# Cognitive Rehabilitation for Service Members and Veterans Following Mild to Moderate Traumatic Brain Injury

## APPENDIX A: Glossary

**Active listening**: The use of verbal and nonverbal behaviors to convey to the receiver of the communication that you are listening. Active listening includes behaviors such as turning toward the speaker; displaying open posture, leaning toward the speaker; and maintaining eye contact (CogSMART curriculum; Twamley et al., 2014).

**Assistive technology for cognition**: Assistive technology for cognition (ATC) refers to a subset of assistive technology used to compensate for cognitive impairments in memory, attention, and executive function. Devices in this category are also known as memory aids or cognitive prostheses (VA/DoD Clinical Practice Guideline for the Management of Concussion-Mild Traumatic Brain Injury, 2016).

**Chronic injury period (or phase)**: Greater than 12 weeks since the time of the TBI event (VA/DoD Clinical Practice Guideline for the Management of Concussion-Mild Traumatic Brain Injury, 2016).

**Clinical recommendation**: A clinical recommendation informs clinical practice by providing guidance for assessing and managing symptoms and conditions associated with TBI and is based on the best available evidence and consensus of expert opinion (Health.mil/TBIClinicalRecommendations).

**Cognitive flexibility**: The ability to shift thoughts and appropriately adjust behavior according to an ever-changing environment in order to execute goal directed behavior (Dajani & Uddin, 2015).

**Cognitive rehabilitation**: A systematic, functionally-oriented service of therapeutic cognitive activities, based on an assessment and understanding of the person's brain-behavior deficits. Cognitive rehabilitation consists of interventions that "achieve functional changes by (1) reinforcing, strengthening, or reestablishing previously learned patterns of behavior, or (2) establishing new patterns of cognitive activity or compensatory mechanisms for impaired neurological systems" (Harley et al., 1992).

**Cognitive reserve**: Individual factors of intelligence (IQ), years of education, occupational attainment and participation in cognitively stimulating activities that at higher pre-morbid levels are known to be protective with better preservation of cognitive function after a TBI (Sterr, Herron, Hayward, & Montaldi, 2006, 2006; Valenzuela & Sachdev, 2006).

**Comorbid**: The presence of more than 1 distinct condition in an individual (Valderas, Starfield, Sibbald, Salisbury, & Roland, 2009).

**Compensatory strategy (internal and external)**: Compensatory strategies allow individuals to work around their cognitive difficulties. Compensatory approaches are typically categorized as internal or external. Internal strategies (e.g., mnemonics) or external devices or aids (e.g., memory notebooks) are intended to support activity performance despite the presence of a cognitive impairment (Huckans et al., 2010; Institute of Medicine, 2011).

**Dual task**: Divided attention or the ability to complete two tasks simultaneously (e.g., walking and talking). (Institute of Medicine, 2011).

**Executive functioning (EF)**: EF is an umbrella term that includes metacognition and a variety of effortful higher order abilities enabling an individual to engage successfully and independently in goal oriented behavior (Kennedy et al., 2008).

**Goal attainment scaling (GAS)**: "GAS is a system that tracks progress toward achievement of a functional outcome. In GAS, a patient defines their baseline (i.e., current level of performance) and desired performance levels along a scale, where (-1) is their baseline and (0) is the minimum acceptable level of performance" (Working Group to Develop a Clinician's Guide to Cognitive Rehabilitation in mTBI: Application for Military Service Members and Veterans, 2016).

**Holistic or integrated approach**: "Holistic treatment programs may also be referred to as comprehensive, integrated, or multi-modal. In a holistic approach, a number of different treatment components may be combined. These approaches are more likely to be used for patients with multiple cognitive or behavioral impairments and may include a combination of specific cognitive rehabilitation interventions coupled with psychotherapy, pharmacotherapy, behavior modification, vocational rehabilitation, and other therapies (e.g., nutrition, art or music therapy, acupuncture)" (Institute of Medicine, 2011).

**Interdisciplinary rehabilitation**: An interdisciplinary team of rehabilitation professionals delivers cognitive rehabilitation to patients and education, training, and support to families and/or other key members in the patient's psychosocial system. The team may include medicine (e.g. physical medicine and rehabilitation, neurology), nursing, clinical psychology, neuropsychology, speech-language pathology, occupational therapy, physical therapy, audiology or neuro-ophthalmology (Institute of Medicine, 2011; Prigatano, 2005).

**Manualized intervention**: Manualized interventions operationalize specific cognitive rehabilitation interventions with prescribed goals and techniques to be used during each session of treatment (Institute of Medicine, 2011).

**Metacognitive strategy training**: Metacognitive strategy training promotes the development of self-directed strategies and fosters generalization to real-world tasks by focusing on self-monitoring and self-regulation (Cicerone et al., 2011).

**Motivational interviewing**: "Motivational Interviewing (MI) is a method of engaging the [patient] to explore areas of concern and identify functional goals which provide the focus for rehabilitation. In MI, the clinician adopts a 'guiding' communication style, which is between a 'following' and 'directive' style, to help the [patient] self-identify their challenges" (Working Group to Develop a Clinician's Guide to Cognitive Rehabilitation in mTBI: Application for Military Service Members and Veterans, 2016).

**Operant conditioning paradigm**: This model of learning emphasizes that behavior is shaped by its consequences and maintained by reinforcement schedules (Staddon & Cerutti, 2003).

**Post-acute injury period (or phase)**: The period of 7 to 12 weeks post injury (Department of Veterans Affairs & Department of Defense Clinical Practice Guideline for the Management of Concussion-mild Traumatic Brain Injury, 2016).

**Posttraumatic stress disorder (PTSD)**: "PTSD is a clinically-significant condition with symptoms that have persisted more than one month after exposure to a traumatic event and caused significant distress or impairment in social, occupational, or other important areas of functioning" (Department of Veterans Affairs & Department of Defense Clinical Practice Guideline for the Management of Posttraumatic Stress Disorder and Acute Stress Disorder, 2017).

**Prospective memory**: "Prospective memory is defined as the ability to remember to carry out intended actions in the future" (Brandimonte, Einstein, & McDaniel, 1996).

**Psychoeducation**: "Psychoeducation provides information about the condition, expectations surrounding recovery, and best approaches for treatment" (Working Group to Develop a Clinician's Guide to Cognitive Rehabilitation in mTBI: Application for Military Service Members and Veterans, 2016).

**Rehabilitation Treatment Taxonomy Project**: This tripartite treatment model divides rehabilitation treatments into ingredients (what the provider does), targets (the aspects of functioning those ingredients are known or hypothesized to change), and mechanism of action (how the ingredients work) (Dijkers et al., 2014).

**Rehabilitation Treatment Taxonomy Project – Ingredients**: Specific clinician actions chosen to bring about change. Most cognitive rehabilitation treatments have multiple ingredients such as providing information and opportunities for practice (Dijkers et al., 2014).

**Rehabilitation Treatment Taxonomy Project – Representations**: Representation targets refer to providing or discussing information that modifies thoughts, beliefs, or motivations. Ingredient example: providing information about sleep hygiene (Dijkers et al., 2014).

**Rehabilitation Treatment Taxonomy Project – Targets**: The specific aspect of patient functioning to be changed (Dijkers et al., 2014).

**Service member**: "The term 'service member' includes military members of all U.S. military services (Army, Air Force, Navy, Marine Corps), as well as those activated under appropriate authorities and policies (e.g., Coast Guard, National Oceanic and Atmospheric Administration, Public Health Service). When deployed, civilians requiring protection and sustainment are also considered service members" (Clinical and Rehabilitative Medicine (CRM) Capabilities-Based Assessment (CBA) Study).

**Telehealth (or telemedicine)**: Rapid access to shared and remote medical expertise by means of telecommunications and information technologies to deliver health services and exchange health information for the purpose of improving patient care (DoD Dictionary).

**Therapeutic milieu**: An approach to post-acute brain injury rehabilitation in which the treatment program becomes a "community" that supports and facilitates the patient's recovery from brain injury (Ben-Yishay, 1996).

**Tiered approach**: A two level model for delivery of cognitive rehabilitation after mild to moderate TBI which considers time since injury as well as significant risk factors for symptom chronicity (TBICoE Cognitive Rehabilitation Clinical Recommendation Expert Work Group, 2017).

**Universal design/universal design principles**: "Universal design is the design of products and environments to be usable by all people, to the greatest extend possible, without the need for adaption or specialized design." (Mace, Center for Universal Design, North Carolina State University).

## APPENDIX B1: Resource Table

| # | RESOURCE | DESCRIPTION |
|---|---|---|
| 1 | **Clinician's Guide to Cognitive Rehabilitation in Mild Traumatic Brain Injury: Application for Military Service Members and Veterans.** December, 2016. (Pages 1-107) https://www.asha.org/uploadedFiles/ASHA/Practice_Portal/Clinical_Topics/Traumatic_Brain_Injury_in_Adults/Clinicians-Guide-to-Cognitive-Rehabilitation-in-Mild-Traumatic-Brain-Injury.pdf | Rich resource written by members of a working group of speech-language pathologists, neuropsychologists, and occupational therapists. Not an official policy of DoD, VA or any U.S. government office. This guide was written to assist clinicians at all levels of proficiency with planning and delivering cognitive rehabilitation. The stepwise process for cognitive intervention is based upon six guiding principles that support patient-centered care with sensitivity to service member/veteran population characteristics, culture, and context. Clinical "pearls" highlight main points, and case studies or simulations provide instructive examples of the decision-making process with: 1) application of concepts; and 2) implementation of techniques and strategies. Links to resources are embedded throughout the guide. |
| 2 | **Compensatory Cognitive Training (CCT) Facilitator Manual.** April 2012 (Pages 1-96) https://s3.amazonaws.com/cogsmart/Compensatory+Cognitive+Training+facilitator+manual+June+2013.pdf<br>**Compensatory Cognitive Training Participant Manual**. July 2016 (Pages 1-97) https://s3.amazonaws.com/cogsmart/Compensatory+Cognitive+Training+participant+manual+July+2016.pdf<br>**Cognitive Symptom Management and Rehabilitation Therapy (CogSMART) for Traumatic Brain Injury**. July 2009 (Pages 1-73) http://www.cogsmart.com/ | The CCT manual is a 10-session version of the original 12-session CogSMART. It contains both a therapist and client version that can be freely downloaded from the website. The therapist and client versions align with the same page numbers and are designed to be used side-by-side with agendas and lesson plans on topics such as understanding TBI, managing symptoms, organization, attention, concentration, learning and memory, planning, goal setting, problem solving and cognitive flexibility. This curriculum is designed for group intervention; however, some of the material could be useful for individual interventions that target psychoeducation and strategies.<br>Note: Therapists can use either the CCT or CogSMART manuals. They are two separate manuals, based on two separate interventions studied in different randomized controlled trials. For the Clinical Resource Links web tool, we have chosen to resource the CCT manual as it is based on a more recent study and adapted to be more concise.<br>The CogSMART manual for clinicians includes 12 sessions on the following topics: psychoeducation regarding TBI; strategies to improve sleep, fatigue, headaches, and tension; and compensatory cognitive strategies in the domains of prospective memory, attention, learning and memory, and executive functioning. A CogSMART web-based app can be freely download on www.cogsmart.com. This app includes 12 modules that cover the original CogSMART content, and can be used independently or with a trainer/therapist. |

## APPENDIX B1: Resource Table (Contd.)

| # | RESOURCE | DESCRIPTION |
|---|---|---|
| 3 | **Traumatic Brain Injury Center of Excellence (TBICoE)**<br>Health.mil/TBICoE<br>**Medical Providers**<br>Health.mil/TBIProviders<br>**Service Members and Veterans**<br>Health.mil/TBIPatientResources<br>**Family and Caregivers**<br>Health.mil/TBICaregivers | TBICoE provides free downloadable educational resources on TBI relevant to health care providers, service members, veterans and their families.<br>The following clinical recommendations are evidence-based resources to help providers assess and manage treatment for patients with mild TBI:<br>▪ Management of Headache Following Concussion/Mild TBI: Guidance for Primary Care Management in Deployed and Non-Deployed Settings<br>▪ Management of Sleep Disturbances Following Concussion/Mild TBI: Guidance for Primary Care Management in Deployed and Non-Deployed Settings<br>▪ Progressive Return to Activity Following Acute Concussion/Mild Traumatic Brain Injury Clinical Recommendation<br>▪ Assessment and Management of Visual Dysfunction Associated with Mild TBI<br>▪ Assessment and Management of Dizziness Associated with Mild TBI<br>**Selected educational resources for service members and veterans:**<br>▪ Back to School Guide to Academic Success After Traumatic Brain Injury Booklet<br>▪ Concussion Signs and Symptoms Fact Sheet<br>▪ Concussion/Mild Traumatic Brain Injury and Posttraumatic Stress Disorder<br>▪ Mild TBI Symptom Management Fact Sheet: Ways to Improve Your Memory<br>**Selected resources for families and caregivers:**<br>▪ Addressing Family Needs Booklet<br>▪ Traumatic Brain Injury: A Guide for Caregivers of Service Members and Veterans |
| 4 | **DHA Connected Health**<br>https://health.mil/About-MHS/OASDHA/Defense-Health-Agency/Operations/Clinical-Support-Division/Connected-Health/mHealth-Clinical-Integration | DHA Connected Health (formerly the National Center for Telehealth & Technology) has developed a large variety of apps that can be used by service members, veterans, their families and health care providers to address cognitive, mental and behavioral health issues such as sleep disturbances, anxiety, depression, PTSD, and a selection of cognitive therapy approaches. |
| 5 | **Department of Veterans Affairs and Department of Defense (VA/DoD) Clinical Practice Guidelines**<br>https://www.healthquality.va.gov/ | The VA/DoD Clinical Practice Guidelines are an extensive and rich resource for clinicians based on rigorous evidence with regular updates and additions. Clinician tools include a full CPG version, an abbreviated clinician summary, a pocket guide, and patient education materials.<br>▪ **Management of Concussion/Mild Traumatic Brain Injury**<br>https://www.healthquality.va.gov/guidelines/Rehab/mtbi/<br>▪ Full Guideline: https://www.healthquality.va.gov/guidelines/Rehab/mtbi/<br>▪ Clinician Summary: https://www.healthquality.va.gov/guidelines/Rehab/mtbi/mTBICPGClinicianSummary50821816.pdf<br>Guidelines available that address comorbidities associated with TBI in the following selected areas include:<br>▪ **Mental Health**:<br>▪ Posttraumatic Stress Disorder (PTSD)<br>https://www.healthquality.va.gov/guidelines/MH/ptsd/<br>▪ Assessment and Management of Patients at Risk for Suicide<br>https://www.healthquality.va.gov/guidelines/MH/srb/<br>▪ Major Depressive Disorder (MDD)<br>https://www.healthquality.va.gov/guidelines/MH/mdd/<br>▪ Substance Use Disorder (SUD)<br>https://www.healthquality.va.gov/guidelines/MH/sud/ |

## APPENDIX B1: Resource Table (Contd.)

| # | RESOURCE | DESCRIPTION |
|---|---|---|
| 5 | **Department of Veterans Affairs and Department of Defense (VA/DoD) Clinical Practice Guidelines**<br>https://www.healthquality.va.gov/ | ■ **Rehabilitation**<br>▪ The Management of Upper Extremity Amputation https://www.healthquality.va.gov/guidelines/Rehab/UEAR/<br>▪ Rehabilitation of Lower Limb Amputation https://www.healthquality.va.gov/guidelines/Rehab/amp/<br>■ **Pain**<br>▪ Management of Opioid Therapy (OT) for Chronic Pain https://www.healthquality.va.gov/guidelines/pain/cot/index.asp |
| 6 | **Mild Traumatic Brain Injury Rehabilitation Toolkit**<br>December, 2014 (Full Toolkit: Pages 1-569)<br>Borden landing page. Indexed Chapters.<br>http://www.cs.amedd.army.mil/Portlet.aspx?ID=065de2f7-81c4-4f9d-9c85-75fe59dbae13<br><br>**Chapter 7: Cognition Assessment and Intervention**<br><br>**Chapter 9: Performance and Self-management, Work, Social, and School Roles**<br><br>**Chapter 11: Health-related Quality of Life/Participation Assessment**<br><br>**Appendix A: Clinical Management Guidance: Occupational Therapy and Physical Therapy for Mild Traumatic Brain Injury**<br><br>**Appendix B: Speech-Language Pathology Clinical Management Guidance: Cognitive Communication Rehabilitation for Combat-Related Concussion/Mild Traumatic brain Injury** | The Mild Traumatic Brain Injury (mTBI) Rehabilitation Toolkit is published by the Army Medical Department's Borden Institute and consists of 11 chapters and two appendices. The sections of the toolkit resourced in this clinical recommendation come from three chapters and two appendices listed in the left column. Other chapters include assessment and intervention on vestibular, balance, vision, dual-task and fitness.<br><br>The mTBI toolkit was developed by an interdisciplinary group of clinicians, including occupational therapists (OTs) and speech-language pathologists (SLPs). Guidance documents were written to provide practical assistance for clinicians working with service members with concussion/mTBI, including those clinicians with limited experience in cognitive rehabilitation. |

## APPENDIX B1: Resource Table (Contd.)

| # | RESOURCE | DESCRIPTION |
|---|---|---|
| 7 | **Study for Cognitive Rehabilitation Effectiveness (SCORE) Manual**<br>Health.mil/SCORE<br><br>**Chapter 4: Traditional Cognitive Rehabilitation for Persistent Symptoms Following Mild Traumatic Brain Injury (SCORE Arm 3)**<br><br>**Part I: Clinician Guide: Individual Cog. Rehabilitation**<br><br>**Part II: Client Manual: Individual Cog. Rehabilitation**<br><br>**Part III: Clinician Guide to Arm 3 Traditional & Arm 4 Integrated Cognitive Group Interventions**<br><br>**Part IV: Client Manual for Arm 3 Traditional & Arm 4 Integrated Cognitive Group Interventions** | The SCORE trial was a congressionally mandated prospective randomized controlled trial of cognitive rehabilitation for service members with mTBI. This was a joint endeavor with investigators and clinicians from TBICoE, BAMC, VA and WRNMMC. The four treatment arms were designated as:<br>Arm 1. Psychoeducational control group<br>Arm 2. Non-therapist directed computerized cognitive rehabilitation<br>Arm 3. Therapist-directed individualized cognitive rehabilitation<br>Arm 4. Integrated interdisciplinary cognitive rehabilitation combined with cognitive behavioral psychotherapy<br><br>The Traumatic Brain Injury Center of Excellence (TBICoE) created a study manual for researchers and clinicians based on the SCORE trial. Chapter 4 is highlighted left as it is the most relevant chapter for primary providers of cognitive rehabilitation. Chapter 4 includes both a Clinician Guide and a Client Manual to individual and group cognitive rehabilitation interventions.<br><br>The SCORE Manual is divided into seven chapters (six most relevant listed below).<br><br>Chapter 1: Study of Cognitive Rehabilitation Effectiveness Clinical Trial: Overview<br><br>Chapter 2: Psychoeducational Interventions for Persistent Post-Concussion Symptoms Following Combat-Related Mild Traumatic Brain Injury (SCORE Arm 1)<br><br>Chapter 3: Computerized Cognitive Rehabilitation Interventions for Persistent Symptoms Following Mild Traumatic Brain Injury (SCORE Arm 2)<br><br>Chapter 4: Traditional Cognitive Rehabilitation for Persistent Symptoms Following Mild Traumatic Brain Injury (SCORE Arm 3). Most relevant chapter for primary cognitive rehabilitation providers. Divided into 4 parts (see left for further details).<br><br>Chapter 5: (SCORE Arm 4). Parts I-IV are a repeat of Chapter 4 (above). Parts V-VIII are geared more toward behavioral health specialists. Manuals provided that integrate behavioral health and cognitive rehabilitation interventions for individual and group therapy, with a section on mindfulness. Access each part from the main website Health.mil/SCORE<br><br>Chapter 6: Implementation of the SCORE Clinical Trial in DoD and VA Healthcare Settings: Administrative Considerations |

## APPENDIX B1: Other Helpful Manualized Resources not Affiliated with DoD or VA

| # | RESOURCE | DESCRIPTION |
|---|---|---|
| 1 | **Short-Term Executive Plus (STEP): Problem Solving Training and Emotional Regulation Manual**<br>January 2014<br>Joshua Cantor, Theodore Tsaousides, Wayne A. Gordon, Margaret Brown, Teresa Ashman, Kristen Dams-O'Connor<br>http://icahn.mssm.edu/research/brain-injury/resources/treatment<br>To obtain the full version of the 2014 manual contact Dr. Wayne Gordon at wayne.gordon@mssm.edu | Geared to clinicians who have in-depth training and substantial clinical expertise in treating persons with brain injury. STEP was designed as a 3-month program that operated 3 days a week, for 3.5 hours per day, for a total of 36 days.<br>Group training designed for 3-8 participants in problem solving and emotional regulation, and individual treatment of attention deficits.<br>Worksheets provided. |
| 2 | **Strategic Memory Advanced Reasoning Training (SMART)**<br>2016<br>Vas, Chapman, Aslan, Spence, Keebler, Rodriguez-Larrain, Rodgers, Jantz, Martinez, Rakic, Krawczyk<br>For further information about SMART, contact the author at: schapman@udallas.edu | Strategic Memory Advanced Reasoning Training (SMART) emphasizes strategic attention, integrated reasoning, and innovation as applied to daily functioning. Strategic attention focuses on intentional management of input by blocking distractions and irrelevant input and factoring in regular mental breaks. Integrated reasoning strategies involve synthesis, abstraction, and implementation processes. Innovation strategies focus on fluid, flexible, and divergent thinking. |
| 3 | **Goal Management Training (GMT)**<br>2014<br>Waid-Ebbs, Daly, Wu, Berg, Bauer, Peristein, Crosson<br>Manual provided by author upon request; contact: Julia.Waid-Ebbs@va.gov | Goal Management Training (GMT) is a psychoeducational intervention that uses 10 PowerPoint modules to present information, stimulate group interaction, and practice complex tasks. GMT consists of metacognitive training in goal formulation, maintenance, and execution. Exercises include mindfulness, inhibiting, card sorting, decision-making/planning, cataloging, and book keeping. Homework assignment support utilization of the strategies in their daily lives. |

## APPENDIX B2: Resource Matrix

### COGNITIVE REHABILITATION CLINICAL RECOMMENDATIONS AND RESOURCE MATRIX (FULL)

| # | TITLE | RECOMMENDATION | CLINICIANS GUIDE | CCT | DHA CONNECTED HEALTH | TBICoE | mTBI TOOLKIT | SCORE | VA/DoD mTBI CPG |
|---|---|---|---|---|---|---|---|---|---|
| **1** | **Cognitive Rehabilitation Modifications for Service Members and Veterans** | | | | | | | | |
| 1.1 | Return to Productivity: Duty, Employment, Volunteering and School | ▪ Emphasize the goal of return to full duty for service members or to employment and/or volunteer work for veterans by incorporating functional skills training, as well as tasks and aspects of the patient's actual work or duty responsibilities into treatment.<br>▪ Use activities such as notetaking and test taking that underlie successful return to school to address attentional, executive and prospective memory skills. | | X | | X | X | | |
| 1.2 | Considerations for Military Service Members | ▪ Identify and incorporate service member's military specific occupation into treatment goals and interventions.<br>▪ Address factors that may impact the service member's ability or motivation to comply with treatment plans or put the service member at risk for a repeat TBI.<br>▪ Determine whether the TBI was sustained in a traumatic context, such as in a blast during combat operations or in a training mishap, to identify potential post-injury comorbidities such as posttraumatic stress disorder.<br>▪ Consider multiple concussions among the risk factors for persistence of cognitive dysfunction and consider for a trial of cognitive rehabilitation.<br>▪ If family is not involved or available, with the service member's concurrence, consider involving a friend from the patient's unit in treatment to serve in the supportive role usually taken by family members.<br>▪ With the service member's concurrence, collaborate with the service member's leadership to facilitate command support of cognitive rehabilitation treatment goals, translation of compensatory strategies to duty performance, alignment with DoD guidelines on return to duty and medical board processes, and continuity of cognitive rehabilitation treatment if needed at separation from service. | X | | | X | X | | X |

## APPENDIX B2: Resource Matrix (Contd.)

| COGNITIVE REHABILITATION CLINICAL RECOMMENDATIONS AND RESOURCE MATRIX (FULL) | | | CLINICIANS GUIDE | CCT | DHA CONNECTED HEALTH | TBICoE | mTBI TOOLKIT | SCORE | VA/DoD mTBI CPG |
|---|---|---|---|---|---|---|---|---|---|
| # | TITLE | RECOMMENDATION | | | | | | | |
| **2** | **Interventions and Strategies to Address Cognitive Dysfunction** | | | | | | | | |
| 2.1 | Attentional Difficulties | ▪ Provide psychoeducation about attentional difficulties and positive expectations for cognitive recovery in the post-acute phase and as a brief initial intervention in the chronic phase of recovery.<br>▪ Address attentional challenges as a component of a comprehensive treatment plan for executive dysfunction.<br>▪ Ensure that the use of restorative interventions that directly train attention are therapist directed and used in conjunction with or as a supplement to compensatory strategy training; may consider as optional an attentional training component such as attention process training (APT) or interactive metronome (IM) training.<br>▪ Consider adding an attentional training component if using a manualized cognitive rehabilitation intervention that does not specifically address attentional function (e.g., Strategic Memory and Reasoning Training, and Goal Management Training). | | X | | | X | X | |
| 2.2 | Memory and New Learning Difficulties | ▪ Emphasize self-management and internal and external compensatory memory strategies coupled with psychoeducation. If indicated, address within the context of a comprehensive approach.<br>▪ Consider including external cognitive aids and assistive technologies (AT) as a compensation for prospective memory difficulties. | | X | | X | X | X | |
| 2.3 | Executive Dysfunction and Comprehensive Integrated Treatment | ▪ Individualized compensatory strategy training is the key approach for the management of executive dysfunction complaints. The provider advises and coaches the patient to develop and use compensatory strategies for goal setting, planning, self-monitoring, and time management.<br>▪ Approaches that teach and rehearse key compensatory strategies to minimize executive dysfunction often focus on problem solving, goal setting, reasoning, and emotional regulation.<br>▪ Consider using one of the following manualized skills based therapies for treatment of executive dysfunction: Short-Term Executive Plus (STEP), Strategic Memory and Reasoning Training (SMART), Goal Management Training (GMT), or Compensatory Cognitive Training (CCT)/ CogSMART. | | X | | | X | X | |

## APPENDIX B2: Resource Matrix (Contd.)

| COGNITIVE REHABILITATION CLINICAL RECOMMENDATIONS AND RESOURCE MATRIX (FULL) | | | CLINICIANS GUIDE | CCT | DHA CONNECTED HEALTH | TBICoE | mTBI TOOLKIT | SCORE | VA/DoD mTBI CPG |
|---|---|---|---|---|---|---|---|---|---|
| # | TITLE | RECOMMENDATION | | | | | | | |
| **2** | **Interventions and Strategies to Address Cognitive Dysfunction** | | | | | | | | |
| 2.3 | Executive Dysfunction and Comprehensive Integrated Treatment (Continued) | ▪ A therapeutic milieu, which provides integrated cognitive rehabilitation, including emotional self-regulation training, is often indicated for patients with cognitive dysfunction and comorbid psychological health disorders.<br>▪ Consider adapting group content and curriculum pertinent to the individual patient(s) from the integrated treatment arm of Study of Cognitive Rehabilitation Effectiveness (SCORE) (Cooper et al., 2016) (Link: Health.mil/SCORE). | | X | | | X | X | |
| 2.4 | Cognitive-Communication Difficulties | ▪ Tailor cognitive-communication interventions to everyday communication needs based on the patient's functional complaints and an analysis of the individual's communication performance in different contexts.<br>▪ Include interventions such as psychoeducation, environmental modifications (e.g., reducing distractions), external aids (e.g., notetaking and recording), and internal compensatory strategies (e.g., active listening, restating, slowing down).<br>▪ Consider guidance in the INCOG Recommendation for Management of Cognition Following TBI, Part IV; Cognitive Communication (Togher et al., 2014) for moderate to severe TBI, which may be relevant to mTBI including:<br>▪ Consider the person's premorbid native language, literacy, and language proficiency; cognitive abilities; and communication style, including communication standards and expectations in that individual's culture.<br>▪ Provide the opportunity to rehearse communication skills in situations appropriate to the context in which the individual will live, work, study, and socialize.<br>▪ Measure outcomes at the level of participation in everyday life (see Appendix E for the outcome measures used in studies included in the evidence review). | X | X | | | X | | |
| 2.5 | Use of Technology | ▪ Select assistive technology (AT), preferably multi-functional devices, to address the specific cognitive support needs of the patient.<br>▪ Instruct the patient's use of the specific AT and collaborate to apply the AT to situations in which cognitive dysfunction occurs.<br>▪ Educate the key people (employers, instructors, command) in the environment(s) in which the patient will use the AT and elicit support for the patient's use of AT. | X | | | | X | | |

## APPENDIX B2: Resource Matrix (Contd.)

| COGNITIVE REHABILITATION CLINICAL RECOMMENDATIONS AND RESOURCE MATRIX (FULL) | | | CLINICIANS GUIDE | CCT | DHA CONNECTED HEALTH | TBICoE | mTBI TOOLKIT | SCORE | VA/DoD mTBI CPG |
|---|---|---|---|---|---|---|---|---|---|
| # | TITLE | RECOMMENDATION | | | | | | | |
| **2** | **Interventions and Strategies to Address Cognitive Dysfunction** | | | | | | | | |
| 2.6 | Telehealth and Virtual Reality | ▪ Consider telehealth as a mode for cognitive rehabilitation delivery when the patient cannot otherwise access cognitive rehabilitation or ease of access interferes with appointment compliance or follow-up.<br>▪ If possible, provide an initial in-person visit with the therapist or local team member (such as a case manager) to introduce telehealth, ensure that the patient has access to the hardware and software required for the telehealth interface and knows how to use it, and develop a therapeutic alliance with the patient. | | | X | | | | |
| 2.7 | Use of Computerized Cognitive Rehabilitation | ▪ Use therapist-guided computerized interventions to improve attentional function as an adjunct component of an integrated cognitive rehabilitation treatment plan.<br>▪ Avoid self-administered or independent use of computerized cognitive rehabilitation. | | | | | | X | |
| **3** | **Delivery of Rehabilitation for Patients with Cognitive Challenges** | | | | | | | | |
| 3.1 | Treatment Plans | ▪ Incorporate improved self-efficacy and independent management of systems as a central component of the treatment plan.<br>▪ Consider referral for comorbid conditions that may impact cognitive function prior to or concurrent with cognitive rehabilitation. Concerns include mental health issues, sleep disturbance, pain management, headache, poor nutrition, substance use, physical inactivity, hearing loss, family and financial stress, and visual and vestibular disturbances.<br>▪ Collaborate with the patient and any other team members at the outset of treatment to establish patient-centered goals aimed at specific activity or participation outcomes.<br>▪ Identify specific activities or tasks that are problematic; the component knowledge, skills, and abilities necessary for successful completion; and target areas in which the patient has decreased efficiency. | X | | | | X | | |

## APPENDIX B2: Resource Matrix (Contd.)

| COGNITIVE REHABILITATION CLINICAL RECOMMENDATIONS AND RESOURCE MATRIX (FULL) | | | CLINICIANS GUIDE | CCT | DHA CONNECTED HEALTH | TBICoE | mTBI TOOLKIT | SCORE | VA/DoD mTBI CPG |
|---|---|---|---|---|---|---|---|---|---|
| # | TITLE | RECOMMENDATION | | | | | | | |
| 3 | **Delivery of Rehabilitation for Patients with Cognitive Challenges** | | | | | | | | |
| 3.2 | Frequency, Intensity, Length, Duration, and Timing of Interventions | ▪ Frequency, intensity, length of sessions: Provide sufficient treatment intensity and practice for the targeted skills to become habitual or automatic and incorporated into the patient's daily activities. For representation targets, provide lengthy and frequent enough sessions for patient to understand and self-manage the condition(s).<br>▪ Duration of treatment: Adjust the duration of treatment based on the patient's progress toward treatment goals. If a patient is not progressing, determine the underlying cause and adjust the frequency, or intensity of treatment. A time-limited trial of cognitive rehabilitation for patients with complex environmental or personal circumstances may help to further assess their ability to engage effectively in cognitive rehabilitation.<br>▪ Timing: Conduct a motivational interview to indicate the patient's readiness to participate. Patient-identified functional goals for treatment indicate readiness for initiation of cognitive rehabilitation. | X | X | | | X | X | |
| 3.3 | Modality of Treatment: Comparing Individual and Group Therapy | ▪ Consider individual therapy when the rehabilitation targets are skills and habits, such as routine use of strategies and AT, or are highly task or needs specific.<br>▪ Consider group therapy when the rehabilitation targets are representations, with a focus on peer support, education and conscious practice of skills in an interactive format. | | | | | X | X | |
| 3.4 | Manualized Treatments | ▪ Use manuals as a resource but not as a stand-alone treatment or substitute for clinical judgement. | | X | | | | X | |
| 3.5 | Interdisciplinary Rehabilitation of Cognitive Dysfunction | ▪ Consider an interdisciplinary team approach for patients experiencing persisting cognitive difficulties and emotional distress that interfere with activity participation.<br>▪ Referral considerations include:<br>▪ Significant complaints of inefficiency or difficulty participating in important activities that the patient needs, wants, or is expected to perform.<br>▪ Concern by key persons in the patient's life who observe a change in the patient's performance of complex instrumental activities of daily life including home, community, work, school and leisure, as well as interpersonal difficulties in affective distress. | | | | | | | X |

## APPENDIX B2: Resource Matrix (Contd.)

| COGNITIVE REHABILITATION CLINICAL RECOMMENDATIONS AND RESOURCE MATRIX (FULL) | | | CLINICIANS GUIDE | CCT | DHA CONNECTED HEALTH | TBICoE | mTBI TOOLKIT | SCORE | VA/DoD mTBI CPG |
|---|---|---|---|---|---|---|---|---|---|
| # | TITLE | RECOMMENDATION | | | | | | | |
| 3 | **Delivery of Rehabilitation for Patients with Cognitive Challenges** | | | | | | | | |
| 3.6 | Addressing Comorbidities | ▪ Address common comorbid conditions that affect cognition either prior to or concurrent with the initiation of cognitive rehabilitation. These conditions include psychological health disorders, sleep disturbances, headaches, and chronic pain.<br>▪ Refer patients with active substance abuse disorder or active psychotic disorder to a behavioral health care provider prior to initiation of cognitive rehabilitation. Provide cognitive rehabilitation concurrently if adequate resources are available and inter-disciplinary collaboration is possible. If not, defer cognitive rehabilitation until the disorder is adequately managed.<br>▪ Refer patients presenting with decreased alertness and severely diminished attention to the appropriate specialist for assessment and treatment prior to initiating cognitive rehabilitation. Defer cognitive rehabilitation until the patient can sustain adequate attention to benefit from treatment sessions. | X | X | X | X | X | | X |
| 3.7 | Interventions for Patients with Difficulty Engaging in Cognitive Rehabilitation | ▪ Consider factors related to the patient: The team should assess for potential psychosocial barriers to treatment effectiveness and address personal crises that may need management.<br>▪ Consider factors related to the team: Ensure that the team is involved, engaged, and sensitive to the psychosocial needs of the patient, and aim for shared strategy use across providers.<br>▪ Consider factors related to treatment delivery: Modify treatment intensity and/or incorporate treatment pauses; set clear expectations for attendance and functional homework completion; change provider if necessary.<br>▪ Consider factors related to the intervention: Focus treatment on patient-centered, functional goals to maximize motivation; engage in frequent and ongoing conversation with the patient regarding treatment goals; modify intervention approach; set clear and specific expectations for appointment attendance and boundaries for no-shows. If the initial intervention approach is not resulting in patient engagement, consider selecting an alternative approach. | X | | | | | | X |

## APPENDIX B2: Resource Matrix (Contd.)

| COGNITIVE REHABILITATION CLINICAL RECOMMENDATIONS AND RESOURCE MATRIX (FULL) | | | CLINICIANS GUIDE | CCT | DHA CONNECTED HEALTH | TBICoE | mTBI TOOLKIT | SCORE | VA/DoD mTBI CPG |
|---|---|---|---|---|---|---|---|---|---|
| # | TITLE | RECOMMENDATION | | | | | | | |
| 3 | **Delivery of Rehabilitation for Patients with Cognitive Challenges** | | | | | | | | |
| 3.8 | Generalizing and Maintaining Treatment Effects | ▪ Support generalization and maintenance of treatment effects:<br>▪ Engage the patient's network including family, friends, command, academic advisors, and work supervisors.<br>▪ Promote self-management of cognitive challenges.<br>▪ Promote metacognitive approaches that encourage self-monitoring.<br>▪ Encourage skills practice in a variety of environments.<br>▪ Assign functional homework.<br>▪ Promote AT for self-monitoring.<br>▪ Consider training the patient in anticipatory awareness. | | | | | X | | |
| 3.9 | Booster Sessions and Follow-up Options | ▪ Consider a tapered discharge plan in which sessions are spaced out at increasing intervals prior to discharge of the patient from treatment.<br>▪ Consider a booster session after discharge to address specific functional needs. | X | | | | | | X |

## APPENDIX B3: Resource Matrix (SHORT)

| # | COGNITIVE REHABILITATION CLINICAL RECOMMENDATIONS | CLINICIANS GUIDE | CCT | DHA CONNECTED HEALTH | TBICoE | mTBI TOOLKIT | SCORE | VA/DoD CPG |
|---|---|---|---|---|---|---|---|---|
| 1 | **Cognitive Rehabilitation Modifications for Service Members and Veterans** | | | | | | | |
| 1.1 | Return to Productivity, Duty, Employment, Volunteering and School | | X | | X | X | | |
| 1.2 | Considerations for Military Service Members | X | | | X | X | X | X |
| 2 | **Interventions and Strategies to Address Cognitive Dysfunction** | | | | | | | |
| 2.1 | Attentional Difficulties | | X | | X | X | | |
| 2.2 | Memory and New Learning Difficulties | | X | | X | X | X | |
| 2.3 | Executive Dysfunction and Comprehensive Integrated Treatment | | X | | | X | X | |
| 2.4 | Cognitive-Communication Difficulties | X | X | | | X | | |
| 2.5 | Use of Technology | X | | | | X | | |
| 2.6 | Telehealth and Virtual Reality | | | X | | | | |
| 2.7 | Use of Computerized Cognitive Rehabilitation | | | | | | X | |
| 3 | **Delivery of Rehabilitation for Patients with Cognitive Challenges** | | | | | | | |
| 3.1 | Treatment Plans | X | | | | X | | |
| 3.2 | Frequency, Intensity, Length, Duration, and Timing of Interventions | X | X | | | X | X | |
| 3.3 | Modality of Treatment: Comparing Individual and Group Therapy | | | | | X | X | |
| 3.4 | Manualized Treatments | | X | | | | X | |
| 3.5 | Interdisciplinary Rehabilitation of Cognitive Dysfunction | | | | | | | X |
| 3.6 | Addressing Comorbidities | X | X | X | X | X | | X |
| 3.7 | Interventions for Patients with Difficulty Engaging in Cognitive Rehabilitation | X | | | | | | X |
| 3.8 | Generalizing and Maintaining Treatment Effects | | | | | X | | |
| 3.9 | Booster Sessions and Follow-up Options | | | | | X | | |

# APPENDIX C: Methods

## Evidence Review

A surge of research over the past few years has expanded knowledge about cognitive rehabilitation for TBI, including studies with mild and moderate TBI populations. Using PubMed, TBICoE subject matter experts conducted a literature search for cognitive rehabilitation interventions for TBI in peer-reviewed research articles published from January 2009 to March 2017. They cross-searched each TBI term with each cognitive rehabilitation term as identified in Table 1. Following the PubMed database search, TBICoE subject matter experts reviewed abstracts of relevant articles, eliminated from further review those studies meeting the exclusion criteria, and determined which full-text articles met the inclusion criteria for mild to moderate TBI severity. This search strategy yielded 15 studies that met both the inclusion and exclusion criteria. A second search completed through July 2017 produced two additional studies meeting the criteria, yielding a total of 17 studies.

Of these studies, 10 were randomized controlled trials (RCTs), the gold standard for treatment efficacy research and high quality evidence. Twelve of the studies identified included service members or veterans in the sample, and several of these specifically examined military personnel who had served in Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF). The patient populations were largely chronic, usually several years post injury (although not all studies reported this variable).

In some studies, all participants had a comorbid psychological health disorder, while other studies excluded participants with psychological health disorders. Only a few studies examined the sustainment of outcomes beyond discharge from treatment. Several of the better designed studies used manualized treatments.

For each of the studies reviewed as supporting evidence for these clinical recommendations, the tables in Appendix D describe each cognitive rehabilitation intervention, including the cognitive domains addressed, and provide specific information from each study about the dose and modalities of treatment and significant intervention outcomes. The evidence tables also provide information about care settings and patient characteristics (e.g., gender, age, TBI severity, time since injury, service member or veteran, deployment status, and comorbid diagnosis exclusions). The tables also include study methodology, strengths and limitations, significant short and long-term outcomes, and contact information for those interventions with treatment manuals.

**Table 1:** Search Terms for TBI and Cognitive Rehabilitation

| TBI Terms | Cognitive Rehabilitation Terms |
|---|---|
| Mild traumatic brain injury | Cognitive rehabilitation |
| Brain injury | Neuropsychological rehabilitation |
| Post-concussion | Cognitive remediation |
| Concussion | ▪ Memory<br>▪ Executive Function<br>▪ Attention<br>▪ Problem-solving |

## APPENDIX C: Methods

**Table 2:** Inclusion and Exclusion Criteria for Cognitive Rehabilitation and Mild to Moderate TBI Research Studies

| Inclusion | Exclusion |
|---|---|
| Published in peer-reviewed journal, January 2009 to April 2017 | Reviews, consensus statements, case studies or case series |
| Written in English | Pharmacologic intervention |
| Adult population (age 18 or >) | Primary outcome is emotional-behavioral, perceptual, or language function |
| A specific focus or section on cognitive rehabilitation after TBI, defined as systematic therapeutic activities addressing at least one of the following cognitive functions: attention, executive function, cognitive communication or memory. | > 50% of the subjects had sustained a severe or penetrating TBI<br>OR<br>No clear indication of TBI severity |
| 100% of the subjects had mild or mild to moderate cognitive impairment<br>OR<br>A minimum of 50% of the subjects had sustained a mild or moderate TBI | |
| > one month post injury, if time since injury described | |

## APPENDIX D: Evidence Tables

| REFERENCE | Cantor, J., et al. (2014). Evaluation of the short-term executive plus intervention for executive dysfunction after traumatic brain injury: A randomized controlled trial with minimization. |
|---|---|
| COGNITIVE DOMAINS | Executive: Problem solving and emotional regulation |
| INTERVENTION DESCRIPTION | Problem solving group: SWAPS, 5 steps:<br>1. Problem orientation<br>2. Problem definition<br>3. Generating alternative solutions<br>4. Decision making<br>5. Solution implementation and outcome verification |
| | Emotional regulation/cognitive behavioral therapy (CBT) group:<br>1. Developing awareness of physiological, experiential, and cognitive aspects of emotions<br>2. Understanding the relation between antecedents, emotions, thoughts, and behavior<br>3. Acquiring skills to regulate autonomic response and reduce emotional dysregulation/behavioral dyscontrol |
| | Therapist-delivered attention training including Attention Process Training, Second Edition (APT-II) |
| | Advising sessions for compensatory strategy training |
| INTERVENTION DELIVERY | Dose/intensity: 12 weeks, 3 days/week. 9 hours/week for 108 total sessions |
| | Modality: Two groups (45-minutes each) and one individual session (60 minutes)/week |
| | Integrated cognitive rehabilitation: Group cognitive rehabilitation + group psychotherapy + individual cognitive rehabilitation |
| TREATMENT MATERIALS/MANUALS AVAILABLE FOR CLINICAL USE | STEP manual created to train therapists and standardize treatment. Contact Dr. Gordon at Department of Rehabilitation Medicine, Icahn School of Medicine, Mount Sinai, New York, NY: wayne.gordon@mountsinai.org. Use commercially available APT-II manual for the attention training component. |
| PARTICIPANT CHARACTERISTICS | TBI severity: 50% mild TBI (n = 49), 19% moderate TBI (n = 19), 31% severe TBI (n = 30) |
| | Time since injury: mean = 13 ± 14 years |
| | Mean age = 45 ± 14 years |
| | Gender: 38% male; 62% female |
| | Participants: Recruited for study |
| | Sample size: N = 98 (intervention group n = 49, waitlist/control group n = 49) |
| SETTING | Outpatient: TBI program, Mount Sinai Medical Center |
| SUMMARY OF RESULTS WITH RELEVANCE TO EWG QUESTIONS | STEP is an intensive multicomponent treatment that decreases executive dysfunction and improves problem solving. The most effective tasks and interventions in the treatment are unknown. |
| STRENGTHS/LIMITATIONS | Strengths: Randomization with minimization, blinded outcome assessment, comparison group that received usual care, intention-to-treat analysis, 9% dropout rate (8 did not complete treatment; 1 did not start treatment), and relatively high attendance with 80% of the group attending half or more treatment days. |
| | Limitations: Usual care not defined |
| STUDY DESIGN | Randomized controlled trial |
| COMPARISON GROUP | Delayed/waiting list |

## APPENDIX D: Evidence Tables (Contd.)

| REFERENCE | Cantor, J., et al. (2014). Evaluation of the short-term executive plus intervention for executive dysfunction after traumatic brain injury: A randomized controlled trial with minimization. |
|---|---|
| SAMPLE CHARACTERISTICS AFFECTING GENERIZABILITY TO MILITARY HEALTH SYSTEM (MHS) AND VETERANS ADMINISTRATION (VA) PATIENT POPULATIONS | Civilian population, predominantly female (< 40% male) and non-minority (76% Caucasian); higher time post-injury and older age more similar to veterans than active duty service members; excluded individuals with active substance abuse or suicidality |
| PSYCHOLOGICAL HEALTH COMORBID CONDITIONS AND EXCLUSIONS | Comorbidities: 41% receiving psychotherapy and 23% participating in support group |
| | Exclusions: Psychosis, active substance abuse, or suicidality (assessed using the Structured Clinical Interview for DSM-IV Disorders) |
| SHORT-TERM INTERVENTION OUTCOMES | Improved executive function on three measures: (1) A composite executive function measure composed of Problem Solving Inventory (PSI) subscales approach-avoid, confidence, and personal control subscales, and Frontal Systems Behavior (FrSBe) subscales disinhibition and executive dysfunction; (2) FrSBe executive function scale; (3) PSI |
| LONG-TERM INTERVENTION OUTCOMES | N/A |
| **REFERENCE** | **Cooper, D. B., et al. (2016). Cognitive rehabilitation for military service members with mild traumatic brain injury: A randomized clinical trial** |
| COGNITIVE DOMAINS | Cognitive domains addressed specific to treatment arm: Computerized - attention; traditional cognitive - attention and other domains individualized to patient; integrated - attention and other cognitive domains and emotional regulation |
| INTERVENTION DESCRIPTION | Computer-based cognitive rehabilitation: Proctored computer lab; commercially available “brain fitness” or “brain training” programs (did not include APT) |
| | Therapist-directed cognitive rehabilitation: Individual and group therapy by SLPs and OTs; restorative and compensatory strategies; APT-Third Edition |
| | Integrated therapist-directed cognitive rehabilitation + psychotherapy: Individual and group therapy by SLPs, OTs, and psychologists; individual psychotherapy targeted anxiety/stress symptoms through acceptance and commitment therapy (ACT) and mindfulness-based stress reduction; group psychotherapy targeted post concussive and depressive symptoms through CBT |
| INTERVENTION DELIVERY | Dose/intensity: 6 weeks, 10 hours/week. 60 total sessions. Modalities:<br>1. Computer cognitive rehabilitation arm: 10 hours/week plasticity-based cognitive rehabilitation<br>2. Traditional cognitive rehabilitation arm: 3 hours/week self-directed computer-based cognitive rehabilitation; 5 hours/week individualized cognitive rehabilitation; 2 hours/week group cognitive rehabilitation<br>3. Integrated treatment arm (cognitive rehabilitation and psychotherapy): 2 hours/week computer-based cognitive rehabilitation; 3 hours/week, individual cognitive rehabilitation; 2 hours/week group; 1 hour/week individual psychotherapy; 1 hour/week psychotherapy group and CBT/mindfulness homework |
| TREATMENT MATERIALS/MANUALS AVAILABLE FOR CLINICAL USE | Detailed session-by-session treatment manuals for all treatment arms available through TBICoE at: Health.mil/SCORE |
| | For supplemental results: http://dvbic.dcoe.mil/research/long-term-follow-scoreiscore |
| PARTICIPANT CHARACTERISTICS | TBI severity: 100% mild TBI |
| | Time since injury: 3–24 months; mean = 8-10 months (248-307 days) |
| | Mean age = 29.9-33.4 years (varied by group) |
| | Gender: 100% male |
| | Participants: Outpatient referrals to a Military Treatment Facility assigned to attend medical appointment as “place of duty” |
| | Sample size: N = 126 |

## APPENDIX D: Evidence Tables (Contd.)

| REFERENCE | Cooper, D. B., et al. (2016). Cognitive rehabilitation for military service members with mild traumatic brain injury: A randomized clinical trial |
|---|---|
| SETTING | Outpatient, TBI clinic at Brooke Army Medical Center |
| SUMMARY OF RESULTS WITH RELEVANCE TO EWG QUESTIONS | Post-deployment cognitive rehabilitation interventions are effective in improving functional outcomes in military service members with persistent post-concussive symptoms. Therapist directed cognitive rehabilitation had superior outcomes on functional cognition compared to computerized self-directed cognitive rehabilitation. Cognitive Behavior Therapy integrated with cognitive rehabilitation reduced psychological distress and emotional symptoms. Involvement in team-based treatment and therapeutic support may improve cognitive rehabilitation efficacy. |
| STRENGTHS/LIMITATIONS | Strengths: Randomized; treatment midpoint assessment and two follow-up assessments (6 and 12 weeks post treatment); comparison to DoD standard of care for mild TBI (mTBI); intervention and control treatments manualized.<br>Limitations: the therapist directed treatment arms are resource intensive and may be challenging to implement in many clinical settings where resources are limited. |
| STUDY DESIGN | Randomized controlled trial |
| COMPARISON GROUP | "Standard of care": Education about symptom management, medical management, and routine follow up |
| SAMPLE CHARACTERISTICS AFFECTING GENERIZABILITY TO MILITARY HEALTH SYSTEM (MHS) AND VETERANS ADMINISTRATION (VA) PATIENT POPULATIONS | Active-duty service members or activated Reserve/Guard with history of OEF/OIF deployment; 64% had >1 lifetime TBI; 66% had blast as TBI mechanism of injury; mean time since injury < 1 year, therefore may not be as generalizable to veterans who usually present for history of deployment-related mTBI to the VA >3 years post-injury. |
| PSYCHOLOGICAL HEALTH COMORBID CONDITIONS AND EXCLUSIONS | Comorbidities: 100% receiving behavioral health treatment for co-occurring conditions; 50 – 65% for post-traumatic stress disorder (PTSD).<br>Exclusions: Psychosis |
| SHORT-TERM INTERVENTION OUTCOMES | Outcomes assessed midway through treatment (week 3) and discharge (week 6). All arms showed improvement on the three primary outcome measures:<br>1. Functional cognitive and behavioral difficulties: Key Behaviors Change Inventory (KBCI)<br>2. Information processing speed, sustained attention and divided attention: Paced Auditory Serial Additional Test (PASAT)<br>3. Psychological distress: Symptom Checklist Revised (SLC-90 R).Therapist-directed cognitive rehabilitation (both traditional cognitive rehabilitation and integrated treatment) had superior outcomes on functional cognitive abilities (KBCI) compared to treatment arms without therapist-directed cognitive rehabilitation. Integrated cognitive rehabilitation reduced psychological distress/emotional symptoms |
| LONG-TERM INTERVENTION OUTCOMES | Six- and 12-week follow-ups: Improvements on primary outcome measures following treatment maintained with no differences among treatment arms. Therapist-directed cognitive rehabilitation (both traditional cognitive rehabilitation and integrated treatment) had superior outcomes on functional cognitive abilities (KBCI) compared to treatment arms without therapist-directed cognitive rehabilitation. |

## APPENDIX D: Evidence Tables (Contd.)

| REFERENCE | Huckans, M., et al. (2010). A pilot study examining effects of group-based Cognitive Strategy Training treatment on self-reported cognitive problems, psychiatric symptoms, functioning, and compensatory strategy use in OIF/OEF combat veterans with persistent mild cognitive disorder and history of traumatic brain injury |
|---|---|
| COGNITIVE DOMAINS | Attention, learning/memory, executive: Problem solving, goal setting, planning |
| INTERVENTION DESCRIPTION | Semi-manualized curriculum with a series of modules; Cognitive Strategy Training (CST) involves training and practice with a variety of compensatory cognitive strategies and external aids; group structure involves interactive didactic and interactive presentations, discussions + cognitive strategy activities. Modules include psycho-education, lifestyle strategies, organizational strategies, attention strategies, memory strategies, and goal planning and problem solving. |
| INTERVENTION DELIVERY | Dose/intensity: 6–8 weeks; 2 hours/week |
| | Modality: Group |
| TREATMENT MATERIALS/MANUALS AVAILABLE FOR CLINICAL USE | Summary of CST trainings, class activities, and home exercises appears in Table 1, pages 48 - 51. Author-designed self-report scales available at: http://www.rehab.research.va.gov/jour/10/471/Huckans.html. |
| PARTICIPANT CHARACTERISTICS | TBI severity: Neuropsychological assessment described TBI severity as mild in most cases |
| | Time since injury: Mean = 33.8 months |
| | Mean age = 33.8 ± 8.4 years |
| | Gender: 100% male |
| | Participants: Patients in one of five Cognitive Strategy Training (CST) groups: “persistent mild cognitive disorder” accompanied by history of self-reported TBI |
| | Sample size: N =16 |
| SETTING | Outpatient, Portland VAMC |
| SUMMARY OF RESULTS WITH RELEVANCE TO EWG QUESTIONS | Group Cognitive Strategy Training (CST) for veterans with combat related mTBI and persistent mild cognitive impairment is a feasible outpatient intervention for veterans receiving care at a VA medical center outpatient. CST had significant effects on psychological functioning, cognitive functioning, and life satisfaction. The recommended pacing for CST is eight 2-hour weekly sessions. Day planner training was a highly effective component of CST; a weekly reminder call facilitated attendance and homework completion. |
| STRENGTHS/LIMITATIONS | Strengths: Attendance 90% ± 12% |
| | Limitations: No control group; pilot study; completer analysis, 5 dropouts not included (sampling bias may have affected results). |
| STUDY DESIGN | Pre-post repeated measures |
| COMPARISON GROUP | None |
| SAMPLE CHARACTERISTICS AFFECTING GENERIZABILITY TO MILITARY HEALTH SYSTEM (MHS) AND VETERANS ADMINISTRATION (VA) PATIENT POPULATIONS | None |

## APPENDIX D: Evidence Tables (Contd.)

| REFERENCE | Huckans, M., et al. (2010). A pilot study examining effects of group-based Cognitive Strategy Training treatment on self-reported cognitive problems, psychiatric symptoms, functioning, and compensatory strategy use in OIF/OEF combat veterans with persistent mild cognitive disorder and history of traumatic brain injury |
|---|---|
| PSYCHOLOGICAL HEALTH COMORBID CONDITIONS AND EXCLUSIONS | Comorbidities: 87% of those completing post-treatment assessments concurrently receiving psychotherapy or psychiatric medication management |
| | Exclusions: Psychosis, current substance abuse or dependence and abstinent for < 30 days |
| SHORT-TERM INTERVENTION OUTCOMES | Increased frequency of cognitive compensation strategy use, perceived usefulness of cognitive strategies and external aids, day planner use and usefulness: Author-designed scales. Increased use of compensatory strategies: Memory Compensation Questionnaire (MCQ). Decreased depressive symptoms: Beck Depression Inventory (BDI-II). Decreased overall cognitive impairment: Multiple Sclerosis Neuropsychological Screening Questionnaire-Patient (MSNQ). Decreased memory impairment: Prospective-Retrospective Memory Questionnaire (PRMQ). Increased life satisfaction: Satisfaction with Life Scale (SWLS). |
| LONG-TERM INTERVENTION OUTCOMES | N/A |
| TREATMENT MATERIALS/MANUALS AVAILABLE FOR CLINICAL USE | Summary of CST trainings, class activities, and home exercises appears in Table 1, pages 48 - 51. Author-designed self-report scales available at: http://www.rehab.research.va.gov/jour/10/471/Huckans.html. |
| PARTICIPANT CHARACTERISTICS | TBI severity: Neuropsychological assessment described TBI severity as mild in most cases |
| **REFERENCE** | **Lebowitz, M. S., et al. (2012). Feasibility of computerized brain plasticity-based cognitive training after traumatic brain injury** |
| COGNITIVE DOMAINS | Unspecified |
| INTERVENTION DESCRIPTION | Brain plasticity-based cognitive training (BPBCT); computer-based software program by Posit Science, Cortex with InSight. Independent home use. |
| INTERVENTION DELIVERY | Dose/intensity: 6 weeks; 40 minutes/day; 5 days/weekmild cognitive disorder" accompanied by history of self-reported TBI |
| | Modality: Computer (non-therapist directed) |
| TREATMENT MATERIALS/MANUALS AVAILABLE FOR CLINICAL USE | Program is commercially available. |
| PARTICIPANT CHARACTERISTICS | TBI severity: 50% mild TBI (n = 5), 20% moderate TBI (n = 2), 20% severe TBI (n = 2) 10% unclassifiable(n = 1) (self-report of injury characteristics; severity classified according to ACRM criteria) |
| | Time since injury: 0.5–22 years; mean = 9.2 ± 8.3 years |
| | Mean age = 46.3 ± 16.6 years |
| | Gender: 10% male; 90% female |
| | Participants: Recruited from community for study; required home computer compatible with software |
| | Sample size: N = 10 |

## APPENDIX D: Evidence Tables (Contd.)

| REFERENCE | Lebowitz, M. S., et al. (2012). Feasibility of computerized brain plasticity-based cognitive training after traumatic brain injury |
|---|---|
| SETTING | Outpatient; Department of Rehabilitation Medicine, Mount Sinai School of Medicine, NYC |
| SUMMARY OF RESULTS WITH RELEVANCE TO EWG QUESTIONS | Self-administered computerized cognitive rehabilitation has face validity for participants, is well-tolerated, and perceived by participants to positively impact cognitive functioning. A virtual reality technology intervention that integrates cognitive rehabilitation into vocational rehabilitation improved executive function. However, training gains did not transfer into improved vocational outcomes. |
| STRENGTHS/LIMITATIONS | Strengths: Face validity for participants.<br>Limitations: No control group; no follow-up data, small sample; limited outcome measures |
| STUDY DESIGN | Pre-post repeated measures |
| COMPARISON GROUP | None |
| SAMPLE CHARACTERISTICS AFFECTING GENERIZABILITY TO MILITARY HEALTH SYSTEM (MHS) AND VETERANS ADMINISTRATION (VA) PATIENT POPULATIONS | Civilians living in an urban community; generally longer time since injury than in military populations. Civilians in Hong Kong of unknown similarity to U. S. military populations |
| PSYCHOLOGICAL HEALTH COMORBID CONDITIONS AND EXCLUSIONS | Comorbidities not reported<br>Exclusions: None specified |
| SHORT-TERM INTERVENTION OUTCOMES | Most participants reported using the software with the requested frequency and reported improved concentration, executive functioning, visual processing, memory, and processing speed on the User Experience Survey developed by Posit Science Corporation. Positive user feedback on technical ease of using program. Some improvement on Cognitive Failures Questionnaire (Total score; Blunders subscale). |
| LONG-TERM INTERVENTION OUTCOMES | N/A |

## APPENDIX D: Evidence Tables (Contd.)

| REFERENCE | Man, D. W., et al. (2013). The effectiveness of artificial intelligent 3-D virtual reality vocational problem-solving training in enhancing employment opportunities for people with traumatic brain injury |
|---|---|
| COGNITIVE DOMAINS | Executive: Problem solving |
| INTERVENTION DESCRIPTION | Artificial intelligent virtual reality based vocational training system (AIVTS); problem-solving skills training program for clerical work targeting self-efficacy. Includes choice points with reinforcement and higher levels of difficulty involving concept formation, reasoning, and planning. |
| INTERVENTION DELIVERY | Dose/intensity: 20- to 25-minute sessions; 12 total sessions |
| | Modality: Virtual reality |
| TREATMENT MATERIALS/ MANUALS AVAILABLE FOR CLINICAL USE | No known available manuals; for further information about instrumentation contact: david.man@polyu.edu.hk |
| PARTICIPANT CHARACTERISTICS | TBI severity: 50% mild TBI (n = 20); 50% moderate TBI (n = 20); mean GCS = 10.0-10.2 for both groups (used GCS and length of LOC to define mild and moderate TBI) |
| | Time since injury: Not specified |
| | Age: 18-55 years |
| | Gender: Not specified |
| | Participants: Recruited from a local hospital |
| | Sample size: N = 40 (intervention group n = 20; control group n = 20) |
| SETTING | Regional hospital, Hong Kong |
| SUMMARY OF RESULTS WITH RELEVANCE TO EWG QUESTIONS | A virtual reality technology intervention that integrates cognitive rehabilitation into vocational rehabilitation improved executive function. However, training gains did not transfer into improved vocational outcomes. |
| STRENGTHS/LIMITATIONS | Strengths: Randomized; prospective design; multiple follow-up assessments (1, 3, and 6 months) |
| | Limitations: Participants received other vocational training concurrently; single site study; limited demographic and injury characteristics reported (no data on gender composition or mean age of sample; time since injury not given) |
| STUDY DESIGN | Randomized controlled trial |
| COMPARISON GROUP | "Content similar" conventional psycho- educational approach |
| SAMPLE CHARACTERISTICS AFFECTING GENERIZABILITY TO MILITARY HEALTH SYSTEM (MHS) AND VETERANS ADMINISTRATION (VA) PATIENT POPULATIONS | Civilians in Hong Kong of unknown similarity to U. S. military populations |
| PSYCHOLOGICAL HEALTH COMORBID CONDITIONS AND EXCLUSIONS | Comorbidities not reported |
| | Exclusions: None specified |
| SHORT-TERM INTERVENTION OUTCOMES | AIVTS group improved more than control group on some aspects of executive functioning: Wisconsin Card Sorting Test (% errors and conceptual level responses). |
| LONG-TERM INTERVENTION OUTCOMES | 3- and 6-month follow-ups: no significant differences between groups on vocational outcomes. |

## APPENDIX D: Evidence Tables (Contd.)

| REFERENCE | Nelson, L. A., et al. (2013). Effects of interactive metronome therapy on cognitive functioning after blast-related brain injury: A randomized controlled pilot trial |
|---|---|
| COGNITIVE DOMAINS | Attention/information processing |
| INTERVENTION DESCRIPTION | Interactive Metronome Therapy (IM) is a computerized behavioral feedback operant conditioning paradigm in which a patient executes various repetitive body movements in time to a beat while a computer provides performance feedback. The tasks are designed to encourage integrated neuroplastic processes under cognitively demanding circumstances; simultaneous auditory and visual feedback is delivered instantaneously following the motor response. |
| INTERVENTION DELIVERY | Dose/intensity: Mean completion time = 7.5 weeks; 1-hour sessions; 3 sessions/week; 15 total sessions |
| | Modality: Virtual reality |
| TREATMENT MATERIALS/ MANUALS AVAILABLE FOR CLINICAL USE | For further information about the intervention, contact Dr. MacDonald at: margaret.e.macdonald3.ctr@mail.mil. |
| PARTICIPANT CHARACTERISTICS | TBI severity: 100% mild to moderate TBI (no breakdown as to mild vs. moderate) |
| | Time since injury: 100% mild to moderate TBI (no breakdown as to mild vs. moderate) |
| | Mean age = 33 years |
| | Gender: 100% male |
| | Participants: Recruited from referrals by neuropsychology and neurology services at a Warrior Recovery Center (WRC); injury documented in medical record as blast related TBI; mean = 2.9 ± 1.6 blast injury events |
| | Sample size: N = 36 (treatment group n = 18, control group n = 18). Note: Age and TBI characteristics are for 46 enrolled participants; characteristics for 36 completers not provided. |
| SETTING | Outpatient, rehabilitation clinic; Warrior Recovery Center, Evans Army Community Hospital, Ft. Carson, Colorado |
| SUMMARY OF RESULTS WITH RELEVANCE TO EWG QUESTIONS | Improvement in some cognitive domains with IM therapy relative to standard of care for service members with chronic post-concussive symptoms and cognitive difficulties. |
| STRENGTHS/LIMITATIONS | Strengths: Randomized; blinded, 6 month follow up assessment. |
| | Limitations: Lack of completers analysis; 10 enrolled not included due to not completing post- treatment analysis (3 IM, 6 standard care, 1 non-randomized); changes in self-reported symptoms and function not provided; high degree of variation in treatment intensity |
| STUDY DESIGN | Randomized controlled trial |
| COMPARISON GROUP | Standard rehabilitation care with a similar number of sessions |
| SAMPLE CHARACTERISTICS AFFECTING GENERIZABILITY TO MILITARY HEALTH SYSTEM (MHS) AND VETERANS ADMINISTRATION (VA) PATIENT POPULATIONS | Military service members; active duty or veteran; 78% were combat arms or combat support personnel; population has multiple blast-related mTBIs, high rates of comorbid PTSD. |

## APPENDIX D: Evidence Tables (Contd.)

| REFERENCE | Nelson, L. A., et al. (2013). Effects of interactive metronome therapy on cognitive functioning after blast-related brain injury: A randomized controlled pilot trial |
|---|---|
| PSYCHOLOGICAL HEALTH COMORBID CONDITIONS AND EXCLUSIONS | Comorbidities: 30% of 46 enrolled had comorbid diagnosis of PTSD |
| | Exclusions: Active suicidal or homicidal ideation or intent; drug or alcohol abuse/ dependence in past month; using benzodiazepine medication |
| SHORT-TERM INTERVENTION OUTCOMES | Improved attention and memory on RBANS Immediate Memory and DKEFS Color Word Interference (condition I) compared to controls |
| LONG-TERM INTERVENTION OUTCOMES | N/A |
| **REFERENCE** | **O'Neil-Pirozzi, T. M., et al. (2010). A controlled treatment study of internal memory strategies (I-MEMS) following traumatic brain injury** |
| COGNITIVE DOMAINS | Memory |
| INTERVENTION DESCRIPTION | Internal memory strategies (I-MEMS); training methods include errorless learning and metacognitive strategy training. Semantic association (categorization and clustering), semantic elaboration/chaining, and imagery are emphasized. Participants applied internal strategies to self-identified functional memory difficulties |
| INTERVENTION DELIVERY | Dose/intensity: 6 weeks; 2 sessions/week; 90-minute sessions |
| | Modality: Group of 3–6 participants and 2–3 facilitators; 12 groups total |
| TREATMENT MATERIALS/ MANUALS AVAILABLE FOR CLINICAL USE | Cognitive rehabilitation intervention with high level of facilitator interaction may improve memory abilities<br>Commercially available APT-II manual used for the attention training component |
| PARTICIPANT CHARACTERISTICS | TBI severity: Treatment group 26% mild TBI (n = 14), 22% moderate TBI (n = 12), 48% severe TBI (n = 26), 4% unclassifiable (n = 2); control group 12.5% mild TBI (n = 5), 22.5% moderate (n = 9), 45% with severe (n = 18) and 20% unclassifiable (n = 8) |
| | Time since injury: Treatment group mean = 11.8 ± 9.5 years; control group mean = 13.4 ± 9.4 years |
| | Age: Treatment group mean = 47.3 ± 10.8 years; control group mean = 47.0 ± 9.7 years |
| | Gender: Not specified |
| | Participants: Recruited for study from various community support service organization and patients of study affiliated physicians |
| | Sample size: N = 94 (treatment group n = 54, control group n = 40) |
| SETTING | Not reported |
| SUMMARY OF RESULTS WITH RELEVANCE TO EWG QUESTIONS | ▪ Session by session outline of the memory intervention in article Table 3; detailed session by session content available from the first author at: oneil.pirozzi@neu.edu |
| STRENGTHS/LIMITATIONS | Strengths: 1-month post-intervention follow-up |
| | Limitations: Non-randomized; control group a convenience sample |
| STUDY DESIGN | Pre-post repeated measures with non-randomized group comparison |
| COMPARISON GROUP | Non-treatment seeking convenience sample |

## APPENDIX D: Evidence Tables (Contd.)

| REFERENCE | O'Neil-Pirozzi, T. M., et al. (2010). A controlled treatment study of internal memory strategies (I-MEMS) following traumatic brain injury |
|---|---|
| SAMPLE CHARACTERISTICS AFFECTING GENERIZABILITY TO MILITARY HEALTH SYSTEM (MHS) AND VETERANS ADMINISTRATION (VA) PATIENT POPULATIONS | Civilians residing in Massachusetts; older and longer time since injury than active-duty service members. |
| PSYCHOLOGICAL HEALTH COMORBID CONDITIONS AND EXCLUSIONS | Comorbidities not reported |
| | Exclusions: None specified |
| SHORT-TERM INTERVENTION OUTCOMES | Improved performance on Hopkins Verbal Learning Test- Revised (HVLT-R), a word list memory measure and Rivermead Behavioral Memory Test (RBMT-II), a test of everyday memory functioning; individuals with mild or moderate TBI showed more improvement than those with severe TBI |
| LONG-TERM INTERVENTION OUTCOMES | N/A |
| REFERENCE | Pagulayan, K.F. et al., (2017). Mental Health Does Not Moderate Compensatory Cognitive Training Efficacy for Veterans With a History of Mild Traumatic Brain Injury |
| COGNITIVE DOMAINS | Attention; learning/memory; executive: Planning, goal setting, problem solving, and cognitive flexibility |
| INTERVENTION DESCRIPTION | Compensatory Cognitive Training (CCT) is a revised manualized version of CogSMART. Each session consists of interactive didactic presentations, in class discussions, and activities involving a variety of cognitive strategies and external aids. Strategies included time management, weekly planning session, paying attention during conversations, internal memory strategies, overlearning, goal setting, and self-monitoring. |
| INTERVENTION DELIVERY | Dose/intensity: Once a week/10 weeks |
| | Modality: Group |
| TREATMENT MATERIALS/ MANUALS AVAILABLE FOR CLINICAL USE | See Compensatory Cognitive Training (CCT) manual: https://s3.amazonaws.com/cogsmart/Compensatory+Cognitive+Training+facilitator+manual+June+2013.pdf |
| PARTICIPANT CHARACTERISTICS | TBI severity: 100% mild TBI |
| | Time since injury: Typically at least 12-months post-injury, mean not provided |
| | Mean age: 35.4 ± 8.4 years in CCT group; 34.8 ± 7.4 years in usual care (UC) group |
| | Gender: 94% male in CCT, 96% male in UC; |
| | Participants: OEF/OIF/OND (Operation New Dawn) veterans |
| | Sample size: N = 119, CCT (n = 50), UC (n = 69) |
| SETTING | VA outpatient care clinics |
| SUMMARY OF RESULTS WITH RELEVANCE TO EWG QUESTIONS | Examined comorbid psychiatric disorders, including PSD, depression, and substance abuse, as potential moderators of treatment response to CCT:<br>▪ Neither the presence of PTSD or depression affect the response to CCT<br>▪ Severity of PTSD, depression, and substance do not affect the efficacy of CCT treatment outcomes |

## APPENDIX D: Evidence Tables (Contd.)

| REFERENCE | Pagulayan, K.F. et al., (2017). Mental Health Does Not Moderate Compensatory Cognitive Training Efficacy for Veterans With a History of Mild Traumatic Brain Injury |
|---|---|
| STRENGTHS/LIMITATIONS | Strengths: Examines the results of a rigorous RCT of cognitive rehabilitation for veterans after mTBI and potential moderators of efficacy |
| | Limitations: The study sample excluded individuals with a history of substance use disorder (SUD) with < 30 days abstinence; thus, the effect of a current SUD on treatment is unclear. Only one of two tests of treatment effect was possible for substance abuse because of the low frequency of substance use in the sample. |
| STUDY DESIGN | Randomized controlled trial |
| COMPARISON GROUP | Usual care (UC) |
| SAMPLE CHARACTERISTICS AFFECTING GENERIZABILITY TO MILITARY HEALTH SYSTEM (MHS) AND VETERANS ADMINISTRATION (VA) PATIENT POPULATIONS | Participants were OEF/OIF/OND veterans who screened positive for a history of mTBI in a standardized Department of Veterans affairs screening and recruited from outpatient clinics. The results may not generalize to those Veterans who have not deployed in the wars on terrorism or to those individuals who sustained a TBI < one year ago. |
| PSYCHOLOGICAL HEALTH COMORBID CONDITIONS AND EXCLUSIONS | Comorbidities: High rates of PTSD symptoms |
| | Exclusions: History of psychotic disorder or substance use disorder with <30 days abstinence |
| SHORT-TERM INTERVENTION OUTCOMES | N/A |
| LONG-TERM INTERVENTION OUTCOMES | N/A |
| **REFERENCE** | **Riegler, L. J., et al. (2013). Cognitive intervention results in web-based videophone treatment adherence and improved cognitive scores** |
| COGNITIVE DOMAINS | Executive: Problem solving |
| INTERVENTION DESCRIPTION | Military On-Line Problem Solving Videotape Intervention (MOPS-VI); incorporated military themes; modules focused on communication strategies, organization, emotional regulation, self-monitoring and changing behavior. Videophones were used to provide weekly live support with a SLP experienced in treating TBI. |
| INTERVENTION DELIVERY | Dose/intensity: Six 1-hour telehealth modules + therapist support |
| | Modality: Telehealth |
| TREATMENT MATERIALS/ MANUALS AVAILABLE FOR CLINICAL USE | Access to modules may be available through contact with author at: jamesls@mail.us.edu |
| PARTICIPANT CHARACTERISTICS | TBI severity: 100% mild |
| | Time since injury: Not reported |
| | Mean age: Intervention group = 30.2 ± 5.3 years; Control group = 30.7 ± 6.8 years; range 20-43 |
| | Gender: Not specified |
| | Participants: Patients receiving care for TBI |
| | Sample size: N = 12; intervention group n = 6, control group n = 6 |

## APPENDIX D: Evidence Tables (Contd.)

| REFERENCE | Riegler, L. J., et al. (2013). Cognitive intervention results in web-based videophone treatment adherence and improved cognitive scores |
|---|---|
| SETTING | VA Cincinnati TBI clinics, SLP department |
| SUMMARY OF RESULTS WITH RELEVANCE TO EWG QUESTIONS | Telehealth is an alternative cognitive rehabilitation intervention for training metacognitive strategies in veterans who are non-compliant with clinic treatment. |
| STRENGTHS/LIMITATIONS | Strengths: Control group matched on age, marital status, education, and TOMAL score<br>Limitations: Nonparametric statistics; completers analysis (3 of 9 did not complete intervention, 1 of whom did not complete baseline testing; risk of sampling bias) |
| STUDY DESIGN | Case-control |
| COMPARISON GROUP | Standard clinic-based treatment |
| SAMPLE CHARACTERISTICS AFFECTING GENERIZABILITY TO MILITARY HEALTH SYSTEM (MHS) AND VETERANS ADMINISTRATION (VA) PATIENT POPULATIONS | Veterans ("non-compliant"): No-shows or non-completers for traditional cognitive rehabilitation delivered by a SLP. |
| PSYCHOLOGICAL HEALTH COMORBID CONDITIONS AND EXCLUSIONS | Comorbidities: Not reported<br>Exclusions: Active treatment for substance use disorders or pre-TBI psychiatric history |
| SHORT-TERM INTERVENTION OUTCOMES | 67% of MOPS-VI participants, none of whom had previously completed in-clinic treatment, completed the MOPS-VI intervention and improved on the Test of Memory and Learning –Second Edition (TOMAL-2) from pre-treatment to post-treatment, to a degree similar to that attained by participants in face to face therapy. |
| LONG-TERM INTERVENTION OUTCOMES | N/A |
| REFERENCE | Storzbach, D., et al., (2016). Compensatory cognitive training for Operation Enduring Freedom/Operation Iraqi Freedom/Operation New Dawn veterans with mild traumatic brain injury |
| COGNITIVE DOMAINS | Attention learning/memory executive: Planning, goal setting, problem solving, and cognitive flexibility |
| INTERVENTION DESCRIPTION | Compensatory Cognitive Training (CCT) is a revised manualized version of CogSMART. Each session consists of interactive didactic presentations, in class discussions, and activities involving a variety of cognitive strategies and external aids. Strategies included time management, weekly planning session, paying attention during conversations, internal memory strategies, overlearning, goal setting, and self-monitoring. |
| INTERVENTION DELIVERY | Dose/intensity: 10 weeks; 2-hrs,/week<br>Modality: Group |
| TREATMENT MATERIALS/ MANUALS AVAILABLE FOR CLINICAL USE | Summary of Compensatory Cognitive Training curriculum by session appears in Table 1 of article; treatment manual available at: http://www.cogsmart.com/resources |

## APPENDIX D: Evidence Tables (Contd.)

| REFERENCE | Storzbach, D., et al., (2016). Compensatory cognitive training for Operation Enduring Freedom/Operation Iraqi Freedom/Operation New Dawn veterans with mild traumatic brain injury |
|---|---|
| PARTICIPANT CHARACTERISTICS | TBI severity: 100% mild |
| | Time since injury: Not specified |
| | Mean age: CCT group = 35.4± 8.4 years; UC group = 34.8 ± 7.4 years |
| | Gender: 94% male and 6% female in CCT group; 96% male and 4% female in UC group |
| | Participants: Recruited from clinic referrals at participating VAs, flyers and medical record reviews followed by recruitment letters; OEF/OIF/OND veterans; screened positive for history of mild TBI by a clinician using a standardized interview + endorsement of cognitive symptoms on the Neurobehavioral Symptom Inventory (NSI) |
| | Sample size: N = 119 (CCT n = 50) |
| SETTING | 3 VA medical centers (Portland, Puget Sound, and San Diego) |
| SUMMARY OF RESULTS WITH RELEVANCE TO EWG QUESTIONS | Veterans who participated in this 20-hour program of multimodal cognitive rehabilitation had improvements in targeted cognitive domains compared to usual care. |
| STRENGTHS/LIMITATIONS | Strengths: Randomized, blinding of assessors; monitoring of treatment fidelity; 5 weeks post-treatment follow-up |
| | Limitations: Lack of participant and provider blinding to treatment condition, patient self-reported outcomes |
| STUDY DESIGN | Randomized controlled trial |
| COMPARISON GROUP | Usual Care (UC) |
| SAMPLE CHARACTERISTICS AFFECTING GENERIZABILITY TO MILITARY HEALTH SYSTEM (MHS) AND VETERANS ADMINISTRATION (VA) PATIENT POPULATIONS | Veterans of OEF/OIF/OND who screened positive for a history of mTBI. |
| PSYCHOLOGICAL HEALTH COMORBID CONDITIONS AND EXCLUSIONS | Comorbidities: High rates of PTSD symptoms (average PCL-M score above typical diagnostic cutoff) |
| | Exclusions: Psychotic disorder; substance use disorder with less than 30 days of abstinence. |
| SHORT-TERM INTERVENTION OUTCOMES | Decreased self-reported cognitive and memory difficulties on Multiple Sclerosis Neuropsychological Screening Questionnaire – Patient version (MSNQ) and Prospective-Retrospective Memory Questionnaire (PRMQ). Increased use of cognitive strategies on Portland Cognitive Strategies Scale 2.0 (PCSS). Improved attention, learning, and executive function on some neurocognitive test measures (WAIS-IV Digit Span, HVLT- Learning, and DKEFS- Letter Fluency). |
| LONG-TERM INTERVENTION OUTCOMES | 5-week follow-up: Post-treatment gains in cognitive functioning maintained |

## APPENDIX D: Evidence Tables (Contd.)

| REFERENCE | Sullivan, K.W., et al., (2012). Outcomes from a pilot study using computer-based rehabilitative tools in a military population |
|---|---|
| COGNITIVE DOMAINS | N/A |
| INTERVENTION DESCRIPTION | One of several commercially available computerized cognitive rehabilitation programs (Dakim Brain Fitness, Luminosity, and Posit Science Brain Fitness Classic) accessed in the Brain Fitness Center or from home |
| INTERVENTION DELIVERY | Dose/intensity: Mean total visits to Brain Fitness Center (BFC) = 29 |
| | Modality: None |
| TREATMENT MATERIALS/ MANUALS AVAILABLE FOR CLINICAL USE | N/A |
| PARTICIPANT CHARACTERISTICS | TBI severity: 50% = mild TBI (n = 12), 25% = moderate TBI (n = 6), 12.5% = severe TBI (n = 3); 12.5% = penetrating TBI (n = 3) |
| | Time since injury: 45% < one year |
| | Mean age = 39 years |
| | Gender: 90% male, 10% female; |
| | Participants: Patients at an Army MTF |
| | Sample size: N = 29; 83% with TBI diagnosis (n = 24) |
| SETTING | Walter Reed National Military Medical Center, Brain Fitness Center |
| SUMMARY OF RESULTS WITH RELEVANCE TO EWG QUESTIONS | In a group of patients receiving self-administered computerized cognitive rehabilitation in addition to other rehabilitation therapies, retrospective chart review showed decreased symptoms and improved function. |
| STRENGTHS/LIMITATIONS | Strengths: None |
| | Limitations: Retrospective; no control group |
| STUDY DESIGN | Retrospective chart review (cohort) |
| COMPARISON GROUP | None |
| SAMPLE CHARACTERISTICS AFFECTING GENERIZABILITY TO MILITARY HEALTH SYSTEM (MHS) AND VETERANS ADMINISTRATION (VA) PATIENT POPULATIONS | Predominantly military population predominantly; 38% blast injury. |
| PSYCHOLOGICAL HEALTH COMORBID CONDITIONS AND EXCLUSIONS | Comorbidities: 20% of participants without a TBI diagnosis had PTSD diagnosis; comorbidities of those with TBI not reported |
| | Exclusions: None |
| SHORT-TERM INTERVENTION OUTCOMES | Decreased self-reported symptoms on NSI and improved function on MPAI-4 |
| LONG-TERM INTERVENTION OUTCOMES | N/A |

## APPENDIX D: Evidence Tables (Contd.)

| REFERENCE | Twamley, E.W., et al., (2014). Cognitive symptom management and rehabilitation therapy (CogSMART) for veterans with traumatic brain injury: Pilot randomized controlled trial |
|---|---|
| COGNITIVE DOMAINS | Attention learning/memory executive: Problem solving, hypothesis testing, self-monitoring |
| INTERVENTION DESCRIPTION | CogSMART and supported employment; CogSMART is a manualized intervention that emphasizes habit learning and compensatory strategies in prospective memory, attention, learning and memory, and executive functioning. Involvement of the family or other support persons is encouraged in the first two and last two sessions of the intervention. |
| INTERVENTION DELIVERY | Dose/intensity: 12 weeks, 1 hour/week |
| | Modality: Group |
| TREATMENT MATERIALS/ MANUALS AVAILABLE FOR CLINICAL USE | Treatment manual available at: http://www.cogsmart.com/resources |
| PARTICIPANT CHARACTERISTICS | TBI severity: 100% mild to moderate TBI (no breakdown as to mild vs. moderate) (classified according to the VA/DoD CPG for management of mild TBI/concussion) |
| | Time since injury: CogSMART group mean = 3.6 ± 2.7 years, control group mean = 5.1 ± 5.3 years |
| | Mean age: CogSMART group = 29.4 ± 6.2 years, control group = 34.3 ± 6.4 years |
| | Gender: 94% male, 6% female |
| | Participants: Patients receiving healthcare at the VA and referred by one of three clinics or by the neuropsychological assessment unit; history of TBI documented in a neuropsychological evaluation and confirmed by clinical interview |
| | Sample size: N = 34 (Supported Employment + CogSMART = 16; Enhanced Supported Employment = 18) |
| SETTING | VA San Diego Healthcare System |
| SUMMARY OF RESULTS WITH RELEVANCE TO EWG QUESTIONS | In a group of patients receiving self-administered computerized cognitive rehabilitation in addition to other CogSMART in the context of supported employment is associated with improvement in post-concussive symptoms, functional memory, PTSD symptoms, depression, and return to competitive employment.improved function. |
| STRENGTHS/LIMITATIONS | Strengths: Randomized; fidelity monitoring |
| | Limitations: Small sample size affected by 6% dropout within the first 3 months; missing data at 2 month assessment. The groups differed in age at baseline. Outcome assessment was not blinded; therapist factors are a potential confound. |
| STUDY DESIGN | Randomized controlled trial |
| COMPARISON GROUP | Enhanced supported employment (ESE) |
| SAMPLE CHARACTERISTICS AFFECTING GENERIZABILITY TO MILITARY HEALTH SYSTEM (MHS) AND VETERANS ADMINISTRATION (VA) PATIENT POPULATIONS | OEF/OIF veterans receiving healthcare at the VA with history of mild to moderate TBI; unemployed but stated work goal; 76% racial/ethnic minority, 76% with comorbid PTSD. |
| PSYCHOLOGICAL HEALTH COMORBID CONDITIONS AND EXCLUSIONS | Comorbidities: 76% met criteria for PTSD |
| | Exclusion: Current alcohol/substance abuse |

## APPENDIX D: Evidence Tables (Contd.)

| REFERENCE | Twamley, E.W., et al., (2014). Cognitive symptom management and rehabilitation therapy (CogSMART) for veterans with traumatic brain injury: Pilot randomized controlled trial |
|---|---|
| SHORT-TERM INTERVENTION OUTCOMES | Decreased post-concussive symptoms (NSI) and improved prospective memory performance (Memory and Intentions Screening Test (MIST)- 24 hr. probe) at post-treatment |
| LONG-TERM INTERVENTION OUTCOMES | 3-, 6-, and 12-month follow-ups: Reduced post-concussive symptoms (NSI), Improved quality of life (Quality of Life Interview-Brief, Satisfaction Scale); strongest effect at 12 months. Improved prospective memory (MIST 24-hour probe) at 3- and 6-month follow-ups. |
| **REFERENCE** | **Twamley, E.W., et al., (2015). CogSMART compensatory cognitive training for traumatic brain injury: Effects over 1 Year** |
| COGNITIVE DOMAINS | Attention learning/memory executive: Problem solving, hypothesis testing, self-monitoring |
| INTERVENTION DESCRIPTION | CogSMART and 1 year of supported employment; CogSMART is a manualized intervention that emphasizes habit learning and compensatory strategies in prospective memory, attention, learning and memory, and executive functioning. Involvement of the family (or other support persons) is encouraged in the first two and last two sessions of the intervention. |
| INTERVENTION DELIVERY | Dose/intensity: 12 weeks, 1 hour/week |
| | Modality: Group |
| TREATMENT MATERIALS/ MANUALS AVAILABLE FOR CLINICAL USE | Treatment manual available at: http://www.cogsmart.com/resources |
| PARTICIPANT CHARACTERISTICS | TBI severity: Mild to moderate TBI |
| | Time since injury: Intervention mean = 4.1 ± 2.8 years; control mean = 5.0 ± 4.6 years |
| | Mean age: Intervention group = 29.7 ± 6.0; control group = 33.8 ± 7.9 |
| | Gender: 96% male; 4% female |
| | Participants: Patients receiving healthcare at the VA and referred by one of three clinics or by the neuropsychological assessment unit; history of TBI documented in a neuropsychological evaluation and confirmed by clinical interview |
| | Sample size: N = 42 |
| SETTING | VA San Diego Healthcare System |
| SUMMARY OF RESULTS WITH RELEVANCE TO EWG QUESTIONS | Compared with patients who participated only in ESE, patients who also received CogSMART experienced significant reductions in post concussive symptoms and improvements in quality of life and prospective memory performance. |
| STRENGTHS/LIMITATIONS | Strengths: Randomized; fidelity monitoring; 12-month follow-up period |
| | Limitations: Sample size was small and there was a 16% dropout rate; Non-blinded treatment condition |
| STUDY DESIGN | Randomized controlled trial |
| COMPARISON GROUP | Enhanced supported employment (ESE) |

## APPENDIX D: Evidence Tables (Contd.)

| REFERENCE | Twamley, E.W., et al., (2015). CogSMART compensatory cognitive training for traumatic brain injury: Effects over 1 Year |
|---|---|
| SAMPLE CHARACTERISTICS AFFECTING GENERIZABILITY TO MILITARY HEALTH SYSTEM (MHS) AND VETERANS ADMINISTRATION (VA) PATIENT POPULATIONS | OEF/OIF veterans receiving healthcare at the VA with history of mild to moderate TBI; unemployed but stated work goal; 64% racial/ethnic minority, 74% with comorbid PTSD |
| PSYCHOLOGICAL HEALTH COMORBID CONDITIONS AND EXCLUSIONS | Comorbidities: 76% met criteria for PTSD<br>Exclusion: Current alcohol/substance abuse |
| SHORT-TERM INTERVENTION OUTCOMES | Decreased post-concussive symptoms (on the NSI) and improved prospective memory performance (Memory and Intentions Screening Test (MIST) 24-hour probe) at post-treatment |
| LONG-TERM INTERVENTION OUTCOMES | 3-, 6-, and 12-month follow-ups: Reduced post concussive symptoms (on the NSI), Improved quality of life (Quality of Life Interview-Brief, Satisfaction Scale); strongest effect at 12 months. Improved prospective memory (MIST 24-hour probe) at 3- and 6-month follow-ups. |
| **REFERENCE** | **Van Vleet, T. M., et al. (2015). Tonic and phasic alertness training: A novel treatment for executive control dysfunction following mild traumatic brain injury** |
| COGNITIVE DOMAINS | Attention/information processing |
| INTERVENTION DESCRIPTION | Multicomponent intervention: Tonic and phasic alertness training (TAPAT) is a computerized training with three 12-minute blocks of a continuous performance task requiring inhibition of the prepotent response. The patient must respond quickly to all non-target objects or tones while looking (or listening) for the random presentation of an infrequent target object or tone. A novel target image is given in each block. |
| INTERVENTION DELIVERY | Dose/intensity: 3 weeks: nine 30-minute cognitive rehabilitation sessions; 4.5 total hrs.<br>Modality: Computer (non-therapist directed) |
| TREATMENT MATERIALS/ MANUALS AVAILABLE FOR CLINICAL USE | TAPAT, a self-administered computerized intervention, may improve attentional and executive control functions. Controlled study with larger sample and long-term follow up is needed to show that benefits are sustained. |
| PARTICIPANT CHARACTERISTICS | TBI Severity: Mild to moderate<br>Time Since Injury: 2–12 years<br>Mean age: 41.4 ± 14.8 years<br>Gender: 60% male; 40% female<br>Participants: Selected based on interview with researchers<br>Sample size: n = 5 (TAPAT intervention = 3, control = 2) |
| SETTING | VA Northern California |
| SUMMARY OF RESULTS WITH RELEVANCE TO EWG QUESTIONS | Further information about TAPAT may be available from the author at: tomvanvleet@gmail.com |

## APPENDIX D: Evidence Tables (Contd.)

| REFERENCE | Van Vleet, T. M., et al. (2015). Tonic and phasic alertness training: A novel treatment for executive control dysfunction following mild traumatic brain injury |
|---|---|
| STRENGTHS/LIMITATIONS | Strengths: Control group (time and contact matched) |
| | Limitations: Very small sample size |
| STUDY DESIGN | Case control |
| COMPARISON GROUP | Delayed/Waiting list |
| SAMPLE CHARACTERISTICS AFFECTING GENERIZABILITY TO MILITARY HEALTH SYSTEM (MHS) AND VETERANS ADMINISTRATION (VA) PATIENT POPULATIONS | Military vs. civilian status unclear; one patient had blast-related TBI |
| PSYCHOLOGICAL HEALTH COMORBID CONDITIONS AND EXCLUSIONS | Comorbidities: One patient with PTSD diagnosis |
| | Exclusion: Current alcohol/substance abuse |
| SHORT-TERM INTERVENTION OUTCOMES | No statistical significance testing due to small sample size. Two patients showed PTSD symptom reduction and clinical improvement on neuropsychological tests administered 5 hours after completion of TAPAT training. |
| LONG-TERM INTERVENTION OUTCOMES | N/A |
| **REFERENCE** | **Vanderploeg, R.D. et al., (2018). Predicting Treatment Response to Cognitive Rehabilitation in Military Service Members with mild Traumatic Brain Injury** |
| COGNITIVE DOMAINS | Cognitive domains addressed specific to treatment arm: Computerized - attention; traditional cognitive - attention and other domains individualized to patient; integrated - attention and other cognitive domains and emotional regulation |
| INTERVENTION DESCRIPTION | 1. Computer-based cognitive rehabilitation: Proctored computer lab; commercially available “brain fitness” or “brain training” programs (did not include APT)<br>2. Therapist-directed cognitive rehabilitation: Individual and group therapy by SLPs and OTs; restorative and compensatory strategies; APT-Third Edition<br>3. Integrated therapist-directed cognitive rehabilitation + psychotherapy: Individual and group therapy by SLPs, OTs, and psychologists; individual psychotherapy targeted anxiety/stress symptoms through acceptance and commitment therapy (ACT) and mindfulness-based stress reduction; group psychotherapy targeted post concussive and depressive symptoms through CBT |
| INTERVENTION DELIVERY | Dose/intensity: 6 weeks, 10 hours/week, 60 total sessions |
| | Modality: Individual and group or computer-based cognitive rehabilitation treatment arms |
| TREATMENT MATERIALS/ MANUALS AVAILABLE FOR CLINICAL USE | See SCORE manuals: Health.mil/SCORE |

## APPENDIX D: Evidence Tables (Contd.)

| REFERENCE | Vanderploeg, R.D. et al., (2018). Predicting Treatment Response to Cognitive Rehabilitation in Military Service Members with mild Traumatic Brain Injury |
|---|---|
| PARTICIPANT CHARACTERISTICS | TBI severity: 100% mild TBI; GCS < 15 = 6.3% (n = 8); most with history of multiple TBIs (65.1% had 2 or more lifetime TBIs) |
| | Time since injury: 3-24 months post-injury; mean = 9.5 months |
| | Mean age: 31.31 years ± 9.05 years |
| | Gender: Not reported |
| | Participants: Outpatient referrals to a Military Treatment Facility (MTF) assigned to attend medical appointment as "place of duty" |
| | Sample size: N = 126 |
| SETTING | Outpatient TBI Clinic at Brooke Army Medical Center (BAMC) |
| SUMMARY OF RESULTS WITH RELEVANCE TO EWG QUESTIONS | This study examined factors contributing to treatment response in the SCORE Trial Patients with comorbid depression had better cognitive outcomes compared to those without depression (5.29 times greater likelihood of functional cognitive improvement). Results show (1) Team-milieu treatment (standard of care for mental health comorbidities and a supportive team milieu) is associated with a positive treatment response and improvement on functional cognition (7.48 times more likely to demonstrate a reliable functional cognitive improvement); (2) Self- administered or independent used computerized cognitive rehabilitation is negatively associated with cognitive and neurobehavioral improvement; (3) High dosage intensive multidisciplinary rehabilitation may be beneficial for individuals with chronic post-concussive symptoms. |
| STRENGTHS/LIMITATIONS | Strengths: Presents the results of one of the largest and most comprehensive RCTs of cognitive rehabilitation after mTBI and examines potential treatment mechanisms |
| | Limitations: A multivariate model that included demographic, injury, and treatment variables was not presented, so unknown moderator relations may have influenced results |
| STUDY DESIGN | Randomized controlled trial |
| COMPARISON GROUP | 4 treatment arms in original study; this analysis did not compare arms |
| SAMPLE CHARACTERISTICS AFFECTING GENERIZABILITY TO MILITARY HEALTH SYSTEM (MHS) AND VETERANS ADMINISTRATION (VA) PATIENT POPULATIONS | Active-duty (or activated reserve/guard) military service members; 71% (n = 90) assigned to the Warriors in Transition Unit (WTU), a military designation for service members who are not on full duty status for medical reasons; 87% in Army; 91.3% (n = 115) enlisted; all had been combat deployed and 54.8% had two or more deployments. TBI was primarily blast related (64.3%) and participants had psychological comorbidities. The results may not generalize to service members in operational units (e.g., those who are on full duty), those with greater chronicity (e.g., persisting symptoms for several years), or to individuals receiving care in the VA healthcare system. |
| PSYCHOLOGICAL HEALTH COMORBID CONDITIONS AND EXCLUSIONS | Comorbidities: 57.9% (n = 73) with current PTSD; 45.2% (n = 57) with current mood disorder; 19.0% (n = 24) with current learning disability or attention deficit hyperactivity disorder; 1.6% (n = 2) with current alcohol use; 19.8% (n = 25) with prior mental health condition |
| | Exclusions: Psychosis |
| SHORT-TERM INTERVENTION OUTCOMES | N/A |
| LONG-TERM INTERVENTION OUTCOMES | N/A |

## APPENDIX D: Evidence Tables (Contd.)

| REFERENCE | Vas, A., et al., (2016). Reasoning training in veteran and civilian traumatic brain injury with persistent mild impairment |
|---|---|
| COGNITIVE DOMAINS | Executive: Cognitive flexibility and abstract reasoning |
| INTERVENTION DESCRIPTION | Strategic Memory Advanced Reasoning Training (SMART) emphasizes strategic attention, integrated reasoning, and innovation as applied to daily functioning. Strategic attention focuses on intentional management of input by blocking distractions and irrelevant input and factoring in regular mental breaks. Integrated reasoning strategies involve synthesis, abstraction, and implementation processes. Innovation strategies focus on fluid, flexible, and divergent thinking. |
| INTERVENTION DELIVERY | Dose/Intensity: 8 weeks; 1.5-hour sessions; 12 total group sessions. 18 hours of training (The first 15 hours of training were conducted in the first 5 weeks; the final 3 hours of training were at spaced intervals over the next 3 weeks). 12 group sessions |
| | Modality: Group (two trained clinicians for a group of 4–5 participants) |
| TREATMENT MATERIALS/ MANUALS AVAILABLE FOR CLINICAL USE | Brief description of training groups in Table 3 of article, page 10; for further information about SMART, contact the author at: schapman@udallas.edu |
| PARTICIPANT CHARACTERISTICS | TBI severity: History of "mild spectrum" TBI defined as Glasgow Outcome Score-Extended (GOS-E) score = 6-7 (mild functional impairment) |
| | Time since injury: > 6 months post injury; mean time since injury = 8.6 years; > 66% > 10 years |
| | Mean age: Intervention group = 40.0 ± 14.2 years; control group = 42.8 ± 14.1years |
| | Gender: 53% male; 47% female |
| | Participants: Recruited for study from flyers, website, brain injury support groups, and local veterans centers; selected based on interview |
| | Sample size: N = 60 (SMART intervention n = 31, BHW control n = 29); 47 civilians; 13 veterans |
| SETTING | Center for Brain Health, University of Texas at Dallas |
| SUMMARY OF RESULTS WITH RELEVANCE TO EWG QUESTIONS | SMART demonstrated efficacy for a strategy-based approach to abstract thinking and executive function in chronic mild-spectrum TBI and there was convergence of these changes with neuronal integrity as measured by cerebral blood flow. In addition, participants showed a decrease in symptoms associated with depression and stress-related symptoms. |
| STRENGTHS/LIMITATIONS | Strengths: Randomized, double blinded; three month follow-up; |
| | Limitations: Self-report for functional outcomes |
| STUDY DESIGN | Randomized controlled trial |
| COMPARISON GROUP | Brain Health Workshop (education based) |
| SAMPLE CHARACTERISTICS AFFECTING GENERIZABILITY TO MILITARY HEALTH SYSTEM (MHS) AND VETERANS ADMINISTRATION (VA) PATIENT POPULATIONS | Civilian (78.3%) & veterans (21.7%) recruited from community; all participants reported post-TBI vocational difficulties; participants were excluded for pre-TBI substance abuse or major psychological health disorder so may not match OEF/OIF deployment-related mTBI service member or veteran population |
| PSYCHOLOGICAL HEALTH COMORBID CONDITIONS AND EXCLUSIONS | Comorbidities: Participants had elevated pre-treatment scores on Beck Depression Inventory (SMART group mean = 18.8) and PTSD Checklist (38.9) |
| | Exclusions: None stated |

## APPENDIX D: Evidence Tables (Contd.)

| REFERENCE | Vas, A., et al., (2016). Reasoning training in veteran and civilian traumatic brain injury with persistent mild impairment |
|---|---|
| SHORT-TERM INTERVENTION OUTCOMES | Improved gist reasoning as measured by the Test of Strategic Learning (TOSL) (primary outcome). Improved on some of the secondary outcome measures: Trail Making Test subtest of the Delis-Kaplan Executive Function Scale (DKEFS), memory for details (TOSL) and awareness (Awareness Questionnaire). Decreased depression severity on Beck Depression Inventory (BDI) |
| LONG-TERM INTERVENTION OUTCOMES | 3-month follow-up: Post-treatment gains maintained. PTSD symptoms (PCL) reduced from post-treatment to follow-up. |
| **REFERENCE** | **Waid-Ebbs et al., (2014). Response to goal management training in veterans with blast-related mild traumatic brain injury** |
| COGNITIVE DOMAINS | Executive: Goal setting |
| INTERVENTION DESCRIPTION | Goal Management Training (GMT) is a psychoeducational intervention that uses 10 PowerPoint modules to present information, stimulate group interaction, and practice complex tasks. GMT consists of metacognitive training in goal formulation, maintenance, and execution. Exercises include mindfulness, inhibiting, card sorting, decision-making/planning, cataloging, and book keeping. Participants had homework assignment to utilize the strategies in their daily lives. |
| INTERVENTION DELIVERY | Dose/Intensity: Biweekly; 10 total sessions |
| | Modality: Group |
| TREATMENT MATERIALS/ MANUALS AVAILABLE FOR CLINICAL USE | Manual provided by author upon request; contact: Julia.Waid-Ebbs@va.gov |
| PARTICIPANT CHARACTERISTICS | TBI severity: 100 % mild TBI; 2–4 injury events |
| | Time since injury: > 4 months post-injury, mean = 2.8 ± 1.3 years |
| | Mean age = 31.3 ± 6.7 years |
| | Gender: 67% male; 33% female |
| | Participants: Patients receiving speech services at the VA recruited for this study |
| | Sample size: N = 6 |
| SETTING | North Florida/South Georgia Veterans Health System, Speech Services |
| SUMMARY OF RESULTS WITH RELEVANCE TO EWG QUESTIONS | Veterans with blast related mTBI who participated in goal management training demonstrated improvement in problem solving but no improvement on self-reported or proxy-reported functioning in daily activities. The lack of generalization may be attributable to insufficient homework completion. |
| STRENGTHS/LIMITATIONS | Strengths: N/A |
| | Limitations: No control group; very small sample size; poor adherence (homework completion rate mean 38% ± 23) |
| STUDY DESIGN | Pre-post repeated measures |
| COMPARISON GROUP | None |

## APPENDIX D: Evidence Tables (Contd.)

| REFERENCE | Waid-Ebbs et al., (2014). Response to goal management training in veterans with blast-related mild traumatic brain injury |
|---|---|
| SAMPLE CHARACTERISTICS AFFECTING GENERIZABILITY TO MILITARY HEALTH SYSTEM (MHS) AND VETERANS ADMINISTRATION (VA) PATIENT POPULATIONS | OEF/OIF veterans with repeated blast-related mTBIs; excluded veterans with learning disability diagnosis, any psychiatric hospitalizations, and substance abuse in past year. |
| PSYCHOLOGICAL HEALTH COMORBID CONDITIONS AND EXCLUSIONS | Comorbidities: All participants had a diagnosis of PTSD |
| | Exclusions: learning disability, lifetime history of psychiatric diagnosis with hospitalization, alcohol or substance abuse in past year |
| SHORT-TERM INTERVENTION OUTCOMES | Improved planning and problem solving on the computerized Tower of London (TOL) test (total time; optimal moves) during treatment as compared to before treatment. |
| LONG-TERM INTERVENTION OUTCOMES | No significant results. |

## APPENDIX E: Outcome Measures

Outcome Measures for cognitive rehabilitation research are not standardized and hence vary across studies with different types of measures used including neuropsychological tests, interviews, rating scales, and questionnaires. Clinical outcomes can be patient reported outcomes (PRO) or clinician reported outcomes (CRO) or performance-based such as neuropsychological test (NPTs). If a provider observes the patient for outcomes, the outcomes are considered observer reported outcomes (OROs).

Tables 1 and 2 describe the measures and tests that proved sensitive to change with intervention in the cognitive rehabilitation research literature.

NOTE: Analysis of these measures for their psychometric properties or clinical utility was outside the scope of this clinical recommendation. As such, these tables serve as a reference only and should not be construed as recommendations.

**Table 1:** Patient Reported (PR), Clinician Reported (CR), and Observer Reported (OR) Outcome Measures (OMs)

| Domain Type | | | PR, CR, or OR |
|---|---|---|---|
| **Cognition** | | | |
| 1 | Problem Solving Inventory (PSI) | Executive Function (problem solving) | PR |
| 2 | Frontal Systems Behavior Scale (FrSBe) | Executive Function | PR |
| 3 | Self-Awareness of Deficits Interview (SA-DI) | Executive Function (self-awareness) | OR |
| 4 | Prospective-Retrospective Memory Questionnaire (PRMQ) | Memory | PR |
| 5 | Memory Compensation Questionnaire (MCQ) | Memory (aids and compensation strategy use) | PR |
| 6 | Key Behaviors Change Inventory (KBCI) | Not domain specific | PR |
| 7 | Multiple Sclerosis Neuropsychological Screening Questionnaire (MSNSQ) | Not domain specific | PR |
| 8 | Cognitive Failures Questionnaire (CFQ) | Not domain specific (self-reported failures in perception and memory) | PR |
| 9 | Portland Cognitive Strategies Scale 2 (PCSS-2) | Not domain specific (use of cognitive strategies) | PR |

## APPENDIX E: Outcome Measures (Contd.)

**Table 1:** Patient Reported (PR), Clinician Reported (CR), and Observer Reported (OR) Outcome Measures (OMs)

| Domain Type | | | PR, CR, or OR |
|---|---|---|---|
| **Quality of Life** | | | |
| 1 | Satisfaction with Life Scale (SWLS) | Satisfaction with life | PR |
| 2 | Quality of Life Interview (QOLI)-Brief | Global life satisfaction and objective and subjective quality of life | OR |
| **Psychological Health** | | | |
| 1 | Symptom Checklist Revised (SLC- 90 R) | Emotional distress/wellness; psychological symptomatology | PR |
| 2 | Beck Depression Inventory (BDI) | Depression severity | PR |
| **Symptoms** | | | |
| 1 | Neurobehavioral Symptom Inventory (NSI) | Post concussive symptom severity | PR |
| **Life Function/Reintegration** | | | |
| 1 | Mayo- Portland Adaptability Inventory-4 (MPAI-4)* | Impairment; ability, adjustment, and societal participation | PR or CR |

**A military version of the MPAI-4 has been validated with active-duty service members and is briefer than the MPAI-4 (Kean, Malec, Cooper, & Bowles, 2013).*

**Table 2:** Neuropsychological Tests (NPTs)

| Measure | | Cognitive Components |
|---|---|---|
| **Executive*** | | |
| 1 | Tower of London (TOL) | Planning |
| 2 | Wisconsin Card Sorting Test | Cognitive flexibility |
| 3 | Delis-Kaplan Executive Function System (DKEFS) | Multiple executive functions; most subtests are modifications of other existing NPTs measures |
| 4 | Test of Strategic Learning (TOSL) | Abstraction/conceptualization; Gist reasoning and fact learning from complex text |
| **Attention** | | |
| 1 | Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) – attention subtests | Attention/speed of information processing (screening test) |
| 2 | Paced Auditory Serial Additional Test (PASAT) | Speed of information processing and sustained/divided attention |
| **Memory** | | |
| 1 | Rivermead Behavioral Memory Test – II (RBMT) | Functional memory (remembering names, hidden belongings, an appointment, an errand; picture, date and face recognition; recall of prose and a short route; orientation) |
| 2 | Test of Memory and Learning-2 (TOMAL) | Immediate and delayed memory (verbal and non-verbal), attention/ concentration, learning |
| 3 | Memory and Intentions Screening Test (MIST) | Prospective memory |
| 4 | RBANS –memory subtests | Immediate and delayed memory (screening test) |
| 5 | Hopkins Verbal learning Test (HVLT) | Verbal learning and memory |

**There is not a consensus in the literature about how to subdivide the sub-components of executive function and whether to include directed attention and working memory within executive function or in the attentional domain; for consistency with the IOM (2011) and Cicerone and colleagues (Cicerone, Langenbahn, Braden, Malec, Kalmar, Fraas, Felicetti, Laatsch, Harley, Bergquist, Azulay, Cantor, & Ashman (2011) systematic reviews, we have not included the latter in executive function.*

## APPENDIX F: Clinical Questions

With input from the DoD TBI Advisory Committee's subgroup on cognitive rehabilitation, the TBICoE cognitive rehabilitation clinical core work group identified and prioritized key questions to be addressed at the expert work group (EWG) meeting. These questions formed the basis for the clinical recommendations.

An end-user group (EUG) of providers at MTFs was queried about the relevance of the draft questions to clinical practice. There was 100 percent consensus on the appropriateness of the questions for supporting clinical practice. The EUG providers were also asked to identify potential critically important gaps not addressed in the draft clinical questions. Two cognitive rehabilitation subject matter experts reviewed the comments and categorized each comment. Eight questions were modified and three new questions were added about cognitive-communication challenges, technology and holistic treatment. Modifications included dosing, return to duty, return to school and return to learn.

**Clinical Questions**

A. Cognitive Rehabilitation Interventions and Strategies

Evidence-based cognitive rehabilitation strategies/training/interventions for executive, attentional, and memory difficulties and the role of computerized and emotional regulation training:

A1. What cognitive domains are important to address in mild-moderate TBI?
A2. What specific strategies/interventions for cognitive-communication difficulties are supported by the evidence?
A3.What specific strategies/interventions for executive dysfunction are supported by the evidence?
A4. What specific strategies/interventions for attentional difficulties are supported by the evidence?
A5. What specific strategies/interventions for memory and new learning difficulties are supported by the evidence?
A6. What specific technologies are supported by the evidence across the various cognitive domains?
A7. What specific computerized interventions (e.g., APT-3) are supported by the evidence for addressing cognitive dysfunction?
A8. What specific behavioral interventions such as emotional regulation training and mindfulness are supported by the evidence for addressing cognitive dysfunction?

B. Cognitive Rehabilitation Delivery

Effective and efficient care delivery of cognitive rehabilitation including group therapies, manuals, tele-health, booster sessions, dosing, interdisciplinary teams, integrated treatment and tele-health:

B1. What is the role of individual vs. group therapy in cognitive rehabilitation and under what circumstances is each modality indicated? What is the role of computers in cognitive rehabilitation and under what circumstances is this mode of delivery indicated?
B2. What is the role of manualized treatments in cognitive rehabilitation delivery (e.g., CogSMART/ Compensatory Cognitive Training, STEP, SCORE, Goal Management Training, etc.)?
B3. What adaptions in treatment delivery need to be made for cognitive rehabilitation by telehealth?
B4. What is the recommended dose of cognitive rehabilitation for specific interventions? Specify (if possible), total number of sessions, length of sessions, pacing (number of sessions/hours per week/month) and duration of intervention considering mode (therapist directed, computerized, telehealth) and modality (e.g., group vs. individual vs. computer) of intervention.
B5. What criteria determine if the patient needs referral to an interdisciplinary team for comprehensive holistic cog rehab utilizing an integrated approach vs cog rehab by an individual therapist?
B6. How is the content of the cognitive rehabilitation intervention tailored and the delivery structured into a holistic cognitive rehabilitation treatment plan that efficiently and effectively addresses the patient's various cognitive and behavioral impairments?
B7. What strategies promote generalization and sustainment of treatment effects?
B8. What is the role of booster sessions and other follow-up options in cognitive rehabilitation?

## APPENDIX F: Clinical Questions (Continued)

**Clinical Questions**

C. Service Members/Veterans and Special Considerations

Intervention enhancements and adaptations to address the unique characteristics of service members and veterans who sustain mild-moderate TBI and the rehabilitation care settings within the Military Health System (MHS) and Veterans Health Administration (VHA).

C1. What factors unique to military populations need to be considered in providing evidence based cognitive rehabilitation at individual and health system levels and how is the focus and content of cognitive rehabilitation developed and adapted to address these factors?

C2. How is cognitive rehabilitation structured differently for veterans and service members?

C3. What patient comorbidities need to be addressed before initiating cognitive rehabilitation?

C4. How does a patient's comorbid psychological condition change the timing of cognitive rehabilitation delivery?

C5. What interventions are indicated if a patient's psychological status makes it difficult to engage in cognitive rehabilitation?

C6. How is cognitive rehabilitation structured to support return to duty?

C7. How is cognitive rehabilitation structured to support:

1. Return to competitive employment?
2. Return to supported employment?

C8. How is cognitive rehabilitation structured to support:

1. Return to learn?
2. Return to school?

## APPENDIX G: Expert Work Groups

The Traumatic Brain Injury Center of Excellence (TBICoE) established a subject matter expert work group (EWG) composed of providers and researchers from the DoD, VA, and civilian health care and academic settings. The experts represented various disciplines, including neuropsychology, speech-language pathology, occupational therapy, clinical psychology, physical therapy, physical medicine and rehabilitation, and nursing. Several of the EWG members had been involved in previously published guidelines on cognitive rehabilitation and TBI including the Institute of Medicine's Report on Cognitive Rehabilitation and TBI, the VA/DoD Clinical Practice Guideline for concussion/mTBI, and the INCOG Recommendations for Cognitive Rehabilitation for TBI.

The EWG members used evidence from the literature, existing clinical guidance, clinical experience and consensus opinion developed at a meeting in August 2017 to guide discussions and formulate recommendations. A subgroup of the Expert Work Group, designated by the Department of Defense's Traumatic Brain Injury Advisory Committee, met monthly with TBICoE leads to provide guidance and feedback on the iterative development of the clinical recommendations. These members are designated with an asterisk (*).

**Expert Work Group Members**

Department of Defense

- Shannon Auxier, M.S., CCC-SLP, National Intrepid Center of Excellence (Speech-Language Pathologist)
- Carole Roth-Abramson, Ph.D., CCC, BC-ANCDS, Naval Medical Center San Diego (Speech-Language Pathologist)
- Joseph Bleiberg, Ph.D., ABPP, National Intrepid Center of Excellence (Neuropsychologist)
- Amy Bowles, M.D., Brooke Army Medical Center (Physical Medicine and Rehabilitation Physician)*
- Marjorie Campbell, Ph.D., Psychological Health Center of Excellence (Clinical Psychologist)
- Douglas Cooper, Ph.D., ABPP-CN, Brooke Army Medical Center (Neuropsychologist)
- CDR Tara A. Cozzarelli, USPH, Defense Health Agency (Registered Nurse)*
- Lindsey-Kirsch Darrow, Ph.D. Walter Reed NMMC (Neuropsychologist)
- Kevin Kelley, PA-C, Defense Health Agency/OpMed (Casualty Care) (Physician Assistant)
- Deana Kubosh, OTD, Joint Base Elmendorf-Richardson Hospital (Occupational Therapist)
- Diane Lent-Tucker, MBA, R.N., BSN, Defense Health Agency (Registered Nurse)
- CDR Deborah Manning, MC, USN, Headquarters, Marine Corps (Family Medicine)*
- Lt Col Jeffrey McClean, USAF, MC, Joint Base San Antonio (Neurologist)*
- Jeannine Mielke, Ph.D., National Intrepid Center of Excellence (Neuropsychologist)
- LCDR Joseph Newcomb, MSC, USN, Womack Army Medical Center (Physician Assistant)
- Dorothy Porcello, MSOT, OTR/L, Walter Reed NMMC (Occupational Therapist)
- Melissa Ray, M.S., CCC-SLP, Brooke Army Medical Center (Speech-Language Pathologist)*
- CDR Randy Reese, MSC, USN, Navy Bureau of Medicine and Surgery (Neuropsychologist)*
- LTC Matthew Scherer, Ph.D., USAMRMC (Physical Therapist)
- Jami Skarda, M.S., CCC-SLP, CBIS, Evans Army Community Hospital (Speech-Language Pathologist)*
- Edison Wong, M.D., M.S., TBICoE (Physical Medicine and Rehabilitation Physician)

## APPENDIX G: Expert Work Groups (Continued)

**Expert Work Group Members**

Department of Veterans Affairs

- Micaela Cornis-Pop, Ph.D. (Speech-Language Pathologist)
- Linda Picon, MCD, CCC-SLP (Senior Consultant/Speech-Language Pathologist)*

Civilian or Academic Settings

- Leslie Freeman Davidson, Ph.D., OT/L, FAOTA, George Washington University (Occupational Therapist)
- Wayne Gordon, Ph.D., ABPP, Mount Sinai Hospital (Neuropsychologist)
- Mary Radomski, Ph.D., OTR/L, FAOTA, Courage Kenny Rehabilitation Institute (Occupational Therapist)
- Lyn Turkstra, Ph.D., University of Wisconsin Rehabilitation Institute (Speech-Language Pathologist)
- John Whyte, M.D., Ph.D., Moss Rehab Research Institute (Physical Medicine and Rehabilitation Physician and Cognitive Psychologist)

TBICoE Core Work Group Members

- Katharine Stout, P.T., D.P.T., N.C.S., MBA (Lead Program Manager of Clinical Affairs, Physical Therapist)
- Gary McKinney, M.S, CBIS (Government Lead, Healthcare Program Specialist)
- Inbal Eshel, M.A. CCC-SLP (Contract Lead, Speech-Language Pathologist)
- Emmanuel Baah, CPA, MBA
- Brooke Heintz, Ph.D., DSW (Social Worker)
- Dorothy Kaplan, Ph.D. (Neuropsychologist)
- Elizabeth Myhre, MSN, M.S., CPNP (Project Manager, Nurse Practitioner)
- Jessicah Ray, M.S., PA-C (Physician Assistant)
- Maryanne Sacco, M.A, OTR/L (Occupational Therapist)
- Edison Wong, M.D., M.S. (Physical Medicine and Rehabilitation Physician)

# APPENDIX H: References

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