HEART & STROKE FOUNDATION | CANADIAN Stroke BEST PRACTICE RECOMMENDATIONS

CANADIAN STROKE BEST PRACTICE RECOMMENDATIONS

Mood, Cognition and Fatigue Following Stroke

Evidence Tables

Vascular Cognitive Impairment: Cognitive Rehabilitation

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Mood, Cognition and Fatigue Writing Group

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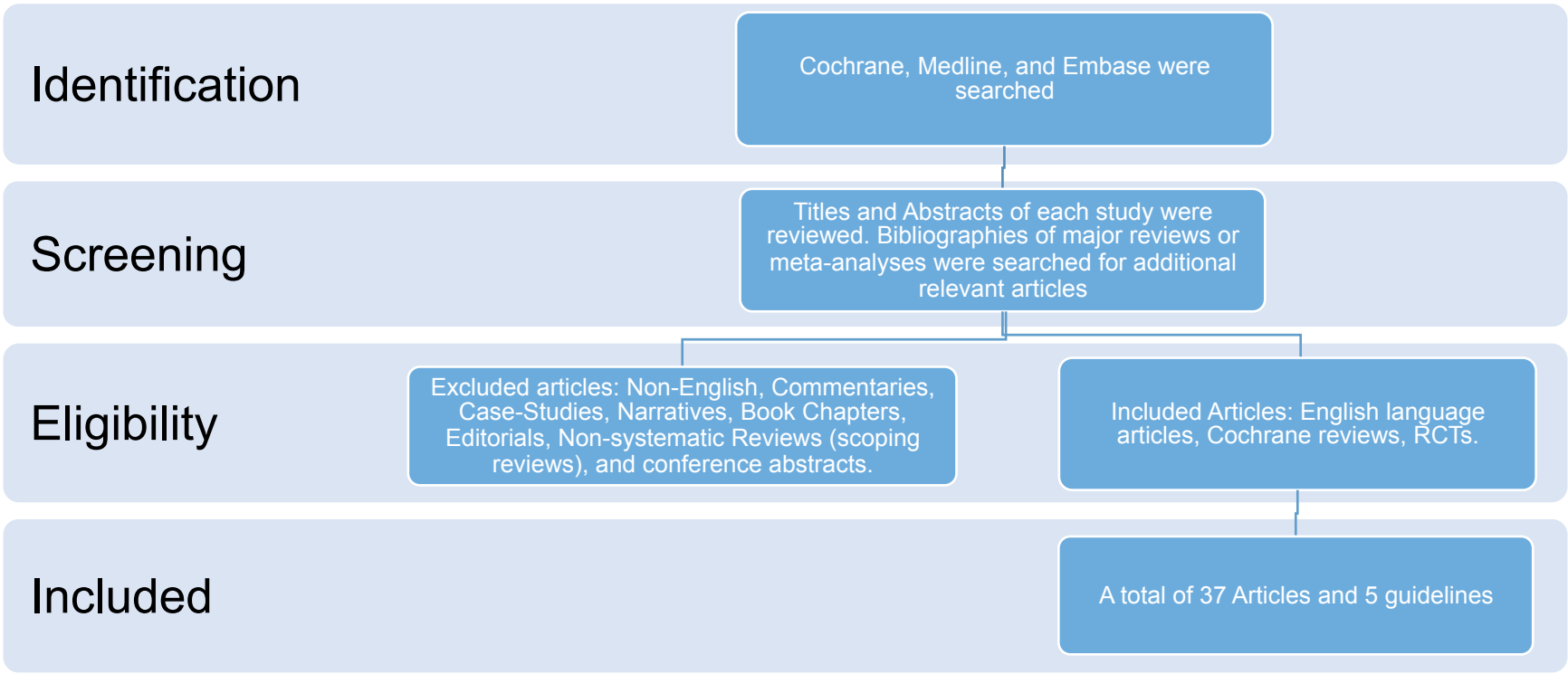
Search Strategy



The Medline, Embase, PsycInfo, and Cochrane databases were searched using the terms [stroke OR cerebrovascular disorders] and [cognition OR neuropsychology OR mild cognitive impairment OR cognitive training OR cognitive rehabilitation]. The title and abstract of each article was reviewed for relevance. Bibliographies were reviewed to find additional relevant articles. Articles were excluded if they were: non-English, commentaries, case-studies, narrative, book chapters, editorials, non-systematic review, or conference abstracts. Additional searches for relevant best practice guidelines were completed and included in a separate section of the review. A total of 37 articles and 5 guidelines were included and were separated into categories designed to answer specific questions.

Published Guidelines

Guideline	Recommendations
National Stroke Foundation. Clinical Guidelines for Stroke Management 2010 Recommendations. Melbourne Australia.	**Assessment of Cognition** 1. All patients should be screened for cognitive and perceptual deficits using validated and reliable screening tools (GPP). 2. Patients identified during screening as having cognitive deficits should be referred for comprehensive clinical neuropsychological investigations (GPP). **Attention and Concentration** 1. Cognitive rehabilitation can be used in stroke survivors with attention and concentration deficits (C). **Memory** 1. Any patient found to have memory impairment causing difficulties in rehabilitation or adaptive functioning should: • Be referred for a more comprehensive assessment of their memory abilities (GPP) • Have their nursing and therapy sessions tailored to use techniques which capitalize on preserved memory abilities (GPP) • Be assessed to see if compensatory techniques to reduce their disabilities, such as notebooks, diaries, audiotapes, electronic organizers and audio alarms, are useful (D) • Be taught approaches aimed at directly improving their memory (GPP) • Have therapy delivered in an environment as like the patient's usual environment as possible to encourage generalization (GPP) **Executive functions** 1. Patients considered to have problems associated with executive functioning deficits should be formally assessed using reliable and valid tools that include measures of behavioural symptoms (GPP). 2. External cues, such as a pager, can be used to initiate everyday activities in stroke survivors (C). In stroke survivors with impaired executive functioning, the way in which information is provided should be considered (C).
Intercollegiate Stroke Working Party. National clinical guideline for stroke, 4th edition. London: Royal College of Physicians, 2012.	**Cognitive impairments** 1. Interventions or patient management should be organised so that people with cognitive difficulties can participate in the treatments and are regularly reviewed and evaluated. 2. Every patient seen after a stroke should be considered to have at least some cognitive losses in the early phase. Routine screening should be undertaken to identify the patient's broad level of functioning, using simple standardised measures (eg Montreal Cognitive Assessment (MOCA)). 3. Any patient not progressing as expected in rehabilitation should have a more detailed cognitive assessment to determine whether cognitive losses are causing specific problems or hindering progress. 4. Care should be taken when assessing patients who have a communication impairment. The advice from a speech and language therapist should be sought where there is any uncertainty about these individuals' cognitive test results (see section 6.20). 5. The patient's cognitive status should be taken into account by all members of the multidisciplinary team when planning and delivering treatment. 6. Planning for discharge from hospital should include an assessment of any safety risks from persisting cognitive

Guideline	Recommendations
	impairments. 7. Patients returning to cognitively demanding activities (eg some work, driving) should have their cognition assessed formally beforehand. **Attention and concentration** 1. Any person after stroke who appears easily distracted or unable to concentrate should have their attentional abilities (eg focused, sustained and divided) formally assessed. 2. Any person with impaired attention should have cognitive demands reduced through: • having shorter treatment sessions • taking planned rests • reducing background distractions • avoiding work when tired. 3. Any person with impaired attention should: • be offered an attentional intervention (eg Time Pressure Management, Attention Process Training, environmental manipulation), ideally in the context of a clinical trial • receive repeated practice of activities they are learning. **Memory** 1. Patients who complain of memory problems and those clinically considered to have difficulty in learning and remembering should have their memory assessed using a standardised measure such as the Rivermead Behavioural Memory Test (RBMT). 2. Any patient found to have memory impairment causing difficulties in rehabilitation or undertaking activities should: • be assessed medically to check that there is not another treatable cause or contributing factor (eg delirium, hypothyroidism) • have their profile of impaired and preserved memory abilities determined (as well as the impact of any other cognitive deficits on memory performance, for example attentional impairment) • have nursing and therapy sessions altered to capitalise on preserved abilities • be taught approaches that help them to encode, store and retrieve new information, for example, spaced retrieval (increasing time intervals between review of information) or deep encoding of material (emphasising semantic features) • be taught compensatory techniques to reduce their prospective memory problems, such as using notebooks, diaries, electronic organisers, pager systems and audio alarms • have therapy delivered in an environment that is as similar to the usual environment for that patient as possible. **Executive Functioning** 1. Any person who appears to have adequate skills to perform complex activities but who fails to organise the tasks needed should be formally assessed for the dysexecutive syndrome, for example using the Behavioural Assessment of the Dysexecutive Syndrome (BADS). 2. Any person with an executive disorder and activity limitation should be taught compensatory techniques. This may include internal strategies (eg self-awareness and goal setting) and/or external strategies (eg use of electronic organisers or pagers, or use of written checklists) ideally in the context of a clinical trial. 3. When a patient's activities are affected by an executive disorder, the nature and effects of the impairment and ways of supporting and helping the patient should be discussed with others involved (eg family, staff).

Guideline	Recommendations
	Psychological Care 1. Interventions for individual disorders of mood or cognition should be applied within the framework of a stepped care and comprehensive model. 2. Patients with continuing disorders should be considered for comprehensive interventions tailored towards developing compensatory behaviours and the learning of adaptive skills. 3. Within Step 1 care all patients after stroke should be screened within 6 weeks of diagnosis, using a validated tool, to identify mood disturbance and cognitive impairment. 4. Any patient assessed as having a cognitive impairment should be considered for referral to a specialist in cognitive aspects of stroke. Patients identified as having cognitive impairment or mood disorder should be reassessed before discharge decisions are taken.
Scottish Intercollegiate Guidelines Network (SIGN). Management of patients with stroke: Rehabilitation, prevention and management of complications, and discharge planning: A national clinical guideline, 2010. Edinburgh, Scotland.	• A full understanding of the patient's cognitive strengths and weaknesses should be an integral part of the rehabilitation plan (GPP). • Stroke patients should have a full assessment of their cognitive strengths and weaknesses when undergoing rehabilitation or when returning to cognitively demanding activities such as driving or work (GPP). • Cognitive assessment may be carried out by occupational therapists with expertise in neurological care, although some patients with more complex needs will require access to specialist neuropsychological expertise (GPP). **Cognitive rehabilitation**: "There is not yet sufficient evidence to support or refute the benefits of cognitive rehabilitation for patients with problems of attention or memory. When cognitive problems are suspected and relatives report personality change, the patient can be referred to a clinical psychologist to provide assessment and where appropriate, psychological intervention which may include carer education and support" (page 22)
VA/DoD clinical practice guideline for the management of stroke rehabilitation 2010.	**Assessment of cognitive function** 1. Assessment of arousal, cognition, and attention should address the following areas: a. Arousal b. Attention deficits c. Visual neglect d. Learning and Memory deficits e. Executive function and problem-solving difficulties 2. There is insufficient evidence to recommend for the use of any specific tools to assess cognition. Several screening and assessment tools exist. (See Appendix B for standard screening instruments for cognitive assessment.) **Use of standardized assessments** 1. Recommend that all patients should be screened for depression and motor, sensory, cognitive, communication, and swallowing deficits by appropriately trained clinicians, using standardized and valid screening tools. [C] 2. If depression, or motor, sensory, cognitive, communication, or swallowing deficits are found on initial screening assessment, patients should be formally assessed by the appropriate clinician from the coordinated rehabilitation team. [C] **Non-drug therapies for cognitive impairment** a. Recommend that patients be given cognitive re-training, if any of the following conditions are present:

Guideline	Recommendations
	a. Attention deficits [A] b. Visual neglect [B] c. Memory deficits [B] d. Executive function and problem-solving difficulties [C] 2. Patients with multiple areas of cognitive impairment may benefit from a variety of cognitive re-training approaches that may involve multiple disciplines. [C] 3. Recommend the use of training to develop compensatory strategies for memory deficits in post-stroke patients who have mild short term memory deficits. [B] **Use of drugs to improve cognitive impairment** 1. Consider using acetylcholinesterase inhibitors (AChEIs), specifically galantamine, donepezil, and rivastigmine, in patients with vascular dementia or vascular cognitive impairment in the doses and frequency used for Alzheimer's disease. 2. Consider using the NMDA receptor inhibitor memantine (Namenda) for patients with vascular dementia (VaD) or vascular cognitive impairment (VCI). [B] 3. The use of conventional or atypical antipsychotics for dementia-related psychosis or behavioral disturbance should be used with caution for short term, acute changes. 4. Recommend against centrally acting a2-adrenergic receptor agonists (such as clonidine and others) and a1-receptor antagonists (such as prazosin and others) as antihypertensive medications for stroke patients because of their potential to impair recovery. [D] Recommend against the use of amphetamines to enhance motor recovery following stroke. [D]
Duncan PW, Zorowitz R, Bates B, et al. Management of adult stroke rehabilitation care: a clinical practice guideline. Stroke 2005;36:e100-e143.	**Assessment of Cognition and Communication** 1. Recommend that assessment of cognition, arousal, and attention address the following areas: learning and memory, visual neglect, attention, apraxia, and problem solving. 2. The Working Group does not recommend for or against the use of any specific tools to assess cognition. Several screening and assessment tools exist. Appendix D includes standard instruments for assessment of cognition. **The use of standardized assessment tools** 1. Recommend that all patients be screened for depression and motor, sensory, cognitive, communication, and swallowing deficits by appropriately trained clinicians, using standardized and valid screening tools. 2. Recommend that if depression and motor, sensory, cognitive, communication, and swallowing deficits are found, all patients should be formally assessed by the appropriate clinician from the coordinated rehabilitation team. **Cognitive Remediation** b. Recommend that patients be assessed for cognitive deficits and be given cognitive retraining, if any of the following conditions are present: Attention deficits, Visual neglect, Memory deficits, or Executive function and problem-solving difficulties c. Patients with multiple areas of cognitive impairment may benefit from a variety of cognitive retraining approaches that may involve multiple disciplines. Recommend the use of training to develop compensatory strategies for memory deficits in poststroke patients who have mild short-term memory deficits.

Evidence Tables

Cognitive Rehabilitation

Factors underlying rehabilitation

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Jones and Riazi 2011 **Systematic review**	n/a	22 articles examining the relationship between self-efficacy and stroke rehabilitation outcomes or the effectiveness of a post-stroke self-management program.	Articles were identified using a combination of electronic and hand-searching techniques. Included articles were summarized using a narrative approach.	n/a	The authors report that self-efficacy is associated with quality of life, depression, activities of daily living, and physical functioning, although further research is needed to confirm these findings. The authors also report that there is some evidence to support the use of self-management programs based on self-efficacy principles, though more research is also needed this area to determine optimal formats of delivery.
Chan et al., 2013 **USA** **Prospective Longitudinal cohort study** **Added 2014**	No intervention	222 patients post-stroke were enrolled and completed the study Exclusion criteria: TIA, tumour, significant brain trauma, age < 18 years, survival prognosis < 6 months, non Kaiser health plan patients	Patients were assessed twice: at discharge from acute care facility and again 6 months later. Trajectory was followed, and patients were grouped based on type of rehab treatment: 36% - home (no treatment) 22% - home health care/outpatient 30% - included inpatient rehab facility 13% - skilled nursing facility w/o inpatient rehab admission	Primary outcome measure: Boston University Activity Measure for Post Acute Care (AM-PAC), which contains three functional domains (basic mobility, daily activities, applied cognitive functioning - using phone, following complex instructions, reading print material). 7 point change in AM-PAC score reflects minimal detectable change in cognitive domain. Computer version was used which adjusts questions asked to patients based on previous response to reduce burden.	Note: age, and functional impairment, and therapy time were not consistent across groups. Regression: after controlling for age, BMI, function at acute discharge, history of previous stroke, rehospitalization status, total hours of rehab, those who went to IRF had significant improvements in applied cognitive function compare to those who received HH/OP, but no difference to those who went home with no treatment.
Koh et al. 2009 **Australia**	n/a	102 occupational therapists who worked with stroke patients at the time of study enrolment.	Participants completed an on-line questionnaire.	Theoretical approaches, assessment tools used, interventions used, and use of research.	The majority of respondents reported using client-centred and compensatory approaches often or all of the time with inpatients (81.3% vs 78.9%) and outpatients (72% vs. 67.9%). The

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Survey					most commonly used cognitive screening and assessment tools were the MMSE (63.7%) and the LOTCA (45.1%), respectively. Respondents most frequently reported using ADL training (88.5%) and instrumental ADL training (83.9%) most or all of the time for intervention, although 67.8% reported using compensatory techniques. 60.8% of respondents reported that they used research literature to inform clinical decisions most or all of the time, whereas 88.3% reported using past experience.

Cardiovascular Risk Factors

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Hsu et al. 2011 **Taiwan** **Cohort study**	n/a	127,209 individuals 50 years of age or older and dementia-free at the time of enrolment.	The Longitudinal Health Insurance Database was used to collect data regarding diagnosis of dementia and Type 2 diabetes and prescription of diabetes medications for an 8-year period.	Incident dementia.	20% (n=25,393) of the cohort were diabetic and, of these, 59% were prescribed sylfonylureas or metformin medication. The dementia incidence rate was 46.2 (95% CI 44.6 to 47.4) per 10,000 person years for non-diabetics, as compared to 119 (95% CI 108 to 130) per 10,000 person years for untreated diabetic individuals, 117 (95% CI 101-34) for diabetics treated with sylfonylureas, 95.4 (95% CI 72.5 to 118) for diabetics treated with metformin, and 77.8 (95% CI 70.2 to 85.4) for diabetics treated with both medications.
Knopman et al., 2001 **Atherosclerosis Risk in Communities (ARIC) Cohort Longitudinal** **Minnesota**	n/a	At first assessment subjects ranged 47-70 yrs. Retested individuals: 8,729 white subjects, 2,234 black subjects. Women (n = 6,126) Educational varied (45% with 9 - 12 years, 39% with at least some college)	Cognitive assessment given twice with 6 years in between each assessment.	Cognition: Delayed word recall (DWR) test, the digit symbol subtest (DSS) of the Wechsler Adult Intelligence Scale–Revised (WAIS-R) and the first-letter word fluency (WF) test. Hypertension (BP) Diabetes mellitus (blood	In multivariate analyses (controlling for demographic factors), the presence of diabetes at baseline was associated with greater decline in scores on both the DSS and WF ($p < 0.05$), and the presence of hypertension at baseline was associated with greater decline on the DSS alone ($p < 0.05$). The association of diabetes with cognitive decline persisted when analysis was restricted to

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
				glucose) Hyperlipidemia Non-steroidal anti-inflammatory drug use Carotid wall intima–media thickness	the 47- to 57-year-old subgroup. Smoking status, carotid intima–media wall thickness, and hyperlipidemia at baseline were not associated with change in cognitive test scores.
Novak & Hajjar, 2010 **Non-Systematic Review**	n/a	From Table 2: Studies ranged from having 1,814, participants to 19,836 participants, Ranging in age from 30-74.	From Table 2: Cross sectional, and follow-ups (4-14 years)	MCI, MMSE, Neuropsych tests	General Conclusion: Substantial evidence exists supporting the link between BP and cognition. This relationship might be mediated by impairment of vascular reserve and microvascular disease. Both hypertension and hypotension contribute to cognitive decline, and a combination of vascular risk factors during an individual's lifetime could accelerate functional cognitive loss later in life. Combined anti-hypertensive therapy could have protective effects on vascular disease and cognition. Effective approaches for prevention of cognitive decline, risk reduction, and extension of survival are needed for treatment of hypertension in old age.
Freitag et al., 2006 **The Honolulu-Asia Aging Study (Cohort)**	n/a	Population-based study of Japanese American men born between 1900 and 1919 and living on Oahu, Hawaii	Participants examined on 3 times between 1965 and 1974. Of 4768 survivors, 3734 (80%) participated in a fourth examination including dementia case–finding between 1991 and 1993. A further 2 examinations were subsequently carried out between 1994 and 1999, with participation rates among survivors of 84% and 90%, respectively.	Total cohort was screened with the 100-point Cognitive Abilities Screening Instrument (CASI), 21 and a subset was selected to undergo further evaluation that included more detailed neuropsychologic testing, a neurologic examination, and a proxy interview.	Over a mean of 5.1 years of follow-up, 189 cases (7.5%) of incident Alzheimer disease or vascular dementia were identified. After adjustment for cerebrovascular risk factors, dementia was significantly associated with systolic blood pressure, but not with pulse pressure tertiles.
Williamson et al., 2014	CA: ☒ Blinding: Patient ☒	A North American multi-center clinical trial including 2977 participants without	Cognition was assessed at baseline and 20 and 40 months.	Primary: Digit Symbol Substitution Test	The primary outcome, DSST score, declined in the BP and lipid intervention groups but no significant difference in the adjusted 40-month

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MIND sub-study of ACCORD Trial **Randomized Clinical Trial**	Assessor☒ ITT: ☒	baseline clinical evidence of cognitive impairment or dementia and with hemoglobin A1c (HbA1c) levels less than 7.5% randomized to a systolic BP goal of less than 120 vs less than 140 mm Hg (n = 1439) or to a fibrate vs placebo in patients with low-density lipoprotein cholesterol levels less than 100 mg/dL (n = 1538).		Secondary: Rey Auditory Verbal Learning Test, Stroop Color-Word Test, Mini-Mental State Examination Subset of participants underwent MRI	DSST mean scores between intensive vs standard BP therapy Mean 40-month cognitive function did not differ between intervention groups in the BP or the lipid trial for any of the other 3 cognitive tests.

Attention

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Loetscher and Lincoln 2013 **Cochrane Review and Meta-analysis**	n/a	6 RCTs (n=223) comparing cognitive rehabilitation to usual care among patients with stroke. Trials that included >25% of participants with conditions other than stroke were excluded unless subgroup analyses were reported.	Trials were identified through electronic and manual search techniques and methodological quality was assessed according to the Cochrane Collaboration Guidelines. Pooled data was analyzed using fixed-effects methods and summarized as mean difference or standardised mean difference, as appropriate. Heterogeneity was assessed with the I^2 statistic.	**Primary outcome**: measures of global attentional functions. **Secondary outcomes**: measures of attention, activities of daily living, mood, and quality of life.	A non-significant trend in favour of cognitive rehabilitation was reported In terms of the effect of cognitive rehabilitation on measures of global attention functions at the end of treatment, as compared to care as usual (SMD 0.53, 95% CI -0.03 to 1.08, p=0.06; based on 2 trials, n=53). Cognitive rehabilitation was not associated with significant long-term effects (>3 months following the end of treatment) on global attention functions (SMD 0.16, 95% CI -0.23 to 0.56, p=0.41; based on 2 trials, n=99). Cognitive rehabilitation was associated with a significant treatment effect on divided attention (measured using the Paced Auditory Serial Addition Test), as compared to usual care (SMD 0.67, 95% CI 0.35 to 0.98, p<0.001; based on 4 trials, n=165).

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Cha & Kim, 2013 **Korea** **Systematic review & meta analysis** **Added 2014**	n/a	12 studies included in systematic review, and 8 in the meta analysis Acute in 6 studies, chronic in 6 studies (from M= 6 weeks to 4.1 yrs) Included studies used computer-based cognitive rehabilitation programs (CBCR) with different studies targeting different domains. Treatment sessions and periods varied from 10 to 60 minute sessions and 3 to 6 week periods.	Papers Included: Between January 1980 and February 2012. Found through Cochrane database, EBSCO (CINAHL), PsychINFO, PubMed, and Web of Science Keywords: computer, cognitive rehabilitation, stroke, etc. Inclusion: adults with stroke, intervention in computer-based cognitive rehab, outcome variable is cognitive function assessed by validated standardized evaluation tools 107 identified, 95 excluded due to insufficient data, leaving 12 studies	Meta-analysis statistics - authors calculated statistical heterogeneity effect size and publication bias using Comprehensive Meta Analysis v 2.0. Cochran's Q test conducted to see if results of individual studies are statistically significant. (Q < 0.1, heterogeneity is significant). Publication bias evaluated by funnel plot (points are asymmetric if publication bias exists) and Egger's regression intercept (p > 0.05 indicates no publication bias)	Data on effectiveness of CBCR in improving cognitive functions were not significantly heterogeneous Overall effect size of CBCR in patients with stroke as 0.54 (medium effect) Effect size for acute = 0.54 and chronic = 0.54. No publication bias was detected.
Cicerone et al. 2011 **Systematic Review and Meta-analysis** **From 2013**	n/a	112 studies investigating cognitive rehabilitation interventions among patients with stroke and/or traumatic brain injury (TBI). Articles describing pharmacologic interventions or predominately including participants with conditions other than stroke or TBI.	Studies were identified via electronic databases. Included articles were categorized into levels of evidence on the basis of study methodology. Conclusions were summarized as levels of recommendations, as based on the level of supporting evidence and consensus group agreement. Note: this review is an update to an earlier review that focuses on	Articles were categorized into one of the following 6 groups according to the primary area of cognitive rehabilitation addressed by the intervention: attention; vision and visuospatial functioning; language and communication skills; memory; executive functioning, problem solving and awareness; and comprehensive holistic cognitive rehabilitation.	A total of 8 new studies were identified that primarily addressed the remediation of attention. The authors concluded that, as a practice standard, post-TBI remediation of attention should include direct attention training and metacognitive training. The authors also recommend that computer-based interventions be considered as an adjunct to clinician guided treatment following TBI or stroke.

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
			literature published from 2003-2008.		
Prokopenko et al. 2013 **Russia** **RCT**	CA: ☒ Blinding: Patient ☒ Assessor☑ ITT: ☑	43 stroke rehabilitation inpatients with post-stroke cognitive impairment. **Exclusion criteria**: severe cognitive impairment (MMSE<20) and medical instability.	Participants were randomized to receive o standard care plus supplemental computer training (n=24) or standard care only (n=19). Computer training focused on attention (using Schulte's Tables) and visual and spatial gnosis (using figure-background test). Computer training was provided for 20-35min per day for 14 days.	Mini Mental State Exam (MMSE), Frontal Assessment Battery (FAB), Clock Drawing Test, Montreal Cognitive Assessment (MoCA), Schulte's Test, and the Hospital Anxiety and Depression Scale (HADS). **Timing of assessment**: baseline and at the end of the study period.	As compared to those receiving standard inpatient rehabilitation, participants who additionally received computer training demonstrated significantly better mean performance on the FAB (p=0.02), Clock Drawing Test (p=0.05), and Schulte's test (p=0.01) at the end of the study period. No significant between group differences were reported with respect to the MMSE, MoCA, or HADS.
Barker-Collo et al. 2009 **New Zealand** **RCT**	CA: ☑ Blinding: Patient ☒ Assessor☑ ITT: ☑	78 patients with post-stroke attention deficits identified through neuro-psychological assessment. **Exclusion criteria**: severe cognitive impairment (MMSE<20) and medical instability. 23.4% of those screened for eligibility were included in the study.	Participants were randomized to receive standard care plus Attention Process Training (APT; n=38) or standard care (n=40). APT is a hierarchical, multilevel intervention that focuses on sustained, selective, alternating, and divided attention. APT was administered by clinical neuropsychologists for a maximum of 30 hours provided in hour sessions over 4 weeks.	The Integrated Visual Auditory Continuous Performance Test (IVA-CPT) Full-Scale Attention Quotient (FSAQ). **Timing of assessment**: baseline and at 5 weeks and 6 months.	As compared to those who received only standard care, participants who additionally received APT demonstrated significantly more improvement on the IVA-CPT FSAQ at both the 5-week (Mean difference in change = 2.76, 95% CI 1.31 to 4.21, p<0.001) and 6-month follow-ups (mean difference in change = 2.49, 95% CI 1.24 to 3.74, p<0.001). Significant between group differences remained after adjusting for age, sex, ethnicity, and baseline functional impairment and IVA-CPT score.
Westerberg et al. 2007 **Sweden** **RCT**	CA: ☑ Blinding: Patient ☒ Assessor☒	21 stroke patients 30-65 years of age with attention deficits. Individuals diagnosed with major depression were excluded.	Participants were randomized 12-36 months post-stroke to receive computerized working memory training (n=11) or control (n=10).	A neuropsychological test battery (including the stroop test, Claeson-Dahl, span board, digit span, RUFF 2&7, PASAT, and delayed recall) and the Cognitive	As compared to those in the control group, participants who received computerized working memory training demonstrated significantly more improvement in terms of the span board (ES=0.83, p=0.05), digit span (ES=1.58, p=0.005), PASAT (ES=0.61, p=0.001), Ruff 2&7

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
	ITT: ☒		Participants completed training at home using the RoboMemo® software program in 40 minute sessions, five days per week, for a total of five weeks.	Failure Questionnaire (CFQ). **Timing of assessment**: At baseline and following the intervention.	(ES=0.81, p=0.005), and the CFQ (ES=0.80, p=0.005). **Lost to follow-up**: intervention group=18% (n=2), control=10% (n=1).
Mazer et al. 2003 **Canada** **RCT**	CA: ☒ Blinding: Patient ☒ Assessor☑ ITT: ☑	97 stroke patients who wanted to drive and who drove during the 6-months before stroke. **Exclusion criteria**: homonymous hemianopsia, primary visual impairment, seizures, and severe cognitive, perceptual, comprehension, or motor impairments, among others.	Participants were randomized to receive 20 sessions of UFOV training (n=47) or traditional computerized visuoperception retraining (n=50). UFOV training involved training of visual procession speed, divided attention, and selective attention. Both groups of subjects received a total of 20 sessions at a rate of 2 to 4 treatment sessions per week. The duration of each session ranged from 30 to 60 minutes, according to each individual's needs and tolerance.	On road driving evaluation, visuoperseption test, and the Test of Everyday Attention (TEA). **Timing of Assessment**: before and after the intervention.	No significant between group difference was reported in terms of successful completion of the on-road driving test (39% vs. 32.6%, p>0.05) or any of the visuopercetion tests or TEA subtests (p>0.05). However, based on a secondary analysis, the authors reported a non-significant trend in driving outcomes in favour of participants with right-sided lesions who completed UFOV training, as compared to those in the control group (52.4% vs. 28.6%, p>0.05). **Lost to follow-up**: intervention=12.8%, control=14%
Mazer et al. 2001 **Canada** **Pre-post**	n/a	52 stroke patients referred to a driving evaluation service. 6 of these participants completed the training portion. **Exclusion criteria**: homonymous hemianopsia, primary visual impairment, seizure, and impaired comprehension, cognition,	All participants underwent assessment of visual attention using the UFOV, which assesses processing speed, divided attention, and selective attention. The first 6 participants who agreed to complete training program completed 20 sessions of difficulty-level adapted	The UFOV visual attention analyzer. **Timing of assessment**: before and after the intervention for those participating in training.	Participants demonstrated significant deficits in visual attention, with a mean reduction in UFOV of 39.5%. Visual attention performance was worse in subsections of increasing difficulty. Visual processing ability was negatively associated with increased age (p=0.03). However, UFVO scores were not significantly correlated with stroke severity or time since stroke onset. The 6 participants who underwent UFOV training demonstrated significant improvement in visual processing following the 20 training sessions

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
		perceptual or motor impairments deemed incompatible with driving.	UFOV training presented via computer.		(6.3% vs 36.3%, p<0.001).
Sturm et al. 1997 **Germany** **Before and after**	n/a	38 neurological rehabilitation patients with unilateral lesions and attention deficits. (22 patients left hemisphere, 16 in right hemisphere) **Exclusion criteria**: symptomatic epilepsy or progressive neurological/internal disease.	Participants completed a game-like computerized adaptive training programme. Each participant underwent training for two of the following areas of attention in which they had the most deficits: alertness, vigilance, selective attention, and divided attention. Participants received specific training for one area of attention and non-specific training for the other. 14 one-hr training sessions were provided for each area of attention addressed.	Level of difficulty, reaction time, kind and number of errors. **Timing of assessment**: before and after training for each area of attention addressed.	Participants who received specific training for alertness demonstrated a significantly faster reaction time without warning, as compared to those who received non-specific alertness training (p=0.05). Participants who received specific vigilance training achieved significantly more hits than those who received non-specific vigilance training (p<0.002). No significant differences were reported between those who received specific vs. non-specific selective or divided attention training (p>0.05). The authors concluded that for patients with localized vascular lesions, “specific attention disorders need specific training”.

Note: CA: Concealed Allocation; ITT: Intention-to-treat

Memory

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Cicerone et al. 2011 **Systematic Review and Meta-analysis**	n/a	112 studies investigating cognitive rehabilitation interventions among patients with stroke and/or traumatic brain injury (TBI). Articles describing pharmacologic interventions or predominately including	Studies were identified via electronic databases. Included articles were categorized into levels of evidence on the basis of study methodology. Conclusions were summarized as levels of recommendations, as	Articles were categorized into one of the following 6 groups according to the primary area of cognitive rehabilitation addressed by the intervention: attention; vision and visuospatial functioning; language and communication skills;	A total of 17 new studies were identified that primarily addressed the remediation of memory. The authors recommend that, as a practice standard, remediation of mild post-TBI memory impairment should include the use of internalized strategies (e.g., visual imagery) and external compensatory strategies (e.g., notebooks). For severe memory impairment following TBI or

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
		participants with conditions other than stroke or TBI.	based on the level of supporting evidence and consensus group agreement. Note: this review is an update to an earlier review that focuses on literature published from 2003-2008.	memory; executive functioning, problem solving and awareness; and comprehensive holistic cognitive rehabilitation.	stroke, the authors recommend "external compensations with direct application to functional activities."
das Nair and Lincoln 2008 **Cochrane Review and Meta-analysis**	n/a	2 RCTs (n=18) comparing a memory intervention to a control condition among patients with stroke. Trials that included >25% of participants with conditions other than stroke were excluded unless subgroup analyses were reported.	Trials were identified through electronic and manual search techniques and methodological quality was assessed according to the Cochrane Collaboration Guidelines. Pooled data was analyzed using random-effects methods and summarized as standard mean difference.	**Primary outcome**: functional measures, including quality of life. **Secondary outcomes**: measures of memory.	Neither of the included studies included measures of functional outcome or quality of life. With respect to objective assessment of memory, a significant treatment effect in favour of memory intervention was reported for route learning tasks (SMD 2.23, 95% CI 0.66 to 3.80) but not for list learning, face recognition, or immediate or delayed recall. No significant effects of memory intervention were reported in terms of subjective or observer-rated measures of memory.
Aben et al., 2013 **The Netherlands** **Randomized controlled trial** **Added 2014**	CA: ☑ Blinding: Patient ☒ Assessor☑ ITT: ☑	153 participants enrolled in study. Mean age 58 years, mean time post-stroke was 53.9 months (SD = 37.2 months). Included if at least 18 months post-stroke, reported subjective memory complaints. Excluded if had progressive neurological disorders, insufficient knowledge of Dutch, alcohol or drug abuse, subdural hematomas or subarachnoid hemorrhages.	Participants were randomly allocated to either Memory Self-Efficacy (MSE) training or active control group. Participants did not know details of each intervention. MSE - 9 twice-weekly group sessions of 1 hour, with ~30 minutes of homework per session. Training consisted of discussions about general information regarding memory and stroke,	MSE - Metamemory-In-Adulthood questionnaire (MIA) - validated for Dutch. Measures subjective memory experiences in daily living. Depression - Center of Epidemiological Studies-Depression Scale (CES-D) Health-related quality of life - EuroQol EO5D questionaire give perspective on quality of life. Also, Multidimensional WhoQol Bref questionnaire.	Intervention: significant improvement in MSE score, psychological health component of QOL, delayed recall of AVLT Control: significant improvement in delayed recall of AVLT and RBMT. MSE score for Intervention group increased significantly more than for control group

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
			training in internal and external memory strategies, psycho-education on influence of beliefs and anxiety on memory performance, and realistic goal setting for memory tasks. Control - 9 twice-weekly group sessions of 1 hour, no homework. The control group participated in a peer support group, and learned general information about the causes and consequences of stroke. Patients were assessed within 3 weeks prior to intervention, and within 10 days following intervention. Assessors were blind to group allocation.	Memory capacity - Dutch version of Auditory Verbal Learning Test (AVLT) and parallel versions (before/after) of Story Recall from Rivermead Behavioural Memory Test (RBMT). Specifically used delayed recall for both measures as outcomes. Collected other demographic and health information to measure predictive factors of MSE.	
das Nair and Lincoln 2012 **UK** **RCT**	CA: ☒ Blinding: Patient ☒ Assessor☑ ITT: ☒	72 patients with stroke (n=17), traumatic brain injury (=16), or multiple sclerosis (n=39). Exclusion criteria: age <18 years and previous diagnosis of brain damage or other sever disability. 50.7% of those screened for eligibility were included in the study.	Participants were randomized to one of three study arms: Compensation (n=24), Restitution (n=24), and Self-help (n=24). Each study arm consisted of 10, 1.5 hour sessions administered by research assistants. The use of internal memory aids and errorless learning techniques were taught in both memory programmes. The	**Primary outcome**: the Everyday Memory Questionnaire (EMQ). **Secondary outcomes**: Rivermead Behavioural Memory Test-Extended version (RBMT), General Health Questionnaire-12 (GHQ), and the Nottingham Extended Activities of Daily Living Scale (NEADLS). **Timing of assessment**: baseline and at 5 and 7	No significant between group differences were reported with respect to the primary outcome at either 5 or 7 months. Participants in both the compensation and restitution study arms used significantly more internal memory aides than did those in the self-help group ($p<0.05$). The groups did not differ significantly on measures of mood, adjustment, or activities of daily living. **Lost to follow-up**: Compensation=16.7%, Restitution=4.2%, Self-help=4.2%.

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
			compensation program additionally taught external memory aides whereas the restitution program additionally included encoding and retrieval exercises. The self-help program consisted of relaxation training with no memory training.	month follow-up.	
Fish et al. 2008 **UK** **Randomized Cross-over trial**	CA: ☒ Blinding: Patient ☒ Assessor☒ ITT: ☒	36 stroke patients with memory and/or planning impairment.	All participants completed a 2-week baseline period (T1). After 2-weeks, participants in group A (n=24) used a compensatory pager system (NeuroPage) for 7-weeks (T2) followed by another 7-week period without the pager (T3). Participants in group B (n=12) completed a second baseline period of 7-weeks (T2) preceding the 7-week intervention period (T3).	Percentage of patient/carer defined goals achieved.	The authors report that participants in both groups demonstrated significantly better goal attainment when using NeuroPage than during study periods in which NeuroPage was not used ($p<0.001$ for group A, $p<0.01$ for group B). Significant between group comparisons were reported, with group A performing significantly better than group B during T2 ($p<0.01$) and group B performing significantly better than group A during T3 ($p<0.01$).
Hildebrandt et al. 2006 **Germany** **Non-randomized controlled trial**	CA: ☒ Blinding: Patient ☒ Assessor☒ ITT: ☒	62 neurological rehabilitation patients (41 with stroke) with an acute, organic memory disorder. **Exclusion criteria**: severe memory impairment, age >30 or <81, Wernicke's or Borca's aphasia, or pharmacotherapy for memory impairment, and complete amnesia.	Participants were allocated to receive process oriented memory training (POT, n=24), compensatory strategy training (ST, n=22), or control (n=16). POT involved practice of acquisition and retrieval through the use of memory lists, word fluency training, semantic organization, and retrieval cues. ST	California Verbal Learning Test (CVLT), Rivermead Behavioural Memory Test (RBMT), text reproduction, map learning, categorical word fluency, and Digit/Symbol Test. **Timing of Assessment**: baseline and following the intervention.	A significance level of $p<0.01$ was used given the use of multiple comparisons. As compared to those in the control group, participants who received POT demonstrated significantly more improvement in terms of short-term free recall on the CVLT, test reproduction, and categorical word fluency (each at $p<0.01$) and improvement in cued recall approached significance ($p<0.05$). Participants in the ST group also demonstrated significantly more improvement in categorical word fluency than those in the control group ($p<0.01$) and improvement in text reproduction approached significance ($p<0.05$). The authors concluded that memory training must be applied

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
			focused more on teaching strategies than on practicing the process of acquisition and retrieval. The control group received an intervention similar to POT but only received seven 2-hr sessions, whereas participants in the active treatment groups received 5 five 1-hour sessions per week for 4-weeks.		frequently to be effective and that POT "seems to be superior to teaching a set of compensation strategies".

Note: CA: Concealed Allocation; ITT: Intention-to-treat

Executive Functioning and Problem Solving

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Chung et al. 2013 **Cochrane Review and Meta-analysis**	n/a	19 RCTs (n=907) examining cognitive rehabilitation interventions for the remediation of executive dysfunction in patients with stroke or other non-progressive acquired brain injuries. Participants were excluded if they were <15 years of age or had a progressive neurological condition, such as a primary diagnosis of dementia.	Studies were identified through electronic and manual search techniques. Methodological quality was assessed using the Cochrane domain-specific risk-of-bias tool. Pooled data was analyzed using random-effects models and the Mantel-Haenszel method and reported as odds ratios (OR) and standardized mean difference (SMD), and mean difference (MD), as appropriate.	**Primary outcome**: measures of global executive function, such as the Behavioural Assessment of Dysexecutive Syndrome (BADS) and the Hayling and Brixton Tests. **Secondary outcomes**: measures of components of executive function, functional ability in ADLs and extended ADLs, and quality of life.	**Cognitive rehabilitation vs. standard care**: None of the included trials reported the primary outcome. On the basis of a single RCT (n=86), results significantly favoured cognitive rehabilitation as compared to sensorimotor therapy in terms of concept formation (MD 0.43, 95% CI -0.76 to -0.10) and ADLs (MD 28.3, 95% CI -33.50 to -23.06). **Cognitive rehabilitation vs. placebo/no treatment**: 4 RCTs (n=184) were included in the meta-analyses. None of the included trials reported the primary outcome. No significant treatment effects were reported with respect to concept formation, planning, flexibility, working memory, or extended ADLs.

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
			Heterogeneity was assessed with the I^2 statistic.		**Comparison of two types of cognitive rehabilitation**: 2 RCTs (n=82) reported measures of global executive function: no significant treatment effects were reported (SMD -0.41, 95% CI -0.85 to 0.03). On the basis of 8 RCTs (n=404), no significant treatment effects were reported for any of the secondary outcomes.
Poulin et al. 2012 **Systematic Review**	n/a	10 studies (n=186) examining the effect of cognitive rehabilitation to remediate executive function among individuals with stroke, as compared to alternative or no treatment. Study design was not an inclusion criterion.	Studies were identified using electronic and manual search techniques. Methodological quality was assessed using the PEDro Scale. A meta-analysis was not performed due to between study heterogeneity. Results were summarized according to stage of recovery and intervention type.	Measures of executive functioning were considered.	No studies were identified that examined cognitive rehabilitation for executive function during the acute stage of care. A single pre-post study (n=18) provided limited evidence that computerized dual-task training is associated with significant improvement in executive functioning, as compared to no treatment ($p<0.05$). 9 studies (n=186) examined an intervention during the chronic phase of care. The authors concluded that there is limited evidence to suggest that paging systems are associated with significant improvement in performance on functional tasks that involve executive control, as compared to no treatment ($p<0.05$).
Cicerone et al. 2011 **Systematic Review**	n/a	112 studies investigating cognitive rehabilitation interventions among patients with stroke and/or traumatic brain injury (TBI). Articles describing pharmacologic interventions or predominately including participants with conditions other than stroke or TBI.	Studies were identified via electronic databases. Included articles were categorized into levels of evidence on the basis of study methodology. Conclusions were summarized as levels of recommendations, as based on the level of supporting evidence and consensus group agreement. Note: this review is an update to an earlier review that focuses on literature published from	Articles were categorized into one of the following 6 groups according to the primary area of cognitive rehabilitation addressed by the intervention: attention; vision and visuospatial functioning; language and communication skills; memory; executive functioning, problem solving and awareness; and comprehensive holistic cognitive rehabilitation.	A total of 19 new studies were identified that primarily addressed the remediation of executive functioning. The authors recommend that, as a practice standard, metacognitive strategy training should be used for the remediation of post-TBI executive functioning deficits. Formal problem-solving strategy training is also recommended post TBI.

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
			2003-2008.		
Hoffman et al. 2010 **Systematic Review** **From 2013**	n/a	4 RCTs/quazi-RCTs (n=376) examining the impact of a cognitive intervention on performance of basic and/or instrumental activities of daily living (ADLs) among individuals with post-stroke cognitive impairment.	Studies were identified using a combination of electronic and manual search techniques. Methodological quality was assessed using the PEDro scale. It was determine that meta-analysis was not appropriate. Therefore a narrative summary of results was undertaken.	Measures of basic or instrumental ADLs.	The authors reported that cognitive intervention was not associated with significant treatment effects in terms of either basic ADLs (based on 4 trials, n=376) or instrumental ADLs (based on 1 trial, n=228). The authors concluded that "more research is required before conclusions can be made about the effect of cognitive interventions on functional outcomes post stroke".
Stablum et al., 2000 **Non-randomized study** **Italy**	CA: ☒ Blinding: Patient ☒ Assessor☒ ITT: ☒	**ACoA Study** 9 anterior communicating artery (ACoA) patients, between 2 and 7 months after aneurysm rupture 9 controls (controls did not do training) **CHI study**: 10 Closed Head Injury (CHI) patients, 10 uninjured controls, (normal CT, no history previous head injury, psychiatric illness, mental retardation, alcoholism, drugs/medicine, no motor deficit, not seeking financial compensation for injury, All had some of the following Complaints: difficulty concentrating, fatigue, irritability,	**ACoA Study** Dual task = responding by button press to location of two letters on screen (left or right) and verbally saying if the letters were the same or different Completed this task once a week for 5 weeks (each session contained 75 blocks of 72 trials) **CHI Study** Completed same dual task training as above.	**ACoA Study** Dual Task PASAT CPT Neuropsych testing & Cognitive Failures Questionnaire (12 month follow up only) **CHI Study** To measure rehabilitation outcomes used the dual-task paradigm and Paced Auditory Serial Addition Task (PASAT). The dual-task cost at assessment before treatment), retest immediately after treatment) and 3-month follow-up indexed improvement and capacity to maintain improvement over time. PASAT at assessment and retest indexed improvement and capacity to generalize improvement over other executive functions.	**ACoA Study** Before treatment, the dual-task cost was greater for ACoA aneurysm patients than for controls. After treatment patients were as able as controls in coordinating two actions. (note that controls were from the CHI study) PASAT: The Time main effect was significant ($F = 11.64$; $df = 3, 21$; $p < 0.0001$) – only between assessment and all other conditions. CPT: the inhibition cost was greater at assessment than at the 3 month ($t = 2.32$, $p = 0.034$) and at the 12-month follow-up ($t = 4.05$, $p = 0.005$). Neuropsych: only significant differences were for the Backward Digit Span ($t= +2.30, p=0.02$),TrailMaking Test-part A ($t = +2.06$, $p = 0.03$) and Part B ($t= +3.42, p=0.004$), PASAT ($t=A3.66, p=0.003$), and CFQ ($t= -4.10$, $p = 0.001$). **CHI Study** Dual task - CHI Group x Task x Time. It reached significance: $F = 3.35$; $df = 2, 36$; $p = 0.046$. The dual-task cost was greater for patients than for controls, but only in the assessment condition.

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
					PASAT - Group x Time reached significance ($F = 4.76$; $df = 2, 27$; $p < 0.017$; Table 3). Patients and controls with treatment showed a greater improvement on PASAT scores than controls without treatment.
Winkens et al., 2009 **RCT** **The Netherlands**	CA: ☒ Blinding: Patient ☒ Assessor☒ ITT: ☒	Inclusion: Patients who had stroke >= 3 months earlier and referred for cognitive rehabilitation for mental slowness (both inpatients and outpatients) Exclusion criteria: (1) < 18 years; (2) stroke < 3 months ago; (3) very severe or disabling premorbid or current pathologic conditions, or (4) such severe cognitive, communication, physical, or psychologic problems that the patient was unable to perform the tasks, Treatment group (n=20) care as usual group (n=17)	A multicenter, randomized, single-blind, controlled trial de- sign was used to compare the effect of Time Pressure Management (TPM) with the effect of care as usual. Outcome assessments conducted at baseline, at the end of treatment (at 5–10wk), and at 3 months. Intervention: 10 hours of treatment teaching patients a Time Pressure Management strategy to compensate for mental slowness in real-life tasks. Teaching is conducted in three stages and focuses on preventative and management strategies	Information intake task, Mental Slowness Observation Test, Mental Slowness Questionnaire, Barthel Index, Fatigue Severity Scale, Center for Epidemiologic Studies Depression Scale, EuroQol-5D, Symbol Digit Modalities Test, Paced Auditory Serial Addition Task, Auditory Verbal Learning Test, Trail Making Test parts A and B, Stroop Color Word Task.	Both groups showed a significant decline in number of complaints on the Mental Slowness Questionnaire. This decline was still present at 3 months. At 3 months, the Mental Slowness Observation Test revealed significantly higher increases in speed of performance of the TPM group in comparison with the care-as-usual group ($t = –2.7$, $P = .01$).
Skidmore et al. 2014 **US** **Non-randomized controlled trial**	CA: ☒ Blinding: Patient ☒ Assessor☑ ITT: ☒	10 stroke patients with cognitive impairment admitted to inpatient rehabilitation. **Exclusion criteria**: severe aphasia, pre-stroke	Participants were allocated to receive strategy training (n=5) or a control condition (n=5). Strategy training involved self-selection of goals, self-evaluation,	Length of rehabilitation inpatient stay, disability in activities of daily living (assessed with the Functional Independence Measure [FIM]), and satisfaction with the	All 10 participants in both study arms reported moderate to high satisfaction with the intervention. No significant between group difference was reported in terms of rehabilitation length of stay (24.3 vs. 20.2, p>0.05). As compared to those in the control group, participants in the active intervention group

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
		dementia, major depression disorder, among others.	strategy development, and generalization and transfer. Participants in both conditions received 5, 30-40 minute sessions per week for the duration of their inpatient stay. All participants received usual rehabilitation services.	intervention (assessed with the Client Satisfaction Questionnaire). **Timing of assessment**: baseline and 3 and 6 month follow-ups.	demonstrated significantly less disability on the FIM at the 6-month follow-up (117 vs. 96, p=0.02). However, in analysis of variance, no significant effect of treatment was observed in terms of disability, although a significant effect of time (p<0.001) and time by group interaction was reported (p<0.01). No loss to followup.
Levine et al. 2011 **Canada** **Quasi-randomized controlled trial**	CA: ☒ Blinding: Patient ☒ Assessor☑ ITT: ☒	19 patients with chronic brain injury (11 post-stroke) and executive functioning deficits. **Exclusion criteria**: impairment of basic linguistic, mnemonic, motor, or perceptual functioning.	Participants were allocated to receive goal management training (GMT, n=11) or the control condition (brain health workshop, n=8). Goal management training is an "executive functioning intervention that draw upon theories concerning goal processing and sustained attention". Participants in both conditions received a total of seven 2-hour sessions.	The Sustained Attention to Response Task (SART), the D-KEF Tower Test, the Hotel Task, the Dysexecutive Questionnaire, and the Cognitive Failures Questionnaire. **Timing of assessment**: baseline, following the intervention, and at a 4-month follow-up.	Participants who received goal management training demonstrated significant improvement from baseline to post-intervention in omission errors on the SART, total scores on the D-KEF Tower Test, and deviations form optimal time on the Hotel Task (all ta p<0.05). Improvements on the SART and D-KEF Tower Test were maintained at follow-up. Conversely, no significant differences in performance were reported for participants in the control group. Significant group x session interactions were reported with respect to SART omission errors (0.05), and Hotel Task total deviation time (p<0.05). No significant within or between group comparisons were reported for either the Dysexecutive Questionnaire or the Cognitive Failures Questionnaire.
Man et al. 2006 **Hong Kong** **Quasi-RCT**	CA: ☒ Blinding: Patient ☒ Assessor☒ ITT: ☒	109 individuals with acquired brain injury (including stroke) and mild cognitive impairment who had completed a neurorehabilitation program. **Exclusion criteria**: age >18 or <55, history or psychiatric illness or mental handicap, and poor attention span or verbal comprehension.	Participants were randomized to one of four study arms: computer-assisted training (CAT, n=30), therapist-administered training (TAT, n=30), online interactive computer-assisted training (ICAT, n=30), and no treatment control (n=20). Participants in each of the active treatment groups completed 20, 45-minute	Alternative analogous target insight problems, the Comparing Category Test, Lawton IADL Scale, and Problem Solving Self-Efficacy. **Timing of assessment**: at baseline and following the intervention.	Participants in each of the three intervention groups demonstrated significant improvement from baseline in terms of overall basic and functional problem solving ability, the Comparing Caterogy Test, and the Lawton IADL Scale following completion of the training program (p<0.05), whereas those in the control group did not demonstrate significant improvement. Between group comparison of the three active conditions did not reveal any significant group differences with respect to these outcomes. However, participants who received therapist-administered training reported a significant increase in Problem Solving Self-Efficacy (p<0.01 for both within and between group

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
			sessions of analogy problem solving skills training.		comparisons). **Lost to follow-up**: CAT=6.7% (n=2), TAT=0%, ICAT=16.7% (n=5), Control=0%.
Liu et al. 2004 **Hong Kong** **RCT**	CA: ☒ Blinding: Patient ☒ Assessor☑ ITT: ☒	46 patients with a first-ever ischemic stroke. **Exclusion criteria**: age<60 years and dependant in ADLs prior to stroke. 80% of those screened for eligibility were included in the study.	Participants were randomized to receive a mental imaging program (n=27) or conventional functional training (n=22). Both study arms consisted of 5, 1-hour sessions per week for 3 weeks. The memory imaging program consisted of training in mental imaging techniques to perform specific tasks whereas functional training utilized the demonstration-then-practice method.	Performance on 15 trained and 5 untrained tasks (e.g., household, cooking, and shopping tasks), the Fugl-Meyer Assessment (FMA), and the Color Trails Test (CTT). **Timing of assessment**: before and after training sessions.	As compared to those who received functional training, participants randomized to the mental imaging program demonstrated significantly better performance on trained tasks at the end of the second (p=0.011) and third (p=0.046) weeks of training. Participants in the mental imagery arm also performed significantly better than those in the control condition on untrained tasks assessed at the end of the third week of training (5.1±1.3 vs. 3.8±0.9, p<0.001). **Lost to follow-up**: Mental imaging=3.7%, functional training=901%
Kivipelto et al, 2001 **Population-based follow up study** **Finland**	n/a	Those individuals still alive, aged 65 to 79 at the end of 1997 and living in two geographically defined areas in or close to the towns of Kuopio and Joensuu (n = 2,293). From these subjects, a random sample of 2,000 persons was invited to undergo reexamination dur- ing 1998. Altogether, 1,449 subjects (72.5%) were reexamined. 240 subjects participated in phase 2 screening for MCI.	Subjects were derived from random, population-based samples previously studied in surveys carried out in 1972, 1977, 1982, and 1987. After an average follow-up of 21 years, 1,449 subjects aged 65 to 79 years were reexamined in 1998. Subjects scoring <=24 on MMSE were invited phase 2 to assess MCI.	MMSE Serum total cholesterol Height, weight, body mass index, blood pressure Phase 2 screening for MCI: Buschke Selective Reminding Test, the Logical Memory Test from the Wechsler Memory Scale–Revised, the Boston Naming Test, the Vocabulary subtest of the Wechsler Adult Intelligence Scale, the Verbal Fluency Test, the Copy a Cube Test, the Clock Setting Test, the Block Design subtest of the Wechsler Adult Intelligence Scale, the	82 subjects, 6.1% of the population (average age, 72 years) met the criteria for MCI. Midlife elevated serum cholesterol level (>= 6.5 mmol/L) was a significant risk factor for MCI (OR, 1.9; 95% CI, 1.2 to 3.0, adjusted for age and body mass index); the effect of systolic blood pressure approached significance.

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
				Wisconsin Card Sorting Test using Nelson's version, and the Trail Making Test Cognitive decline rated according to the Clinical Dementia Rating scale.	

Note: CA: Concealed Allocation; ITT: Intention-to-treat

Exercise Interventions

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Cumming et al. 2012 **Australia** **Systematic Review**	n/a	12 RCTs and controlled clinical trials (n=907) investigating the effect of exercise on cognition in individuals with stroke. Studies with mixed population were included provided that stroke represented at least one-third of the sample.	Articles were identified through a combination of electronic and manual search techniques. Methodological quality was assessed using 4-criteria representing important sources of bias. Where possible, data were pooled using the DerSimonian and Laird random-effect model and summarized as standardized mean difference. Statistical heterogeneity was assessed with the I^2 statistic.	Change in cognitive performance on a range of tests, including FIM-Cog, MMSE, Trailmaking, Symbol Digit, PASAT, WCST, Stroop, SRTT, FIM problem solving, SIS cog domains.	9 of the 12 included studies provided sufficient data for pooling. On the basis of these 9 trials, the authors reported a significant treatment effect in favour of exercise (SMD=0.2, 95% CI 0.04 to 0.36; p=0.015). No significant heterogeneity was detected (I^2=0%). The authors concluded that while "there is some evidence that increased physical activity after stroke enhances cognitive performance," the existing literature base is small and contains widespread methodological shortcomings.
McDonnell et al. 2011 **Australia** **Systematic**	n/a	7 trials (n=249) comparing aerobic exercise to a control condition in adults with neurologic disorders (1 trial with stroke). Included controlled trials in which a	Trials were identified through a combination of electronic and manual search techniques. Methodological quality was assessed using the	Global measures of cognition (e.g., the Mini-Mental State Exam [MMSE]) or other cognitive outcome measures.	Of the 7 trials included, only one included individuals with stroke (n=38). This study (Quaney et al., 2009), which investigated the impact of an 8 week aerobic exercise program, did not report any significant between group differences in terms of any of the measured

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Review		cognitive outcome was reported with comparisons between aerobic exercise and control or no treatment.	methods described in the Cochrane Handbook. Meta-analysis was performed where possible using random effects models, with results presented as standardized mean differences.		cognitive outcomes. It was only possible to pool results for one outcome, the Stroop Color and Word Test; however, results of pooling were not significant (SMD=0.15, 95% CI -032 to 0.61; based on two trials, n=73). Although a few significant outcomes were reported across the included trials, the authors concluded that there is "limited evidence to support the use of aerobic exercise to improve cognition in adults with neurologic disorders".
Tanaka et al., 2013 **Japan** **Pre-post study** **Added 2014**	CA: ☒ Blinding: Patient ☒ Assessor☒ ITT: ☒	10 Post-stroke vascular dementia patients (6 patients in experimental group, 4 approximately matched in control) Inclusion: probably vascular dementia diagnosed, no CVD in right insula, disease period > 3 months with stable symptoms, presence of hemiparesis and use of WC for transfer, institutionalized for at least 2 months, requirement for help, MMSE score >= 10 Exclusion: marked behaviour disorder, severe aphasia, right or left insular lesions, bilateral hemiparesis, terminal systemic disease or neuro/psych disorder, resistance to care	Intervention: The intervention lasted 2 months. Consisted of physical therapy 40 minutes/day 5 times/week; psychosocial support 20 minutes/day 3 times/week.	Scores on MMSE, Geriatric Depression Scale, Functional Independence Measure (FIM), measured before and after program. Statistics calculated using Mann-Whitney U test for unpaired samples to compare groups. Wilcoxon used for within group comparisons. PET scan was also conducted before and after.	No difference in MMSE, GDS scores after intervention. All subjects in intervention group showed increase in cerebral glucose metabolism (CMRglc) in posterior insula; subjects in control group did not.
Marzolini et al. 2012 **Canada** **Pre-post study**	CA: ☒ Blinding: Patient ☒ Assessor☒ ITT: ☒	45 patients >10 weeks post-stroke with a stroke-related motor impairment score of <7 on the Chedoke McMaster Stroke Assessment Scale and able to walk ≥10 meters	Participants received a cardiac rehabilitation program that combined aerobic and resistance training approaches. Aerobic training consisted of walking	The Montreal Cognitive Assessment (MoCA). **Timing of assessment**: baseline and following the 6-month intervention.	Mean MoCA scores significantly improved from baseline to the end of the 6-month intervention (22.5±4.5 vs. 24.0±3.9, p<0.001). Moreover, the number of participants who scored <24 on the MoCA decreased from 51.2% (n=21) at baseline to 34.1% (n=14) following the intervention. Considering the subdomains of the MoCA, the

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
		independently. **Exclusion criteria**: neurological conditions other than stroke, significant cardiac arrhymia, and severe hypertension.	stationary recumbent, and/or upright cycling. Resistance training incorporated task specific exercises using hand-held weights, exercise bands, and/or body weight. The intervention was provided in 90-minute sessions once per week for six-months. Participants were also advised to complete additional exercise sessions at home for the duration of the study.		authors reported significant improvement in the Visuospatial/Executive ($p<0.01$) and Attention/Concentration ($p<0.05$) domains. Change in cognition was also reported to be significantly associated with change in fat-free mass of the non-affected limb ($p<0.01$) and total appendicular fat-free mass ($p<0.05$), controlling for age, sex, time from stroke, , change in fat mass, and depression symptomatology. Lost to follow-up: 9% (n=4).
Vercambre et al. 2011 **US** **Cohort**	CA: ☒ Blinding: Patient ☒ Assessor☒ ITT: ☒	2,824 women 65 years of age or older with prevalent vascular disease or >2 coronary risk factors.	Participants completed assessments of cognitive function and physical activity via telephone interviews. Physical activity levels at baseline were determined using metabolic equivalent of task (MET), whereby each activity is assigned a value of energy expenditure.	Telephone Interview for Cognitive Status (TICS) and the East Boston Memory Test (EBMT). **Timing of assessment**: baseline and at 2, 4, and 6 year follow-ups	As compared to those with low levels of physical activity at baseline, women with higher levels of energy expenditure experienced significantly less cognitive decline during the duration of the study with respect to global cognitive functioning ($p<0.001$), verbal memory ($p<0.001$), and scores on the TICS ($p<0.05$), but not category fluency ($p>0.05$), in tests for trend controlling for several covariates. Significant differences in the rate of cognitive decline were observed for women who reported energy expenditure equivalent to walking briskly for >30 minutes per day **Lost to follow-up**: 81% completed at least 3 of the 4 assessments. 24.3% were not contacted for a 4th assessment. 15 participants with Parkinson's disease were excluded.
Rand et al. 2010 **Canada** **Pre-post study**	CA: ☒ Blinding: Patient ☒ Assessor☒ ITT: ☒	11 community residing adults (50 years of age or older) >12 months post-stroke. **Exclusion criteria**: Cognitive impairment (MMSE <24), inability to	Patients participated in an exercise program that included stretching, balancing, and task-specific exercises. The program was offered in 2 weekly one-hour sessions. Patients also	A Neurological test battery, including the Stroop test, the Verbal Digit Span Backward Test, the Digit Symbol Test, the Trail Making Test, Walking While Talking (WWT), and the Rey Auditory Verbal	Time since stroke at study enrolment ranged from 1-9.5 years. The authors report that 90% of participants completed 90% of the offered exercise and recreation sessions. As compared to baseline, mean scores at 3 months were improved on the Trail Making Test (Effect Size (ES) =0.48), RAVLT short delay (ES=-0.04) and long-delay (ES=-0.59), and WWT (ES=0.42).

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
		walk ≥3m without physical assistance.	participated in a recreation and leisure program for 1 hour per week. **Duration of intervention**: 6 months.	Learning Test (RAVLT). **Timing of assessment**: baseline and at 3 and 6 months following the initiation of the intervention.	The authors also noted improvement in mean scores on the Digit Span Backward Test (ES=-0.09), the RAVLT long-delay (ES=-0.43), and the Stroop test (ES=0.12) from 3 months to 6 months. Significant main effects of time were reported with respect to the RAVLT long-delay ($p<0.05$), the WWT ($p<0.01$), and the Stroop Test ($p<0.01$). Motor abilities improved for knee strength, gait speed, and 6 minute walk test.

Note: CA: Concealed Allocation; ITT: Intention-to-treat

Other Articles for Consideration

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Bahar-Fuchs et al. 2013 **Cochrane Review and Meta-analysis**	n/a	11 RCTs (n=579) evaluating the effect of cognitive training and cognitive rehabilitation (broadly defined) in individuals with mild Alzheimer's disease or vascular dementia.	Trials were identified through electronic and manual search techniques. Methodological quality was assessed with the Cochrane Risk of Bias tool. Data was pooled using fixed effects models and summarized as mean difference or standardized mean difference, as appropriate. Statistical heterogeneity was assessed using the I^2 statistic.	Change in performance on global cognitive screening measures and neuropsychological measures and change in mood, activities of daily living, behaviour, adjustment, general health, and quality of life.	In terms of cognitive training, no significant effect of treatment was reported for any primary or secondary outcomes. With respect to change in global cognitive functioning, the pooled standardized mean difference comparing treatment to control was 0.10 (95 CI -0.21 to 0.40; based on 6 trials, n=173). Only a single trial of cognitive rehabilitation (Clare et al., 2010 with MCI) was identified. In this single study, cognitive rehabilitation was reported to be significantly associated with improved goal performance, memory performance, and satisfaction in ability to perform activities of daily living.
Hoffman et al. 2010 **Cochrane Review** **From 2013**	n/a	1 RCT (n=33) examining the impact of OT provided cognitive skills remediation training in stroke patients based on the Thinking Skills Workbook (Carter 1980).	Articles were identified for inclusion using a combination of electronic and manual search techniques. Although fixed-effect model pooled analyses were	**Primary outcome**: Basic Activities of Daily Living (ADLs). **Secondary outcomes**: Instrumental ADLs, community reintegration,	A single study (Carter et al. 1983) was identified for inclusion, which examined the impact of cognitive skills training administered 3-4 times per week for 4-weeks. No significant effects of treatment were reported. The authors concluded that "the effectiveness of occupational therapy for cognitive impairment post-stroke remains

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
			planned, a narrative approach was used as only one trial was identified for inclusion.	resumption of life roles, and specific cognitive abilities.	unclear".
Chen et al. 2011 **RCT** **China** **From 2013**	CA: ☒ Blinding: Patient ☒ Assessor☒ ITT: ☒	134 stroke patients with vascular dementia. **Exclusion criteria**: mixed dementia and Alzheimer's dementia, and vascular dementia patients at a late stage, among others.	Participants were randomized to one of four study arms: 1) Chinese medicine plus rehabilitation (n=32), 2) Chinese medicine plus acupuncture (n=33), 3) Chinese medicine and acupuncture plus rehabilitation (n=37), and 4) Western Medicine (piracetam at 4.8 mg/day; n=32). Treatment was provided for 12-weeks.	Mini-mental State Exam (MMSE) and the Bless Behaviour Scale (BBS).	No significant between group comparisons were reported. In within-group before-and-after comparisons, participants in the Chinese medicine and acupuncture plus rehabilitation group demonstrated significant improvement in terms of living ability (derived from the BBS) and short-term memory (derived from the MMSE). No other significant within group before-and-after differences were reported.
Kim et al. 2010 **Korea** **RCT**	CA: ☒ Blinding: Patient ☑ Assessor☑ ITT: ☒	22 patients with cognitive deficits at least 1-month following a first-ever stroke. **Exclusion criteria**: Severe cognitive impairment (MMSE<10), severe aphasia, and history of major head trauma.	Participants were randomly assigned to receive repetitive transcranial magnetic stimulation (rTMS) using low-frequency (1Hz; n=6), high-frequency (10 Hz; n=6), or sham (n=6) stimulation. Treatment was provided in 10 sessions over a 2-week period.	A neuropsychological test battery, including the Computerized Neuropsychological Test and the Tower of London Test.	18 participants completed the study protocol and were included in study analyses. No significant between group differences were reported in terms of any of the assessed cognitive outcomes. No major side effects were reported during the duration of the study.
Eggermont et al. 2006 **Netherlands** **Review**	n/a	This article presents a review of the effect of exercise on cognition in cognitively impaired elderly, including those with MCI, AD.	The authors consider the relationship between hypoperfusion, nitric oxide, cognition, and exercise as well as the role of cardiovascular risk factors in the effects of exercise on cognition.	n/a	The authors reviewed 8 studies that examined the impact of exercise on cognitive impairment. Of these, 7 studies reported a beneficial effect of exercise, 2 of which included patients with cardiovascular risk factors. Nevertheless, the authors caution that the "presence of cardiovascular risk factors might attenuate or even undo positive effects of exercise on cognition" in individuals with cognitive impairment.

Note: CA: Concealed Allocation; ITT: Intention-to-treat

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