Review Article

Psychological Intervention in Traumatic Brain Injury Patients

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Objective. To provide a brief and comprehensive summary of recent research regarding psychological interventions for patients surviving a traumatic brain injury. Methods. A bibliographical search was performed in PubMed, Cochrane Library, PsycNET, Scopus, ResearchGate, and Google Scholar online databases. Analysis included distribution by year of publication, age stage of participants (paediatric, adult), location of the research team, study design, type of intervention, and main outcome variables. Results. The initial search eliciting 1541 citations was reduced to 62 relevant papers. Most publications had adult samples (88.7%). The United States outstands as the country with more research (58.1%); Latin America countries provided no results. Cognitive behavioural therapy (CBT) was the most widely used approach for treatment of (sub)clinical mental disturbances (41.9%). Neuropsychological interventions were scarce (4.8%). Outcome measures included psychiatric disorders (e.g., posttraumatic stress disorder (PTSD), depression, and anxiety) (37.1%), postconcussive symptoms (16.1%), cognitive and functional deficits (48.1%), and social and psychological dimensions (62.9%). Conclusions. CBT outstands as the preferred therapeutic approach for treating behavioural and emotional disturbances. Also, other related therapies such as dialectical behaviour, mindfulness, and acceptance and commitment therapies have been proposed, and probably in the years to come, more literature regarding their effectiveness will be available. On the other hand, evidence showed that interventions from the field of neuropsychology are minimal if compared with its contribution to assessment. Future research should be aimed at performing studies on more diverse populations (e.g., nonmilitary communities and paediatric and Latin American populations) and at controlling designs to examine the therapeutic efficacy of psychotherapeutic and neurocognitive rehabilitation interventions and compare amelioration by injury severity, age of patients, and clinical profile, in the hopes of creating better guidelines for practitioners.

1. Introduction

Traumatic brain injury (TBI) is a disruption in normal brain function caused by external mechanical force, such as rapid acceleration or deceleration, a bump or jolt to the head, or penetration by a projectile. As an acquired brain injury (i.e., postnatal brain damage), TBI is differentiated from nontraumatic brain injuries not involving an impact from external forces (e.g., those caused by strokes and infections). Considering symptom severity and duration (loss of consciousness, posttraumatic amnesia, and memory and motor deficits), TBI can be classified as concussion, mild, moderate, or severe [1, 2].

Someone with TBI, even if medically stable, is likely to experience subsequent symptoms ranging from physical (headache, fatigue, and visual/auditory sensitivity) to cognitive (deficits in memory, attention, concentration, and executive function) and emotional (depression, anxiety) symptoms [1]. Various treatment modalities have been proposed and tested, from medical/surgical to behavioural/cognitive methods (see reviews [3–5]). Addressing impairments that cut across multiple disciplines requires assessment and
rehabilitation following an interdisciplinary model with a
team of experts on physical medicine and rehabilitation,
speech-language pathology, social work, and (neuro)psychol-
ology, among others [6].

Current TBI therapies include pharmacotherapy, psy-
chotherapy, and cognitive rehabilitation. However, psycho-
logical and emotional issues often remain overlooked even
when physical, behavioural, and cognitive symptoms are
treated [7]. Psychology has a long history of research and
practice on neuropsychological assessment of TBI patients,
and there is a growing interest in designing, testing, and
providing suitable psychological interventions.

Psychology has contributed to TBI patient care mainly
from a neuropsychological perspective. Neuropsychology is
a hybrid science in which psychology, psychiatry, and neu-
rology converge in the study of connections between the
brain and behaviour. Assessment has been its main role. This
is done through techniques and instruments aimed at evalu-
ating patient neurocognitive, behavioural, and emotional
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ating patient neurocognitive, behavioural, and emotional
strengths and weaknesses and interpreting their link to brain
anatomy and function [8]. Beyond clinical diagnosis for
treatment planning and progress, neuropsychological assess-
ment has also become a core aspect of decision-making
regarding function and disability in legal [9], labour [10],
and sports [11, 12] contexts.

As a result of TBI, cognitive (e.g., deficits in attention,
memory, and executive function) and behavioural (e.g.,
aggression, poor impulse control, irritability, anhedonia, or
apathy) symptoms may occur and psychiatric/affective disor-
ders may initiate or worsen [13]. Beyond neuropsychological
assessments, psychologists have also worked intensively on
the design, implementation, and testing of post-TBI inter-
ventions. Psychology has aided in the cognitive rehabilitation
of TBI patients [14, 15], as well as in helping them to man-
age the emotional impact of this condition through psycho-
therapy [16] or psychoeducational programs [15]. Family
interventions are another technique applied to TBI survi-
ors since the condition can adversely impact relatives, who
often play a critical supporting role in the patient recovery
process [17].

Given their particular health conditions, TBI survivors
may require professional psychological support to deal with
both cognitive and emotional challenges. This review is
aimed at providing a brief and comprehensive summary of
recent research on psychological interventions in TBI survi-
ors that are potentially of interest to professionals working
with this population.

2. Method

A bibliographical search was performed in the PubMed,
PsycNET, Web of Science, Scopus, Cochrane Library, and
Google Scholar databases. The terms “traumatic brain
injury” and “TBI” were entered in combination with “psy-
chology”, “neuropsychology”, “psychoeducation”, and “psy-
chotherapy”. Filters were applied to retrieve only articles
published in English during the decade prior to the search
(2008 to July 2018). Online resources were accessed on 25
to 27 July 2018. Publication relevance was verified based on

3. Results

The initial search from the six selected databases produced
1,541 citations, of which 617 were duplicates, three were
not within the specified publication year range, and seven
were not in English. After applying the exclusion criteria
and reviewing the available abstracts, the list was reduced to
62 relevant publications (Figure 1).

Classification by participant age stage, year, location, and
study design showed that most of the studies have been done
using adult samples (n = 55, 88.7%), with participants aged
16 to 73 (Table 1). Only a small portion (n = 7, 11.3%)
involved pediatric samples; participants were 4 to 18 years
old, and the studies were done in the United States (n = 5)
and Italy (n = 2). The number of relevant publications
increased notably during the last three years of the publica-
tion time range and accounted for 41.9% (n = 26) of the
results; no results were found for the year 2010. Most of the
study design, four protocols describe 2-group
(n = 3) and 3-group (n = 1) randomized control trials; these
were done in the United States, Australia, Norway, and
Finland. The case-study reports only involved adults (8 civil-
cases and 3 veterans). One qualitative study analysed patient
interaction content to provide feedback to therapists and
improve their performance. One-group quasiexperimental
designs (n = 13) were mostly tested in community samples
(n = 7), and four of these were pilot studies. Most of the
randomized control trials were two-armed (n = 27), but
there were also 3-armed (n = 4) and four-armed (n = 1)
studies; two were pilot studies and three included wait list
control groups. Only one two-armed study was a nonran-
domized trial.

Two types of interventions were used: cognitive
behavioural therapy (known as CBT) was the intervention
technique of choice (n = 26, 41.9%), followed by psychoe-
ducation (n = 16, 25.8%). Very few publications addressed
neuropsychological interventions in TBI patients \( (n = 3, \ 4.8\%) \). Outcome measures were diverse, and most studies included various domains, such as psychiatric disorders (e.g., PTSD, depression, and anxiety) \( (n = 23, \ 37.1\%) \), post-concussive symptoms \( (n = 10, \ 16.1\%) \), cognitive and functional deficits \( (n = 30, \ 48.1\%) \), and social and psychological aspects \( (n = 39, \ 62.9\%) \) (Table 2).

Of note, not all the reported interventions were done following standard, face-to-face techniques. Limited access to psychological services has fuelled increasing interest in implementing technology to broaden intervention options. Some studies involved telephone-based [18–21] or computer-based [22, 23] interventions, while others employed diverse technologies such web-based programs [24, 25], mobile applications [26], videogames [27], and virtual reality [28].

### 4. Discussion

This review is a brief, comprehensive overview of scientific manuscripts reporting on psychological treatments applied to TBI survivors with the purpose of helping them to directly or indirectly overcome cognitive and emotional issues linked to their physical condition.

Once a TBI patient is physically stable, subsequent cognitive, emotional, behavioural, and social difficulties may manifest, hindering engagement with treatment and daily activities. Managing these challenges requires a comprehensive neuropsychological treatment approach. As the most widely used psychotherapeutic approach, CBT is built on the assumption that cognitions (i.e., thoughts) strongly affect behaviours, but, through awareness, can be quantified and controlled. In other words, a person can attain behavioural changes through acknowledgment and control of preceding cognitions. Application of CBT for TBI patients has been aimed at reducing anger, depression, anxiety, and PTSD symptoms and at improving coping, with promising results [29, 30]. However, adaptations are still needed for this population to improve intervention efficacy and allow replication [31]. If the aim of a multidisciplinary team is to achieve the best possible outcome, the medical professionals involved need information on the aims and techniques of psychotherapy whereas the psychotherapists need to understand the disorder’s medical characteristics. Psychotherapy with TBI patients can be challenging and frustrating at times but is worth attempting since it can be very rewarding for both the survivor and therapist [30].

Research on psychological interventions in TBI patients has grown over the last decade and boomed during the last three years. The United States is the apparent leader in this research area since TBIs have been acknowledged as an important public health issue. Estimates from the United States indicate that TBIs annually account for approximately...
TBIs in children are less frequent, they imply a higher risk of with TBI has been less frequent than that in adults. Although present results indicated that research in paediatric patients through qualitative and quasi experimental designs requiring sharing their knowledge on psychological intervention as results were obtained from Latin America. Researchers Australia, North America, Europe, and Asia. Of note, no in this area has also been published for populations in this country for both research and clinical practices. Research the development of various psychological interventions in TBI [32]. These particular circumstances may account for instance, an estimated 4.2% of veterans from the Army, Air duty military members and veterans). Those who have served in the United States military are at significant risk for TBI; for instance, an estimated 4.2% of veterans from the Army, Air Force, Navy, or Marine Corps have been diagnosed with TBI [32]. These particular circumstances may account for the development of various psychological interventions in this country for both research and clinical practices. Research in this area has also been published for populations in Australia, North America, Europe, and Asia. Of note, no results were obtained from Latin America. Researchers and clinicians from this region could benefit greatly from sharing their knowledge on psychological intervention as an element in TBI treatment; initially, this could be done through qualitative and quasi experimental designs requiring little infrastructure.

As observed in a previous review of this area [33], the present results indicated that research in paediatric patients with TBI has been less frequent than that in adults. Although TBIs in children are less frequent, they imply a higher risk of negative impact given that physical and cognitive development are still very much in the process in children. Interventions in paediatric populations also bring additional challenges. For instance, neurocognitive skills are not as fully development are still very much in the process in children. Inter- negative impact given that physical and cognitive development can be diminished by symptomatology, which occurs in some TBI cases, can pres- therapy relies on parents.

Treating patients with psychiatric and neurocognitive symptomatology, which occurs in some TBI cases, can pres- a unique challenge. Progress in psychotherapy can be significantly hindered by cognitive deficits, and the effectiveness of neurocognitive rehabilitation can be diminished by psychiatric overlay [34]. Ample research is available on neuropsychological assessment of TBI patients, but the present review highlights that publications on neuropsychological interventions are scarce and largely focus on validating specific cognitive rehabilitation techniques. For example, one study in paediatric patients explored the effect of a one-time neuropsychological consultation on postconcussive symptoms [35], while another tested an intervention specifically designed to improve attention, working memory, and executive function [36]. The scientific contribution of neuro- psychology to clinical assessment of TBI patients will no doubt continue providing valid and efficient measurements. Neuropsychologists now need to apply themselves to designing, implementing, and testing novel cognitive rehabilitation

| Year of publication | Paediatric sample (age ≤ 18) (n = 7) | Adult sample (age ≥ 16) (n = 55) | Total (n = 62) |
|---------------------|-------------------------------------|---------------------------------|---------------|
| 2008                | 0                                   | 1                               | 1             |
| 2009                | 1                                   | 3                               | 4             |
| 2011                | 1                                   | 4                               | 5             |
| 2012                | 0                                   | 9                               | 9             |
| 2013                | 0                                   | 5                               | 5             |
| 2014                | 1                                   | 6                               | 7             |
| 2015                | 0                                   | 5                               | 5             |
| 2016                | 3                                   | 7                               | 10            |
| 2017                | 1                                   | 10                              | 11            |
| 2018                | 0                                   | 5                               | 5             |

| Location             | Paediatric sample (age ≤ 18) (n = 7) | Adult sample (age ≥ 16) (n = 55) | Total (n = 62) |
|---------------------|-------------------------------------|---------------------------------|---------------|
| United States       | 5                                   | 31                              | 36            |
| Australia           | 0                                   | 7                               | 7             |
| Canada              | 0                                   | 2                               | 2             |
| Europe              | 2                                   | 13                              | 15            |
| Asia                | 0                                   | 2                               | 2             |

| Study design         | Paediatric sample (age ≤ 18) (n = 7) | Adult sample (age ≥ 16) (n = 55) | Total (n = 62) |
|---------------------|-------------------------------------|---------------------------------|---------------|
| Protocol            | 0                                   | 4                               | 4             |
| Content analysis    | 0                                   | 1                               | 1             |
| Case study          | 0                                   | 11                              | 11            |
| 1-group             | 3                                   | 10                              | 13            |
| 2-group             | 4                                   | 24                              | 28            |
| 3-group             | 0                                   | 4                               | 4             |
| 4-group             | 0                                   | 1                               | 1             |
interventions that, together with neuropsychological evaluations, provide patients with the most adequate treatment.

In terms of outcomes, most of the reviewed studies included mental health variables ranging from symptoms below the clinical threshold to diagnosed mental disorders such as depression, anxiety, or PTSD. Regardless of the approach, be it psychotherapy or neuropsychological rehabilitation, all psychological interventions in TBI patients ideally need to consider outcome variables from both fields, including examination for mental disorders and evaluation of cognitive functioning. The use of scales facilitates assessment of patients for clinical and research purposes, although most outcome scales for TBI are functional measures. As the emotional, cognitive, psychosocial, and health-related quality of life aspects of recovery are increasingly recognised, metrics to assess these domains are becoming essential [37–39]. Clinicians and researchers require reliable, valid measures to comprehensively quantify the level of burden and functional impairment in TBI survivors in the short and long terms. These will improve patient care by allowing proper diagnosis, prompt assignment to rehabilitation, and accurate assessment of intervention impact [37, 39].

In neurological disorders, including TBI, biomarkers play an important role in research and clinical practice by allowing physiological processes to be monitored in health and sickness [40]. Magnetic resonance imaging provides several measurement options that can function as TBI biomarkers, including detection of hemosiderin and white matter abnormalities, assessment of white matter integrity derived from diffusion tensor imaging, and quantitative measurements that directly assess neuroanatomy. Magnetic resonance could also be a useful biomarker in individuals who, having survived TBI, have recovered without neuroimaging signs or neuropsychological effects detected with current methods [41]. Blood biomarkers have also been proposed recently as surrogate markers to improve care quality and reduce diagnosis costs [42]. Evidence-based treatments (i.e., pharmacological or nonpharmacological interventions) of TBI are currently extremely limited, and further research is needed including prospective, longitudinal studies to explore biomarkers along with standard outcome measures [43].

As a final note, TBI severity is an important factor to consider when selecting patients for a specific intervention and for assessing outcome. Because the studies included in this review relied on diverse TBI severity scales (e.g., Glasgow Coma Scale, Barell Matrix, and Abbreviated Injury Scale), some omitted reporting the classification criteria and others did not specify the level of severity and therefore did not analyse this variable.

5. Conclusions

This brief overview of recent research on psychological interventions for TBI patients showed that CBT is the preferred therapeutic approach for treating behavioural and emotional disturbances. Other related therapies such as dialectical behaviour, mindfulness, and acceptance and commitment therapies have been proposed, and the literature regarding their effectiveness is sure to grow in the coming years. When compared to its contribution to TBI assessment, neuropsychology is used minimally for interventions. Psychotherapeutic and neurocognitive rehabilitation interventions for TBI patients are challenging for both clinicians and researchers. Future research needs to include more diverse populations (e.g., nonmilitary communities and pediatric and Latin American populations). In addition, it should focus on controlled designs to examine the therapeutic efficacy of psychotherapeutic and neurocognitive rehabilitation interventions and compare amelioration by injury severity, patient age, and clinical profile in the hopes of creating the best practice guidelines for practitioners.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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References

[1] M. Pervez, R. S. Kitagawa, and T. R. Chang, “Definition of traumatic brain injury, neurosurgery, trauma orthopedics, neuroimaging, psychology, and psychiatry in mild traumatic brain injury,” Neuroimaging Clinics of North America, vol. 28, no. 1, pp. 1–13, 2018.
[2] A. I. R. Maas, N. Stocchetti, and R. Bullock, “Moderate and severe traumatic brain injury in adults,” Lancet Neurology, vol. 7, no. 8, pp. 728–741, 2008.
[3] M. Galgano, G. Toshkezi, X. Qiu, T. Russell, L. Chin, and L.-R. Zhao, “Traumatic brain injury,” Cell Transplantation, vol. 26, no. 7, pp. 1118–1130, 2017.
[4] B. Dang, W. Chen, W. He, and G. Chen, “Rehabilitation treatment and progress of traumatic brain injury dysfunction,” Neural Plasticity, vol. 2017, Article ID 1582182, 6 pages, 2017.
[5] C. Prince and M. Bruhns, “Evaluation and treatment of mild traumatic brain injury: the role of neuropsychology,” Brain Sciences, vol. 7, no. 12, p. 105, 2017.
[6] J. M. Levine and S. R. Flanagan, “Rehabilitation of traumatic brain injury,” The Psychiatric Clinics of North America, vol. 33, no. 4, pp. 877–891, 2010.
[7] M. Bédard, M. Felteau, S. Marshall et al., “Mindfulness-based cognitive therapy: benefits in reducing depression following a traumatic brain injury,” Advances in Mind-Body Medicine, vol. 26, no. 1, pp. 14–20, 2012.
[8] K. Podell, K. Gifford, D. Bougakov, and E. Goldberg, “Neuropsychological assessment in traumatic brain injury,” The Psychiatric Clinics of North America, vol. 33, no. 4, pp. 855–876, 2010.
[9] I. Z. Schultz, A. K. Law, and L. C. Cruikshank, “Prediction of occupational disability from psychological and neuropsychological evidence in forensic context,” International Journal of Law and Psychiatry, vol. 49, Part B, pp. 183–196, 2016.
[10] D.-K. Chien, H.-F. Hwang, and M.-R. Lin, “Injury severity measures for predicting return-to-work after a traumatic brain injury,” Accident Analysis & Prevention, vol. 98, pp. 101–107, 2017.
[11] G. L. Iverson and P. Schatz, “Advanced topics in neuropsychological assessment following sport-related concussion,” Brain Injury, vol. 29, no. 2, pp. 263–275, 2015.

[12] R. J. Echemendia, G. L. Iverson, M. McGrea et al., “Advances in neuropsychological assessment of sport-related concussion,” British Journal of Sports Medicine, vol. 47, no. 5, pp. 294–298, 2013.

[13] S. Riggio, “Traumatic brain injury and its neurobehavioral sequelae,” The Psychiatric Clinics of North America, vol. 33, no. 4, pp. 807–819, 2010.

[14] K. Dams-O’Connor and W. A. Gordon, “Role and impact of cognitive rehabilitation,” The Psychiatric Clinics of North America, vol. 33, no. 4, pp. 893–904, 2010.

[15] D. L. Snell, L. J. Surgenor, E. J. C. Hay-Smith, and R. J. Siegert, “A systematic review of psychological treatments for mild traumatic brain injury: an update on the evidence,” Journal of Clinical and Experimental Neuropsychology, vol. 31, no. 1, pp. 20–38, 2009.

[16] K. Bergersen, J. O. Halvorsen, E. A. Tryti, S. I. Taylor, and A. Olsen, “A systematic literature review of psychotherapeutic treatment of prolonged symptoms after mild traumatic brain injury,” Brain Injury, vol. 31, no. 3, pp. 279–289, 2017.

[17] J. S. Kreutzer, J. H. Marwitz, E. E. Godwin, and J. C. Arango-Lasprilla, “Practical approaches to effective family intervention after brain injury,” The Journal of Head Trauma Rehabilitation, vol. 25, no. 2, pp. 113–120, 2010.

[18] T. Hart, J. A. Brockway, J. Whyte, K. R. Bell, S. Neuberger, and I. Chervoneva, “Analyzing the ingredients of a telephone counseling intervention for traumatic brain injury,” Disability and Rehabilitation, vol. 35, no. 19, pp. 1668–1675, 2013.

[19] J. S. Richardson, J. R. Fann, K. R. Bell, and N. Temkin, “Impact of telephone-based problem-solving treatment on the use of medical and psychological services in the military,” The Journal of Head Trauma Rehabilitation, vol. 33, no. 2, pp. 1–E6, 2018.

[20] C. H. Bombardier, K. R. Bell, N. R. Temkin, J. R. Fann, J. Hoffman, and S. Dikmen, “The efficacy of a scheduled telephone intervention for ameliorating depressive symptoms during the first year after traumatic brain injury,” The Journal of Head Trauma Rehabilitation, vol. 24, no. 4, pp. 230–238, 2009.

[21] K. R. Bell, J. A. Brockway, T. Hart et al., “Scheduled telephone intervention for traumatic brain injury: a multicenter randomized controlled trial,” Archives of Physical Medicine and Rehabilitation, vol. 92, no. 10, pp. 1552–1560, 2011.

[22] E. G. King, T. S. Kretzmer, R. D. Vanderploeg, S. B. Asmussen, V. L. Clement, and H. G. Belanger, “Pilot of a novel intervention for postconcussive symptoms in active duty, veterans, and civilians,” Rehabilitation Psychology, vol. 58, no. 3, pp. 272–279, 2013.

[23] M. R. Schoenberg, W. D. Ruwe, K. Dawson, N. B. McDonald, B. Houston, and P. G. Forducey, “Comparison of functional outcomes and treatment cost between a computer-based cognitive rehabilitation teletherapy program and a face-to-face rehabilitation program,” Professional Psychology: Research and Practice, vol. 39, no. 2, pp. 169–175, 2008.

[24] B. G. Kurowski, S. L. Wade, J. W. Dexheimer, J. Dyas, N. Zhang, and L. Babcock, “Feasibility and potential benefits of a web-based intervention delivered acutely after mild traumatic brain injury in adolescents: a pilot study,” The Journal of Head Trauma Rehabilitation, vol. 31, no. 6, pp. 369–378, 2016.

[25] H. G. Belanger, F. Barwick, M. A. Silva, T. Kretzmer, K. E. Kip, and R. D. Vanderploeg, “Web-based psychoeducational intervention for postconcussion symptoms: a randomized trial,” Military Medicine, vol. 180, no. 2, pp. 192–200, 2015.

[26] S. L. Wade, G. Bedell, J. A. King et al., “Social Participation and Navigation (SPAN) program for adolescents with acquired brain injury: pilot findings,” Rehabilitation Psychology, vol. 63, no. 3, pp. 327–337, 2018.

[27] M. Välimäki, J. Korkkela, K. Kauppi et al., “Digital gaming for improving the functioning of people with traumatic brain injury: protocol of a feasibility study,” JMIR Research Protocols, vol. 5, no. 1, article e6, 2016.

[28] I. Cikajo, U. Cizman Staba, S. Vrhovac, F. Larkin, and M. Roddy, “A cloud-based virtual reality app for a novel tele-mindfulness service: rationale, design and feasibility evaluation,” JMIR Research Protocols, vol. 6, no. 6, article e108, 2017.

[29] B. Waldron, L. M. Casserly, and C. O’Sullivan, “Cognitive behavioural therapy for depression and anxiety in adults with acquired brain injury. What works for whom?,” Neuropsychological Rehabilitation, vol. 23, no. 1, pp. 64–101, 2013.

[30] C. K. Block and S. E. West, “Psychotherapeutic treatment of survivors of traumatic brain injury: review of the literature and special considerations,” Brain Injury, vol. 27, no. 7-8, pp. 775–788, 2013.

[31] M. Gallagher, H. J. McLeod, and T. M. McMillan, “A systematic review of recommended modifications of CBT for people with cognitive impairments following brain injury,” Neuropsychological Rehabilitation, vol. 29, no. 1, pp. 1–21, 2016.

[32] Centers for Disease Control and Prevention, The Report to Congress on Traumatic Brain Injury in the United States: Epidemiology and Rehabilitation, National Center for Injury Prevention and Control; Division of Unintentional Injury Prevention, Atlanta, GA, USA, 2015.

[33] N. Creasey, J. Benger, I. Wright, and M. Lyttle, “Non-pharmacological interventions to reduce psychological sequelae of mild traumatic brain injury in adults and children: a systematic review,” Brain Injury, vol. 30, no. 5-6, pp. 709-710, 2016.

[34] M. A. Cole, J. J. Muir, J. J. Gans et al., “Simultaneous treatment of neurocognitive and psychiatric symptoms in veterans with post-traumatic stress disorder and history of mild traumatic brain injury: a pilot study of mindfulness-based stress reduction,” Military Medicine, vol. 180, no. 9, pp. 956–963, 2015.

[35] M. W. Kirkwood, R. L. Peterson, A. K. Connery, D. A. Baker, and J. Forster, “A pilot study investigating neuropsychological consultation as an intervention for persistent postconcussive symptoms in a pediatric sample,” The Journal of Pediatrics, vol. 169, pp. 244–249.e1, 2016.

[36] M. M. Söhlberg, B. Harn, H. MacPherson, and S. L. Wade, “A pilot study evaluating attention and strategy training following pediatric traumatic brain injury,” Clinical Practice in Pediatric Psychology, vol. 2, no. 3, pp. 263–280, 2014.

[37] J. A. Kosty and S. C. Stein, “Measuring outcome after severe TBI,” Neurological Research, vol. 35, no. 3, pp. 277–284, 2013.

[38] D. Shukla, B. I. Devi, and A. Agrawal, “Outcome measures for traumatic brain injury,” Clinical Neurology and Neurosurgery, vol. 113, no. 6, pp. 435–441, 2011.

[39] A. D. Nichols, A. M. Higgins, B. J. Gabbe, L. J. Murray, D. J. Cooper, and P. A. Cameron, “Measuring functional and quality of life outcomes following major head injury: common scales and checklists,” Injury, vol. 42, no. 3, pp. 281–287, 2011.
[40] E. Toman, S. Harrisson, and T. Belli, “Biomarkers in traumatic brain injury: a review,” Journal of the Royal Army Medical Corps, vol. 162, no. 2, pp. 103–108, 2016.

[41] E. D. Bigler, “Neuroimaging biomarkers in mild traumatic brain injury (mTBI),” Neuropsychology Review, vol. 23, no. 3, pp. 169–209, 2013.

[42] A. Dadas, J. Washington, R. Diaz-Arrastia, and D. Janigro, “Biomarkers in traumatic brain injury (TBI): a review,” Neuropsychiatric Disease and Treatment, vol. 14, pp. 2989–3000, 2018.

[43] V. Rao, V. Koliatsos, F. Ahmed, C. Lyketsos, and K. Korte, “Neuropsychiatric disturbances associated with traumatic brain injury: a practical approach to evaluation and management,” Seminars in Neurology, vol. 35, no. 1, pp. 64–82, 2015.

[44] P. Tuerk, K. T. Brady, and A. L. Grubaugh, “Clinical case discussion: combat PTSD and substance use disorders,” Journal of Addiction Medicine, vol. 3, no. 4, pp. 189–193, 2009.

[45] H. Hofer, S. Frigerio, E. Frischknecht, D. Gassmann, K. Gutbrod, and R. M. Müri, “Diagnosis and treatment of an obsessive-compulsive disorder following traumatic brain injury: a single case and review of the literature,” Neurocase, vol. 19, no. 4, pp. 390–400, 2013.

[46] M. Y. Hsieh, J. Ponsford, D. Wong, M. Schönberger, A. McKay, and K. Haines, “A cognitive behaviour therapy (CBT) programme for anxiety following moderate–severe traumatic brain injury (TBI): two case studies,” Brain Injury, vol. 26, no. 2, pp. 126–138, 2012.

[47] B. B. Matarazzo, A. S. Hoffberg, T. A. Clemons, G. M. Signoracci, G. K. Simpson, and L. A. Brenner, “Cross-cultural adaptation of the Window to Hope: a psychological intervention to reduce hopelessness among US veterans with traumatic brain injury,” Brain Injury, vol. 28, no. 10, pp. 1238–1247, 2014.

[48] M. E. Scheenen, A. C. Visser-Keizer, J. Van Der Naald, and J. M. Spikman, “Description of an early cognitive behavioral intervention (UPFRONT-intervention) following mild traumatic brain injury to prevent persistent complaints and facilitate return to work,” Clinical Rehabilitation, vol. 31, no. 8, pp. 1019–1029, 2017.

[49] V. Pastore, K. Colombo, M. Liscio et al., “Efficacy of cognitive behavioural therapy for children and adolescents with traumatic brain injury,” Disability and Rehabilitation, vol. 33, no. 8, pp. 675–683, 2011.

[50] J. Ponsford, N. K. Lee, D. Wong et al., “Efficacy of motivational interviewing and cognitive behavioral therapy for anxiety and depression symptoms following traumatic brain injury,” Psychological Medicine, vol. 46, no. 5, pp. 1079–1090, 2016.

[51] T. Aboulafia-Brakha, C. G. Buschbeck, L. Rochat, and J.-M. Annoni, “Feasibility and initial efficacy of a cognitive-behavioural group programme for managing anger and aggressiveness after traumatic brain injury,” Neuropsychological Rehabilitation, vol. 23, no. 2, pp. 216–233, 2013.

[52] T. Tsoulidou, L. Spielman, M. Kajankova, G. Guetta, W. Gordon, and K. Dans-O’Connor, “Improving emotion regulation following web-based group intervention for individuals with traumatic brain injury,” The Journal of Head Trauma Rehabilitation, vol. 32, no. 3, pp. 354–365, 2017.

[53] T. Hart, J. A. Brockway, J. R. Fann, R. D. Maiuro, and M. J. Vaccaro, “Anger self-management in chronic traumatic brain injury: protocol for a psycho-educational treatment with a structurally equivalent control and an evaluation of treatment enactment,” Contemporary Clinical Trials, vol. 40, pp. 180–192, 2015.

[54] A. Arundine, C. L. Bradbury, K. Dupuis, D. R. Dawson, L. A. Ruttan, and R. E. A. Green, “Cognitive behavior therapy after acquired brain injury: maintenance of therapeutic benefits at 6 months posttreatment,” The Journal of Head Trauma Rehabilitation, vol. 27, no. 2, pp. 104–112, 2012.

[55] M. E. Scheenen, A. C. Visser-Keizer, M. E. de Koning et al., “Cognitive behavioral intervention compared to telephone counseling early after mild traumatic brain injury: a randomized trial,” Journal of Neurotrauma, vol. 34, no. 19, pp. 2713–2720, 2017.

[56] D. B. Cooper, A. O. Bowles, J. E. Kennedy et al., “Cognitive rehabilitation for military service members with mild traumatic brain injury: a randomized clinical trial,” The Journal of Head Trauma Rehabilitation, vol. 32, no. 3, pp. E1–E15, 2017.

[57] S. Backhaus, S. Ibarra, D. Parrott, and J. Malec, “Comparison of a cognitive-behavioral coping skills group to a peer support group in a brain injury population,” Archives of Physical Medicine and Rehabilitation, vol. 97, no. 2, pp. 281–291, 2016.

[58] T. Ashman, J. B. Cantor, T. Tsoulidou, L. Spielman, and W. Gordon, “Comparison of cognitive behavioral therapy and supportive psychotherapy for the treatment of depression following traumatic brain injury: a randomized controlled trial,” The Journal of Head Trauma Rehabilitation, vol. 29, no. 6, pp. 467–478, 2014.

[59] E. D’Antonio, T. Tsoulidou, L. Spielman, and W. Gordon, “Depression and traumatic brain injury: symptom profiles of patients treated with cognitive–behavioral therapy or supportive psychotherapy,” Neuropsychiatry, vol. 3, no. 6, pp. 601–609, 2013.

[60] M. Y. Hsieh, J. Ponsford, D. Wong, M. Schönberger, A. McKay, and K. Haines, “Development of a motivational interviewing programme as a prelude to CBT for anxiety following traumatic brain injury,” Neuropsychological Rehabilitation, vol. 22, no. 4, pp. 563–584, 2012.

[61] M.-Y. Hsieh, J. Ponsford, D. Wong, M. Schönberger, J. Taffe, and A. Mckay, “Motivational interviewing and cognitive behaviour therapy for anxiety following traumatic brain injury: a pilot randomised controlled trial,” Neuropsychological Rehabilitation, vol. 22, no. 4, pp. 585–608, 2012.

[62] D. J. Taylor, A. L. Peterson, K. E. Pruksma, S. Young-McCaughan, K. Nicholson, and J. Mintz, “Internet and in-person cognitive behavioral therapy for insomnia in military personnel: a randomized clinical trial,” Sleep, vol. 40, no. 6, 2017.

[63] L. Rochat, R. Manolov, T. Aboulafia-Brakha, C. Berner-Burkard, and M. Van der Linden, “Reducing anger outbursts after a severe TBI: a single-case study,” Neuropsychological Rehabilitation, vol. 29, no. 1, pp. 107–130, 2016.

[64] S. D. S. Potter, R. G. Brown, and S. Fleminger, “Randomised, waiting list controlled trial of cognitive-behavioural therapy for persistent postconcussional symptoms after predominantly mild-moderate traumatic brain injury,” Journal of Neurology, Neurosurgery, and Psychiatry, vol. 87, no. 10, pp. 1075–1083, 2016.

[65] G. K. Simpson, R. L. Tate, D. L. Whiting, and R. E. Cotter, “Suicide prevention after traumatic brain injury: a randomized controlled trial of a program for the psychological treatment of hopelessness,” The Journal of Head Trauma Rehabilitation, vol. 26, no. 4, pp. 290–300, 2011.
[66] D. Church and J. Palmer-Hoffman, “TBI symptoms improve after PTSD remediation with emotional freedom techniques,” *Traumatology*, vol. 20, no. 3, pp. 172–181, 2014.
[67] N. Hamzah, J. H. Tan, V. Veeramuthu et al., “The effect of early cognitive therapy in improving cognitive functions using neuropsychotherapy and diffusion tensor imaging measurements following mild traumatic brain injury: a pilot study,” *Annals of Physical and Rehabilitation Medicine*, vol. 61, p. e41, 2018.
[68] L. A. Brenner, J. E. Forster, A. S. Hoffberg et al., “Window to Hope: a randomized controlled trial of a psychological intervention for the treatment of hopelessness among veterans with moderate to severe traumatic brain injury,” *The Journal of Head Trauma Rehabilitation*, vol. 33, no. 2, pp. 1–E73, 2018.
[69] G. K. Wolf, T. Q. Strom, S. M. Kehle, and A. Eftekhar, “A preliminary examination of prolonged exposure therapy with Iraq and Afghanistan veterans with a diagnosis of posttraumatic stress disorder and mild to moderate traumatic brain injury,” *The Journal of Head Trauma Rehabilitation*, vol. 27, no. 1, pp. 26–32, 2012.
[70] J. Trevena-Peters, A. McKay, G. Spitz, R. Suda, B. Renison, and J. Ponsford, “Efficacy of activities of daily living retraining during posttraumatic amnesia: a randomized controlled trial,” *Archives of Physical Medicine and Rehabilitation*, vol. 99, no. 2, pp. 329–337.e2, 2018.
[71] S. J. Trustos, M. W. Kirkwood, H. G. Taylor, T. Stancin, T. M. Brown, and S. L. Wade, “A randomized problem-solving trial for adolescent brain injury: changes in social competence,” *Rehabilitation Psychology*, vol. 61, no. 4, pp. 347–357, 2016.
[72] E. W. Twamley, K. R. Thomas, A. M. Gregory et al., “CogSMART compensatory cognitive training for traumatic brain injury: effects over 1 year,” *The Journal of Head Trauma Rehabilitation*, vol. 30, no. 6, pp. 391–401, 2015.
[73] A. Nehra, S. Bajpai, S. Sinha, and S. Khandelwal, “Holistic neuropsychological rehabilitation: grief management in traumatic brain injury,” *Annals of Neurosciences*, vol. 21, no. 3, pp. 118–122, 2014.
[74] K. R. Bell, J. R. Fann, J. A. Brockway et al., “Telephone problem solving for service members with mild traumatic brain injury: a randomized, clinical trial,” *Journal of Neurotrauma*, vol. 34, no. 2, pp. 313–321, 2017.
[75] S. L. Wade, M. E. Narad, K. M. Kingery et al., “Teen online problem solving for teens with traumatic brain injury: rationale, methods, and preliminary feasibility of a teen only intervention,” *Rehabilitation Psychology*, vol. 62, no. 3, pp. 290–299, 2017.
[76] E. Vikane, T. Hellstrøm, C. Røe, E. Bautz-Holter, J. Afløms, and J. S. Skouen, “Multidisciplinary outpatient treatment in patients with mild traumatic brain injury: a randomised controlled intervention study,” *Brain Injury*, vol. 31, no. 4, pp. 475–484, 2017.
[77] M. K. O’Connor, L. Mueller, E. Kwon et al., “Enhanced vocational rehabilitation for veterans with mild traumatic brain injury and mental illness: pilot study,” *Journal of Rehabilitation Research and Development*, vol. 53, no. 3, pp. 307–320, 2016.
[78] B. Boyd, C. Rodgers, R. Aupperle, and A. Jak, “Case report on the effects of cognitive processing therapy on psychological, neuropsychological, and speech symptoms in comorbid PTSD and TBI,” *Cognitive and Behavioral Practice*, vol. 23, no. 2, pp. 173–183, 2016.
[79] E. W. Twamley, A. J. Jak, D. C. Delis, M. W. Bondi, and J. B. Lohr, “Cognitive symptom management and rehabilitation therapy (CogSMART) for veterans with traumatic brain injury: pilot randomized controlled trial,” *Journal of Rehabilitation Research and Development*, vol. 51, no. 1, pp. 59–70, 2014.
[80] E. I. Howe, K.-P. S. Langlo, H. C. A. Terjesen et al., “Combined cognitive and vocational interventions after mild to moderate traumatic brain injury: study protocol for a randomized controlled trial,” *Trials*, vol. 18, no. 1, p. 483, 2017.
[81] K. R. Archer, R. A. Coronado, L. R. Haislip et al., “Telephone-based goal management training for adults with mild traumatic brain injury: study protocol for a randomized controlled trial,” *Trials*, vol. 16, no. 1, p. 244, 2015.
[82] S. Galbiati, M. Recla, V. Pastore et al., “Attention remediation following traumatic brain injury in childhood and adolescence,” *Neuropsychology*, vol. 23, no. 1, pp. 40–49, 2009.
[83] L. Wiart, E. Richer, J. M. Destaillats, P. A. Joseph, P. Dehail, and J. M. Mazaux, “Psychotherapeutic follow up of out patients with traumatic brain injury: preliminary results of an individual neurosytemic approach,” *Annals of Physical and Rehabilitation Medicine*, vol. 55, no. 6, pp. 375–387, 2012.
[84] P. E. Rapp, C. J. Cellucci, A. M. K. Gilpin, M. A. Jimenez-Montaño, and K. E. Korslund, “Communication patterns in a psychotherapy following traumatic brain injury: a quantitative case study based on symbolic dynamics,” *BMC Psychiatry*, vol. 11, no. 1, 28 pages, 2011.
[85] J. A. Swack, “Elimination of post traumatic stress disorder (PTSD) and other psychiatric symptoms in a disabled Vietnam veteran with traumatic brain injuries (TBI) in just six sessions using healing from the body level up methodology, an energy psychology approach,” *International Journal of Healing and Caring*, vol. 9, p. 3, 2009.
[86] D. L. Whiting, G. K. Simpson, H. J. McLeod, F. P. Deane, and J. Ciarrochi, “Acceptance and commitment therapy (ACT) for psychological adjustment after traumatic brain injury: reporting the protocol for a randomised controlled trial,” *Brain Impairment*, vol. 13, no. 3, pp. 360–376, 2012.
[87] F. Ashworth, F. Gracey, and P. Gilbert, “Compassion focused therapy after traumatic brain injury: theoretical foundations and a case illustration,” *Brain Impairment*, vol. 12, no. 2, pp. 128–139, 2011.
[88] H. E. Andrewes, V. Walker, and B. O’Neill, “Exploring the use of positive psychology interventions in brain injury survivors with challenging behaviour,” *Brain Injury*, vol. 28, no. 7, pp. 965–971, 2014.
[89] J. Bomyea, A. J. Lang, and P. P. Schnurr, “TBI and treatment response in a randomized trial of acceptance and commitment therapy,” *The Journal of Head Trauma Rehabilitation*, vol. 32, no. 5, pp. E35–E43, 2017.
[90] T. Hart, M. J. Vaccaro, C. Hays, and R. D. Maiuro, “Anger self-management training for people with traumatic brain injury: a preliminary investigation,” *The Journal of Head Trauma Rehabilitation*, vol. 27, no. 2, pp. 113–122, 2012.