Clinical Practice Guideline: **Cognitive Rehabilitation**

Date of Implementation: **March 17, 2016**

Product: **Specialty**

GUIDELINES

Medically Necessary

An individualized program of cognitive rehabilitation is considered medically necessary for EITHER of the following:

- stroke/cerebral infarction
- moderate to severe traumatic brain injury

when **ALL** of the following requirements are met:

- A documented cognitive impairment with related compromised functional status exists.
- Neuropsychological testing or an appropriate assessment has been performed and these test or assessment results will be used in treatment planning and directing of rehabilitation strategies.
- The individual is willing and able to actively participate in the treatment plan.
- Significant cognitive improvement with improved related functional status is expected.

Continuation of cognitive rehabilitation is considered medically when both of the following criteria are met:

- The criteria listed above are met
- There is documented progress toward the quantifiable, attainable short- and long-term goals.

Not Medically Necessary

Cognitive rehabilitation to improve academic or work performance is considered not medically necessary.

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Experimental, Investigational, Unproven

Cognitive rehabilitation for ANY other indications is considered unproven. Examples include but are not limited to:

- Cerebral palsy
- Attention deficit disorder, attention deficit hyperactivity disorder
- Pervasive developmental disorders, including autism spectrum disorders
- Learning disabilities
- Developmental delay
- Epilepsy
- Schizophrenia
- Dementia
- Mild traumatic brain injury, including concussion and post-concussion syndrome

ICD-10 Codes and Descriptions That Support Medical Necessity

ICD-10 Codes	ICD-10 Code Description
G97.31-G97.32	Intraoperative hemorrhage and hematoma of a nervous system organ or structure complicating a procedure
I61.0-I61.9	Nontraumatic intracerebral hemorrhage
I63.119	Cerebral infarction due to embolism of unspecified vertebral artery
I63.30-I63.39	Cerebral infarction due to thrombosis of cerebral artery
I63.40-I63.49	Cerebral infarction due to embolism of cerebral artery
I63.50-I63.59	Cerebral infarction due to unspecified occlusion or stenosis of cerebral artery
I63.6	Cerebral infarction due to cerebral venous thrombosis, nonpyogenic
I63.81, I63.89	Other cerebral infarction and other cerebral infarction due to occlusion or stenosis of small artery
I63.9	Cerebral infarction, unspecified
I69.010-169.019	Cognitive deficits following nontraumatic subarachnoid hemorrhage
I69.110-I69.119	Cognitive deficits following nontraumatic intracerebral hemorrhage
I69.210-I69.219	Cognitive deficits following other nontraumatic intracranial hemorrhage
I69.310-I69.319	Cognitive deficits following cerebral infarction

ICD-10 Codes	ICD-10 Code Description
I69.810-I69.819	Cognitive deficits following other cerebrovascular disease
I69.910	Attention and concentration deficit following unspecified cerebrovascular disease
I69.911	Memory deficit following unspecified cerebrovascular disease
I69.912	Visuospatial deficit and spatial neglect following unspecified cerebrovascular disease
I69.913	Psychomotor deficit following unspecified cerebrovascular disease
I69.914	Frontal lobe and executive function deficit following unspecified cerebrovascular disease
I69.915	Cognitive social or emotional deficit following unspecified cerebrovascular disease
I69.918	Other symptoms and signs involving cognitive functions following unspecified cerebrovascular disease
I97.810-I97.811	Intraoperative cerebrovascular infarction during surgery
I97.820-I97.821	Postprocedural cerebrovascular infarction during surgery
S06.1X0S	Traumatic cerebral edema without loss of consciousness, sequela
S06.1X1S	Traumatic cerebral edema with loss of consciousness of 30 minutes or less, sequela
S06.1X2S	Traumatic cerebral edema with loss of consciousness of 31 minutes to 50 minutes, sequela
S06.1X3S	Traumatic cerebral edema with loss of consciousness of 1 hour to 5 hours 59 minutes, sequela
S06.1X4S	Traumatic cerebral edema with loss of consciousness of 6 hours to 24 hours, sequela
S06.1X5S	Traumatic cerebral edema with loss of consciousness greater than 24 hours with return to pre-existing conscious level
S06.1X6S	Traumatic cerebral edema with loss of consciousness greater than 24 hours without return to pre-existing conscious level with patient surviving, sequela
S06.1X9S	Traumatic cerebral edema with loss of consciousness of unspecified duration, sequela
S06.2X0S	Diffuse traumatic brain injury without loss of consciousness, sequela

ICD-10 Codes	ICD-10 Code Description
S06.2X1S	Diffuse traumatic brain injury, with loss of consciousness of 30 minutes or less, sequela
S06.2X2S	Diffuse traumatic brain injury, with loss of consciousness of 31 minutes to 59 minutes, sequela
S06.2X3S	Diffuse traumatic brain injury, with loss of consciousness of 1 hour to 5 hours 59 minutes, sequela
S06.2X4S	Diffuse traumatic brain injury, with loss of consciousness of 6 hours to 24 hours, sequela
S06.2X5S	Diffuse traumatic brain injury, with loss of consciousness greater than 24 hours with return to pre-existing conscious levels, sequela
S06.2X6S	Diffuse traumatic brain injury with loss of consciousness greater than 24 hours without return to pre-existing conscious level with patient surviving, sequela
S06.2X9S	Diffuse traumatic brain injury with loss of consciousness of unspecified duration, sequela
S06.300S	Unspecified focal traumatic brain injury, without loss of consciousness, sequela
S06.301S	Unspecified focal traumatic brain injury, with loss of consciousness of 30 minutes or less, sequela
S06.302S	Unspecified focal traumatic brain injury, with loss of consciousness of 31 minutes to 59 minutes, sequela
S06.303S	Unspecified focal traumatic brain injury, with loss of consciousness of 1 hour to 5 hours 59 minutes, sequela
S06.304S	Unspecified focal traumatic brain injury, with loss of consciousness of 6 hours to 24 hours, sequela
S06.305S	Unspecified focal traumatic brain injury with loss of consciousness greater than 24 hours with return to pre-existing conscious level, sequela
S06.306S	Unspecified focal traumatic brain injury with loss of consciousness greater than 24 hours without return to pre-existing conscious level with patient surviving, sequela
S06.309S	Unspecified focal traumatic brain injury with loss of consciousness of unspecified duration, sequela
S06.310S	Contusion and laceration of right cerebrum without loss of consciousness, sequela
306.311S	Contusion and laceration of right cerebrum with loss of consciousness of 30 minutes or less, sequela
306.312S	Contusion and laceration of right cerebrum with loss of consciousness of 31 minutes to 59 minutes, sequela

ICD-10 Codes	ICD-10 Code Description
306.313S	Contusion and laceration of right cerebrum with loss of consciousness of 1 hour to 5 hours 59 minutes, sequela
306.314S	Contusion and laceration of right cerebrum with loss of consciousness of 6 hours to 24 hours, sequela
306.315S	Contusion and laceration of right cerebrum with loss of consciousness greater than 24 hours with return to pre-existing conscious level, sequela
S06.316S	Contusion and laceration of right cerebrum with loss of consciousness greater than 24 hours without return to pre-existing conscious level with patient surviving, sequela
S06.319S	Contusion and laceration of right cerebrum with loss of consciousness of unspecified duration , sequela
S06.320S	Contusion and laceration of left cerebrum without loss of consciousness, sequela
S06.321S	Contusion and laceration of left cerebrum with loss of consciousness of 30 minutes or less, sequela
S06.322S	Contusion and laceration of left cerebrum with loss of consciousness of 31 minutes to 59 minutes, sequela
S06.323S	Contusion and laceration of left cerebrum with loss of consciousness of 1 hour to 5 hours 59 minutes, sequela
S06.324S	Contusion and laceration of left cerebrum with loss of consciousness of 6 hours to 24 hours, sequela
S06.325S	Contusion and laceration of left cerebrum with loss of consciousness greater than 24 hours with return to pre-existing consciousness level, sequela
S06.326S	Contusion and laceration of left cerebrum with loss of consciousness greater than 24 hours without return to pre-existing consciousness level with patient surviving, sequela
S06.329S	Contusion and laceration of left cerebrum with loss of consciousness of unspecified duration, sequela
S06.330S	Contusion and laceration of cerebrum, unspecified, without loss of consciousness, sequela
S06.331S	Contusion and laceration of cerebrum, unspecified, with loss of consciousness of 30 minutes or less, sequela
S06.332S	Contusion and laceration of cerebrum, unspecified, with loss of consciousness of 31 minutes to 59 minutes, sequela

ICD-10 Codes	ICD-10 Code Description
S06.333S	Contusion and laceration of cerebrum, unspecified, with loss of consciousness of 1 hour to 5 hours 59 minutes, sequela
S06.334S	Contusion and laceration of cerebrum, unspecified, with loss of consciousness of 6 hours to 24 hours, sequela
S06.335S	Contusion and laceration or cerebrum, unspecified, with loss of consciousness greater than 24 hours with return to pre-existing conscious level, sequela
S06.336S	Contusion and laceration of cerebrum, unspecified, with loss of consciousness greater than 24 hours without return to pre-existing conscious level with patient surviving, sequela
S06.339S	Contusion and laceration of cerebrum, unspecified, with loss of consciousness of unspecified duration, sequela
S06.340S	Traumatic hemorrhage of right cerebrum without loss of consciousness, sequela
S06.341S	Traumatic hemorrhage of right cerebrum with loss of consciousness of 30 minutes or less, sequela
S06.342S	Traumatic hemorrhage of right cerebrum with loss of consciousness of 31 minutes to 59 minutes, sequela
S06.343S	Traumatic hemorrhage of right cerebrum with loss of consciousness of 1 hour to 5 hours 59 minutes, sequela
S06.344S	Traumatic hemorrhage of right cerebrum with loss of consciousness of 6 hours to 24 hours, sequela
S06.345S	Traumatic hemorrhage of right cerebrum with loss of consciousness greater than 24 hours with return to pre-existing conscious level, sequela
S06.346S	Traumatic hemorrhage of right cerebrum with loss of consciousness greater than 24 hours without return to pre-existing conscious level with patient surviving, sequela
S06.349S	Traumatic hemorrhage of right cerebrum with loss of consciousness of unspecified duration, sequela
S06.350S	Traumatic hemorrhage of left cerebrum without loss of consciousness, sequela
S06.351S	Traumatic hemorrhage of left cerebrum with loss of consciousness of 30 minutes or less, sequela
S06.352S	Traumatic hemorrhage of left cerebrum with loss of consciousness of 31 minutes to 59 minutes, sequela
S06.353S	Traumatic hemorrhage of left cerebrum with loss of consciousness of 1 hour to 5 hours 59 minutes, sequela

ICD-10 Codes	ICD-10 Code Description
S06.354S	Traumatic hemorrhage of left cerebrum with loss of consciousness of 6 hours to 24 hours, sequela
S06.355S	Traumatic hemorrhage of left cerebrum with loss of consciousness greater than 24 hours with return to pre-existing conscious level, sequela
S06.356S	Traumatic hemorrhage of left cerebrum with loss of consciousness greater than 24 hours
S06.359S	Traumatic hemorrhage of left cerebrum with loss of consciousness of unspecified duration, sequela
S06.360S	Traumatic hemorrhage of cerebrum, unspecified, without loss of consciousness, sequela
S06.361S	Traumatic hemorrhage of cerebrum, unspecified, with loss of consciousness of 30 minutes or less, sequela
S06.362S	Traumatic hemorrhage of cerebrum, unspecified, with loss of consciousness of 31 minutes to 59 minutes, sequela
S06.363S	Traumatic hemorrhage of cerebrum, unspecified, with loss of consciousness of 1 hour to 5 hours 59 minutes, sequela
S06.364S	Traumatic hemorrhage of cerebrum, unspecified, with loss of consciousness of 6 hours to 24 hours, sequela
S06.365S	Traumatic hemorrhage of cerebrum, unspecified, with loss of consciousness greater than 24 hours with return to pre-existing conscious level, sequela
S06.366S	Traumatic hemorrhage of cerebrum, unspecified, with loss of consciousness greater than 24 hours without return to pre-existing conscious level with patient surviving, sequela
S06.369S	Traumatic hemorrhage of cerebrum, unspecified, with loss of consciousness of unspecified duration, sequela
S06.370S	Contusion, laceration, and hemorrhage of cerebellum, without loss of consciousness, sequela
S06.371S	Contusion, laceration and hemorrhage of cerebellum with loss of consciousness of 30 minutes or less, sequela
S06.372S	Contusion, laceration and hemorrhage of cerebellum with loss of consciousness of 31 minutes to 59 minutes, sequela
S06.373S	Contusion, laceration and hemorrhage of cerebellum, with loss of consciousness of 1 hour to 5 hours 59 minutes, sequela

ICD-10 Codes	ICD-10 Code Description
S06.374S	Contusion, laceration and hemorrhage of cerebellum, with loss of consciousness of 6 hours to 24 hours, sequela
S06.375S	Contusion, laceration and hemorrhage of cerebellum, with loss of consciousness greater than 24 hours with return to pre-existing conscious level, sequela
S06.376S	Contusion, laceration, and hemorrhage of cerebellum with loss of consciousness greater than 24 hours without return to pre-existing conscious level with patient surviving, sequela
S06.379S	Contusion, laceration, and hemorrhage of cerebellum with loss of consciousness of unspecified duration, sequela
S06.380S	Contusion, laceration, and hemorrhage of brainstem, without loss of consciousness, sequela
S06.381S	Contusion, laceration and hemorrhage of brainstem with loss of consciousness of 30 minutes or less, sequela
S06.382S	Contusion, laceration and hemorrhage of brainstem with loss of consciousness of 31 minutes to 59 minutes, sequela
S06.383S	Contusion, laceration and hemorrhage of brainstem with loss of consciousness of 1 hour to 5 hours 59 minutes, sequela
S06.384S	Contusion, laceration and hemorrhage of brainstem with loss of consciousness of 6 hours to 24 hours, sequela
S06.385S	Contusion, laceration and hemorrhage of brainstem with loss of consciousness greater than 24 hours with return to pre-existing conscious level, sequela
S06.386S	Contusion, laceration, and hemorrhage of brainstem with loss of consciousness greater than 24 hours without return to pre-existing conscious level with patient surviving, sequela
S06.389S	Contusion, laceration, and hemorrhage of brainstem with loss of consciousness of unspecified duration, sequela
S06.4X0S-	Epidural hemorrhage without loss of consciousness, sequela
S06.4X1S	Epidural hemorrhage with loss of consciousness of 30 minutes or less, sequela
S06.4X2S	Epidural hemorrhage with loss of consciousness of 31 minutes to 59 minutes, sequela
S06.4X3S	Epidural hemorrhage with loss of consciousness of 1 hour to 5 hours 59 minutes, sequela

ICD-10 Codes	ICD-10 Code Description
S06.4X4S	Epidural hemorrhage with loss of consciousness of 6 hours to 24 hours, sequela
S06.4X5S	Epidural hemorrhage with loss of consciousness greater than 24 hours with return to pre-existing conscious level, sequela
S06.4X6S	Epidural hemorrhage with loss of consciousness greater than 24 hours without return to pre-existing conscious level with patient surviving, sequela
S06.4X9S	Epidural hemorrhage with loss of consciousness of unspecified duration, sequela
S06.5X0S	Traumatic subdural hemorrhage without loss of consciousness, sequela
S06.5X1S	Traumatic subdural hemorrhage with loss of consciousness of 30 minutes or less, sequela
S06.5X2S	Traumatic subdural hemorrhage with loss of consciousness of 31 minutes to 59 minutes, sequela
S06.5X3S	Traumatic subdural hemorrhage with loss of consciousness of 1 hour to 5 hours 59 minutes, sequela
S06.5X4S	Traumatic subdural hemorrhage with loss of consciousness of 6 hours to 24 hours, sequela
S06.5X5S	Traumatic subdural hemorrhage with loss of consciousness of 24 hours or greater with return to pre-existing conscious level, sequela
S06.5X6S	Traumatic subdural hemorrhage with loss of consciousness greater than 24 hours without return to pre-existing conscious level with patient surviving, sequela
S06.5X9S	Traumatic subdural hemorrhage with loss of consciousness of unspecified duration, sequela
S06.6X0S	Traumatic subarachnoid hemorrhage without loss of consciousness, sequela
S06.6X1S	Traumatic subarachnoid hemorrhage, with loss of consciousness 30 minutes or less, sequela
S06.6X2S	Traumatic subarachnoid hemorrhage, with loss of consciousness 31 minutes to 59 minutes, sequela
S06.6X3S	Traumatic subarachnoid hemorrhage, with loss of consciousness of 1 hour to 5 hours 59 minutes, sequela
S06.6X4S	Traumatic subarachnoid hemorrhage, with loss of consciousness of 6 hours to 24 hours, sequela

ICD-10 Codes	ICD-10 Code Description
S06.6X5S	Traumatic subarachnoid hemorrhage, with loss of consciousness greater than 24 hours with return to pre-existing conscious level, sequela
S06.6X6S	Traumatic subarachnoid hemorrhage with loss of consciousness greater than 24 hours without return to pre-existing conscious level with patient surviving, sequela
S06.6X9S	Traumatic subarachnoid hemorrhage with loss of consciousness of unspecified duration, sequela
S06.810S-	Injury of right internal carotid artery, intracranial portion, not elsewhere classified, without loss of consciousness, sequela
S06.811S	Injury of right internal carotid artery, intracranial portion, not elsewhere classified, with loss of consciousness of 30 minutes or less, sequela
S06.812S	Injury of right internal carotid artery, intracranial portion, not elsewhere classified, with loss of consciousness of 31 minutes to 59 minutes, sequela
S06.813S	Injury of right internal carotid artery, intracranial portion, not elsewhere classified, with loss of consciousness of 1 hour to 59 minutes, sequela
S06.814S	Injury of right internal carotid artery, intracranial portion, not elsewhere classified, with loss of consciousness 6 hours to 24 hours, sequela
S06.815S	Injury of right internal carotid artery, intracranial portion, not elsewhere classified, with loss of consciousness greater than 24 hours with return to pre-existing conscious level, sequela
S06.816S	Injury of right internal carotid artery, intracranial portion, not elsewhere classified with loss of consciousness greater than 24 hours without return to pre-existing conscious level with patient surviving, sequela
S06.819S	Injury of right internal carotid artery, intracranial portion, not elsewhere classified with loss of consciousness of unspecified duration, sequela
S06.820S	Injury of left internal carotid artery, intracranial portion, not elsewhere classified, without loss of consciousness, sequela
S06.821S	Injury of left internal carotid artery, intracranial portion, not elsewhere classified, with loss of consciousness of 30 minutes or less, sequela

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ICD-10 Codes	ICD-10 Code Description
S06.822S	Injury of left internal carotid artery, intracranial portion, not elsewhere classified, with loss of consciousness of 31 minutes to 59 minutes, sequela
S06.823S	Injury of left internal carotid artery, intracranial portion, not elsewhere classified, with loss of consciousness of 1 hour to 5 hours 59 minutes, sequela
S06.824S	Injury of left internal carotid artery, intracranial portion, not elsewhere classified, with loss of consciousness of 6 hours to 24 hours, sequela
S06.825S	Injury of left internal carotid artery, intracranial portion, not elsewhere classified with loss of consciousness greater than 24 hours with return to pre-existing conscious level, sequela
S06.826S	Injury of left internal carotid artery, intracranial portion, not elsewhere classified with loss of consciousness greater than 24 hours without return to pre-existing conscious level with patient surviving, sequela
S06.829S	Injury of left internal carotid artery, intracranial portion, not elsewhere classified with loss of consciousness of unspecified duration, sequela
S06.890S	Other specified intracranial injury, without loss of consciousness, sequela
S06.891S	Other specified intracranial injury, with loss of consciousness of 30 minutes or less, sequela
S06.892S	Other specified intracranial injury, with loss of consciousness of 31 minutes to 59 minutes, sequela
S06.893S	Other specified intracranial injury, with loss of consciousness of 1 hour to 5 hours 59 minutes, sequela
S06.894S	Other specified intracranial injury, with loss of consciousness of 6 hours to 24 hours, sequela
S06.895S	Other specified intracranial injury, with loss of consciousness greater than 24 hours with return to pre-existing conscious level, sequela
S06.896S	Other specified intracranial injury with loss of consciousness greater than 24 hours without return to pre-existing conscious level with patient surviving, sequela
S06.899S	Other specified intracranial injury with loss of consciousness of unspecified duration, sequela
S06.9X0S	Unspecified intracranial injury, without loss of consciousness, sequela

ICD-10 Codes	ICD-10 Code Description
S06.9X1S	Unspecified intracranial injury, with loss of consciousness of 30 minutes or less, sequela
S06.9X2S	Unspecified intracranial injury, with loss of consciousness of 31 minutes to 59 minutes, sequela
S06.9X3S	Unspecified intracranial injury, with loss of consciousness of 1 hour to 5 hours 59 minutes, sequela
S06.9X4S	Unspecified intracranial injury, with loss of consciousness of 6 hours to 24 hours, sequela
S06.9X5S	Unspecified intracranial injury, with loss of consciousness of greater than 24 hours with return to pre-existing conscious level, sequela
S06.9X6S	Unspecified intracranial injury with loss of consciousness greater than 24 hours without return to pre-existing conscious level with patient surviving, sequela
S06.9X9S	Unspecified intracranial injury with loss of consciousness of unspecified duration, sequela
Z87.820	Personal history of traumatic brain injury

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CPT® Code	CPT® Code Description
97129	Therapeutic interventions that focus on cognitive function (e.g., attention, memory, reasoning, executive function, problem solving, and/or pragmatic functioning) and compensatory strategies to manage the performance of an activity (e.g., managing time or schedules, initiating, organizing, and sequencing tasks), direct (one-on-one) patient contact; initial 15 minutes
97130	Therapeutic interventions that focus on cognitive function (e.g., attention, memory, reasoning, executive function, problem solving, and/or pragmatic functioning) and compensatory strategies to manage the performance of an activity (e.g., managing time or schedules, initiating, organizing, and sequencing tasks), direct (one-on-one) patient contact; each additional 15 minutes (List separately in addition to code for primary procedure)

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BACKGROUND AND DESCRIPTION

Cognition refers to information-processing functions carried out by the brain that include, attention, memory, executive functions (i.e., planning, problem solving, self-monitoring, self-awareness), comprehension and formation of speech, calculation ability, visual perception, and praxis skills. Cognitive processes can be conscious or unconscious and often are divided into basic level skills (e.g., attention and memory processes) and executive functions. Cognitive pertains to the mental processes of comprehension, judgment, memory, and reasoning, as contrasted with emotional and volitional process. Cognitive dysfunction (or cognitive impairment) can be defined as functioning below expected normative levels or loss of ability in any area of cognitive functioning. There is no singular, consensus-based definition for cognitive rehabilitation. In general, it refers to a broad category of "therapeutic interventions designed to improve cognitive functioning and participation in activities that may be affected by difficulties in one or more cognitive domains" (Brain Injury Association of America, 2011, p. 1). Cognitive training focuses on guided practice on a set of tasks that reflect particular cognitive functions, such as memory, attention or problem-solving. Cognitive rehabilitation focuses on identifying and addressing individual needs and goals, which may require strategies for taking in new information or compensatory methods such as using memory aids. Berquist and Malec (1997) state cognitive rehabilitation therapy (CRT) is a 'systematic, functionally oriented service of therapeutic cognitive activities and an understanding of the person's behavioral deficits. Services are directed to achieve functional changes by:

- Reinforcing, strengthening or establishing previously learned patterns of behavior; or
- Establishing new patterns of cognitive activity or mechanisms to compensate for impaired neurological systems.

This definition has also been adopted by the Commission on Accreditation of Rehabilitation Facilities (CARF) and by the National Academy of Neuropsychology (NAN) in their position statement on Cognitive Rehabilitation (May 2002). Cognitive dysfunction may occur across the lifespan and may be associated with a wide range of clinical conditions. Cognitive dysfunction comes in many different forms and can come and go, remain over time, progress, be very specific or general and can range from mild to severe and affect different areas of life; like social participation, well-being, intellect, employment and functional performance. Cognitive impairments are typically categorized by severity or clinical conditions that cause the dysfunction. When rehabilitation therapy practitioners provide intervention to improve cognitive functioning (i.e., cognitive rehabilitation), the therapeutic goal is always to enhance some aspect of occupational or daily activity performance. Occupations refer to "everyday activities" that are important to the individual and that help define the individual to himself or herself and others and that serve an individual's life roles (AOTA, 2008).

EVIDENCE REVIEW

Cognitive rehabilitation interventions for persons with stroke, traumatic brain injury (TBI), and dementias have the most published empirical data (Cicerone et al., 2011; Rohling et al., 2009), and persons with these conditions are among the most frequently seen by rehabilitation therapy practitioners. Additionally, they may address cognitive barriers to functioning resulting from developmental disorders, environmental factors, or disease. Specifically, these populations include those experiencing cognitive dysfunction related to

- Genetics and/or development (e.g., environmental deprivation, fetal alcohol syndrome, learning disabilities, pervasive developmental disorders);
- Other neurologic disease, events, injuries, and disorders (e.g., Parkinson's and Huntington's diseases, HIV/AIDS, Alzheimer's disease and related dementias);
- Mental illness (e.g., schizophrenia, major depressive disorder, bipolar disorder, substance use disorders);
- Transient or continuing life stresses or changes (e.g., stress-related disorders, pain syndromes, anxiety disorders, grief and loss).

Most published evidence evaluates cognitive rehabilitation for treatment of cognitive deficits resulting from moderate or severe traumatic brain injury (TBI) and stroke/cerebral infarction. The available evidence, although not robust, indicates that cognitive rehabilitation may improve functional outcomes for some patients with moderate or severe TBI. Evidence is limited due to the heterogeneity of subjects, interventions and outcomes studied, small sample size, failure to control for spontaneous recovery, and the unspecified confounding effects of social contact. Evidence from available studies indicates, however, that cognitive rehabilitation may reduce anxiety, improve self-concept and relationships for people with TBI, and may improve memory, attention and executive skills. There is insufficient evidence in the published medical literature, however, to support the use of cognitive rehabilitation for patients with mild TBI, including concussion and post-concussion syndrome. Patients who sustain a stroke may exhibit symptoms similar to those experienced by TBI patients, with cognitive deficits in the areas of memory, reasoning and perception. Both TBI and stroke may result in impairment of localized, higher-order, sensory and motor function corresponding to affected anatomic structures, but may also result in loss of a variety of functions that are not clearly localized, such as the ability to abstract and to reason. Although the evidence supporting the use of cognitive rehabilitation to treat cognitive deficits following stroke is limited, there is some evidence that it contributes to visuospatial rehabilitation and improvement in aphasia and apraxia. In addition, the medical community has recognized cognitive rehabilitation as a standard treatment modality for stroke as well as for TBI.

Cappa et al. (2005), as members of the Task Force on Cognitive Rehabilitation under the backings of the European Federation of Neurological Societies (EFNS), reported on the effectiveness of cognitive rehabilitation in stroke and traumatic brain injury (TBI). Evidence was graded A, B, or C based on cognitive rehabilitation was recommended for aphasia, unilateral spatial neglect, attention disorders following TBI, memory and apraxia. The Task Force recommendations were as follows: aphasia therapy received a B recommendation; unilateral spatial neglect received an A recommendation for visual scanning and visio-spatio-motor training and B/C recommendations for other areas of unilateral spatial neglect therapy; attention disorders were given an A in the post-acute phase; the use of memory strategies without electronic aid received a C; errorless learning a B; nonelectronic external memory aids (diaries, notebooks) received a C; electronic external memory devices (computers, pagers) received a B; virtual memory training was given a C; apraxia treatment with compensatory strategies received an A recommendation. The task force suggests that large-scale, high quality randomized clinical trials are needed to evaluate cognitive rehabilitation for TBI and stroke that are diagnosed in a pathologically distinct manner.

Although cognitive rehabilitation has been proposed for numerous other conditions that may cause impaired cognitive function, there is insufficient evidence to support its use for conditions other than moderate to severe TBI or stroke. These include, but are not limited to:

- Multiple sclerosis
- Parkinson’s disease
- Cerebral palsy
- Attention deficit disorder, attention deficit hyperactivity disorder
- Pervasive developmental disorders, including autism spectrum disorders
- Learning disabilities
- Developmental delay
- Epilepsy
- Schizophrenia
- Dementia
- Alzheimer’s disease

There is insufficient evidence in the published medical literature to support the use of cognitive rehabilitation for these conditions and others not included in the medical necessity criteria described above. The role of cognitive rehabilitation for the treatment of conditions other than moderate to severe traumatic brain injury or stroke/cerebral infarction has not been established.

Cerebral Vascular Accident/Stroke

The Stroke Council of the American Heart Association endorsed the Veterans Administration/Department of Defense guidelines for stroke rehabilitation (Duncan, et al., 2005). The panel was made up of experts from the Department of Veterans Affairs and the United States Department of Defense. The panel evaluated published literature through 2002. Recommendations were based on randomized clinical trials, uncontrolled studies, or consensus expert opinion if definitive data were lacking. The guidelines were developed as a means of direction for clinicians and also to assist researchers in identifying areas in need of further investigation. In the area of cognitive rehabilitation, the recommendation was that all patients be assessed for cognitive deficits and be given retraining if any of the following conditions were present: attention deficit, visual neglect, memory deficits, and executive function and problem-solving difficulties. das Nair and Lincoln (2007) reviewed cognitive rehabilitation for memory deficits following stroke in a Cochrane review. Only 2 trials, involving 18 participants, were included. One study compared the effectiveness of a mnemonic strategy treatment group with a 'drill and practice' control, while the other compared the effectiveness of an imagery mnemonics program with a 'pragmatic' memory rehabilitation control program. Authors conclude that there was no evidence to support or refute the effectiveness of memory rehabilitation on functional outcomes, and objective, subjective, and observer-rated memory measures. This review of two trials involving 18 participants found that there was little evidence to support the effectiveness of cognitive rehabilitation for memory problems after stroke and more research in this area is needed.

Loetscher and Lincoln (2013) completed a Cochrane review on cognitive rehabilitation for attention deficits following stroke. They included six RCTs with 223 participants. All six RCTs compared cognitive rehabilitation with a usual care control. Meta-analyses demonstrated no statistically significant effect of cognitive rehabilitation for persisting effects on global measures of attention, standardized attention assessments, or functional outcomes. In contrast, a statistically significant effect was found in favor of cognitive rehabilitation when compared with control for immediate effects on measures of divided attention but no significant effects on global attention, other attentional domains, or functional outcomes. Thus, there was limited evidence that cognitive rehabilitation may improve some aspects of attention in the short term, but there was insufficient evidence to support or refute the persisting effects of cognitive rehabilitation on attention, or on functional outcomes in either the short or long term. The effectiveness of cognitive rehabilitation remains unconfirmed. The results suggest there may be a short-term effect on attentional abilities, but future studies need to assess the persisting effects and measure attentional skills in daily life. Trials also need to have higher methodological quality and better reporting. Hoffman et al. (2010) conducted a systematic review to determine whether interventions for cognitive impairment following stroke may improve functional performance of basic and/or instrumental activities of daily living (ADL). The authors concluded that the small number of high-quality trials did not allow recommendations that support or refute the use of specific cognitive retraining interventions to improve functional outcomes following stroke.

Bowen et al. (2013) authored a Cochrane review on cognitive rehabilitation for spatial neglect following stroke. Authors included 23 RCTs with 628 participants (adding 11 new RCTs involving 322 new participants for this update). Most studies measured outcomes using standardized neglect assessments: 15 studies measured effect on activities of daily living (ADL) immediately after the end of the intervention period, but only six reported persisting effects on ADL. One study (30 participants) reported discharge destination and one study (eight participants) reported the number of falls. Eighteen of the 23 included RCTs compared cognitive rehabilitation with any control intervention (placebo, attention or no treatment). Meta-analyses demonstrated no statistically significant effect of cognitive rehabilitation, compared with control, for persisting effects on either ADL (five studies, 143 participants) or standardized neglect assessments (eight studies, 172 participants), or for immediate effects on ADL (10 studies, 343 participants). In contrast, they found a statistically significant effect in favor of cognitive rehabilitation compared with control, for immediate effects on standardized neglect assessments. Additionally, five of the 23 included RCTs compared one cognitive rehabilitation intervention with another. These included three studies comparing a visual scanning intervention with another cognitive rehabilitation intervention, and two studies comparing a visual scanning intervention plus another cognitive rehabilitation intervention with a visual scanning intervention alone. Only two small studies reported a measure of functional disability but due to heterogeneity, conclusions cannot be drawn. The effectiveness of cognitive rehabilitation interventions for reducing the disabling effects of neglect and increasing independence remains unproven, thus no rehabilitation approach can be supported or refuted based on current evidence from RCTs. However, there is some very limited evidence that cognitive rehabilitation may have an immediate beneficial effect on tests of neglect which justifies further high-quality clinical trials of cognitive rehabilitation for neglect.

Gillespie et al. (2015) provided an overview of the evidence for the effectiveness of cognitive rehabilitation for patients with stroke and to determine the main gaps in the current evidence base. Data arising from 44 trials involving over 1500 patients was identified. Though there was support for the effectiveness of cognitive rehabilitation for some cognitive impairments, significant gaps were found in the current evidence base. All of the Cochrane reviews identified major limitations within the evidence they identified. Authors concluded that there is currently insufficient research evidence, or evidence of insufficient quality, to support clear recommendations for clinical practice. Das Nair et al. (2016) sought to determine if participants receiving cognitive rehabilitation for memory problems following a stroke have better outcomes than those given no treatment or a placebo control. They included 13 trials involving 514 participants. There was a significant effect of treatment on subjective reports of memory in the short term, but not the long term. Authors concluded participants who received cognitive rehabilitation for memory problems following a stroke reported benefits from the intervention on subjective measures of memory in the short term (i.e., the first assessment point after the intervention, which was a minimum of four weeks). This effect was not, however, observed in the longer term (i.e., the second assessment point after the intervention, which was a minimum of three months). There was, therefore, limited evidence to support or refute the effectiveness of memory rehabilitation. The evidence was limited due to the poor quality of reporting in many studies, lack of consistency in the choice of outcome measures, and small sample sizes. There is a need for more robust, well-designed, adequately powered, and better-reported trials of memory rehabilitation using common standardized outcome measures.

Nie et al. (2021) sought to determine the effectiveness of computer-assisted cognitive rehabilitation in improving cognitive function in patients with post-stroke cognitive impairment in a systematic review. Thirty-two studies comprising 1837 participants were included. Compared with conventional therapy alone, the addition of computer-assisted cognitive rehabilitation significantly improved the global cognition of patients, evaluated using the Montreal cognitive assessment, mini-mental state examination and Loewenstein occupational therapy cognitive assessment. The therapy also significantly improved activities of daily living, assessed using the Barthel index, modified Barthel index and functional independence measure. Authors concluded that computer-assisted cognitive rehabilitation significantly improved the cognitive function and activities of daily living of patients with post-stroke cognitive impairment.

Xiao et al. (2022) compared the rehabilitation efficacy of virtual reality (VR) and computer-assisted cognitive rehabilitation (CACR) for patients with post-stroke cognitive impairment (PSCI). The primary outcomes of the included studies contained at least one of the following clinical outcome measures: Mini-mental state examination (MMSE) or Montreal Cognitive Assessment (MoCA). A total of 21 randomized controlled trials were included, including 1,047 patients. The results of network meta-analysis showed that under MMSE index, VR group and CACR group tended to be superior to the conventional therapy group, but it was not significant. Both the VR and CACR groups had significantly better outcomes compared to the conventional therapy group in terms of MoCA. The ranking results under both indicators showed that CACR had the best treatment effect, followed by VR. Authors concluded that, in general, VR and CACR have superior efficacy compared with conventional therapy, in which CACR may be the best treatment option.

Zhou et al. (2023) evaluated the effects of computerized cognitive training on the cognitive functions of stroke patients in a systematic review and meta-analysis. With increased publications on computerized cognitive training, a meta-analysis is essential to determine the effects of computerized cognitive training among stroke patients. A total of 622 patients with 17 studies were included. Computerized cognitive training significantly improves global cognition, working memory, attention and executive function of stroke patients. However, there was inadequate evidence to demonstrate any effects of computerized cognitive training on activities of daily living and depression. Authors concluded that computerized cognitive training improves the cognitive functions of stroke patients. However, further research studies are needed to confirm its efficacy in activities of daily living as well as on alleviating depression.

Traumatic Brain Injury/Acquired Brain Injury

Turner-Stokes et al. (2015) investigated multi-disciplinary rehabilitation for acquired brain injury in adults of working age in a Cochrane review. Authors identified 19 studies (3480 people). Twelve studies were of good methodological quality and seven were of lower quality. Within the subgroup of predominantly mild brain injury, 'strong evidence' suggested that most individuals made a good recovery when appropriate information was provided, without the need for additional specific interventions. For moderate to severe injury, 'strong evidence' showed benefit from formal intervention, and 'limited evidence' indicated that commencing rehabilitation early after injury results in better outcomes. For participants with moderate to severe ABI already in rehabilitation, 'strong evidence' revealed that more intensive programs are associated with earlier functional gains, and 'moderate evidence' suggested that continued outpatient therapy could help to sustain gains made in early post-acute rehabilitation. The context of multi-disciplinary rehabilitation appears to influence outcomes. 'Strong evidence' supports comprehensive cognitive rehabilitation in a therapeutic environment that involves a peer group of patients. 'Limited evidence' shows that specialist in-patient rehabilitation and specialist multi-disciplinary community rehabilitation may provide additional functional gains. In conclusion, for mild brain injury, information and advice were usually more appropriate than intensive rehabilitation. Patients with moderate to severe brain injury who received more intensive rehabilitation showed earlier improvement and earlier rehabilitation was better than delayed. It also supports that cognitive rehabilitation be provided in an environment where patients receive group-based therapy with peers facing the same challenges.

Chung et al. (2013) investigated how effective cognitive rehabilitation interventions are at improving executive function after brain injury in a Cochrane review. Thirteen studies were included consisting of 770 participants in the meta-analyses (417 traumatic brain injury, 304 stroke, 49 other acquired brain injury) which reduced to 660 participants once non-included intervention groups were removed from some studies. Three studies (134 participants) compared cognitive rehabilitation with sensorimotor therapy. Six studies (333 participants) compared cognitive rehabilitation with no treatment or placebo. Ten studies (448 participants) compared two different cognitive rehabilitation approaches. They also explored the effect of restorative interventions (10 studies, 468 participants) and compensative interventions (four studies, 128 participants) and found no statistically significant effect compared with other interventions. They found no evidence that cognitive rehabilitation interventions were helpful for people with executive dysfunction for any other outcomes. Authors identified insufficient high-quality evidence to reach any generalized conclusions about the effect of cognitive rehabilitation on executive function, or other secondary outcome measures. Further high-quality research comparing cognitive rehabilitation with no intervention, placebo or sensorimotor interventions is recommended.
Park et al. (2015) investigated the overall effect of occupation-based cognitive rehabilitation on patients' improvement in cognitive performance components, activity of daily living (ADL) performance, and values, beliefs and spirituality functions of patients

with TBI. Evidence from this meta-analytic study suggests that occupation-based cognitive rehabilitation would be beneficial for individuals with TBI for improving daily functioning and positively be able to affect their psychosocial functions.

An Agency for Healthcare Research and Quality (AHRQ) comparative effectiveness review was conducted to determine the effectiveness and comparative effectiveness of multidisciplinary postacute rehabilitation for moderate to severe traumatic brain injury TBI in adults (Brasure et al., 2012; 2016). Twelve studies assessed a primary outcome and eight assessed secondary outcomes and four of these were considered to have a high risk of bias and were excluded from analysis. Studies of multidisciplinary postacute rehabilitation programs often do not define interventions sufficiently. Although newer studies provide more useful definitions, it remains difficult to decipher what the individual components of the program entailed and how, when and why individuals received specific therapies. The review found that currently available evidence is insufficient to draw conclusions about the effectiveness of multidisciplinary postacute rehabilitation for moderate to severe TBI. Although the authors found stronger evidence on the comparative effectiveness of different approaches to multidisciplinary postacute rehabilitation for participation outcomes, there were a limited number of eligible studies and no clear demonstration that one approach was superior to another. The authors stated that future research to identify and test hypothesized combinations between patient types and intervention approaches would have important clinical implications. Recommendations for brain injury rehabilitation in adults from the Scottish Intercollegiate Guidelines Network (SIGN) (2013) include:

- Assessment and treatment of mild brain injury
    - Patients presenting with non-specific symptoms following mild traumatic brain injury should be reassured that the symptoms are benign and likely to settle within three months.

- Cognitive rehabilitation:
    - Patients with memory impairment after TBI should be trained in the use of compensatory memory strategies with a clear focus on improving everyday functioning rather than underlying memory impairment.
    - For patients with mild-moderate memory impairment both external aids and internal strategies (e.g., use of visual imagery) may be used.
    - For those with severe memory impairment external compensations with a clear focus on functional activities is recommended.
    - In the post-acute setting interventions for cognitive deficits should be applied in the context of a comprehensive/holistic neuropsychological rehabilitation program. This would involve an interdisciplinary team using a goal-focused program which has the capacity to address cognitive, emotional and behavioral difficulties with the aim of improving functioning in meaningful everyday activities.

American Occupational Therapy Association (AOTA): AOTA published occupational therapy practice guidelines for adults with traumatic brain injury (Wheeler et al., 2016). The recommendation for occupational therapy interventions for adults with TBI include:

- Interventions to Improve Occupational Performance of People with Cognitive Impairments:
  - General memory interventions (involving restorative and/or compensatory approaches) to improve memory (A)
  - Attention regulation interventions with or without goal problem-solving training to improve attention and executive functioning (A)
  - Executive function strategy training such as goals management training and meta-cognitive strategy instruction to improve attention and executive functioning (A)
  - Training in encoding techniques to improve recall (A)
  - Training in use of cognitive assistive technology (except voice recorders and navigation devices) to improve memory (A)
  - Various memory-specific compensatory approaches to improve memory (A)
  - Use of compensatory interventions to improve multiple cognitive domains (B)
  - Cognitive interventions to improve self-awareness (B)
  - Computer-based interventions to enhance occupational performance (I)
  - General restorative and/or compensatory approaches to improve attention and executive dysfunction (I)

- Interventions to Improve Occupational Performance of People with Visual and Visual–Perceptual Impairments
  - Scanning training to improve search skills when measured with digit search, computer tests, and a functional search task (A)
  - Cognitive rehabilitation to improve performance in neuropsychological measures focused on visual perception (A)
  - Scanning training accompanied by a visual and/or auditory stimulus to improve visual search skills and reading performance (B)
  - Vision therapy to remediate oculomotor signs and symptoms (C)
  - Cognitive compensatory strategies such as pacing, chunking, and self-talk to improve activity of daily living (ADL) performance (C)
  - Fresnel 40-diopter prism to improve visual field awareness and functional mobility (C)
  - Scrolling text to improve reading performance of people with reading difficulties as a result of hemianopsia (C)
  - Cognitive strategies focused on social skills training to improve the ability to name basic emotions, interpret comments, and determine whether a person is lying or being sarcastic (I)
  - Scanning as a standalone intervention to improve reading (I)

- Interventions to Improve Occupational Performance of People with Psychosocial, Behavioral, or Emotional Impairments
  - Cognitive-behavioral therapy (CBT) interventions to address psychosocial, behavioral, and emotional impairments and to improve occupational performance (A)
  - Goal-directed outpatient rehabilitation to improve ratings of self-performance and satisfaction (A)
  - Goal-directed outpatient rehabilitation to improve goal attainment, occupational performance, psychosocial reintegration, and adjustment levels (B)
  - Aquatic exercise to improve tension, depression, anger, vigor, fatigue, and confusion (B)
  - Functional skills training to improve social participation, community reintegration, independent living, emotional well-being, and quality of life (B)
  - CBT modified to include mindfulness-based cognitive therapy (MBCT) to decrease depression and motivational interviewing to improve anxiety (C)
  - CBT administered in the virtual context to address psychosocial and emotional distress, anxiety, and depression (C)
  - Aerobic exercise to improve self-esteem, depression, quality of life, and community activity (C)

Strength of Recommendation

A–There is strong evidence that occupational therapy practitioners should routinely provide the intervention to eligible clients. Good evidence was found that the intervention improves important outcomes and concludes that benefits substantially outweigh harm.

B–There is moderate evidence that occupational therapy practitioners should routinely provide the intervention to eligible clients. There is high certainty that the net benefit is moderate, or there is moderate certainty that the net benefit is moderate to substantial.

C–There is weak evidence that the intervention can improve outcomes. It is recommended that the intervention be provided selectively on the basis of professional judgement and patient preferences. There is at least moderate certainty that the net benefit is small.

I–There is insufficient evidence to determine whether or not occupational therapy practitioners should be routinely providing the intervention. Evidence that the intervention is effective is lacking, of poor quality, or conflicting and the balance of benefits and harm cannot be determined.

D–It is recommended that occupational therapy practitioners do not provide the intervention to eligible clients. At least fair evidence was found that the intervention is ineffective or that harm outweighs benefits.

Note: Criteria for level of evidence and recommendations (A, B, C, I, D) are based on standard language from the U.S. Preventive Services Task Force (2012). Suggested recommendations are based on the available evidence and content experts' clinical expertise regarding the value of using it.

Kumar et al. (2017) evaluated whether cognitive rehabilitation for people with TBI improves return to work, independence in daily activities, community integration and quality of life. Nine studies with 790 participants were included. Authors state that there is insufficient good-quality evidence to support the role of cognitive rehabilitation when compared to no intervention or conventional rehabilitation in improving return to work, independence in ADL, community integration or quality of life in adults with TBI. There is moderate-quality evidence that cognitive rehabilitation provided as a home program is similar to hospital-based cognitive rehabilitation in improving return to work status among active duty military personnel with moderate-to-severe TBI.

Cicerone et al. (2019) conducted an updated, systematic review of the clinical literature, classify studies based on the strength of research design, and derive consensual, evidence-based clinical recommendations for cognitive rehabilitation of people with traumatic brain injury (TBI) or stroke. Articles were reviewed by the Cognitive Rehabilitation Task Force (CRTF) members according to specific criteria for study design and quality, and classified as providing class I, class II, or class III evidence. Of 121 studies, 41 were rated as class I, 3 as class Ia, 14 as class II, and 63 as class III. Recommendations were derived by CRTF consensus from the relative strengths of the evidence, based on the decision rules applied in prior reviews. CRTF has now evaluated 491 articles (109 class I or Ia, 68 class II, and 314 class III) and makes 29 recommendations for evidence-based practice of cognitive rehabilitation (9 Practice Standards, 9 Practice Guidelines, 11 Practice Options). Evidence supports Practice Standards for (1) attention deficits after TBI or stroke; (2) visual scanning for neglect after right-hemisphere stroke; (3) compensatory strategies for mild memory deficits; (4) language deficits after left-hemisphere stroke; (5) social-communication deficits after TBI; (6) metacognitive strategy training for deficits in executive functioning; and (7) comprehensive-holistic neuropsychological rehabilitation to reduce cognitive and functional disability after TBI or stroke. The results support moderate evidence for cognitive rehabilitation effects on function after TBI and CVA. Niemeijer et al. (2020) evaluated benefits and harms for computer based cognitive rehabilitation (CBCR) on working memory impairment after stroke.

Literature was limited and reported effects of CBCR on working memory after stroke were very heterogeneous. A meta-analysis was not performed as all studies used different measures of working memory. An additional analysis was performed in order to cautiously estimate the difference between the control interventions (whether passive or active) and CBCR interventions. The analysis revealed no meaningful differences in increase of working memory measures between control conditions and intervention conditions. However, this additional analysis should be interpreted with caution as it does not take the heterogeneity of outcome measures or the differences in sample sizes between studies into account. No harms were observed. Authors concluded that there is insufficient evidence to conclude if CBCR is beneficial for patients with working memory deficits after stroke.

Cisneros et al. (2021a) evaluated the impact of a 12-week, 24-session multimodal group cognitive rehabilitation intervention, the Cognitive Enrichment Program (CEP), on executive functioning and resumption of daily activities after traumatic brain injury (TBI) in older individuals as compared with an active control group that received individual holistic rehabilitation as usual care. In total, 37 patients with a TBI and aged 57 to 90 years were assigned to experimental (n = 23) and control (n = 14) groups in a semi-randomized, controlled, before-after intervention trial with follow-up at 6 months, with blinded outcome measurement. The CEP's executive function module included planning, problem solving, and goal management training as well as strategies focusing on self-awareness. Efficacy was evaluated by neuropsychological tests (Six Elements Task-Adapted [SET-A], D-KEFS Sorting test and Stroop four-color version); generalization was measured by self-reporting questionnaires about daily functioning (Dysexecutive Functioning Questionnaire, forsaken daily activities). ANCOVA results showed significant group-by-time interactions; the experimental group showed a statistically significant improvement on Tackling the 6 subtasks and Avoiding rule-breaking measures of the SET-A, with medium effect sizes. The generalization measure, the Dysexecutive Functioning Questionnaire, showed a significant reduction in experimental patient-significant other difference on the Executive cognition subscale. The number of forsaken daily activities was reduced in the experimental versus control group, which was not significant immediately after the CEP but was significant 6 months later. Authors concluded that older adults with TBI can improve their executive functioning, with a positive impact on everyday activities, after receiving multimodal cognitive training with the CEP.

Cisneros et al. (2021b) evaluated the impact of a 12-week, 24-session multimodal group cognitive intervention, the Cognitive Enrichment Program (CEP), on episodic memory in older adults with traumatic brain injury (TBI) compared to an active control group that received usual care in the form of individual holistic rehabilitation. In total, 37 patients with a TBI who were 57 to 90 years old were assigned to experimental (n = 23) and control (n = 14) groups in a semi-randomized, controlled, before-after intervention trial with follow-up at 6 months, with blinded outcome measurement. The CEP's Memory module consisted of memory strategies to promote encoding. Efficacy was evaluated by using

Face-name association, Word list recall, and Text memory measures, and generalization was assessed with the Self-Evaluation Memory Questionnaire (SEMQ), the Psychological General Well-Being Index, and a satisfaction questionnaire. ANCOVA mixed model repeated-measures analysis revealed a strong group-by-time interaction, with the experimental group showing statistically significant improvement on the Face-name association test, with a large effect size. They also found a statistically significant group-by-time interaction on 3 dimensions of the SEMQ generalization measure: the experimental group showed increased memorization of the content of Conversations, reduced Slips of attention, and increased memory of Political and social events, with medium to large effect sizes. The group also showed clinically significant improvements in psychological well-being. Scores on the satisfaction questionnaire indicated a perceived positive impact on daily life habits requiring memory abilities. Authors concluded that CEP is a promising cognitive rehabilitation program for older individuals with TBI, showing high satisfaction in participants, that could improve their episodic memory functioning as well as enhance their psychological well-being.

Radomski et al. (2022) provided a summary of the findings from systematic reviews developed in conjunction with the American Occupational Therapy Association’s Evidence-Based Practice Program. Eleven articles were included in the review related to cognitive interventions to improve a specific cognitive impairment for adults with TBI. Interventions were found to address specific cognitive impairment, multiple cognitive impairments, and cognitive–emotional symptoms associated with concussion. This systematic review provides evidence in support of individual, group, and computer- and virtual-reality-based (VR) intervention approaches to help adults with a range of injury severity associated with TBI to improve on measures of cognition, self-awareness, and quality of life. Evidence regarding the impact of the interventions described here on occupational performance is limited, and the use of domain-specific measures of cognitive information processing may not be adequate to indicate the adoption of such interventions by occupational therapy practitioners. According to the authors, occupational therapy practitioners may consider combining such interventions with therapeutic approaches intended to translate improved cognition to improved occupational performance.

Jeffay et al. (2023) provided an update to the INCOG 2014 guidelines for the clinical management of debilitating and enduring impairments of executive functioning and self-awareness caused by moderate-to-severe traumatic brain injury (MS-TBI). Recommendations relative to cognitive rehabilitation include the following:

- EXEC #1: Self-monitoring and feedback to enhance self-awareness
    - 1a. Strategies that encourage self-monitoring of performance and involve feedback should be used with individuals with TBI who have impaired self-awareness.

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- 1b. Consider self-awareness training such as video feedback to improve the ability to recognize and correct errors during task performance.
- Level A evidence.

- EXEC #2: Metacognitive strategy instructions (e.g., goal management training, plan-do-check-review, and prediction performance) should be used with individuals with TBI for difficulties with a range of executive functioning impairments that may include problem-solving, planning and organization, and other elements of executive function. Common elements of all metacognitive strategies are self-monitoring, incorporating feedback into future performance, and emotional self-regulation training. These strategies should be focused on everyday problems and functional outcomes of personal relevance to the person.
  - Level A evidence.

- EXEC #3: Strategies to improve the capacity to analyze and synthesize information should be used with individuals with TBI who have impaired reasoning skills.
  - Level A evidence.

- EXEC #4: Group-based interventions should be considered for remediation of executive and problem-solving deficits after traumatic brain injury.
  - Level A evidence

- EXEC #6: Where available, authors recommend clinicians consider the use of virtual reality programs, in addition to inperson visits to provide timely and equitable access to care for individuals with a TBI with executive dysfunction.
  - Level A evidence.

- EXEC #7: One-to-one remotely delivered interventions (e.g., for goal management training), set up according to established telerehabilitation guidelines, are recommended if remote delivery is the most convenient or the only mode of reaching the person.
  - Level C evidence.

- EXEC #8: Telerehabilitation-delivered group-based treatments of executive function may not achieve the same outcomes as in person and require further evaluation. Therefore, they are not recommended at this time.
  - Level C evidence.

Togher et al. (2023) reports the updated INCOG 2.0 recommendations for management of cognitive-communication disorders. As social cognition is central to cognitive communication disorders, this update includes interventions for social cognition. Recommendations relative to cognitive rehabilitation include the following:

- Cognitive-communication #1: Rehabilitation staff should recognize that levels of communication competence and communication characteristics may vary as a function of their communication partners, environment, communication demands, communication priorities, fatigue, physical and sensory issues (e.g., vision, hearing), psychosocial variables, behavioral dyscontrol, emotional variables, and other personal factors
    - Level B evidence

- Cognitive-communication #2: A cognitive-communication evaluation and rehabilitation program for individuals with TBI should be culturally responsive and take into account the person's premorbid physical and psychosocial variables, including gender identity; native, first, and preferred languages; literacy and language proficiency; cognitive abilities; communication style considering expectations in the person's cultural linguistic background and tradition; and gender identity
    - Level C evidence.

- Cognitive-communication #4: A person with TBI who has a cognitive-communication disorder should be provided with interventions and intervention materials that are both grounded in the principles of cognitive-communication rehabilitation and individualized, taking the person's context into account to maximize communication competence
    - Recommended cognitive-communication interventions can be direct or indirect at any level of impairment and include:
      a. Communication partner training (level A),
      b. Communication strategy and metacognitive awareness training (level A),
      c. Reintegration to daily functions, productive activities, participation and competence, modification of the communication environment, and assistance with adjustment to impairments (level C),
      d. Communication coping treatment (level C),
      e. Focus on confidence, self-esteem, and identity formation (level C), and
      f. Provision of education and information regarding the nature of acquired cognitive-communication disorders to both the patient and close other and communication partners (level C).
    - Level A-C evidence.

- Cognitive-communication #5: A cognitive-communication rehabilitation program for individuals with TBI should provide the opportunity for practicing and using communication skills in situations appropriate to the context in which the person will live, work, study, and socialize. Goal attainment scaling is recommended as a method to measure person-centered intervention outcomes
    - Level A evidence.

- Cognitive-communication #6: Individuals with severe communication disability following TBI should be provided with proper assessment to determine the appropriate augmentative and alternative communication (AAC) intervention by trained clinicians. The individual and close communication partners should be provided with training to effectively use AAC aids. This training should be ongoing as needs change and technology evolves
    - Level C evidence

- Cognitive-communication #7: Clinicians should consider group therapy as an appropriate means of remediation of cognitive-communication training when social communication impairments exist post-TBI. Where aligned with their communication goals, clinicians should consider group therapy.
    - Level A evidence

- Cognitive-communication #8: Telerehabilitation is as efficacious, feasible, and acceptable for communication partner training compared to in-person intervention.
    - Level B evidence.

- Social cognition #1: Clinicians should consider evaluating aspects of social cognition ability, including emotion perception, theory of mind (ToM), and emotional empathy. Interventions, which aim at improving emotion perception, perspective taking, ToM, and social behavior, are recommended. Computerized social cognition treatments are not recommended given lack of evidence of generalization to real-life activities.
    - Level A evidence.

Velikonja et al. (2023) reviewed interventional research primarily focused on mild to severe memory impairments in episodic and prospective memory. Recommendations relative to cognitive rehabilitation include the following:

Memory #1: Teaching internal compensatory strategies may be used for individuals with TBI who have memory impairments. Their use tends to be most effective with individuals who have mild-to-moderate memory impairments and/or some preserved executive cognitive skills. They include instructional strategies (e.g., visual imagery, repeated practice, retrieval practice, and Preview, Question, Read, State, Test [PQRST]) and metacognitive strategies (e.g., self-awareness and self-regulation).

- Using multiple strategies is considered effective. They can be selected separately or combined in a structured program. Strategies can be taught individually or in a group format. With severe memory impairment, internal compensatory strategies that are effective may be used in conjunction with external memory compensatory strategies
- Level A Evidence.

Memory #2: Environmental supports and reminders (e.g., mobile/smartphones, notebooks, and whiteboards) are recommended for individuals with TBI who have memory impairment, especially for those with severe memory impairment. Individuals with TBI and their caregivers must be trained in how to use these supports.

- The selection of environmental supports and reminders should take into account the following factors:
    - Age
    - Severity of impairment
    - Premorbid use of electronic and other memory devices
    - Cognitive strengths and weaknesses (e.g., executive cognitive skills)
    - Physical comorbidities
    - Affordability, portability, and reliability
- Level A evidence.

Memory #3: Cognitive skills training for moderate to severe (MS)-TBI, across all levels of memory impairment, should be strategy-focused and conducted by a TBI-experienced therapist who can facilitate the functional integration of the strategy being practiced into meaningful and practical tasks. There is little evidence for using restorative techniques such as computerized cognitive training (CCT) alone.

- Level B evidence.

Memory #4: There are several key instructional practices that can promote learning for individuals with TBI memory impairments, which include:

- Clearly defining intervention goals
- Selection of and training of goals that are relevant to the person with TBI (i.e., ecologically valid)
- Allowing sufficient time and opportunity for practice
- Breaking down tasks into smaller components such as task analysis when training multistep procedures
- Use of distributed practice
- Teaching strategies using variations in the stimuli/information being presented (e.g., multiple exemplars)

    - Teaching strategies to promote effortful processing of information/stimuli (e.g., verbal elaboration and visual imagery)
    - Use of techniques that constrain errors (e.g., errorless, spaced retrieval)
    - Consider the use of behavioral memory strategies with a focus on context and imagery in the acquisition phase of learning.
  - Level A evidence.

Memory #5: Group-based interventions may be considered for teaching memory strategies with individuals with MS-TBI, but there is no evidence that it is more effective than individually oriented rehabilitation. Consider reducing heterogeneity in group membership, encourage participation for an adequate number of sessions, and teach generalization of learned skills

- Level A evidence

Ponsford et al. (2023) reviewed evidence published from 2014 and developed updated guidelines for the management of attention in adults, as well as a decision-making algorithm, and an audit tool for review of clinical practice. This update incorporated 27 studies and made 11 recommendations. The team recommends screening for and addressing factors contributing to attentional problems, including hearing, vision, fatigue, sleep-wake disturbance, anxiety, depression, pain, substance use, and medication. Metacognitive strategy training focused on everyday activities is recommended for individuals with mild-moderate attentional impairments. Practice on de-contextualized computer-based attentional tasks is not recommended because of lack of evidence of generalization, but direct training on everyday tasks, including dual tasks or dealing with background noise, may lead to gains for performance of those tasks. Authors note that evidence for interventions to improve attention after TBI is slowly growing. However, more controlled trials are needed, especially evaluating behavioral or nonpharmacological interventions for attention.

Alzheimer’s Disease and Dementia

Clare et al. (2019) sought to determine whether individual goal-oriented cognitive rehabilitation (CR) improves everyday functioning for people with mild-to-moderate dementia. Participants allocated to CR received 10 weekly sessions over 3 months and four maintenance sessions over 6 months. The primary outcome was self-reported goal attainment at 3 months. At 3 months, there were statistically significant large positive effects for participant-rated goal attainment. These effects were maintained at 9 months. The observed gains related to goals directly targeted in the therapy. There were no significant differences in secondary outcomes. Authors concluded that CR enables people with early-stage dementia to improve their everyday functioning in relation to individual goals targeted in the therapy. More studies are necessary to confirm results.

Bahar-Fuchs et al. (2013) authored a Cochrane systematic review on cognitive training and cognitive rehabilitation for mild to moderate Alzheimer's disease and vascular dementia. This review included 11 trials of cognitive training and a single trial of cognitive rehabilitation. Researchers found no evidence for the efficacy of cognitive training in improving cognitive functioning, mood or activities of daily living in people with mild to moderate Alzheimer's disease or vascular dementia; however, the quality of the studies was generally not high. The single trial of cognitive rehabilitation provided preliminary indications of the potential benefits of individual cognitive rehabilitation in improving activities of daily living in people with mild Alzheimer's disease. More high-quality trials of both cognitive training and cognitive rehabilitation are needed to establish their efficacy for people with early-stage dementia. Thus, results demonstrated that cognitive training was not associated with positive or negative effects in relation to any reported outcomes. Authors conclude that available evidence is limited, and the quality of evidence is low, which results in insufficient information from which to draw conclusions. At this time, there is no indication that cognitive training provides significant benefit in this area. The single RCT shows promise, but more high-quality research is necessary. Clare et al. (2019) sought to determine whether individual goal-oriented cognitive rehabilitation (CR) improves everyday functioning for people with mild-to-moderate dementia. Participants allocated to CR received 10 weekly sessions over 3 months and four maintenance sessions over 6 months. The primary outcome was self-reported goal attainment at 3 months. At 3 months, there were statistically significant large positive effects for participant-rated goal attainment. These effects were maintained at 9 months. The observed gains related to goals directly targeted in the therapy. There were no significant differences in secondary outcomes. Authors concluded that CR enables people with early-stage dementia to improve their everyday functioning in relation to individual goals targeted in the therapy. More studies are necessary to confirm results.

Wang et al. (2022) performed a systematic review to re-assess the efficacy of cognitive intervention for the patients with Alzheimer's disease (AD). Cognitive intervention includes cognitive stimulation, cognitive training, and cognitive rehabilitation. Twenty studies (2012 participants) were eventually included. For global cognitive function, the combined mean difference (MD) in eight studies was 1.67 for the short term. The pooled standardized mean difference (SMD) of six RCTs was 1.61 for the medium term. The pooled SMD of seven studies was 0.79 for the long term. Cognitive training may show obvious improvements in global cognitive function whether after short, medium, or long-term interventions. However, the positive effect of the intervention on general cognitive function did not seem to persist after intervention ended. There is still a lack of reliable and consistent conclusions relevant to the effect of cognitive stimulation and cognitive rehabilitation on observed outcomes, cognitive training for memory or other non-cognitive outcomes.

Other Conditions

Schizophrenia

McGrath and Hayes (2000) found that data are inconclusive and provide no evidence for or against cognitive rehabilitation as a treatment for schizophrenia. Only 3 small studies met the inclusion criteria. Two compared cognitive rehabilitation to a placebo intervention (total *n*=84), and the other to occupational therapy (*n*=33). Although cognitive rehabilitation was as acceptable as placebo and occupational therapy, with low attrition in both groups, no effects were demonstrated on measures of mental state, social behavior, or cognitive functioning. Velligan et al. (2006) conducted a literature review to examine research findings on the eight evidence-based approaches to cognitive rehabilitation, as listed in the 2005 Training Grid Outlining Best Practices for Recovery and Improved Outcomes for People with Serious Mental Illness, developed by the American Psychological Association Committee for the Advancement of Professional Practice, for patients with schizophrenia. The eight approaches included: attention process training, integrated psychological therapy, cognitive enhancement therapy, neurocognitive enhancement therapy, cognitive remediation therapy, the neuropsychological educational approach to remediation, errorless learning approaches, and attention shaping. According to the authors, the studies that were included varied considerably in areas such as criteria for study inclusion, the conceptual organization of studies, and interpretation of findings. The authors stated that few approaches had more than three data-based studies supporting their efficacy in schizophrenia and that there are no agreed upon guidelines for levels of intensity or duration of training. The authors concluded that the findings of this review were not uniformly positive but encouraging, which is what they would expect at this stage of cognitive rehabilitation development.

McGurk et al. (2007) conducted a meta-analysis of 26 randomized controlled trials that evaluated the effects of cognitive remediation on cognitive performance, symptoms and psychosocial functioning in 1,151 patients with schizophrenia. The authors reported a medium effect size for cognitive performance (0.41), a slightly smaller effect size for psychosocial functioning (0.36), and a small effect size for symptoms (0.28). According to the authors, the impact of cognitive remediation on function was moderated by several factors including the addition of adjunctive psychiatric rehabilitation, cognitive training method, and patient age. They also noted there was a lack of data regarding long term effects as only six studies examined if results were maintained at a post treatment follow-up (average of eight months). The authors concluded that cognitive remediation may have a moderate effect on cognitive performance and when combined with psychiatric rehabilitation, may improve functional outcomes. Retention of benefit beyond eight months was not explored.

Wykes et al. (2007a) conducted a randomized controlled trial to evaluate if cognitive remediation improved cognition in people with schizophrenia. Eighty-five participants with schizophrenia and cognitive difficulties were randomized to 40 sessions of cognitive remediation (n=43) or treatment as usual (n=42). Outcome measures included working memory, cognitive flexibility, and planning. Evaluations took place at 1, 14, and 40 weeks. For working memory, 21 in the therapy group and 18 in the control group had abnormal working memory scores at baseline. After the intervention, the authors reported a significant advantage to the therapy group at the 14-week post-therapy assessment (p=0.037), but at the time of the 40-week follow-up, there was no longer any statistical significance (p=0.10). There was no difference between the two groups for cognitive flexibility, and there was no statistically significant difference at any point in time for planning. The authors noted that there was a significant group by medication interaction, suggesting that medications may hinder or enhance the effects of cognitive remediation. Methodological considerations, according to the authors, included: some improvement may have been due to increased social interaction, medications may have affected the outcomes, blinding was not maintained, and the sample size was small. Although most of the improvements did not obtain statistical significance, the authors stated that cognitive improvement was noted in many areas.

Wykes et al. (2007b) conducted a single-blind randomized controlled trial of 40 young early onset patients with schizophrenia to evaluate the efficacy of cognitive remediation therapy (CRT) in alleviating cognitive deficits compared to treatment as usual. Twenty-one patients received CRT and 19 received standard care. Primary outcome measures included: cognitive flexibility (measured on the Wisconsin Cars Sort Test [WCST]), memory (measured on Digit Span), planning (measured on the Modified Six Elements Test). Secondary outcomes included: symptoms, social contacts and self-esteem. Assessments took place at baseline, post-treatment (week 14) and follow-up (week 28). The only measure that reached statistical significance when compare to the standard care group was the WCST scores (p = 0.04). The authors stated that larger trials that evaluate the long-term maintenance of the effects of CRT are warranted. Eack et al. (2010) evaluated the one-year durability of the effects of cognitive enhancement therapy on functional outcomes in patients with early schizophrenia (*n*=28) or schizoaffective disorder (*n*=20). Functional outcome was measured using the Social Adjustment Scale-II (SAS-II) and the Major Role Adjustment Inventory (MRA). Patients were randomized to receive cognitive enhancement therapy (CET) or an Enriched Supportive Therapy (EST) control. CET consisted of 60 hours of computer-based training in attention, memory, and problem-solving, integrated with 45 1.5 hour social-cognitive group therapy sessions. EST is a personalized, individual approach including illness management and psychoeducation. Participants met individually with a clinician to learn about schizophrenia, effects of stress and how to develop and apply healthy coping strategies. Significant differences in effects favoring CET on overall social adjusted persisted at one-year follow-up and no significant decreases in adjustment were observed in CET patients during the follow-up period. Patients treated with EST showed a slight but significant level of continued improvement in overall adjustment at 1 year post-treatment. Maintenance of CET effects was found on social functioning in relationships outside the household and participation in social leisure activities, as well as on major role adjustment and overall ratings of global functioning. The authors concluded that the beneficial effects of CET on functional outcome in early schizophrenia can be maintained a year after completion of treatment, and that CET has the potential of a lasting impact on the early trajectory of the disease. The authors acknowledged limitations of the study, including the lack of durability data on cognition, as well as the use of non-blinded raters.

Multiple Sclerosis (MS)

Rosti-Otajärvi and Hämäläinen (2014) addressed neuropsychological rehabilitation for multiple sclerosis in a Cochrane review. The aim of this review was to evaluate the effects of cognitive (neuropsychological) rehabilitation in MS through consideration of the effects of rehabilitation on cognitive test performance and everyday cognitive performance, as well as on depression, fatigue, personality/behavior disturbances, anxiety and quality of life. Twenty relevant studies comprising a total of 986 participants (966 MS participants and 20 healthy controls) were identified and included in this review. Low-level evidence was found that neuropsychological rehabilitation reduces cognitive symptoms in MS. Cognitive training was found to improve memory span and working memory. Cognitive training combined with other neuropsychological rehabilitation methods was found to improve attention, immediate verbal memory and delayed memory. However, small sample sizes and some methodological weaknesses reduce the rating of the evidence to a low-level. And there was no evidence of an effect of neuropsychological rehabilitation on emotional functions. In conclusion, this review found low-level evidence for positive effects of neuropsychological rehabilitation in MS. The interventions and outcome measures included in the review were heterogeneous, which limited the comparability of the studies. New trials may therefore change the strength and direction of the evidence.

Messinis et al. (2017) studied the efficacy of a computer-assisted CR intervention in relapsing-remitting MS (RRMS) patients. Fifty-eight clinically stable RRMS patients with mild to moderate cognitive impairment and relatively low disability status were randomized to receive either computer assisted (RehaCom) functional cognitive training with an emphasis on episodic memory, information processing speed/attention, and executive functions for 10 weeks or standard clinical care. Only the intervention group showed significant improvements in verbal and visuospatial episodic memory, processing speed/attention, and executive functioning from pre – to post-assessment. Also, treated patients rated the intervention positively and were more confident about their cognitive abilities following treatment. Mani et al. (2018) investigated the efficacy of group compensatory cognitive rehabilitation (CR) in patients with MS-related cognitive impairment. CR intervention consisted of eight 2-hour sessions of comprehensive group CR over a 4-week period that focused on improvement of memory, attention, and executive function. As placebo, the control group received the same number of non-therapeutic group sessions. Assessment of cognitive function was performed before intervention (pretest), at the end of intervention (post-test), and 3 months later (follow-up). Results demonstrated significantly higher scores in the CR group for memory and executive function. Authors concluded that this study supported the efficacy of group CR in the improvement of cognitive function in patients with MS. Mousavi et al. (2018) evaluated the effectiveness of cognitive rehabilitation on everyday memory in multiple sclerosis patients. A total of 60 multiple sclerosis patients with cognitive impairment were randomly assigned to three groups, experimental, placebo and control. The results indicated that a cognitive rehabilitation program had a positive effect on the everyday memory of patients in the experimental group post-intervention. However, there was no significant effect of intervention 5 weeks post-intervention. Authors concluded that this study demonstrated that cognitive rehabilitation had a positive effect on the everyday function of the multiple sclerosis patients. However, the effect did not last, and that everyday memory function returned to its pre-intervention level.

Rilo et al. (2018) aimed to determine the efficacy of the integrative group-based cognitive rehabilitation program, REHACOP, on improving cognitive functions in multiple sclerosis (MS). Forty-two MS patients were randomized to the treatment program or waiting list control condition. The REHACOP group received cognitive rehabilitation in group format for three months focused on attention, processing speed, learning and memory, language, executive functioning, and social cognition. Patients receiving REHACOP showed improvements in several cognitive domains. Authors suggested that this study provided initial evidence for integrative group-based cognitive rehabilitation efficacy in MS patients through the implementation of the REHACOP cognitive rehabilitation program.

Stuifbergen et al. (2018) sought to determine the effectiveness of a novel computer-assisted cognitive rehabilitation intervention MAPSS-MS (Memory, Attention, Problem Solving Skills in MS) in a multi-site trial with persons with MS. Persons with MS with cognitive concerns were randomly assigned to either the 8-week MAPSS-MS intervention or usual care plus freely available computer games. Results demonstrated that both groups improved significantly on all outcome measures. The intervention group outperformed the comparison group on all measures, and there were statistically significant differences on selected measures. Dardiotis et al. (2018) aim to quantitatively investigate the effect of computer-based cognitive rehabilitation on the neuropsychological performance of patients with MS. In total, 9 studies fulfilled the criteria for inclusion. Authors concluded that computer-based cognitive training was found to improve the performance in the memory domain of MS patients compared to control interventions. Goverover et al. (2018) updated the clinical recommendations for cognitive rehabilitation of people with multiple sclerosis (MS) in a systematic review. Fifty-nine articles were selected for inclusion after initial screening. Forty studies were fully reviewed and evaluated. Authors concluded that substantial progress has been made since the previous review regarding the identification of effective treatments for cognitive impairments in persons with MS. However, more research is required with better methodology to support this therapy for patients with MS.

Brochet et al. (2021) reviewed all blinded RCTs on CR in MS published since 2013. After the exclusion of some papers not specifically focused on CR, a final list of 26 studies was established. The papers belong to three main categories: individual specific rehabilitation (8studies), group rehabilitation (4 studies), and computerized training (CT) (14 studies), while one study combined group rehabilitation and CT. Among the individual rehabilitation studies, 5 were devoted to memory, and most of the 19 other selected studies were about several cognitive domains. Most of the studies mainly concerned RRMS patients, except for 2 studies that were carried out exclusively in progressive forms. Despite the methodological limitations of some studies and the great heterogeneity of the protocols, the results are generally in favor of the efficacy of CR in neuropsychological tests. Authors concluded that recent blinded RCTs about CR in MS show promising results. Chen et al. (2021) provided a brief overview of cognitive rehabilitation in MS. There is limited evidence that disease-modifying therapies are effective in treating cognitive dysfunction. Cognitive rehabilitation is a promising approach to treat cognitive dysfunction in MS, gaining empirical support over the last 10 years. Overall, there is evidence that cognitive rehabilitation programs (either restorative or compensatory) are efficacious in treating MS-related cognitive dysfunction. Clinicians should consider this low-cost, low-risk, yet effective treatment approach for their patients.

Longley (2022) outlined the evidence supporting cognitive rehabilitation in MS. More intensive compensatory and restorative cognitive rehabilitation interventions can be effective in MS. Choosing an intervention will depend on the patients' goals, which may range from specific everyday activity/participation goals to preserving existing cognitive functioning by building up cognitive reserve or delaying further cognitive decline by slowing the underlying neurobiological changes. Both compensatory and restorative forms of cognitive rehabilitation interventions can improve a patient’s everyday cognitive functioning, quality of life, mood and/or coping with cognitive impairments in daily life, not just improve their performance on cognitive tests. General practitioners can best assist their patients by understanding the treatment options and facilitating their patients' access to the most appropriate cognitive rehabilitation services available.

Nauta et al. (2023) investigated the effectiveness of cognitive rehabilitation therapy (CRT) and mindfulness-based cognitive therapy (MBCT) on patient-reported cognitive complaints in MS. In this randomized-controlled trial, MS patients with cognitive complaints completed questionnaires and underwent neuropsychological assessments at baseline, post-treatment and 6-month follow-up. Patient-reported cognitive complaints were primarily investigated. Secondary outcomes included personalized cognitive goals and objective cognitive function. CRT and MBCT were compared to enhanced treatment as usual (ETAU). Patients were randomized into CRT (n = 37), MBCT (n = 36) or ETAU (n = 37), of whom 100 completed the study. Both CRT and MBCT positively affected patient-reported cognitive complaints compared to ETAU at post-treatment ($p<.05$), but not 6 months later. At 6-month follow-up, CRT had a positive effect on personalized cognitive goals (p=.028) and MBCT on processing speed (p=.027). Patients with less cognitive complaints at baseline benefited more from CRT on the Cognitive Failures Questionnaire (i.e. primary outcome measuring cognitive complaints) at post-treatment (p=.012-.040), and those with better processing speed at baseline benefited more from MBCT (p=.016). Authors concluded that both CRT and MBCT alleviated cognitive complaints in MS patients immediately after treatment completion, but these benefits did not persist. In the long term, CRT showed benefits on personalized cognitive goals and MBCT on processing speed. These results thereby provide insight in the specific contributions of available cognitive treatments for MS patients.

Parkinson's Disease

Díez-Cirarda et al. (2018) performed a critical review to present up-to-date neurorehabilitation effects of cognitive rehabilitation in Parkinson's Disease, with special emphasis on the efficacy on cognition, quality of life aspects, brain changes, and the longitudinal maintenance of these changes. Thirteen studies were reviewed, including 6 randomized controlled trials for the efficacy on cognition, 2 randomized controlled trials regarding the brain changes after cognitive training, and 5 studies which evaluated the long-term effects of cognitive treatments. Authors concluded that cognitive rehabilitation programs have demonstrated to be effective on improving cognitive functions, but more research is needed focusing on the efficacy on improving behavioral aspects and producing brain changes in patients with PD. Moreover, authors state there is a need of randomized controlled trials with long-term follow-up periods. Alzahrani and Venneri (2018) reviewed the existing literature on the efficacy of cognitive rehabilitation in PD. Authors identified 15 articles that examined the effects of cognitive rehabilitation in PD and met inclusion criteria. The main outcomes of this review indicated that, although previous studies used different CR methodologies, all studies reported cognitive improvements on at least 1 cognitive domain. Additionally, the most frequent cognitive domains showing improvements were executive functions and attention. The authors concluded that this review reported the outcomes of studies that examined the effectiveness of CR in PD. It also pointed out the drawbacks of the studies indicating the limited availability of follow-up data on the long-term effects of CR. The review also high-lighted the fact that some of the studies did not include a PD group who did not undergo training. Thus, these researchers noted that there is a need for longitudinal studies to examine the potential long-term benefits of cognitive training. In addition, future investigations should determine if any disease characteristics such as disease stage, degree of cognitive impairment and/or the dominant side (right/left) or specific motor symptoms (rigidity/tremor) influence treatment efficacy.

Svaerke et al. (2020) evaluated effects of computer-based cognitive rehabilitation (CBCR) on working memory (WM) in patients with PD. Only six studies were included despite broad inclusion criteria. Study results were heterogeneous, and the risk of bias in study methodology was either unclear or high. Two studies were eligible for meta-analysis. A meta-analysis was not performed, because these studies used different measures of WM which were not rated as equally valid and reliable. Authors concluded that the existing literature is sparse and provides insufficient evidence to conclude if CBCR benefits WM in PD patients. Sanchez-Luengos et al. (2021) performed a systematic review and meta-analysis regarding the effectiveness of cognitive rehabilitation in non-demented PD patients. Twelve articles were selected according to PRISMA guidelines. The systematic review showed that attention, working memory, verbal memory, executive functions and processing speed were the most frequently improved domains. Meta-analysis results showed moderate effects on global cognitive status and working memory; small significant effects on verbal memory, overall cognitive functions and executive functions; small non-significant effects on attention, visual memory, verbal fluency and processing speed; and no effect on visuospatial and visuoconstructive abilities. Depressive symptoms showed small effect and quality of life showed no effect. A meta-regression was performed to examine moderating variables of overall cognitive function effects, although moderators did not explain the heterogeneity of the improvement after cognitive rehabilitation. The findings suggest that cognitive rehabilitation may be beneficial in improving cognition in non-demented PD patients, although further studies are needed to obtain more robust effects.

Gavelin et al. (2022) aimed to investigate the efficacy of Computerized cognitive training CCT on cognitive, psychosocial and daily function, and assess potential effect moderators in people with PD without dementia. Randomized controlled trials of CCT were included in multivariate meta-analyses and meta-regressions. Seventeen studies (16 trials) encompassing 679 participants were included. The pooled effect of CCT relative to control was small and statistically significant for overall cognitive function. There was robust evidence for benefit on clinical measures of global cognition across 10 trials, especially in PD with mild cognitive impairment (PD-MCI), as well as on individual cognitive domains. Greater CCT dose and PD-MCI population were associated with larger effect sizes, but no statistically significant differences were found between subgroups. There was no significant difference in the efficacy of home-based compared to supervised training. Authors findings suggest that CCT is associated with cognitive benefits in PD, including when delivered remotely. Larger, well-powered trials are warranted to examine what specific CCT regimens are most likely to promote cognitive and everyday functioning in the long-term.

Brain Tumors

Weyer-Jamora et al. (2021) reviewed the effectiveness of post-acute cognitive rehabilitation across the continuum of care for adult patients with a brain tumor. Most treatment focus has been on acute rehabilitation, but emerging evidence supports outpatient and post-acute settings. The cognitive impairments including processing speed, attention, memory, and executive function resulted in positive outcomes with a multidisciplinary approach to treatment. Ongoing development of cognitive screenings and planning during the medical course of care are suggested to improve cognitive rehabilitation outcomes and supported in the clinical practice of treatment of this population. Although additional research is warranted to differentiate the specific outcomes resulting from cognitive rehabilitation for varying tumor grades and stages, authors conclude that the multidisciplinary approach and cognitive intervention was beneficial for cognitive outcomes in patients diagnosed with a brain tumor across programs.

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