Advanced International Journal for Research (AIJFR)
E-ISSN: 3048-7641 ● Website: www.aijfr.com ● Email: editor@aijfr.com

Effectiveness Of Virtual Reality in Young Adults Testing Executive Function in Traumatic Brain Injury – A Scoping Review.

Poojitha S[1], Nikita Das [2], Belle Sharvani[3], Dr. Manjunatha H[4]

[1]BPT intern, Akash institute of Physiotherapy, Rajiv Gandhi University of Health Science, Devanahalli, Bangaluru, India
[2]Lecturer, Akash institute of Physiotherapy, Rajiv Gandhi University of Health Science, Devanahalli, Bangaluru, India
[3]Associate Professor, Akash institute of Physiotherapy, Rajiv Gandhi University of Health Science, Devanahalli, Bangaluru, India
[4]Principal, Akash institute of Physiotherapy, Rajiv Gandhi University of Health Science, Devanahalli, Bangaluru, India

Abstract

Traumatic Brain Injury (TBI) commonly affects executive functions such as attention, memory, planning, problem-solving, and decision-making, reducing independence and quality of life in young adults. Virtual Reality (VR) has emerged as an innovative rehabilitation approach by providing immersive and interactive environments that improve patient engagement and simulate real-life activities. This literature review aimed to evaluate the effectiveness of VR in improving executive function in young adults with TBI. A literature search was conducted using PubMed, Google Scholar, and the Cochrane Library for studies published between 2016 and 2026. Eight review articles met the inclusion criteria and were included in the analysis. The findings showed that VR-based rehabilitation improves attention, working memory, planning, cognitive flexibility, and problem-solving. Several studies also reported improvements in functional independence, balance, motivation, and quality of life. Overall, the evidence suggests that virtual reality is a safe and effective adjunct to conventional rehabilitation for enhancing executive function in young adults with traumatic brain injury. However, further high-quality studies with larger sample sizes are needed to establish its long-term effectiveness.

Keywords: Traumatic Brain Injury, Virtual Reality, Executive Function, Cognitive Rehabilitation, Young Adults.

1. Introduction

Finding the effectiveness of virtual reality in young adults testing executive function in Traumatic brain injury, traumatic brain injury (TBI) is one of the leading causes of mortality and morbidity around worldwide, contributing Approximately 30% of all injury-related deaths in the United States[1]. In India TBI represents a substantial and growing health issue. It is estimated that 1.5 to 2 million people sustain TBI annually, with nearly 1 million deaths and a similar number of individuals left with long-term

disabilities [2]. Road traffic accidents are the predominant cause, accounting for the majority of cases, particularly among young adults aged 18–40 years. This age group is especially vulnerable due to increased mobility, occupational exposure, and risk-taking behaviors. According to the 2016 Global Burden of Disease report, TBI was responsible for 8.1 million healthy years of life lost due to TBI related disability. It is also a leading cause of disability[3].TBI is an injury to the brain that is not hereditary, congenital, degenerative, or caused by birth trauma, as it occurs after birth .TBI is characterized as "an alteration in brain function, or other evidence of brain pathology, caused by an external force" TBI is the most common type of ABI (Acquired brain injury) where motor vehicle accidents and falls being the most common causes .Brain injuries can be divided into two main categories according to their cause: traumatic brain injury and non-traumatic brain injury. In TBI, brain damage is usually caused by direct or transmitted external influences such as falls, vehicle collisions, sports injuries, abuse/assault, and pressure. The incidence of TBI peaks in both young and late adulthood. TBI is traditionally classified mild, moderate, and severe, using injury severity scores. The most widely used scoring system in the acute phase is the Glasgow Coma Scale (GCS), it is performed within 24 hours of injury to assess impairment of consciousness and coma. Scores range from 3 to 15, with higher scores indicating better function. The clinical picture is characterized as dysfunctions in different brain regions depending on the affected area, leading to many cognitive, motor, emotional, attention, memory, executive function, and problem-solving skills. This results in a considerable impact on every day functioning activities[4]. One of the most debilitating consequences of TBI is impairment in cognitive functions, particularly executive functioning. Executive f1unctions are higher-order cognitive processes that include planning, problem-solving, decision-making, working memory, attention control, and cognitive flexibility. These functions are primarily mediated by the frontal lobes, which are highly susceptible to injury in TBI. Deficits in executive functioning can severely impact an individual's ability to perform daily activities, return to work or education, maintain social relationships, and achieve independent living[5],[6]. Traditional rehabilitation approaches for cognitive deficits following TBI include paper-based tasks, computer-assisted cognitive training, and therapist-guided interventions. While these methods have shown some effectiveness, they often lack ecological validity, engagement, and real-world applicability. In recent years, Virtual Reality (VR) has emerged as an innovative and promising tool in Cognitive rehabilitation, VR technology creates immersive, interactive, and controlled environments that simulate real-life scenarios, allowing individuals to practice and improve cognitive skills in a safe and engage manner.

VR is a computer technology that refers to a computer-generated artificial environment with special sensory characteristics that can be interacted with in real time. VR can be categorized into immersive, non -immersive, And semi- immersive. In fully immersive VR, users wear high resolution head – mounted displays to experience a 360 – degree virtual environment. This creates a strong sense of presence, making users feel as if they are part of the virtual world while allowing them to interact with the environment in real time. semi -immersive VR focuses on intentional isolation from real – world using head -mounted devices interact in real-time. Similarly, semi-immersive VR lets users experience elements of VR while maintaining contact with the real surroundings, whereas the non- immersive VR by no means focuses on intentional isolation from the real-world using head-mounted devices in order to enhance the immersive[7,8,9,10].

2. NEED OF STUDY

Virtual Reality has emerged as a promising tool for cognitive assessment and rehabilitation in individuals with traumatic brain injury. Virtual reality provides immersive, interactive, and controlled environments that simulate real-world tasks, thereby offering more realistic evaluation of executive functioning. Studies suggest that VR-based interventions may improve cognitive engagement, motivation, attention, and functional outcomes in individuals with TBI. the present literature review is needed to critically examine and synthesize existing evidence regarding the effectiveness of virtual reality in testing executive function in young adults with traumatic brain injury. The review will help identify current trends, strengths, limitations, research gaps, and future directions for integrating VR technologies into neuropsychological assessment and rehabilitation practices.

3. OBJECTIVE

To know the evidences on the effectiveness of virtual reality in improving executive function in young adults with traumatic brain injury by reviewing the available literature.

4. METHODOLOGY

A review of currently published studies was carried out for articles in which VR was used as a tool, technique, or intervention in patients with TBI in young adults. The literature search was conducted via PubMed, Cochrane Library, and Google scholar and it was carried out for articles using the following search keyword terms: virtual reality, computer simulation, executive function, traumatic brain injury, cognitive rehabilitation, Acquired brain injury.

Search period studies published between 2016- 2026 in English language were searched. In total 29 articles were identified through database, articles screened by tittle and abstract are 29, 14 duplicate articles removed, 15 articles met eligible criteria, 8 research article met the inclusion criteria. remaining articles are excluded as some articles were not present in English and some are removed based on screening for inadequate study design and untrace able articles.

The review included studies involving young adults aged 18–40 years who were diagnosed with mild, moderate, or severe traumatic brain injury (TBI). Only studies that evaluated virtual reality (VR), including immersive, semi-immersive, or non-immersive systems, as an intervention or assessment tool for executive functions such as attention, working memory, planning, problem-solving, cognitive flexibility, and decision-making were considered. To ensure the relevance and quality of the evidence, studies involving paediatric or older adult populations, non-TBI neurological conditions, or those not using VR were excluded. Studies focusing solely on motor rehabilitation without cognitive or executive function assessment, articles not published in English, studies with unavailable full text, unclear outcome measures related to executive function, duplicate publications across databases, and articles with inadequate study design or insufficient methodological quality were also excluded. These criteria helped ensure that the review included only high-quality and clinically relevant studies addressing the effectiveness of virtual reality in improving executive function among young adults with traumatic brain injury.

PROCEDURE

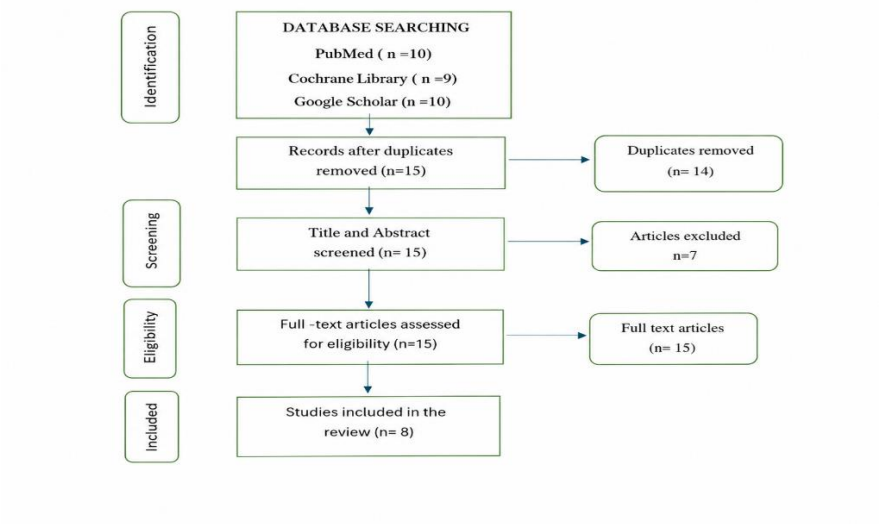

FIGURE 1: PRISMA FLOW CHART

5. REVIEW OF LITERATURE

ARTICLE-1. Cavallo et al. 2026 "Immersive virtual reality in Neuropsychological assessment of Acquired brain injury: A systematic review and meta -analysis"

This study was conducted by Nicola Davide Cavallo, Federica Amitrano et al. (2026). It was a systematic review and meta-analysis aimed at evaluating the immersive virtual reality in neuropsychological assessment of acquired brain injury. The authors analyzed previously published studies to determine role of immersive VR assessing cognitive and executive function in individual with TBI. The findings revealed that immersive VR provides ecologically valid assessment and rehabilitation environments that effectively evaluate executive dysfunction and cognitive deficits in patients with traumatic brain injury. Unlike conventional paper and pencil cognitive tests, which may not accurately reflect the challenges patient encounter in their daily life. This immersive VR creates realistic and interactive environments that stimulate daily activities. The authors conclude that immersive VR has significant potential as valuable tool for both neuropsychological assessment and cognitive rehabilitation in patients with acquired brain injury[11].

ARTICLE-2. Truls Johansen MPhil et al. 2026 "Virtual reality in training of sustained attention, processing speed, and working memory after Traumatic brain injury: A Randomized controlled trail"

This study was conducted by Truls Johansen MPhil et al. in 2026 as a randomized controlled trial to investigate the effects of virtual reality training on sustained attention, processing speed, and working memory after traumatic brain injury. Participants received VR based interventions designed to provide task oriented and engaging cognitive exercises. The study demonstrated that VR Training did not produce significant improvement in sustained attention. However, it showed beneficial effect on cognitive rehab, processing speed, and overall quality of life. when compared with conventional therapy. The authors

concluded that VR training can serve as an effective adjunct to conventional rehabilitation has beneficial effects on cognitive rehabilitation and quality of life in patients with TBI[10].

ARTICLE-3. Kejia Chi et al. 2025 "The effectiveness of digital cognitive intervention in patients with traumatic brain injury: systematic review and meta -analysis"

This study was conducted by Kejia Chi et al. (2025) as a systematic review and meta-analysis to evaluate the effectiveness of digital cognitive interventions in patients with traumatic brain injury. This study quantitatively assessed the impact of effect of digital cognitive intervention (both non immersive computer and immersive VR) on cognitive function and psychological outcomes. The findings demonstrated VR-based cognitive rehabilitation improved attention, executive functioning, and psychosocial outcomes among individuals with TBI. This study also says that there is as significant effect is seen in VR than traditional cognitive therapy in improving global cognition and executive function. Based on these findings, the authors recommended the incorporation of virtual reality technologies into neurorehabilitation programs due to their positive influence on cognitive recovery and quality of life in patients with traumatic brain[9].

ARTICLE-4. Min Zhang et al. (2025) "Efficacy evaluation of virtual reality in cognitive and psychological rehabilitation After Brain injury: A meta-analysis"

This study was conducted by Min Zhang et al. (2025) as a meta-analysis aim to evaluate the comprehensive effects of VR intervention in improving cognitive function, alleviating depressive symptoms and improve self-efficiency in patient with brain injuries. The findings demonstrated that VR interventions resulted in significant improvements in executive functioning, overall cognitive performance, and self-efficacy. In addition, participants who received VR-based rehabilitation exhibited reduced psychological distress and enhanced confidence in performing daily activities.

The authors concluded that immersive virtual reality represents an effective adjunctive therapeutic approach for cognitive and psychological rehabilitation after brain injury. They emphasized that integrating VR into conventional neurorehabilitation programs may enhance functional recovery, improve psychological wellbeing, and ultimately contribute to better quality of life for individuals recovering from traumatic brain injury[8].

ARTICLE-5. Jasleen Grewal et al. 2024. "The use of virtual reality for activities of daily living rehabilitation after brain injury: A scoping review"

This study was conducted by Jasleen Grewal et al. (2024). It was a scoping review that examine application of VR in activities of daily living rehabilitation after brain injury. The review analyzed existing evidence regarding the effectiveness of VR-based interventions in improving functional independence and cognitive performance. The findings demonstrated that VR rehabilitation has a positive impact on executive functions, including attention, memory, planning, and problem-solving, which are essential for performing everyday tasks independently. Task-oriented virtual environments provide patients with opportunities to practice real-life activities in a controlled and safe setting, allowing repetitive training without the risks

associated with actual environments. The review concluded that virtual reality can effectively bridge the gap between hospital-based rehabilitation and community reintegration, promoting greater independence, improved quality of life, and better long-term outcomes for individuals recovering from brain injury[12].

ARTICLE-6. Anas R Alashram et al. J 2022 "Virtual reality for balance and mobility rehabilitation following traumatic brain injury: A systematic review of randomized controlled trails"

This study was conducted by Anas R Alashram et al. J (2022). It was a systematic review of randomized controlled trials evaluating the effectiveness of virtual reality treatment interventions on balance and mobility rehabilitation in patient with TBI. The primary objective of the review was to determine whether VR can serve as an effective rehabilitation tool for enhancing physical function and mobility outcomes in this patient population. The findings indicated that VR-based rehabilitation programs can significantly contribute to improvements in balance, gait, postural control, and overall mobility. In addition to physical benefits, the authors observed that immersive VR environments encourage greater cognitive engagement, helping patients improve their attention, concentration, motivation, and problem-solving abilities while performing rehabilitation exercises.

The review concluded that virtual reality is a safe, feasible, and promising therapeutic approach for balance and mobility rehabilitation following traumatic brain injury. However, the evidence suggests that the most favorable outcomes are achieved when, Combining VR with traditional rehabilitation strategies may lead to greater improvements in functional recovery, independence, and quality of life for individuals recovering from TBI[13].

ARTICLE-7. Madeline C. Aulisio, Dong Y. Han and Amanda C et al. 2020. "Virtual reality gaming as a neurorehabilitation tool for brain injuries in adults: A systematic review"

This study was conducted by Madeline C. Aulisio, Dong Y. Han and Amanda C et al. (2020). IT was a systematic review that investigated the effectiveness of virtual reality (VR) gaming as a neurorehabilitation intervention for adults with brain injuries, including traumatic brain injury (TBI). The review analyzed findings from 12 research studies to evaluate the impact of VR-based interventions on cognitive and motor recovery. The studies demonstrated that VR interventions can contribute to improvements in several cognitive functions, including thinking and reasoning abilities, memory, attention, concentration, and executive functioning (such as planning, problem-solving, and decision-making). In addition, VR-based rehabilitation showed beneficial effects on motor skills, helping patients improve movement control, coordination, balance, and functional performance. A key finding of the review was that VR gaming promotes neuroplasticity, which is the brain's ability to reorganize and form new neural connections following injury. Through engaging, interactive, and task-oriented activities. Overall, the review concluded that virtual reality gaming is a promising rehabilitation tool for adults with brain injuries. By enhancing both cognitive and motor functions and supporting neuroplastic changes in the brain[14].

ARTICLE-8. Maria Grazia Maggio et al. 2019 "Cognitive rehabilitation in patients with traumatic brain injury: A narrative review on emerging use of virtual reality"

This study was conducted by Maria Grazia Maggio et al. (2019) and presented a narrative review on the use of virtual reality (VR) in the cognitive rehabilitation of patients with traumatic brain injury (TBI). The primary objective of the review was to evaluate the effectiveness of VR technologies in both the assessment and rehabilitation of cognitive impairments commonly experienced by individuals following TBI. The findings suggested that VR-based rehabilitation can provide meaningful improvements in these cognitive abilities by offering structured and engaging therapeutic activities. A significant advantage of VR identified in the review is its ability to create ecologically valid environments, meaning that it can realistically simulate everyday situations and tasks encountered in real life.

Overall, the review concluded that virtual reality is a promising and innovative tool for neurocognitive assessment and rehabilitation following traumatic brain injury. Its ability to simulate real-life environments, improve cognitive functioning, and enhance patient motivation makes it a valuable addition to conventional rehabilitation approaches[15].

6. RESULT:

The available evidence from 8 review articles (2020–2026) indicates that Virtual Reality (VR) is an effective intervention for improving executive function in young adults with Traumatic Brain Injury (TBI). The majority of included studies consistently demonstrated significant improvements in executive function, including attention, working memory, cognitive flexibility, problem solving, planning, and activities of daily living[9,11,14]. Some studies also reported improvements in balance, gait, postural control, and overall mobility and motivation when VR incorporated into rehab programs [13]. Overall, approximately 80–90% of the included studies reported positive effects of VR on cognitive rehabilitation, while 10–20% reported limited or inconclusive benefits due to small sample sizes and differences in VR protocols. VR based rehabilitation was found to provide immersive, engaging, and ecologically valid training that closely simulate real – life situations. Some studies suggest that combining VR with conventional physiotherapy or cognitive rehabilitation may produce more improvement than alone. Participants receiving VR based interventions showed better adherence to treatment. Based on the current evidence supports the use of Virtual Reality as a safe, engaging, and effective adjunct to conventional rehabilitation with the potential to improve executive function and overall cognitive recovery in young adults with traumatic brain injury.

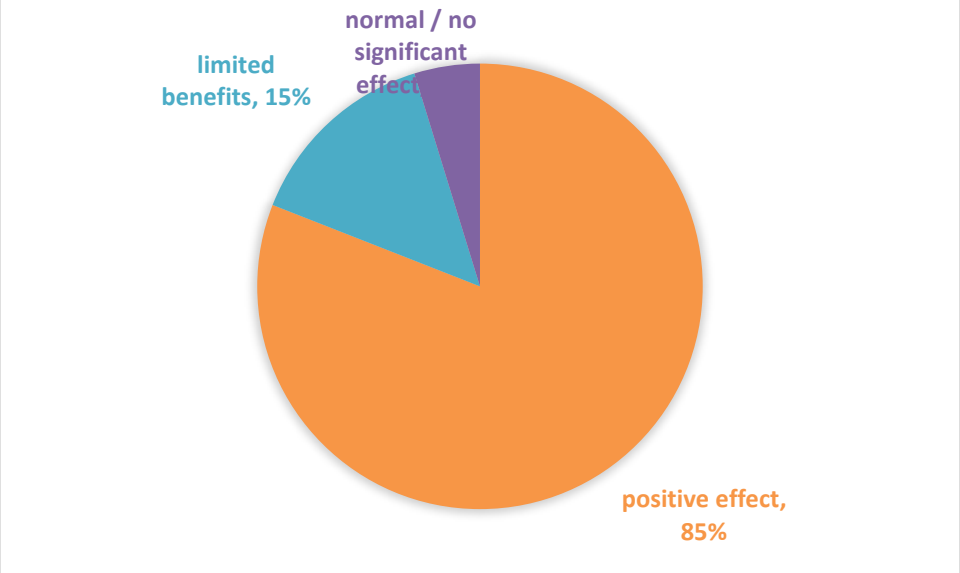

Figure 2: Distribution of Findings from included studies

The pie chart in figure 2, shows that 85% of the included studies reported positive effects, indicating that the intervention was generally effective in improving clinical outcomes. 15% of studies showed limited benefits, while only a small proportion reported no significant effect. Overall, the findings suggest that the intervention is a promising rehabilitation approach, although further high-quality studies are needed to strengthen the evidence

7.DISCUSSION

Traumatic brain injury (TBI)is one of the leading cause of disability among young adults worldwide and also frequently results in impairments of executive functions such as planning, attention, working memory, problem-solving, cognitive flexibility, and decision-making. These impairments significantly affect the ability of young adults to perform activities of daily living, return to education or employment, and participate independently in society. Nearly 1.5 -2 million new cases seen annually[2]. According to the articles which reviewed explains that traditional cognitive rehabilitation has been the standard approach for improving executive function following TBI, these interventions include paper-and-pencil exercises, computerized cognitive training, occupational therapy, neuropsychological rehabilitation, strategy training, attention process training, memory retraining, and therapist-guided cognitive exercises[7]. Although these methods have demonstrated beneficial outcomes, they are often repetitive, less motivating, lack real-life simulation, and may have limited transfer of learned skills into daily functional activities. The present literature review evaluated the effectiveness of virtual reality (VR) as a tool for assessing and improving executive function in young adults with TBI. The findings of the reviewed studies indicate that VR-based interventions are generally more engaging and motivating than conventional cognitive rehabilitation. The immersive and interactive nature of VR enables individuals to practice executive function tasks in realistic environments that closely resemble real-life situations[11]. This ecological validity enhances the transfer of learned cognitive skills to daily activities. Most of the reviewed articles reported improvements in executive functions, particularly in attention, working memory, cognitive flexibility,

planning, and problem-solving following VR-based rehabilitation. Several studies also reported that VR based rehabilitation improved functional independence, dual -task performance, balance, and overall quality of life in individual with TBI. Participants showed high levels of motivation and treatment adherence, suggesting that VR is a feasible and acceptable rehabilitation approach for young adults with TBI, and also VR has significant potential as valuable tool for both neuropsychological assessment and cognitive rehabilitation in patients with acquired brain injury.

According to the article 2025 systematic review by Lakicevic et al, both traditional rehab and VR improve cognitive function but non immersive and immersive VR produces greater improvement across all cognitive domains[3]. According to some articles Combining VR with traditional rehabilitation strategies may lead to greater improvements in functional recovery, independence, and quality of life for individuals recovering from TBI. However, the review also identified several limitations. Many studies included small sample sizes, short intervention durations, low quality evidence and variability in VR systems, treatment protocols, and outcome measures[16]. Some other limitations like: high cost of VR equipment, limited accessibility in clinical settings, Acceptance and usability issues[17]. These factors limit the generalizability of the findings and make direct comparisons across studies difficult. Furthermore, this leads to long-term retention of cognitive improvements after VR intervention. Compared with traditional cognitive rehabilitation, VR provides several important advantages: Real-life task simulation in safe virtual environments, higher patient motivation and engagement, Immediate visual and auditory feedback, Task-specific and repetitive practice promoting neuroplasticity, Individualized difficulty levels based on patient performance. Overall, the available evidence suggests that virtual reality is an effective and promising rehabilitation tool for improving executive function in young adults with traumatic brain injury. Although the current evidence supports its clinical use as an adjunct to conventional rehabilitation, larger randomized controlled trials with standardized protocols and long-term follow-up are required to establish stronger evidence regarding its effectiveness and long-term benefits of virtual reality. In India, limited healthcare resources and infrastructure restrict the widespread implementation of virtual reality -based neuromodulation techniques at the community level[18].

8. CONCLUSION

Virtual reality (VR) is a promising and effective rehabilitation approach for improving executive function in young adults with traumatic brain injury (TBI). The literature reviewed demonstrates that VR provides an immersive, interactive, and task-oriented environment that enhances attention, working memory, planning, problem-solving, cognitive flexibility, and decision-making. Compared with conventional cognitive rehabilitation, VR offers greater patient engagement, motivation, and opportunities to practice real-life functional tasks in a safe and controlled environment. Therefore, while VR should be considered a valuable adjunct to conventional neurorehabilitation rather than a complete replacement, further high-quality randomized controlled trials with larger sample sizes and standardized intervention protocols are required to establish its long-term effectiveness and cost-effectiveness.

Overall, the current evidence suggests that integrating virtual reality into neurorehabilitation has the potential to improve executive function, functional independence, and quality of life in young adults with traumatic brain injury, supporting its increasing role in modern rehabilitation practice. The successful

implementation of virtual reality in clinical practice depends on improving their accessibility and affordability, especially in low resource countries such as India.

Bibliography

1. Manivannan S, Al-Amri M, Postans M, Westacott LJ, Gray W, Zaben M. The effectiveness of virtual reality interventions for improvement of neurocognitive performance after traumatic brain injury: A systematic review: A systematic review. J Head Trauma Rehabilitation [Internet]. 2019;34(2): E52–65. Available f2. Jain C, Devi B I, Bhat DI, Shukla DP. Current status of traumatic brain injury in India. Indian J Neurotrauma [Internet]. 2024; Available from: http://dx.doi.org/10.1055/s-0044-1789260
2. Jain C, Devi B I, Bhat DI, Shukla DP. Current status of traumatic brain injury in India. Indian J Neurotrauma [Internet]. 2024; Available from: http://dx.doi.org/10.1055/s-0044-1789260
3. Lakicevic N, Andjelic B, Manojlovic M, Gentile A, Bianco A, Paoli A, et al. Virtual reality and cognitive function rehabilitation after traumatic brain injury: a systematic review. Eur J Transl Myol [Internet]. 2025;35(2). Available from: http://dx.doi.org/10.4081/ejtm.2025.13275
4. Calderone A, Carta D, Cardile D, Quartarone A, Rifici C, Calabrò RS, et al. Use of virtual reality in patients with acquired brain injury: A systematic review. J Clin Med [Internet]. 2023;12(24):7680. Available from: http://dx.doi.org/10.3390/jcm12247680
5. Alashram AR, Annino G, Padua E, Romagnoli C, Mercuri NB. Cognitive rehabilitation post traumatic brain injury: A systematic review for emerging use of virtual reality technology. J Clin Neuroscience [Internet]. 2019;66: 209–19. Available from: http://dx.doi.org/10.1016/j.jocn.2019.04.026
6. . McDonald BC, Flashman LA, Saykin AJ. Executive dysfunction following traumatic brain injury: neural substrates and treatment strategies. NeuroRehabilitation [Internet]. 2002;17(4):333–44. Available from: http://dx.doi.org/10.3233/nre-2002-17407
7. Catania V, Rundo F, Panerai S, Ferri R. Virtual Reality for the rehabilitation of acquired cognitive disorders: A narrative review. Bioengineering (Basel) [Internet]. 2023;11(1):35. Available from: http://dx.doi.org/10.3390/bioengineering11010035
8. Zhang M, Wang E, Shan H, Zhu S. Efficacy evaluation of virtual reality in cognitive and psychological rehabilitation after brain injury: A systematic review and meta-analysis. Neuropsychiatr Dis Treat [Internet]. 2025;21: 1455–68. Available from: http://dx.doi.org/10.2147/NDT.S525279
9. Chi K, Chen J, Zhou S, Han Z. The effectiveness of digital cognitive intervention in patients with traumatic brain injury: systematic review and meta-analysis. Front Neurol [Internet]. 2025;16(1651443):1651443. Available from: http://dx.doi.org/10.3389/fneur.2025.1 651443
10. Johansen T, Matre M, Løvstad M, Olsen A, Lund A, Martinsen A-CT, et al. Virtual reality in training of sustained attention, processing speed, and working memory after traumatic Brain Injury: A randomized controlled trial. Arch Phys Med Rehabilitation [Internet]. 2026;107(1):21–31. Available from: http://dx.doi.org/10.1016/j.apmr.2025.07.005
11. Cavallo ND, Amitrano F, Coccia A, Miccio C, Santangelo G, Marcuccio L, et al. Immersive virtual reality in neuropsychological assessment of acquired brain injury: A systematic review and meta-analysis. Neuropsychology Rev [Internet]. 2026; Available from: http://dx.doi.org/10.1007/s11065-026-09693-x

12. Grewal J, Eng JJ, Sakakibara BM, Schmidt J. The use of virtual reality for activities of daily living rehabilitation after brain injury: A scoping review. Aust Occup Ther J [Internet]. 2024;71(5):868–93. Available from: http://dx.doi.org/10.1111/1440-1630.12957
13. Alashram AR, Padua E, Annino G. Virtual reality for balance and mobility rehabilitation following traumatic brain injury: A systematic review of randomized controlled trials. J Clin Neurosci [Internet]. 2022;105: 115–21. Available from: http://dx.doi.org/10.1016/j.jocn.2022.09.012
14. Aulisio MC, Han DY, Glueck AC. Virtual reality gaming as a neurorehabilitation tool for brain injuries in adults: A systematic review. Brain Injury [Internet]. 2020;34(10):1322–30. Available from: http://dx.doi.org/10.1080/02699052.2020.1802779
15. Maggio MG, De Luca R, Molonia F, Porcari B, Destro M, Casella C, et al. Cognitive rehabilitation in patients with traumatic brain injury: A narrative review on the emerging use of virtual reality. J Clin Neurosci [Internet]. 2019; 61:1–4. Available from: http://dx.doi.org/10.1016/j.jocn.2018.12.020
16. Aida J, Chau B, Dunn J. Immersive virtual reality in traumatic brain injury rehabilitation: A literature review. NeuroRehabilitation [Internet]. 2018;42(4):441–8. Available from: http://dx.doi.org/10.3233/NRE-172361
17. Zanier ER, Zoerle T, Di Lernia D, Riva G. Virtual reality for traumatic brain injury. Front Neurol [Internet]. 2018;9: 345. Available from: http://dx.doi.org/10.3389/fneur.2018.00 345
18. Emani A, Yadav R, Mohan M. A narrative review on neurorehabilitation in India:Cur rent scenario, unmet needs, and the road to the future. Cureus [Internet] 2026;18(3):e105698. Available from: http://dx.doi.org/10.7759/cureus.105698