Educational Administration: Theory and Practice
2024, 30(4), 9684 - 9691
ISSN: 2148-2403
https://kuey.net/

Research Article

Current Physiotherapy Interventions For Higher Mental Function In Traumatic Brain Injury: Systematic Review

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Citation: Dr Suraj B. Kanaseet.al (2024), Current Physiotherapy Interventions For Higher Mental Function In Traumatic Brain Injury: Systematic Review, Educational *Administration: Theory and Practice, 30(4), 9684 - 9691*
Doi: 10.53555/kuey.v30i4.4839

ARTICLE INFO

ABSTRACT

Cognitive disability is usually a result of post-traumatic brain injury and can have significant impacts on an individual's quality of life. This systematic review targets evaluating the current physiotherapy interventions for cognitive recovery in individuals with post-TBI cognitive impairment. The review includes a comprehensive analysis of relevant studies to identify the efficacy of different cognitive rehabilitation strategies. The selected studies encompass a variety of cognitive abilities, such as memory and attention, executive function language, and visoperceptual ability. The review also considers the interrelated and interconnected nature of cognitive impairments in post-TBI individuals. The identified interventions were Combined Compensatory cognitive training, Plasticity based cognitive training in TBI, CogSMART Therapy, Advanced Therapy for Executive Dysfunction After Traumatic Brain Injury, Transcranial Direct Current Stimulation, evaluated for their effectiveness in improving cognitive ability and everyday functioning in the long term. The reason for this evaluation is to find the current physiotherapy for cognitive recovery in post-TBI patients. Articles were included on the inclusion criteria of topics and underwent the selection process. The reviewed research gives proof that physiotherapy interventions are highly useful in the treatment of cognitive recovery in post-TBI patients. This review provides valuable insights into the efficacy of physiotherapy interventions and guides the development of scientific exercise guidelines for cognitive rehabilitation in post-TBI individuals.

Keywords: Post-Traumatic Brain Injuries, Cognition Recovery, Cognitive Rehabilitation, Evidence-Based Medicine.

Introduction:

Traumatic brain injury (TBI) is a growing health problem among people and is a main reason for morbidity and death in India. Millions of people throughout the whole globe face TBI each year. Traumatic brain injury (TBI) will become the main cause of death and disability by 2020, according to the record of the World Health Organization. About 10 million people are affected by TBI each year, and the resulting death and illness make TBI a public health emergency and medical problem. [1,2] Alcohol is known to play a role in 15-20% of TBIs at the time of incidence. The medical needs of the mentally ill are high and increasing every year. India and other growing international countries face more challenges in prevention, pre-healthcare centres and rehabilitation centres to reduce the load of brain injury in a rapidly changing environment. [3, 4] TBI rate is increasing rapidly as India continues to urbanize. Data from an epidemiological study in Bangalore showed morbidity, mortality and case-fatality rates of 150/100,000, 20/100,000 and 10% respectively. About 2 million individuals are affected by brain injury and about 1 million of these require national medical services. [5] Cognitive skills are the mainstay of treatment for TBI-related cognitive impairment. Cognitive rehabilitation usually focuses on compensatory strategies that improve cognitive dysfunction. Rehabilitation

experience is also beneficial in terms of re-education. There is some growing evidence about the potential of cognitive rehabilitation to improve cognitive function. Few reviews of cognitive rehabilitation for TBI have been published. However, as mentioned above, no problems or issues have been reported yet. [6] Cognitive rehabilitation is a set of treatments and therapies using techniques to enhance cognitive abilities after traumatic brain injury. While interventions can be widely used in neurological diseases, their development and use is focused on people with brain injury. These interventions are the result of rehabilitation efforts focused on identifying areas of damage and implementing strategies to address these deficiencies to get people back to their work. Focusing on the individual's integration into community and family life remains an important part of recovery. Rehabilitation programs may focus on individual skills such as speech therapy for aphasia, but are often offered in a rehabilitation program that focuses on the cognitive, neurobehavioral, and physical needs of individuals with TBI. Evidence-based reviews often support rehabilitation programs that include community participation, cognitive impairment, behavioural and emotional, physical and social, and group interactions that support effective communication. Regarding specific interventions based on clinical discipline, evidence supports the treatment of traumatic brain injury patients and, to a greater extent, treatment of non-communicable diseases, forgetfulness, aphasia, and communication deficits, along with unilateral spatial neglect. The challenges inherent in this review included the heterogeneity of patients and lesions, large differences in pre-disease activity levels, small sample sizes, and differences in access to treatment and the level of social support involved [7,8]

What is Cognitive Rehabilitation ?

Cognitive Rehabilitation is a functional cognitive intervention designed to improve cognitive function. After a complete neuropsychological assessment of the patient's cognitive strengths and weaknesses, interventions are made to reconstruct or strengthen previous skills, establish strategies to compensate for cognitive impairment, or help to avoid mental illness. [9] Regardless of the specific intervention, the ultimate aim of cognitive impairment rehab is to promote functional improvement and prevent permanent cognitive impairment, with quality of daily work and life. Recovering knowledge is often multifaceted, but each item encourages improvement in specific skills or abilities. Programs targeting listening, language and communication, memory, visuospatial processing and executive dysfunction in TBI patients should be examined. The literature on cognitive enhancement is complex and clinical trials are difficult to interpret. [10]

How is cognitive impairment diagnosed?

To determine if a person has a mental disorder, doctors may ask questions that test memory, thinking, and understanding. History from the patient and family/friends should focus on changes in cognitive functions (onset, course, and pattern), changes in functioning - self-care (cooking, examination, hygiene, money), physical symptoms (such as nausea), Vomiting, blurred vision, hearing, Speech, speech, Gait, sensory and motor balance, psychological symptoms (mood changes, behaviour and behaviour changes) current medications (if any) various tests used by patients, families and physicians to assess the patient's cognitive ability. Screening is performed to identify patients suitable for full evaluation. Doctors often assess a patient's mental state with short tests. Mini-Mental Status Exam (MMSE). The MMSE is primarily used to evaluate patients with Alzheimer's disease as it focuses on measuring memory. The most commonly used tools by primary care physicians are the Cognitive Disorder Assessment (MIS) Montreal Rating Scale (MoCA), Mini-Cog Memory and Executive Screen (MES) [11, 12]

Methods:

A comprehensive search was conducted in various databases, including GOOGLE SCOLAR, MEDLINE, REASEARCHGATE, EMBASE, CENTRAL, PsycINFO, CINAHL, PubMed, and clinical trial registries. The search includes suitable randomized clinical trials with no restrictions on publication date or language. With criteria included patients older 18 or over with TBI and exhibiting cognitive impairment. Only RCT's were compared with cognitive rehabilitation intervention with other interventions taken into consideration. The primary outcome was any clinical changes in general or specific cognitive domains, such as executive function, attention, memory, or perception. Second, outcomes include adverse effects (e.g., stroke, disability, or mortality) and quality of life. Two independent reviewers assessed the articles, to identify eligible trials, extract data, and calculate the risk of bias. Discrepancies were resolved by discussion and a third reviewer was engaged to synthesize the data.

METHODOLOGY

Search Strategy

We conducted this systematic review for current physiotherapy interventions in cognitive recovery in post TBI individuals. Main purpose behind this review is an internet search for relevant recent studies was done using Google scholar, PubMed central, Pedro, research gate and CINHAL database from 2013 to March 2023 was done where in Mesh search terms such ascognitive rehabilitation in traumatic brain injury individuals,

cognitive assessment tools, physiotherapy interventions in post TBI, Index quality of life, recent advances and free words were used. In addition to this, relevant books were also searched manually. Articles were chosen based on the expertise, self-awareness, and reflective practice.

Study Selection

The selection criteria of review were:

- Cognitive impairments in Post TBI
- Mild-Moderate-Severe TBI injury
- Interventions in Cognitive Recovery

Data Extraction

All steps in selecting the studies were assessed for the inclusion criteria. The titles and abstract of the studies were reviewed by reviewers. Full text of related articles were reviewed and included if they met inclusion criteria. The data were conducted from related articles: study design, study population, physiotherapy interventions,physical impact, selected outcome measures, and key findings.

RESULT

The searches recognized seven relevant studies which met the criteria for inclusion in further analysis. These studies suggest beneficial results of physiotherapy interventions in cognitive recovery in post-traumatic brain injury patients. Studies show that physiotherapy interventions have effectiveness in attention, executive function, memory along with language and visoperceptual ability. It helps in restoring cognitive function and everyday functioning in the long term with quality of life. In Cognitive and vocational rehabilitation after mild to moderate traumatic brain injury: A randomized controlled trial by Silje C.R. Fure a, b, Emilie Isager Howe and others. In this study, they compared a 6-month combined compensatory cognitive training and supported employment (CCT-SE) intervention with 6 months of treatment as usual (TAU). This RCT was to examine the effects on RTW, percentage of work, hours on time. Worked every week and stability of work. Eligible patients were 50% with mild-to-moderate TBI at the time of incidence, 18 to 60 years of age, and 50% sick-listed 8 to 12 weeks after incidence of TBI, due to post-concussive symptoms, as checked by the River Mead Post-concussion Symptomsnaire was done. Both treatments were provided at the outpatient TBI department of Oslo University Hospital and follow-ups were conducted at 3, 6, and 12 months after consideration. We included 116 people, 60 randomized to CCT-SE and 56 to TAU. Groups did not match in characteristics at the 12-month follow-up. Overall, a high proportion had returned to work in 12 months (CCT-SE, 90%; TAU, 84%, P = 0.40), and all but 3 were stably employed after RTW. However, a significantly higher proportion of participants in the CCT-SE than the TAU group had returned to stable employment at 3 months (81% vs. 60%, P = 0.02). [13]

A randomized clinical trial of plasticity based cognitive training in mild traumatic brain injury by Henry W. Mahncke, Joseph DeGutis and others considered a randomized double-blind clinical trial of a behavioural intervention with active control was included from September 2013 to February 2017, including assessments at standard, post-training, and after a 3-month follow-up period. Members were self-administered in the cognitive training experimental and active control programmes at home, remotely controlled by a healthcare coach, with an intended training schedule of 5 days per week, 1h per day, for 13 weeks. 149 participants contacted, 83 intent-to-treat were confirmed to have a history of mild TBI (mean of 7.2 years post-injury) through medical history/clinician interview and persistent cognitive disability through special test or quantitative participant reported measure. The test mediation was a brain plasticity-based computerized cognitive training program focusing on speed/accuracy of data preparation, and the dynamic control was composed of computer games. The primary cognitive function measure was a composite of nine standardized neuropsychological assessments, and the primary directly observed functional measure was timed activities of daily living assessment. Secondary outcome measures included contributors-reported assessments of cognitive functions and mental health. The treatment group presented an improvement in the composite cognitive measure significantly larger than that of the active control group in both the post-training [+6.9 points, confidence interval (CI) +1.0 to +12.7, P = 0.025, d = 0.555] and the follow-up visit (+7.4 points, CI +0.6 to +14.3, P = 0.039, d = 0.591). Minor and major cognitive function improvements were seen twice as frequently in the treatment group than in the active control group. None of adverse effects were recorded on other measures, including the directly-observed functional and symptom measures. Statistically comparable improvements in both groups were seen in depressive and cognitive symptoms.[14]Cognitive Symptoms and Their Management and Rehabilitation Therapy for Veterans with TBI, A Pilot randomized controlled trial was discussed by Elizabeth W. Twamley, PhD;1–2 Amy J. Jak, PhD;1–3 Dean C. Delis, PhD and others in this article 50 Veterans received treatment in healthcare centre at the VA SAN DIEGO and joined in the research study with permission on written informed consent form with prior to study participation. Inclusion criteria were 1. OIF/OEF Veteran, 2. Previous history of any type of TBI (loss of consciousness [LOC]<6 h; posttraumatic amnesia <7 d) by the Guidelines for Clinical Practice were studied in a clinical neuropsychological testing and by an interview they had seen impairment in any one of neuropsychological

domain such as attention, processing speed, learning, memory, working memory, executive functioning as underpinned by special clinical neurological testing by a VA or DOD neuropsychologist by the use of one effort test (e.g. Test of Memory Malingering, California Verbal Learning Test-2nd edition [CVLT-II] and with no employment but outlining a task's objective. Veterans with inclusion criteria for current alcohol/drug abuse dependency or participation were not included in other intervention studies. Eight participants gave up. Four of Fivefive were lost to follow-up, one moved, and each group decided not to work. Data in available following treatment for 34 participants in 12 weeks in supported employment plus CogSMART with moderate TBI and 18 in higher supported employment with moderate TBI. The 34 participants with complete baseline and data from the post-treatment period showed no changes in age, gender, degree of education, race, ethnicity, premorbid intelligence quotient (IQ), length of LOC during their worst TBI, or length of total LOC summed across up to four TBIs (all $p > 0.13$) from the 16 participants with no 3 months of assessment. On average, the 34 people with full data were 32 yr. old, had 13.6 yr. of education, were 94 percent male, and were 76 percent participants of a minority race or ethnicity group, 76 percent met with eligibility for edge PTSD. For the worst TBI, the median length of LOC was 1.5 minutes and 82 percent of these injuries were contact TBIs vs. blast only; the median length of total LOCs added across up to four TBIs was 1.7 min. Race, ethnicity, sex, post-psychiatric symptom severity did not alter the treatment groups, presence of mild or greater depressive symptoms, presence of threshold PTSD, TBI severity (length of LOC in the TBI and summed across up to 4 TBIs), years from their most recent TBI, nature of their worst TBI (contact vs. blast only), or years since their worst TBI (all $p \geq 0.06$). The group that met with supported employment plus CogSMART, however, was about 5 yrs younger on average than the group that met with improved employment support. ($p = 0.05$).[15]Evaluation of the Short-Term Executive Plus Intervention for Executive Dysfunction After TBI was discussed by Joshua Cantor, PhD, and Teresa Ashman, PhD, in this study of members with TBI and executive dysfunction (NZ98; TBI severity 50% moderate/severe; mean time since injury _ SD, 12_14y; mean age _ SD, 45_14y; 62% women; 76% white).STEP program: 12 weeks (9h/week) of group training in problem-solving and emotional guidelines and individual sessions of attention and compensatory strategy training. Intention-to-treat mixed-effects evaluates demonstrated notable treatment outcomes for the composite executive function measure (PZ.008) and the Frontal Systems Behaviour Scale (PZ.049) and Problem-Solving Inventory (PZ.016). We found no between-group differences on the neuropsychological measures or on measures of attention, emotional regulation, self-awareness, affective distress, self-confidence, participation, or quality of life.[16]

Trans cranial Direct Current Stimulation of the Left Prefrontal Cortex Improves Attention in Patients with Traumatic Brain Injury was A Pilot Study discussed by Eun-Kyoung Kang, MD, PhD1, Dae-Yul Kim, MD in this study Patients undergo through a computerized contrast reaction time task before and after the application of real trans cranial direct current stimulation (2 mA for 20 min) or sham trans cranial direct current stimulation (2 mA for 1 min) to the left dorsolateral prefrontal cortex in a doubleblind, crossover method. Results showed that Immediately post-stimulation, the trans cranial direct current stimulation group showed a tendency ofshortened reaction time relative to baseline (87.3 ± 7.8%), whereas the sham stimulation group (122.4 ± 715.5%) did not ($p = 0.056$). There were no notable differencesfound between 3hr or 24hr stimulation ($p > 0.05$). The numbers of accurate responses were not changed at any time after stimulation.[17]Combined cognitive and vocational interventions after mild to moderate TBI,discussed by Emilie I. Howe, Knut-Petter S. Langlo, In this research studyprotocol defines an innovative randomized controlled trial in which there is a discovery of the result of combining cognitive rehabilitation (Compensatory Cognitive Training [CCT]) and supported employment (SE) on RTW and associated results for individuals withmild to moderate TBI in real-life viable work settings. The studydirected in the southeastern region of Norway and thereby be implemented within the Norwegian welfare system. Patients aged 18–60 years with TBI patients who are employed in a minimum 50% position at the time of incidence and sick-listed 50% or more for postconcussive symptomsinclude data from two months after the injury.A comprehensive assessment of neurocognitive functions, self-reported symptoms, emotional distress, coping style, and quality of life was performed at its standard and immediately after CCT (3 months after inclusion),following the 6 months after inclusion and 12 months along with study inclusion. The main outcome measures were the proportion of participants who have returned to work at 12-month follow-up and length of time until RTW, in calculation to work stability, work productivity over the first year following the intervention. Another outcomes include changes in self-reported symptoms, emotional and cognitive function, and QOL. Additionally, a qualitative RTW process evaluation focused on structural challenges at the workshop were performed.[18]Comprehensive cognitive training improves attention and memory in patients with severe or moderate traumatic brain injury discussed by Marcin M. Le_sniaka, SzczepanIwa_nskibthis study aimed to evaluate the results of a cognitive rehabilitation program, involving of participants andgroup treatments on memory and attention in TBI patients.Following mild to severe traumatic brain injury, fifteen patients in the post-acute stage of recovery were placed on a 3 week on observation list and did participationin a three-week cognitive training rehabilitation program.Five neuropsychological tests measuring memory and attention were used to examine the patients.Inquiries were made of the patients and their caregivers in order to look for any slight variations in the way their daily lives were going about things.The presentation of cognitive training was related with improvement in one memory test and in two measures of attention. Mean effect size across all tests was much over the time with treatment compared to

the time without (d¼0.36 vs. 0.03). Both participants and caretakersinformed higher improvements in daily routine (p < .05).[19]

Discussion

Post-traumatic brain injury (TBI) individuals often experience cognitive impairments that can greatly affect their quality of life. Cognitive rehabilitation interventions aim to improve cognitive functioning and promote recovery in these individuals. This systematic review was supervised to investigate theefficacy of various cognitive rehabilitation techniques for cognitive impairment following traumatic brain injury. The review aimed to provide valuable insights for clinical decision-making and the development of clinical practice guidelines.

The findings of this systematic review including study According to Silje C.R. Fure, Emilie Isager Howe, Nada Andelic. The research report, Analysis of Cognitive Skills and Functional Recovery Following Traumatic Brain Injury demonstratesthat by combining the skill and work can improve early back to work in participants with mild to moderate traumatic brain injurywith stablemindset. To help patients back to pre-injury work levels, rapid RTW stabilization can also reduce the costs associated with lost jobafter mild to moderate TBI. (13) Henry W.Mahncke and Joseph DeGutis reviewed computer-based learning-based experiments on brain flexibility, target speed/accuracy of information processing, control, including computer games. The main measure of cognitive function is a combination of nine neuropsychological tests, and the first measure of direct assessment of function is the duration of the main function of the test live each day. Secondary outcome measures included participant-reported cognitive and mental health outcomes. [14]

(CogSMART) Therapy for Veterans with Traumatic Brain Injury (CogSMART) Elizabeth W. Twamley, Ph.D. and Amy J. Jak, Ph.D. Based on research by CogSMART, it is a 12-week intervention designed to bring about improvement in post-traumatic symptoms (including sleep, anxiety, fatigue, headaches, and irritability) and cognition in the areas of prospective memory, attention, learning and memory, and performance. They determined that CogSMART could improve post-injury symptoms and future prospects. According to veterans, psych education about TBI and post-injury symptoms appears beneficial, as well as education in compensatory strategies. [15] A review of Dr Joshua Cantor and Dr Teresa Ashman's executive summary on interventions for limitations to illness following traumatic brain injury reveals some important implications of this research. The results support the application of interventions to improve functional deficits being the most common adverse effects of TBI. [16]According to this study by Eun-Kyoung Kang, MD, PhD andDae-Yul Kim, MD, trans cranial direct current stimulation of the left prefrontal cortex enhances emotional intelligence in patients with brain damage. Patients with TBI showed increased attention compared to sham stimulation, indicating the potential of this intervention to improve attention during the cognitive process after exposure to mental illness. [17] Cognition and functional integration after mild to moderate brain injury according to Emilie I. Howe, Knut-Petter S. Langlo, In addition to job stability and job satisfaction, the percentage of respondents who returned to work 12 months after intervention and time since RTW were measured. Secondary outcomes included changes in self-reported symptoms, emotional and cognitive functioning, and quality of life. [18]According to Marcin M. Le_sniaka, SzczepanIwa_nskib, cognitive training can improve focus and memory in patients with severe or moderate brain injury A report on remedial therapy, which includes individual and group therapy, can improve attention and memory in patients with moderate brain damage. [19]

Conclusion

Progression has been made in recent years in processes but less research were conducted on cognitive impairments after traumatic brain injury, such as Cognitive and vocational rehabilitation, compensatory cognitive training (CCT) and supported Employment, Direct electric magnetic stimulation, Evaluation of the Short-Term Executive Plus Intervention for Executive Dysfunction, Comprehensive cognitive training.There are numerousunusedinnovationsaccessible to address TBI and recognition-related questions. Integration of the various techniques will facilitate our comprehending of TBI, cognitive function and social function, and improve treatment and rehabilitation efforts. In a developing country like India, focus should be directed toward rehabilitation interventions that are not only effective and easily applicable but are also low cost. Increasing public awareness and attention will take to further new innovations and research opportunities with better advocacy.

ACKNOWLEDGEMENT: The Authors would like to thank our colleagues from the Department of Neuroscience of Krishna College of Physiotherapy.

Table: Summary of review of literature.

STUDY	AUTHOR	INTERVENTION	OUTCOME MEASUREMENT
Cognitive and vocational rehabilitation after mild-to-moderate traumatic brain injury	Silje C.R. Furea,b, Emilie Isager Howe a,c Nada Andelica,b	compensatory cognitive training (CCT) and supported employment (SE [24]). CCT is a 10-week, group-based, manualized intervention with weekly treatment of 2 hr given by a clinician psychologist and a physician.	6 months of treatment as usual (TAU) in a randomised controlled trial to investigatethe impact on work stability, hours worked per week, work percentage, and time to RTW.
A randomized clinical trial of plasticity based cognitive training in mild TBI.	Henry W. Mahncke, Joseph DeGutis	brain plasticity-based computerized cognitive training programme targeting speed/accuracy of information processing, and the active control was composed of computer games.	Rey Auditory Verbal Learning Test delayed recall, Ruff Light Trails Test Digit Span (WAIS,56 sum of forwards, backwards, sequencing), Symbol Span (WMS57) anti-saccades, flanker, and set-shifting.
Cognitive Symptom Management and Rehabilitation Therapy (Cog SMART) for Veterans with TBI	Elizabeth W. Twamley, PhD, Amy J. Jak, PhD	CogSMART intervention to improve postconcussive symptoms (e.g., sleep disturbance, fatigue, headaches, and tension) and cognition in the domains of prospective memory, attention, learning and memory, and executive functioning.	Premorbid IQ was estimated with the Wide Range Achievement Test-3rd edition (WRAT-3) Reading test, Memory for Intentions Screening Test (MIST) Wechsler Adult Intelligence Scale-3rd Edition [36] Digit Span scaled score, Verbal learning and memory were measured with the CVLT-II Delis-Kaplan Executive Function System (D-KEFS) Verbal Fluency test.
Evaluation of the Short-Term Executive Plus Intervention for Executive Dysfunction After TBI.	Joshua Cantor, PhD,Teresa Ashman, PhD	STEP program: 12 weeks (9h/wk) of group training in problem solving and emotional regulation and personaltreatment sessions of attention and compensatory strategies training.	Executive function measure using the Problem Solving Inventory, Frontal Systems Behavior Scale, Behavioral Assessment of the Dysexecutive Syndrome, and Self-Awareness ofThe Difficulties in Emotion Regulation Scale was used to measure emotional regulation. The primary attention measure was the Attention Rating andMonitoring Scale. Secondary measures included.Neuropsychological measures of executive function, attention, and memory and measures of affective distress, self-efficacy, social participation, and quality of life.
Transcranial Direct Current Stimulation of the Left Prefrontal Cortex Improves Attention in individual with TBI.	Eun-Kyoung Kang, MD, PhD1, Dae-Yul Kim, MD	Anodal transcranial direct current stimulation applied to the left dorsolateral prefrontal cortex improvesattention compared with sham stimulation in patients withtraumatic brain injury, which suggests a potential role for this intervention in improving attention during cognitive training after traumatic brain injury	Before stimulation (Pre) and immediately after the final (Post 3) session, patients were asked to describe levels of attention, fatigue, task difficulty, and sleep quality using a numeric rating scale to demonstrate the possible influence of psychological condition on the outcome measures (range 0–10, where 0 = worst). A computerized contrast reaction time task (CCRTT) was designed to measure attention using Superlab pro v.4.0 software (Cedrus Corporation, San Pedro, CA, USA)
Combined cognitive and vocational interventions after mild to moderate traumatic brain injury	Emilie I. Howe1,2*†, Knut-Petter S. Langlo1,3	Compensatory cognitive training plus supported employment	participants who havereturned to work at 12-month follow-up and length of time before return to work (in days), work productivity (hours worked, work-related changes [i.e., reduced productivity,

			increased supervision, work content changes], and work stability [i.e., sickness absence after initial RTW and throughout the study period]).Post concussive symptoms and qualitydomains of fatigue, sleep, emotional distress, self-efficacy, and cognition.
Comprehensive cognitive training improves attention and memory in patients with severe or moderate traumatic brain injury	Marcin M. Le_sniaka, SzczepanIwa_nskib	A comprehensive program of cognitive rehabilitation may improve attention and memory, as well as everyday cognitive functioning, in patients with severe or moderate TBI.	episodic memory, working memory, and attention—were assessed in both visual and auditory modalities. visual tests were selected from the Cambridge Neuropsychological Test Automated Battery (CANTAB, Cambridge Cognition,Cambridge, UK). Visual episodic memory was checked with a Pattern Recognition Memory test (PRM- delayedrecognition) and auditory episodic memory was assessed with Rey's Auditory Verbal Learning Test (RAVLT).

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Figure 1. Flowchart depicting selection of database for the review.