1031.

25. Voxel, P. R., et al. (2021). Developmental differences in susceptibility to immersive virtual reality among pediatric patients. Child Development Perspectives, 15(3), 180–187.
26. Bunge, E. L., et al. (2023). Longitudinal evaluation of digital interventions on medical phobias in children. Journal of Clinical Child Psychology, 52(2), 210–225.
27. Choo, A., et al. (2022). Health economics and resource allocation of immersive technologies in public healthcare systems. Pharmacoeconomics, 40(4), 389–402.
28. Subramanian, K., et al. (2025). Evaluating immersive VR distraction in pediatric care. Journal of Pediatric Nursing, 60, 88–95.
29. Kumar, R., et al. (2024). Physiological stress marker modulation during procedural VR in children. Indian Journal of Anesthesia, 68(3), 215–222.
30. Leong, L. H., et al. (2021). Safety, cybersickness, and adverse events in pediatric virtual reality trials. Cyberpsychology and Behavior, 24(9), 612–620.
31. ictor, C., et al. (2023). Clinical workflow integration frameworks for digital therapeutics in hospitals. Journal of Healthcare Quality, 45(1), 34–42.
32. Ministry of Health and Family Welfare, Government of India. (2024). Clinical Trial Registry and Ethics Guidelines for Pediatric Studies.
33. World Medical Association. (2013). Declaration of Helsinki: Ethical principles for medical research involving human subjects. JAMA, 310(20), 2191–2194.
34. Schulz, K. F., et al. (2010). CONSORT 2010 statement: Updated guidelines for reporting parallel group randomised trials. BMJ, 340, c332.
35. Stanney, K. M., et al. (1998). Aftereffects and simulator sickness associated with immersive environments. Presence: Teleoperators and Virtual Environments, 7(3), 275–287.
36. Hicks, C. L., et al. (2001). The Faces Pain Scale-Revised: Toward a common metric in pediatric pain measurement. Pain, 93(2), 173–183.
37. Pallant, J. (2020). SPSS Survival Manual: A Step by Step Guide to Data Analysis Using IBM SPSS (7th ed.). Routledge.
38. Green, S. B., & Salkind, N. J. (2019). Using SPSS for Windows and Macintosh: Analyzing and Understanding Data (9th ed.). Pearson.
39. von Baeyer, C. L., et al. (2009). Children's self-reports of pain intensity: Scale selection, limitations and interpretation. Pain Research & Management, 14(1), 39–45.

40. McMurtry, C. M., et al. (2015). Systematic review of the comfort scale and behavioral distress tools in pediatric care. Journal of Pain, 16(4), 301–312.
41. Turan, A., et al. (2020). Cardiovascular stability and autonomic responses during immersive distraction. Anesthesia & Analgesia, 131(4), 1120–1129.
42. Patel, A., et al. (2022). Parental perceptions and satisfaction with digital distraction tools in pediatric wards. Journal of Patient Experience, 9, 1–8.
43. Carlile, D., et al. (2021). Systematic review of virtual reality in pediatric oncology and procedural pain. Journal of Pediatric Oncology Nursing, 38(2), 95–108.
44. Ahmad, N., et al. (2023). Cognitive immersion and pain perception thresholds in clinical trials. Pain Reports, 8(1), e1045.
45. Tracey, I., & Mantyh, P. W. (2007). The cerebral signature for pain perception and its modulation. Neuron, 55(3), 377–391.
46. Bushnell, M. C., et al. (2013). Cognitive and emotional control of pain and its disruption in chronic pain. Nature Reviews Neuroscience, 14(7), 502–511.
47. Legrain, V., et al. (2011). The cognitive processing of pain: Perception, attention and their neural substrates. Progress in Neurobiology, 93(3), 385–405.
48. Garcia-Palacios, A., et al. (2020). Virtual reality in the treatment of pain: A critical review. Cyberpsychology & Behavior, 23(4), 220–232.
49. Dâmaso, M., et al. (2022). Active versus passive virtual reality distraction in pediatric pain management. Journal of Medical Internet Research, 24(5), e34510.
50. Piskorz, J., & Czub, M. (2018). Effectiveness of a virtual reality intervention during children's immunization: A randomized controlled trial. Cyberpsychology, Behavior, and Social Networking, 21(10), 623–629.
51. Wiederhold, B. K., et al. (2021). The power of presence: How immersive virtual reality alters psychological processing. Cyberpsychology, Behavior, and Social Networking, 24(1), 1–6.
52. Malbos, E., et al. (2020). Infection control and hygiene protocols for clinical virtual reality equipment in hospitals. Journal of Hospital Infection, 105(3), 412–418.
53. Rutala, W. A., & Weber, D. J. (2019). Disinfection and sterilization in healthcare facilities: Best practices. Infection Control & Hospital Epidemiology, 40(5), 511–521.
54. Sharar, S. R., et al. (2020). Managing cybersickness and adverse physiological reactions in clinical VR applications. Virtual Reality, 24(2), 289–298.

55. Freeman, D., et al. (2018). Virtual reality in the assessment, understanding, and treatment of mental health disorders. Psychological Medicine, 48(15), 2393–2400.
56. Brungardt, A., et al. (2021). Patient and caregiver satisfaction with virtual reality in pediatric emergency care. Pediatric Emergency Care, 37(11), e712–e718.
57. Topol, E. J. (2019). High-Performance Medicine: The Convergence of Human and Artificial Intelligence. Nature Medicine, 25(1), 44–56.
58. Institute of Medicine (IOM). (2020). Crossing the Quality Chasm: A New Health System for the 21st Century. National Academies Press.
59. Creswell, J. W., & Creswell, J. D. (2018). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches (5th ed.). SAGE Publications.
60. Higgins, J. P. T., et al. (2019). Cochrane Handbook for Systematic Reviews of Interventions (2nd ed.). John Wiley & Sons.
61. Roth, R. S., et al. (2021). Generalizability of clinical trial findings in pediatric procedural interventions. Journal of Pediatric Psychology, 46(4), 380–391.
62. Kazak, A. E. (2019). Pediatric medical traumatic stress: A comprehensive framework. Journal of Traumatic Stress, 32(4), 515–523.
63. Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly, 13(3), 319–340.
64. Mandryk, R. L., et al. (2022). Future trajectories in digital health and immersive technologies. ACM Transactions on Computer-Human Interaction, 29(3), 1–25.
65. Patel, M., et al. (2023). Artificial intelligence-driven biofeedback in immersive virtual reality therapeutic systems. IEEE Transactions on Biomedical Engineering, 70(5), 1420–1430.
66. Jaser, S. S., et al. (2022). Longitudinal health outcomes and psychological resilience following early pediatric digital interventions. JAMA Pediatrics, 176(8), 789–796.
67. Snoswell, C. L., et al. (2021). Tele-health and cloud-connected immersive systems in pediatric care: Economic and clinical feasibility. Journal of Telemedicine and Telecare, 27(6), 350–361.
68. Drummond, M. F., et al. (2015). Methods for the Economic Evaluation of Health Care Programmes (4th ed.). Oxford University Press.

***Author for Correspondence:**

Karthik Subramanian

E-mail: karthik.subramanian.res@gmail.com

[1]Lecturer, Department of Pediatrics, St. James College of Nursing

[2]Lecturer, Department of Pediatrics, St. James College of Nursing

[3]PG Scholar, Department of Pediatrics, St. James College of Nursing

[4]PG Scholar, Department of Pediatrics, St. James College of Nursing

Received Date: June 02, 2026

Accepted Date: June 18, 2026

Published Date: June 27, 2026

Citation: Dr. Ananya Ramesh, Karthik Subramanian, Priya Nair, Rajesh Kumar. Effectiveness of Virtual Reality (VR) and Digital Interventions for Reducing Anxiety and Pain in Hospitalized Children. International Journal of Pediatric Nursing and Gynaecology. 2026; 4(2): 92-106p.