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REVIEW ARTICLE (META-ANALYSIS)

Participation After Multidisciplinary Rehabilitation for Moderate to Severe Traumatic Brain Injury in Adults: A Systematic Review

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Abstract

Objective: To determine the effectiveness and comparative effectiveness of multidisciplinary rehabilitation programs for moderate to severe traumatic brain injury (TBI) in improving participation-related outcomes in adults. This article presents results of select key questions from a recent Agency for Healthcare Quality and Research comparative effectiveness review.

Data Sources: MEDLINE, Cochrane Central Register of Controlled Trials, and PsycINFO; hand searches of previous relevant reviews.

Study Selection: We included prospective controlled studies that evaluated the effectiveness or comparative effectiveness of multidisciplinary rehabilitation programs delivered to adults with moderate to severe TBI on their participation in life and community.

Data Extraction: We extracted data, assessed risk of bias, and evaluated strength of evidence. Participation was selected as our primary outcome and included measures of productivity (eg, return to employment or military service) and select scales measuring community integration. Only data from studies with a low or moderate risk of bias were synthesized.

Data Synthesis: Twelve studies met our inclusion criteria; of these, 8 were of low or moderate risk of bias (4 randomized controlled trials of 680 patients and 4 cohort studies of 190 patients, sample size 36−366). Heterogeneous populations, interventions, and outcomes precluded pooled analysis. Evidence was insufficient to draw conclusions about effectiveness. Evidence on comparative effectiveness often demonstrated that improvements were not different between groups; however, this evidence was low strength and may have limited generalizability.

Conclusions: Our review used a rigorous systematic review methodology and focused on participation after multidisciplinary rehabilitation programs for impairments from moderate to severe TBI. The available evidence did not demonstrate the superiority of one approach over another. This conclusion is consistent with previous reviews that examined other patient-centered outcomes. While these findings will have little clinical impact, they do point out the limited evidence available to assess effectiveness and comparative effectiveness while highlighting important issues to consider in future comparative effectiveness research on this topic.

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Rehabilitation after traumatic brain injury (TBI) has recently received increased attention from researchers, policymakers, clinicians, payers, advocates, patients, and the media. This attention is for good reason. TBI is widely understood to be a significant public health issue in the United States. Not well understood, however, is how to best rehabilitate individuals with resulting impairments from TBI. In the face of this uncertainty, patients with impairments from TBI and their health care providers must

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make treatment decisions with the aim of achieving the best possible outcomes.

TBI incidence demonstrates the significance of the problem. The Centers for Disease Control and Prevention estimated, from hospital records, that 1.7 million TBIs occurred in patients each year from 2002 to 2006. Of these, 1.37 million patients were treated and released from emergency departments, 275,000 were hospitalized, and 50,000 died.[1] Additional TBIs, not reflected in the numbers above, are treated in primary care settings and in military and Department of Veterans Affairs hospitals. The Department of Defense reported more than 4,500 moderate to severe TBIs among all service members in 2010.[2] Major causes of TBIs include falls (35.2%), motor vehicle collisions (17.3%), struck by/against events (16.5%), assaults (10%), other/unknown (21%), and, for military personnel deployed in a combat zone, explosions/blasts.[3]

Moderate to severe TBI more often leads to sustained impairments requiring rehabilitation than mild TBI: 40% of those hospitalized with nonfatal TBI sustain impairments that lead to long-term disability.[4] By one estimate, 2% of the U.S. population lives with TBI-related disabilities,[5] presumably from moderate to severe TBI.

Injury type and level of severity are associated with specific impairments. Penetrating injuries can lead to deficits related to the region of the brain injured, and the more common closed head injuries can result in diffuse brain damage and a range of deficits.[6] Evidence suggests that long-lasting effects of moderate to severe TBI include neurocognitive deficits and impaired social functioning.[7] Psychiatric conditions (ie, depressive and aggressive behaviors, post-traumatic stress disorder, psychoses) are also associated with moderate to severe TBI. Some long-term impairments may not become apparent until well after the injury.[7] Among those hospitalized for TBI, social functioning is adversely affected for at least 1 year and can continue for up to 15 years.[7] These long-term neurocognitive deficits and impaired social functioning make returning to previous roles in the workplace or community especially challenging.

Rehabilitation programs seek to restore an individual's functioning and participation to preinjury levels. During the 1970s and 1980s, research suggested that domain-specific training may be insufficient to rehabilitate patients with frontal lobe damage.[8] Because most TBIs involve the frontal lobe, clinicians began to adopt multidisciplinary approaches to TBI rehabilitation.[8] Multidisciplinary programs are delivered by teams that may include physiatrists, neurologists, neuropsychologists, clinical psychologists, physical and occupational therapists, speech language pathologists, recreation therapists, social workers, nurses, and technicians. Specific programs differ by target patient population, setting, program components, and emphases.

Clinicians and researchers have used a variety of outcomes to assess the effectiveness of rehabilitation. Patient-centered outcomes are those valued by patients.[9] Ultimately, survivors of TBI and their families hope for reintegration into previous roles and activities. Therefore, the goal of TBI rehabilitation is to help patients resume meaningful participation in their homes and social environments, regardless of whether specific impairments can be eliminated.[10] For many brain injury survivors, a final goal of community integration may be return to work (RTW), school, or training, all of which are often classified as "productivity" outcomes. Researchers and practitioners agree that "community integration" outcomes, related to the resumption of societal roles, are important indicators of the effectiveness for TBI rehabilitation.[10] However, these outcomes, while obviously important, have not been utilized extensively in TBI rehabilitation outcomes research.[11]

Although experts have increasingly identified comprehensive multidisciplinary rehabilitation as the best approach for addressing multiple TBI-related impairments, how to best match individual patients to the most appropriate type of program is less clear. This uncertainty results from challenges and limitations inherent in evaluating effectiveness and synthesizing evidence on complex conditions and interventions. Heterogeneity of populations across and within studies makes it difficult to demonstrate effectiveness in original research and compare results across studies in evidence synthesis. Rehabilitation programs can be specific to their setting or may adapt to their populations,[12] resulting in limited generalizability. Not surprisingly, current systematic reviews on this topic arrive at seemingly inconsistent conclusions.

The systematic reviews that have examined brain injury rehabilitation have varied widely with regard to populations, outcomes, and study designs included. For instance, reviews by Cicerone et al[11,13-15] are recognized as demonstrating the effectiveness of cognitive rehabilitation. Cicerone's latest review[15] and a recent Cochrane review of multidisciplinary rehabilitation for acquired brain injury in working-age adults[16] concluded that multidisciplinary programs improved outcomes.[16] However, the recent Institute of Medicine review reported that the evidence on the effectiveness or comparative effectiveness of multimodal cognitive rehabilitation for moderate to severe TBI was not informative.[17] The Institute of Medicine's conclusions drew heavily from randomized controlled trial (RCT) data, included studies predominantly with patients with TBI, and separately assessed effectiveness with the patient-centered outcomes of functional status and quality of life. In contrast, the conclusions from the Cicerone reviews were drawn from a variety of study designs, included a combination of populations with TBI and stroke, assessed effectiveness with patient-centered outcomes as well as intermediate outcomes (ie, neuropsychological test scores), and utilized less rigorous risk of bias and strength of evidence (SOE) assessments. The Cochrane review included controlled trials evaluating rehabilitation for acquired brain injuries in working-age adults. Only 1 recent systematic review[18] focused on participation outcomes after rehabilitation specifically for impairments from TBI. This review included studies of populations with TBI of any severity, addressed interventions relevant to occupational therapy, limited outcomes to community integration, and did not use a rigorous systematic review methodology. They found limited support for certain rehabilitation programs.

Resolving controversy around the effectiveness and comparative effectiveness of TBI rehabilitation is essential. TBI continues to be a major concern for active-duty military, veterans, and civilians. To further explore the evidence on this topic, we conducted a comparative effectiveness review for the Agency for Healthcare Research and Quality (AHRQ) Effective Healthcare

List of abbreviations:

AHRQ	**Agency for Healthcare Research and Quality**
CIQ	**Community Integration Questionnaire**
ICRP	**Intensive Cognitive Rehabilitation Program**
RCT	**randomized controlled trial**
RTW	**return to work**
SOE	**strength of evidence**
TBI	**traumatic brain injury**
TEP	**Technical Expert Panel**