Reducing The Challenges That Traumatic Brain Injury Survivors Experience During the Assessment, Treatment, and Recovery Process

by

Bradley Wall

Paper submitted in partial fulfillment of the requirements for the degree of

Master of Counselling
in the
Division of Arts and Sciences

City University of Seattle
2021

This paper is accepted as conforming to the required standard
October 2021

Christine Mhina, PhD
Research Supervisor
City University of Seattle

Abstract

The number of traumatic brain injuries (TBIs) has steadily increased over the years. This is concerning given their impact on individuals who are recovering from them. These TBI survivors face challenges and hurdles throughout the assessment, treatment, and recovery process that impact their mental health and quality of life. A thorough review of past and current literature helped to highlight some of the potential challenges that TBI survivors may face, with the focus on what could be done to reduce them. Specific interventions of focus within this paper are the Standardized Assessment of Concussions, neurofeedback, rest, cognitive behavioral therapy, and cognitive rehabilitation. An analysis of 11 peer reviewed studied was completed to generate themes relating to the topic of focus. These themes consisted of (a) the benefits of an individualized treatment plans (b) the use of a multidisciplinary team, and (c) the need for support and connection through the recovery process. These findings will benefit TBI survivors by providing insights towards reducing challenges they face. Society, and healthcare providers will also gain benefits from this paper and may lead to the implementation of new interventions and protocols. The findings will also help healthcare providers to gain consistent and appropriate healthcare guidelines to assess, treat, and help TBI survivors recover. This study also helped to generate recommendations moving forward; focus on qualitative studies to gain a better understanding of TBI survivors experiences, utilize larger sample sizes in quantitative research to allow for more generalisability, and developing support groups for TBI survivors within the community.

Keywords: *traumatic brain injury (TBI), survivors, assessment, treatment, recovery, interventions, protocols*

Acknowledgements

First, I would like to thank my parents, Robert and Denise Wall, for their unconditional love and support throughout my life. They have given me an opportunity to pursue a career that I am truly passionate about and have been by my side throughout this journey. Second, I want to thank my wife, Robyn. She has created a sanctuary for me to grow as an individual, learn to express myself, and, most important, take risks and pursue my passion. I will forever be grateful to you for everything you have done for us and the sacrifices you have made that allowed me to get to this point. I would also like to acknowledge my family and friends who have supported me and provided strength and encouragement over the last three years. DW, BF, AB, MC, KP, DB, MG, TV. Last, I would like to thank my capstone supervisor, Dr. Christine Mhina, for her expertise and guidance throughout this process. I will forever appreciate it.

Table of Contents

List of Tables

Reducing The Challenges that TBI Survivors Experience During the Assessment, Treatment, and Recovery Process

Traumatic brain injuries (TBI) have increased steadily over the years. This is alarming given the negative impacts on individuals who have sustained them. They face many challenges and hurdles to overcome as they work through the recovery process, which often impacts their mental health and quality of life (Elder et al., 2019). Also concerning is the lack of research to demonstrate empirically sound assessment, treatment, and recovery protocols. The aim of this paper was to understand more deeply, what could be done to reduce the challenges that TBI survivors face during the assessment, treatment, and recovery process. I conducted a thorough literature review, and critically analysed the current research on this process, and then analysed in depth 11 core articles that relate to this study. I also analyse (a) specific assessment tools and techniques such as the Standardized Assessment of Concussion (SAC) and the neuropsychology assessment for brain injuries; (b) currently available treatment options, such as prescribed rest, exercise, neurofeedback, and cognitive behaviour therapy; and (c) the recovery process, and examine the protocols in place at a systemic level to guide assessment, treatment, and recovery. My focus on these processes helped me to understand and evaluate current practices and gain insight into the challenges that TBI survivors face throughout their own recovery and what can be done to reduce them. The findings will help to advance research to understand the connections between the symptoms associated with TBIs and their impact on individuals' mental health and quality of life.

The research on the prevalence of individuals who have sustained a TBI has shown that in Canada approximately 155,000 people over the age of 12 sustained a TBI in 2014; this number has been rising throughout the years (Rao et al., 2017). In the United States this number is significant in that approximately 1.5 to 2 million people sustain TBI per year, with a total cost of $17 billion to the country (Frost et al., 2013). Australia also has high numbers: Approximately 749 individuals per 100,000 suffer from TBIs. The number is slightly lower in Europe: 235 per 100,000 (Namjoshi et al., 2013). The numbers in Canada, the United States, Australia, and Europe are alarming, because research has shown that, on average, 20%-30% of individuals who have sustained TBI experience long-lasting and impactful symptoms that extend for longer than 6 months (Hiploylee et al., 2017); the number has been as high as 43% (Suleiman et al., 2017). These concerning numbers demonstrate that TBI survivors require more help to reduce the challenges that they face, specifically in the assessment, treatment, and recovery processes.

Research Problem

The prevalence of TBIs demonstrates that a significant number of individuals have had prolonged symptoms from the injuries that they have sustained. A large proportion of TBI survivors, roughly 30%, endure months and even years of associated symptoms without proper treatment (Hiploylee et al., 2017). This creates problems in their overall functioning, mental health, and quality of life. A concern is the inability to access appropriate resources for assessment, treatment, and recovery, as well as many of the guidelines and protocols to treat TBIs lack clarity and consistency.

TBI survivors commonly experience the symptoms of headaches, dizziness, lack of concentration and focus, identity loss, and posttraumatic stress (Mcleod et al., 2017). Cognitive impairments in processing, memory, and overall function; psychological impacts such as depression, anxiety, and alterations in mood; and physical injuries of different natures are very common as well (Namjoshi et al., 2013). These symptoms arise from injuries to the brain tissue following an impact or a significant force that decreases cerebral blood flow and increases inflammation, which causes brain-cell death (Vella et al., 2017). However, the literature demonstrated lack of understanding of the connections between the cause of these symptoms and what can be done to counteract their effects (Milders, 2019). The symptoms that TBI survivors experience depend on the areas of injury within the brain, which means that each survivor's experience differs in severity and symptom representation (Aggarwal et al., 2020). This makes it difficult to understand the internal connections responsible for the injury. Because of the differences in experience from survivor to survivor, the early identification of symptoms is crucial. However, it is unclear which specific intervention strategies are vital for efficient recovery from those symptoms (Eghbali et al., 2020). Researchers has suggested that the current protocols for assessing, treating, and recovering from TBIs are failing TBI survivors who are searching for treatments to heal. The question is, What specific assessment, treatment, and recovery protocols are necessary for a full recovery?

The number of individuals who sustain TBIs annually is concerning; many of them do not know the potential complications that can occur, which leaves TBI survivors confused about the steps to take for proper assessment, treatment, and recovery. The literature on the guidelines and set protocols for the assessment, treatment, and recovery of TBIs has demonstrated major inconsistencies with regard to appropriate approaches to treating TBIs (Mcleod et al., 2017). These inconsistencies result from the discrepancies among healthcare providers that arise from the lack of clear and concise guidelines on recovery from TBIs. Prince and Bruhns (2017) reviewed assessment protocols for TBI in different trauma centres in the United States and other countries. The results of their study show that only 3 of 41 trauma centres had evidence-based guidelines on the assessment of TBI, and that less than half of the 35 traumas centres that they reviewed had standardised protocols for assessment and treatment-plan development. This is a problem because it leads to disagreements among healthcare providers and variations in standard practices for assessment. Furthermore, this facilitates personal bias in diagnoses and leads to inconsistencies in the recovery process and major impacts on TBI survivors' mental health and quality of life. In fact, Prince et al. showed that 50% to 90% of individuals who accessed these specific services were misdiagnosed and received misinformation, which had great impacts on their mental health and quality of life because their symptoms were undiagnosed and unaddressed. This is concerning given that proper information from healthcare professionals reduces stress within the self and within relationships and guides survivors who are recovering on the appropriate actions to take (Barman et al., 2016).

Limited approaches to assessment, treatment, and recovery can cause potential problems with regard to the efficiency of the process of recovery from TBIs. This is evident in the arguments in the literature that suggest that these approaches lack variability and empirically sound evidence (Xiong et al., 2009). These issues can be seen within assessment tools such as the SAC, neurofeedback, cognitive assessments, and physical assessments. Aside from the lack of variability and empirically sound evidence, these assessment processes can be lengthy and costly, presenting potential challenges in accessing and completing the services (Tsaousides & Gordon, 2009). Issues arise due to assessments not being able to paint a full picture of the impacts that have occurred, leading to treatments that are not sufficient on their own to lead to a full recovery.

Treatment approaches such as prescribed rest, neurofeedback, cognitive behavioural therapy (CBT), physical therapy, and pharmaceuticals all present problems with the consistency and efficiency of treatment (Burke et al., 2015). Various opinions regarding the use of prescribed rest creates inconsistencies when it comes to rest as a treatment modality and knowing what the best course of action is. Another issue arising within treatment modalities is the lack of valid evidence to support the use of them as appropriate treatment options. The gaps in or lack of understanding of these treatment approaches have left room for interpretation on how to use them and created a lack of consistency throughout (Morse & Garner, 2018). This is concerning because it suggests that TBI survivors often have limited options for treatment and that they might not lead to a full recovery.

Purpose of the study

The purposes of this study were to examine this question and apply a sense of curiosity and a critical eye to understand the potential challenges that TBI survivors face and how to reduce them. This study will also illuminate TBI survivors' experiences throughout these processes and explore different modalities that healthcare professionals commonly utilise to assess, treat, and enable recovery from TBIs. More specifically, it will answer the research question.

Research Question

The gaps and deficiencies in the literature that I have discussed in the studies research problem led to my exploration of the research question, "What can be done to reduce challenges TBI survivors face throughout the assessment, treatment, and recovery process?"

Significance of the Study

The findings of this study are significant for multiple reasons. The first reason is that they will ensure consistency among healthcare providers who treat individuals who have sustained TBIs with regard to proper treatment referrals, education, and recovery protocols. Creating a clear and concise path and guidelines that everyone can understand and follow will have significant positive impacts in the healthcare community. Second, they will help to revise current assessment and treatment protocols, which could lead to greater accessibility to appropriate services. Revisions at a higher level will help to develop protocols that those in need can easily access; in turn, they will results in a more solidified approach to treatment and recovery in the hope of improving lives and lowering the associated costs. Last, they will positively affect TBI survivors because understanding their experience and how to reduce the challenges within will improve their mental health and quality of life, result in access to appropriate and sufficient treatment and recovery protocols, and decrease the amount of time that they spend searching and accessing resources.

Personal Experiences

Given my own battle with TBI, I have always been interested in its impact on individuals. In dealing with TBIs and having undergone the recovery process firsthand, I was surprised by the lack of clear and concise treatment protocols that are available to the public. The literature and my personal experiences have revealed many assessment and treatment modalities that lack empirical validation but that healthcare professionals are still using as treatment methods. For example, the use of neurofeedback has promising potential but does not have enough support in the research to suggest that it is a viable means of assessing and treating TBIs on its own.

My experience was very frustrating in the sense that I began to lose sight of who I was, what I enjoyed doing, and what I was able to do. I felt a sense of isolation and depression and slowly lost hope that I could return to where I was prior to my injuries. Given the impacts that I noticed in my life, from a decline in cognitive function to the loss of my sense of identity, which impacted my relationships with others, I became very interested in cognitive rehabilitation; more specifically, the role of neuropsychology. Not until years after my initial injury did I discover facilities for cognitive rehabilitation, and I decided to pursue a career in this field to learn more about appropriate treatment and recovery methods and what is necessary to regain control of your life after a TBI. Throughout my work with individuals who were dealing with TBI, I discovered that many of them had similar experiences to my own. Many individuals faced hurdles and challenges to overcome and felt lost or misdirected. Because of this, I wanted to dedicate my research to a focus on how challenges throughout the assessment, treatment, and recovery protocols for TBI can be reduced and how this would benefit society.

Given the closeness of this topic to my experience, I recognised the importance of understanding potential biases that might arise during my research and writing. The main bias was within my interpretation of the information. It was important that I hear the truths of the literature while I set aside my own experiences and beliefs. It was most important that I rely on logic and set aside my emotions from my analysis of the information on the topic of TBIs and reducing the challenges that survivors face. To do this, I needed to be aware of when my biases might interfere with my interpretation of the information and remain conscious of what the research has shown rather than what my own experiences have taught me.

Theoretical Framework

In this paper I examine the research through a neuropsychology lens to guide me in making sense of the information. The theoretical framework for neuropsychology focuses on the brain and the structural components within and understanding changes in function and behaviour because of these components. Furthermore, the purpose of a neuropsychological evaluation of TBIs is to assess the cognitive and functional deficits that result from the injury (Prince & Bruhns, 2017). In this process neuropsychologists interview clients with TBIs to gather information on their history and specific symptoms, with the goal of determining the most appropriate form of testing that will benefit them the most. This process requires the selection of appropriate treatment options, with a focus on improving their cognitive function. This is a suitable framework because neuropsychology creates a bridge between mental health disorders such as depression and anxiety and correlates them with impairments in structures of the brain (Berlucchi, 2010). Simply put, damage to specific areas of the brain that cause impairment also have significant impacts on mental health because of the interconnectedness of the brain structures and the functions within the body.

Literature Review

In this section of my research paper I analyse and discuss the current literature on assessment, treatment, and the recovery process associated with TBIs. A major area of focus is current assessment tools, and I evaluate how they guide treatments to accurately target areas for recovery. Other areas of focus are the classification of TBIs, the common factors associated with them, their history, and specific treatment protocols that therapists commonly use. I review these specific areas with the goal of helping TBI survivors to regain control of their functions and improve their mental health and quality of life.

Classification and Common Factors

TBIs occur when individuals sustain injuries to the head that decrease their brain functioning (Centers for Disease Control and Prevention, 2021). They can experience this type of injury in many ways. TBIs are classified as resulting from mechanical forces such as striking the head on an object, rapid acceleration and deceleration of the head, penetration of the skull and brain by objects that result in brain damage, fluctuation in neurotransmitters, and inflammation of the brain that leads to brain-cell death (Namjoshi et al., 2013). The majority of TBI accidents occur as a result of a nonpenetrating or closed-head impacts in motor vehicle accidents, common trips and falls, and impacts to the head in contact sports (Ng & Lee, 2019). The Centers for

Disease Control and Prevention also classified TBIs into three different categories. Mild TBIs result from impacts or rapid acceleration/deceleration of the brain inside the skull, which leads to deficits in cognitive function; they are referred to as *concussions*. Moderate TBIs are impacts that cause a loss of consciousness for long durations of time. Severe TBIs result in excessive damage to brain tissue and often leave survivors unable to perform regular tasks. Both moderate and severe TBIs require longer ongoing care and resources to assist in recovery.

The impact of TBIs on survivors is evident in the wide array of common symptoms that are associated with the phenomenon. Symptoms can be group into three common categories: physical, psychological, and cognitive (Iverson, 2019). The common physical symptoms associated with TBIs are headaches, dizziness, nausea, fatigue, sleep disturbances, and pain associated with the physical damage that has occurred. The common psychological symptoms are emotional disturbance (the inability to control emotions such as anger and frustration), anxiety, depression, and, in some cases, substance abuse. The common cognitive symptoms associated with TBIs include attention and concentration difficulties, decreased cognitive and executive functioning, and memory deficits. The symptoms indicate the extent of the impacts, likely within minutes after the injury has occurred, and they can persist for weeks, months, or even years. This means that in most cases multiple symptoms are present immediately after the injury, and these symptoms and others that can present later can persist for long periods of time (Belanger et al., 2009).

History of Traumatic Brain Injuries

The understanding of TBIs has advanced tremendously, from the view of brain injuries as demonic possession to trepanation to resolve the symptoms to current practices with imaging techniques and other advancements in assessment and treatment modalities. Knowledge and understanding of this phenomenon began very early. In fact, the earliest medical document on brain injuries dates to 3000 BC, when records from ancient Egyptians explained how injuries to the skull and brain could lead to abnormal functioning in processing information and intellectual abilities (Levin et al., 1982). From here, advancements in knowledge on and understanding of brain injuries and their impact on individuals continued and gained more interest. Levin et al. (1982) reported that around 500 BC, Alcmaeon of Craton labelled the brain as the central structure that creates the senses of hearing, smell, and sight, as well as memory and judgement. This spiked interest in this phenomenon; soon after, Hippocrates made the very important discovery that specific injuries to areas of the brain can result in reactions on the opposite side of the body from the injury (Echemendia, 2006). This led to the discovery of contralateral innervation, which is a cross connection in the brain that makes each hemisphere responsible for the opposite side of the body (Levin et al., 1982). An example of this is an injury to one of the temporal lobes of the brain that causes impairments or paralyses on the opposite side of the body. Likewise, an injury to the occipital lobe (responsible for vision) would impact the eye opposite to the injury. This was a significant discovery and led to new findings on the mechanics of the brain, but it also has a negative aspect. These findings resulted in the suffering and impairment of many individuals for the greater good of research. For example, doctors performed surgeries with the main goal of understanding brain function, but the patients lost their ability to speak and understand language (Levin et al., 1982). This was the dark side of a very important advancement in the understanding of the brain and how injuries impact function.

With advancements in knowledge on brain injuries continuing, another important discovery on how the brain becomes inflamed after an injury emerged. Researchers believed that this inflammation occurred as a result of natural recovery responses that the body and brain had developed, which was correct (Levin et al., 1982). However, the real mechanism for inflammation is specific chemicals that the brain releases to target damaged sites, reduce brain function, and promote rest and healing, although researchers did not discover this until years later (Echemendia, 2006). This led to the one of the earliest treatment methods, *trepanation*, which involved removing portions of the skull to relieve pressure, bleed out excess blood in the brain, and in some cases exorcise demonic possessions from individuals (Levin et al., 1982). This was a misconception in which researchers believed that changes in behaviour and functioning were a result of possession by a demonic presence (Levin et al., 1982). The growing research on brain injuries created a shift from a more spiritual cause such as demonic possession to one that involved scientific discovery. The focus on treatment shifted to a focus on promoting a greater understanding of the impacts associated with brain injuries. This was another major advancement, but it took a negative toll on individuals who had experienced brain injuries. The emphasis was less on helping those individuals and understanding the challenges that they faced and more on understanding what had gone wrong (Levin et al., 1982). This caused even more pain and suffering for patients and very few improvements in their quality of life.

In the 19th century when the industrialisation of society was taking place, physicians saw an increase in TBIs, which led to further research on this topic. With growing interest in brain injuries and the impacts on quality of life and mental health, researcher were making major strides in the understanding of brain injuries and their broad impact on behaviour, functioning, and mental health. The advancements moved into the 20th century with the growing interest in brain injuries that resulted in the publication of many papers (Block et al., 2015). During this time, a paper was published on the societal views of brain injuries and common misconceptions. Their goal paper was to identify the common misconceptions associated with brain injuries and provide evidence to refute them in the hope of educating the public on the realities of brain injuries (Block et al., 2015). This paper was beneficial because it helped to identify and make sense of skewed information on brain injuries and enabled those who had experienced a brain injury to recover because it highlighted evidence-based research on appropriate means of recovery and explained the misconceptions. However, the highlighted means of recovery were less than efficient resources to improve the lives of individuals who had sustained brain injuries.

Another shift followed that focused less on knowledge and understanding and more on advancement in treatment protocols. This led to funding for the first centre for brain injuries in 1992 that opened in 2001 for veterans who had sustained TBIs (Cifu et al., 2010). This facility was the first of its kind, and its establishment emphasised the importance of understanding the common symptoms of TBI survivors. The emphasis was on managing common symptoms such as headaches, dizziness, cognitive dysfunction, and sleep disturbances (Cifu et al., 2010) and on creating a sense of community and facilitating reintegration into society. Even though it was the first facility of its kind, researchers identified shortcomings. Cifu et al. (2010) noted that research on empirically validated treatments was still lacking. This is concerning given that professionals in this facility treated brain injuries with little to no evidence to support their treatment approaches and there was little to no description of the methods that these professionals used to treat brain injuries. In conclusion, this facility was of very little benefit to researchers because it was designed for military veterans, and researchers offered very few insights into the challenges that TBI survivors face during their recovery.

Steady advancements and the establishment of treatment facilities continued following this period, and so did the understanding of TBIs and their impacts. This led to a shift from earlier, more invasive treatment approaches such as trepanation to treatment protocols that involved prescribed rest and avoidance of specific stimuli in the environment (McLeod et al., 2017) in the belief that prescribing rest and time to recover would enable TBI survivors to regain their normal functioning. However, current research and practices have demonstrated that this was the opposite of what is necessary to regain normal function. The current research has shown that, ideally, 3-5 days of rest are required after the initial injury, and then exposure to specific stimuli will enable TBI survivors to gradually build their endurance and tolerance of these stimuli regain function (McLeod et al., 2017). This concept can be compared to weight training, whereby TBI survivors gradually expose themselves to stimuli to increase their tolerance and gain control of some of their symptoms. This reduces the associated challenges that they face, and the recovery process continues. The steady advancements on brain injuries have been gradual given their complex nature. Even though these gradual advancement have led to new insights and understandings, they have not come without a price. Individuals who sustained brain injuries in the early years and even now, have had to suffer as the understanding of brain injuries grows. Unfortunately, it is because they have undergone experimental procedures that researchers have presented new knowledge on the brain and the impacts of injuries. Because of their suffering, advancements have been made throughout history. However, the current state of knowledge on treatment for brain injuries is still not optimal because of limitations in the recovery process, beginning with the assessment of TBI survivors for specific impairments.

Assessment Process

The assessment process for TBIs helps to pinpoint and address specific areas that have been impaired as a result of a brain injury. The goal in assessment is to highlight these areas of impairment, understand the associated symptoms, and identify specific treatment options that are best suited to each TBI survivor. Therefore, accurate assessment of impairment following a TBI is vital to treat TBI survivors appropriately and begin the recovery process. In this section I review three current assessment strategies: the SAC, cognitive assessment, and neurological assessment processes.

Standardised Assessment of Concussion

Many healthcare professionals commonly use one main assessment, the SAC, which, as I mentioned previously, tests for orientation (day, month, time), memory deficits, symptom grading, and concentration (Grubenhoff et al., 2010). This tool is designed to identify the effects of TBIs and enable professionals to roughly estimate the severity of the presenting symptoms (McCrea et al., 1997). More specifically, it tests orientation to space and time and the ability to recall specific details of the injury. Test administrators therefore receive a simplistic score on individuals' current awareness and what they can recall. Other tests also focus on memory and memory recall. Clients must remember words and number sequences and repeat them back. Following this is a graded symptom checklist that healthcare professionals mark on a scale of 0-6, where 6 represents *very severe*. Together, these tests give them a general idea of impairments that might be present and provide an overall score on how individuals who have sustained injuries feel (McCrea et al., 1997).

However, even though the SAC is the main assessment tool that most healthcare providers use, it has some major limitations. It reports only surface-level deficits, such as very general impairments in memory and cognition and how individuals feel based on the Self-Rating Symptoms Scale, It might also recognise deficits in certain areas, but it is unable to explain the deficits. For example, it might demonstrate the presence of impairments in memory function, but it cannot explain why these memory impairments are occurring (Grubenhoff et al., 2010). Also, the SAC is unable to identify psychological deficits that include the presentation of anxiety or depression (McCrea et al., 1997). Another major flaw of this assessment tool is that it can be very subjective. This means that if a person undergoes this assessment process with different health care providers, it is very likely that the diagnoses will differ. Because the SAC is administered via pen and paper and does not have specific guidelines for diagnosis, different interpretations of the results can result in undiagnosed symptoms and impairments, as well as inappropriate treatment plans. The challenges that TBI survivors face are inconsistent assessment protocols and often mis- or undiagnosed symptoms, which will have a great impact on their mental health and quality of life. Even though SAC is still appropriate to assess the impacts of a TBI, it is not sufficient on its own to address the complexity of the impairments after a TBI.

Cognitive Assessment

Cognitive assessment protocols consist of in-depth testing of specific areas to understand the degree of impairment. Common cognitive assessment techniques involve the use of tests and tools to focus on multiple areas of the brain, identify the area that is the most severely impacted, and guide the treatment plans. The first area is overall intellectual functioning, and the use of the Wechsler Adult Intelligence Scale-III, Weschler's abbreviated scale of intelligence, and the Wechsler Adult Intelligence Scale-IV for children are common to gain insight into the level of impairment from a TBI with regard to individuals' preserved premorbid abilities and residual cognitive strengths, which guide the treatment (Tsaousides & Gordon, 2009). The second area is memory. Tests such as word recall, picture matching, concentration grids, and Weschler's memory scale evaluate delayed memory recall, working memory, and visual memory to identify specific areas of the brain that are impacted more than others (Tsaousides & Gordon, 2009). The third area is psychomotor functioning, which refers to fine motor movements and coordination. Tests such as finger tapping, grip strength, and the pegboard test (which measures the ability to move a peg into different holes on a board) determine psychomotor functioning. The fourth area is processing speed, which involves the use of the Wechsler Adult Intelligence Scale-III (a digit symbol coding test), the Stroop Color and Word test, and trail-making tests (which measures the ability to connect numbers and letters in an appropriate order) to understand the functioning of TBI survivors' brains compared to that of the average population (Tsaousides & Gordon, 2009). The fifth area is attention, which involves findings deficits to guide treatment. Tools such as the Paced Auditory Serial Attention Test and concentration grids are effective to test this area (Kaltiainen et al., 2019). The sixth area is language functioning, and tests identify impairments in brain structures associated with language. Tests such as the Boston Naming Test, which assesses the ability to name visual objects, and the Oral Word Association Test are also common. The last area of focus in cognitive assessment is executive function—the ability to problem-solve, plan, and organise day-to-day routines. Test such as the Stroop test, Card Sorting Test, and problem-solving tests help to understand the degree of impairment (Tsaousides & Gordon, 2009).

A review of the methods of cognitive assessment reveals specific impairments that can be present in TBI survivors, especially compared to the use of the SAC. However, this does not mean that it is the most practical choice to assess impairments related to TBIs. The cognitive assessment process consists of many variables and tools, which makes it a very lengthy process. It is unrealistic to expect to use all of the assessment modalities in one session, which leads to selecting only a few strategies to focus on. This is even more true given the impairments in concentration and focus, headaches, and other symptoms that can interfere with TBI survivors' ability to sit through tests for long periods of time. Therefore, the assessment process does not promote a complete understanding of the full impact of TBIs. The length of time that the cognitive approach to assessment requires is a major limitation, and enduring the full assessment and receiving realistic results are other challenges that TBI survivors face.

Neurological Assessments

Neurological assessment and observation of TBI survivors are important. This assessment requires the accurate collection and documentation of information on clients, including the function and status of their nervous systems (Greenshields, 2019). It helps to monitor changes that are taking place in TBI survivors' condition and facilitates quick responses if they are necessary (Stone, 2014).

The two main neurological assessments are magnetic resonance imaging (MRI), and the in-person assessment of nervous system function. The MRI is a common tool that assesses damage and impairments in the brain structures following a TBI. Technicians use radiofrequency pulses to excite hydrogen nuclei (single protons) in water molecules in the brain (Shenton et al., 2012). Scanners modulate the basic magnetic field and the timing of a sequence of radiofrequency pulses and produce signals that are spatially encoded and result in images (Katti et al., 2011). The images show abnormalities in brain structures and guide the next step in the recovery process. However, researchers have debated the use of MRIs to assess TBIs for some time. They have questioned their actual benefit because they do not adequately depict brain injuries because they cannot detect diffuse axonal injuries, the major brain injuries in TBIs (Shenton et al., 2012). Because MRIs are not sensitive enough to capture these injuries, they present only images of the physical structures of the brain. This is concerning given that many TBI survivors have to wait weeks or even months for these scans, only to be told that the brain structure has no physical injuries, and will potentially have to battle symptoms that impact their mental health and quality of life with no further direction (Shenton et al., 2012). This raises a question about better alternatives to assess damage in TBI survivors and reduce the challenges that they face.

The in-person assessment for nervous system function has the structure of a one-on-one interview, which consists of TBI survivors' history and assessment of the symptoms, severity, and motor function (Stone, 2014). Research has shown that patients' history and presenting conditions, the functioning of the nervous/motor system, and specific symptoms are useful in properly identifying impairments if professionals who specialise in brain injuries collect this information (Greenshields, 2019). Utilising this information will paint a detailed picture of TBI survivors' normal functioning prior to the injury while also highlighting comorbidity factors that might impact their functioning (Tsaousides & Gordon, 2009). Even though it can be a very helpful tool to assess impairment that result from TBIs, it is crucial that the assessor specialise in neurological assessment and understand the connections among the brain, nervous system, and the symptoms. TBI survivors often receive neurological assessments from people who are not trained specifically to conduct them (Greenshields, 2019). This creates the issue of whether these assessors have overlooked important details or perhaps do not understand them and can potentially leave TBI survivors in a very vulnerable state without a clear understanding of their situation and the lack of a direction in which to move. This speaks to the potential challenges that TBI survivors face throughout the assessment and recovery process, especially considering the amount of time that it takes to undergo these services.

Physical Assessment

Appropriate healthcare professionals must diagnose the physical injuries associated with TBI. The physical injuries that TBI survivors face can be major challenges during the recovery process, which is why appropriate assessment of their injuries is crucial. Research has shown that the use of chiropractors and physiotherapists to assess TBIs benefits the recovery process (Hanson-Utely & Arvinen-Barrow, 2017) because these specific healthcare providers have much more expertise to treat physical injuries and understand the influence of certain physical impairments on the symptoms associated with TBIs. These specific healthcare providers can also identify links to symptoms such as headaches, dizziness, fatigue, and difficulties with concentration and focus (Germann et al., 2020); identify physical injuries associated with TBIs; and create treatment plans that incorporate physical manipulation, exercise, and stretches to promote recovery and cognitive functioning (Hanson-Utely & Arvinen-Barrow, 2017). The disadvantage of this approach to physical assessment is that it requires very skilled professionals who understand the connections between TBIs and symptom representation/manifestation in physical structures of the body (Germann et al., 2020). It can be difficult to locate healthcare providers who can effectively deal with TBIs and are capable of understanding the connections between physical injuries and TBI symptoms and the appropriate direction for treatment. TBI survivors often feel frustrated with the challenges associated with the assessment and recovery process. Finding appropriate resources to access and understand the best route for recovery while they deal with the symptoms and impairments associated with TBIs is very difficult.

Research has demonstrated the importance of early and accurate assessment strategies and plans to improve mental health and quality of life for individuals who have sustained a TBI. The assessment process is the most important aspect of recovery because it guides the direction for treatment. Researchers who have studied evidence-based assessment strategies have focused on understanding and identifying the common symptoms associated with TBIs and the impacts on survivors in many different areas. Research has also shown that it is necessary to incorporate multifaceted assessment strategies to test cognitive impairments, neurological deficits, and physical injuries (Eghbali et al., 2020). The use of a multidisciplinary team is essential to effectively pinpoint areas of the brain and body that a TBI has impacted and identify treatment protocols that would be beneficial in reversing the effects of the injury. However, even with this knowledge, a team approach to assessing, treating, and recovering from TBIs is still lacking. This is concerning because it creates dependence on current strategies to assess and treat TBIs, but the current protocols do not present a full picture of what survivors need to be able to recover. Shifting from commonplace assessment strategies such as the SAC that are common in most medical centres to more well-rounded assessment approaches will potentially reduce the challenges and hurdles that both healthcare providers and TBI survivors face and increase the chances for a quicker recovery for TBI survivors, which is the main goal to improve their mental health and quality of life.

Treatment Approaches

Treatment approaches to recovery from TBIs consist of many different modalities that range from CBT to exercise to the use of antidepressants**.** Like current assessment protocols, treatment options to combat the effects of TBIs are also flawed in many cases. Research on treatment such as neurofeedback, rest, exercise, antidepressants, and anti-inflammatories has revealed that there is not enough evidence to prove that these strategies alone are effective in treating TBIs (Burke et al., 2015). This is concerning because it demonstrates that treatments for TBIs are often not empirically validated and do not cover all of the requirements for a full recovery. This limits their consistency and clarity for both healthcare providers and TBI survivors as they navigate the recovery process, which can involve potential challenges and hurdles.

Neurofeedback Training

Researchers have studied neurofeedback training. When individuals sustain TBIs, specific brain waves fluctuate (alpha, theta, and beta waves; Mennella et al., 2017). The disruptions in these brainwaves can lead to specific symptoms such as lack of concentration and focus, changes in mood, and sleep disturbances (Kim & Priefer, 2020). Neurofeedback training as a treatment corrects these fluctuations and restore them to their original or normal levels in the brain. For example, individuals with abnormal beta waves undergo specific treatments to increase or decrease these waves as necessary to improve their concentration and focus (Gray, 2017). Likewise, because abnormal alpha wave levels impact mood, survivors receive specific treatments to return the levels to the normal range in the hope of relaxing them and balancing their moods (Mennella et al., 2017). This is a very promising treatment modality, especially for the specific areas of focus, concentration, and mood. However, neurofeedback as the sole means of treatment is limited. There is a lack of evidence of its effectiveness as a tool to improve symptoms, mental health, and quality of life. Limited research exists on neurofeedback as a treatment option for TBIs, and the studies that researchers have conducted have included small sample sizes and demonstrated a lack of efficacy (Kim & Priefer, 2020).

Another limitation in the use of neurofeedback as a main treatment option for TBIs is that, even if research has shown the potential benefits of this treatment modality, it is not sufficient as a single treatment option to address all of the areas that require attention for a full recovery. This raises the question of why it has become a common treatment for TBI? Perhaps it is because of the public’s inability to access evidence-based treatments. Individuals are directed to the limited options for treatment even if they are not empirically validated. This is concerning because TBI survivors often require immediate and appropriate responses to combat the wide array of symptoms and their impact on functioning (Gorgoraptis et al., 2019). The challenges that TBI survivors face throughout the assessment, treatment, and recovery process are a concern, especially if the current approaches to recovery are not empirically validated.

Rest

Rest as a treatment for the symptoms and impacts of TBI is currently the most referred modality. However, this treatment approach has a major limitation, which is that the recommendation of rest after a TBI is very broad and lacks specificity. Rest is very important to the recovery process and benefits the early stages of recovery by reducing inflammation in the brain, headaches, and eye sensitivity and restoring cognitive functioning (Kim & Priefer, 2020). The theory behind rest after a TBI is that because a TBI reduces cognitive activity such as concentrating, problem solving, and participating in day-to-day activities, rest enables the brain to heal from the trauma. However, research has shown that healthcare professions overprescribe rest, and it is often the only means of treatment when survivors seek medical attention (Schneider et al., 2017). This is concerning because research has also show that rest is beneficial for only a short period of time (3-5 days; Leddy et al., 2015). Healthcare professionals tell many individuals who have sustained a TBI to rest for weeks or even months and to avoid stimuli that could cause the symptoms to flare up. However, this can affect their mental health and quality of life and cause them to feel lost and hopeless. with no indication or understanding of what they need to do to improve (Malec et al., 2019). This results in a longer recovery time and extreme sensitivity to external stimuli (Leddy et al., 2015), which is concerning because long-term rest does not promote recovery but is only a setback that delays the recovery process. Research has shown that both cognitive and physical activity are essential to recovery from a TBI (Gupta et al., 2019). This highlights the limitations of this approach that result from the abundance of interpretations of rest as a treatment to the point that they lack consistency and specificity. Rest as a prescribed treatment can be very different for different individuals.. The prescription lacks consistency, and the healthcare community lacks general knowledge on the appropriate use of rest (Leddy et al., 2015), which creates challenges because of the lack of other available means of treatment and recovery for TBI survivors.

Pharmaceuticals

Common treatment modalities that include pharmaceuticals also lack viable evidence to support their use in treating TBIs. Healthcare professionals commonly prescribe antidepressants and anti-inflammatories to target specific symptoms associated with TBIs, such as depression and inflammation of the brain. They also prescribe anti-inflammatories such as aspirin and ibuprofen. Research has shown that even if these pharmaceuticals reduce symptoms temporarily, their effectiveness in recovery is questionable because the symptom reduction is short lived, and they do not have long-lasting benefits (Kim & Priefer, 2020). Similarly, antidepressants such as sertraline and fluoxetine often reduce the symptoms of depression after a TBI. Research on the use of these medications has demonstrated their benefits in reducing depressive symptoms and elevating and balancing mood. However, the Food and Drug Administration in the United States has still not approved the use of antidepressants to promote TBI recovery, which is concerning. Furthermore, antidepressants tend to have adverse side effects that can worsen the symptoms of TBI that are already present (Kim & Priefer, 2020), which can potentially result in excess and unnecessary challenges for TBI survivors. Even if these medications are beneficial in treatment, they are not sufficient on their own to lead to a full recovery. The use of pharmaceuticals on their own as an approach to treatment is concerning because of the lack of evidence on whether they lead to long-lasting improvements in TBI survivors’ mental health and quality of life.

Cognitive Behavioural Therapy

CBT is an example of an evidence-based treatment that healthcare professionals commonly use. It typically reduces anxiety by changing individuals' perceptions of certain situations or experiences and often includes stimulus control, relaxation training, cognitive therapy, and psychoeducation/sleep hygiene (Dietch & Furst, 2020). CBT is useful in recovery from TBIs because it reduces the overall symptoms of stress, helps with sleep disturbances, and reduces fatigue (Gray, 2017). The mechanisms behind CBT that create these positive changes restructure individuals' distortions of their injuries. A major component of CBT is psychoeducation on proper care following a TBI, which leads to overall reductions in stress (Hansen-Utely & Arvinen-Barrow, 2017).

Furthermore, mindfulness-based CBT also benefits the recovery process. Mindfulness improves cognitive processing and the processing speed and reduces fatigue (Hellgren et al., 2019). As with CBT, these changes occur as a result of the reduction and management of stress. Researchers have hypothesised that managing and reducing stress during the recovery period have more positive results than the treatment modalities themselves do, because the way that stress interacts in the body can lead to further inflammation, fatigue, and reduce overall cognitive function (Yaribeygi et al., 2017). Techniques that reduce and help to manage stress are essential tools in the recovery process, because it is one of the most significant challenges that TBI survivors face, and reversing or ending the impacts of stress is essential.

However, even though CBT is beneficial in general, it has specific limitations in treating TBIs. With regard to managing the anxiety and depression of TBI survivors, CBT is less effective than changes to the environment and routine (Gray, 2017), mainly because of the lack of experience of therapists who uses CBT to treat TBI survivors. They are often not trained well enough to understand how TBIs influence symptoms and interact in the brain and body (Dietch & Furst, 2020). In many cases therapists who use CBT to treat TBI survivors also lack appropriate knowledge to educate their patients on TBIs and the requirements for recovery (Dietch & Furst, 2020). The concern is whether most services that TBI survivors receive are sufficient and appropriate. Given the time required for CBT to work effectively, the cost, and the training that therapists need to sue this treatment modality, it might not be the best option for recovery. Even though CBT is a viable means of treating aspects of TBIs such as sleep disturbances and stress reduction, it is not sufficient as a singular treatment. Once again, the concerns is the best course of action to help TBI survivors throughout the recovery process and better understand and reduce the associated challenges.

Cognitive Rehabilitation

Cognitive rehabilitation is one the most beneficial means of recovery from a TBI. Cognitive rehabilitation strategies target and improve specific areas of the brain that are responsible for attention, executive functioning, memory, and processing speed (Bogdanova et al., 2017). Specific tools such as flash cards and concentration grids, word-recall and problem-solving tasks, and other viable tools that address these specific areas improve clients’ cognitive functioning (Tsaousides & Gordon, 2009). Cognitive exercises slowly increase in level of difficulty and duration until progress and improvements are evident. They also increase tolerance to specific stimuli, stimulate the cognitive processes of the brain, and build on the improvements. Essentially, they continually strengthen the brain’s cognitive functioning. However, this process, even though it is helpful, is very taxing and time consuming. Cognitive rehabilitation is a specialised method of treating TBIs that also requires specialised healthcare providers and facilities, which limits access and referral to the facilities (Tsaousides & Gordon, 2009). The limitation is that the treatment requires effort, focus, and time from TBI survivors, and they often need to take breaks to reduce their symptoms, depending on the severity of the TBI (Bogdanova et al., 2017). This results in a very lengthy process of recovery that often stretches over weeks and months (Bogdanova et al., 2017). Although cognitive rehabilitation is a key element of the recovery process, its taxing nature can also cause grief, which is a potential challenge throughout the recovery journey.

Physical Treatment Modalities

Other treatment modalities that focus on the physical side of recovery have been beneficial but also present some limitations. Chiropractors reduce physical pain and headaches during the recovery period, however, in many cases their understanding of TBIs is lacking (Germann et al., 2020). The research on chiropractic care has also demonstrated evidence of its benefit in treating and improving the symptoms associated with balance and eye strain/sensitivity, both of which are common symptoms of TBI. However, it is sometimes difficult to find chiropractors trained to deal with TBIs. Experienced healthcare teams are crucial in helping TBI survivors throughout the recovery process (Eghbali et al., 2020). Access to appropriate treatment and the ability to find appropriate healthcare teams are limitations.

Likewise, physiotherapy and acupuncture are also beneficial to the recovery process but present a similar problem. Research has shown that both reduce the symptoms and improve the quality of sleep (Kim & Priefer, 2020); acupuncture has also shown positive results in that it improves overall cognitive functioning (Morse & Garner, 2018). However, finding properly trained healthcare professionals who specialise in TBIs is a potential challenge.

Researchers have also shown evidence that exercise is effective in the treatment of and recovery from TBIs. It reduces stress and fatigue and improves cognitive functioning (Hellgren et al., 2019). The treatment process should begin with very light exercise, because the goal is to return individuals to their baseline slowly. It is important to progress slowly to avoid worsening the symptom severity, which can result in setbacks in the recovery process. Light aerobic exercise such as walking, riding a bike, and participating in yoga increase the blood flow throughout the body and the brain, as well as the production of endorphins and energy, and positively impact the treatment outcomes (Xiong et al., 2009). Because of the sensitive nature of exercise treatment, it requires trained professionals who are capable of working with TBI survivors. Healthcare providers' lack of knowledge and understanding of TBIs has the potential for them to do more harm than good if the treatments and exercise that they recommend do not align with what the research has shown is beneficial (Xiong et al., 2009). In many cases physical healthcare providers do not fully understand the impact of certain activities such as strenuous exercise on TBI survivors and might worsen their symptoms and cause setbacks. This will affect their overall mental health and quality of life, which will increase the potential for extra challenges and hurdles.

Methodology

Literature Search

My literature search involved the use of specific databases such as City University of Seattle's library database, PubMed, PsycInfo, and Google Scholar. I applied keywords such as *assessment*, *treatment*, *challenges*, *TBI*, *survivors*, and *experience* and phrases that included these words to the search to find relevant articles to review. I then selected a total of 11 studies based on their relevance to reducing the challenges that TBI survivors face during the assessment, treatment, and recovery process and that addressed specific assessment and treatment interventions that healthcare professionals use to help survivors to recover from TBIs. I sorted the studies according to their year of publication and excluded any that were more than 10 years old to ensure that I selected current research on the topic of TBI. Of the 11 studies that I chose, 6 were quantitative studies, 4 were qualitative studies, and 1 had a mixed-method design. Table 1 is a breakdown of the core articles.

Table 1

11 Core Articles Selected for Review

Author	Year	Title and focus of study	Journal	Research method
Spreij, L., Gosselt, I., Visser-Melly, J., Hoogerbrugge, J., Kootstra, T., & Nijboar, T.	2021	The Journey Is Just as Important as the Destination: Digital Neuropsychological Assessment Provides Performance Stability Measures in Patients With Acquired Brain Injury. A study focused on evaluating a digital assessment technique and the benefits of using it.	*PLOS ONE*	Quantitative
Borgen, I., Lovstad, M., Andelic, N., Hauger, S., Sigurdardottir, S., Soberg, H., Sveen. U., Forslund, M., Kleffelgard, I., Lindstad, M., Winter, L., & Roe, C.	2020	Traumatic Brain Injury: Needs and Treatment Options in the Chronic Phase: Study Protocol for a Randomized Controlled Community-Based Intervention. A study focused on the need to understand the necessary treatments in the chronic phase of a TBI.	*Trials*	Mixed-methods
Subramaniam, A., Tan, R., Chan, D., Ng, Z., Dong, C., Feng, X., & Chong, SL.	2020	Assessment of the Understanding of Concussion and Care Protocols Amongst Student Athletes and Coaches: A Qualitative Study. A study focused on coaches' and student athletes' understanding of concussions and return-to-play protocols.	*Frontiers in Pediatrics*	Qualitative
Donnelly, K., Goldberg, S., & Fournier, D.	2019	A Qualitative Study of Loveyourbrain Yoga: A Group-Based Yoga With Psychoeducation Intervention to Facilitate Community Integration for People With Traumatic Brain Injury and Their Caregivers. A study focused on the use of yoga and mindfulness-based interventions to recover from TBI, with a focus on support and psychoeducation.	*Disability and Rehabilitation*	Qualitative
Fadyl, J., Theadom, A., Channon, A., & McPherson, K.	2019	Recovery and Adaptation After Traumatic Brain Injury in New Zealand: Longitudinal Qualitative Findings Over the First Two Years. A study focused on understanding the recovery process	*Neuropsychological Rehabilitation*	Qualitative

	from a TBI, the challenges, and the adaptations that occur over a two-year period.	

(table continues)

Author	Year	Title and focus of study	Journal	Research method
Willer, B., Haider, M., Bezherano, I., Wilber, C., Mannix, R., Kozlowski, K., & Leddy, J.	2019	Comparison of Rest to Aerobic Exercise and Placebo-like Treatment of Acute Sport-Related Concussion in Male and Female Adolescents. A study focused on comparing a sample of adolescents with sport-related concussions who were prescribed rest with two arms of a randomized controlled trial in which researchers compared aerobic exercise with placebo-like stretching.	*Archives of Physical Medicine Rehabilitation*	Quantitative
Theadom, A., Starkey, N., Barker-Collo, S., Jones, K., Ameratunga, S., & Feigin, V.	2018	Population-Based Cohort Study of the Impacts of Mild Traumatic Brain Injury in Adults Four Years Post-Injury. A study focused on the long-term effects of mild TBI four years postinjury.	*PLOS ONE*	Quantitative
Shirvani, S., Davoudi, M., Shirvani, M., Koleini, P., Panah, S., Shoshtari, F., & Omidi, A.	2021	Comparison of the Effects of Transcranial Direct Current Stimulation and Mindfulness-Based Stress Reduction on Mental Fatigue, Quality of Life and Aggression in Mild Traumatic Brain Injury Patients: A Randomized Clinical Trial. A study focused on comparing the effects of the two treatments, transcranial direct current stimulation and mindfulness-based stress reduction on mental fatigue, aggression, and quality of life in mTBI patients.	*Annals of General Psychiatry*	Quantitative
Graff, H., Christensen, U., Poulsen, I., & Egerod, I.	2017	Patient Perspectives on Navigating the Field Of traumatic Brain Injury Rehabilitation: A Qualitative Thematic Analysis. A study focused on the lived experience of rehabilitation in adults with TBIs from hospital discharge to four years postinjury.	*Disability and Rehabilitation*	Qualitative
Fann, J., Bombardier, C., Vannoy, S., Dyer, J., Ludman, E., Dikmen, S., Marshall, K., Barber, J., & Temkin, N.	2015	Telephone and In-Person Cognitive Behavioral Therapy for Major Depression after Traumatic Brain Injury: A Randomized Controlled Trial. A study focused on in-person and telephone-provided CBT to treat the symptoms of depression associated with TBI.	*Journal of Neurotrauma*	Quantitative
Gupta, A., & Taly, A.	2012	Functional Outcome Following Rehabilitation in Chronic Severe Traumatic Brain Injury Patients: A Prospective Study. A study focused on the functional outcomes of rehabilitation in chronic severe TBI in-patients.	*Annals of Indian Academy of Neurology*	Quantitative

Methodological Analysis

In this section I analyse the research methods in the 11 quantitative, qualitative, and mixed method studies. The main areas of focus are the research paradigms, the roles of the researchers, the participants (sampling, recruitment, and selection), the data collection, and the data analysis. I also identify the strengths and weaknesses of each area to determine potential limitations. Later, in the Findings section, I analyse and discuss common themes that I identified in the 11 studies.

Research Paradigms

Researchers use common paradigms, depending on the nature of their research. The two main research paradigms are positivist and constructivist. The positivist approach to research is deductive in nature and associated with a quantitative research methodology in which researchers measure variables and test hypotheses that help them to explain phenomena (Tubey et al., 2015). The strength of the positivist approach is that it enables researchers to use experimentation and the analysis of data to prove the hypotheses that they are testing (Tubey et al., 2015). A constructivist approach differs in that researchers view reality as subjective and socially constructed through the experiences of participants. Qualitative researchers use it to capture the essence of an experience to make sense of a phenomenon (Tubey et al., 2015). The strength of this approach is the rich descriptions of individuals' experiences that further help to understand a specific phenomenon. The quantitative studies involved the positivist paradigm; the qualitative studies, the constructivist paradigm, and the mixed-methods studies, both.

Role of Researcher

The roles of the researchers differ in qualitative and quantitative research. The main differences are in how they interact in their studies. Their role in quantitative research is nonexistent int theory; they must remain separated from the participants (Creswell & Creswell., 2018) to avoid subjectivity and biases and ensure that their results from the data that they collect are true (Fink, 2000). Qualitative researchers spend time interacting with the participants during interviews and observations. Their role is to bring the participants' experiences, thoughts, and feelings about a specific topic of study or phenomenon to life (Creswell & Creswell., 2018). The researchers must also understand their own potential biases and keeping them in check throughout the research process. In the four qualitative studies that I reviewed, with regard to their interactions with their participants, the researchers were involved in the interview process to collect data. These personal interactions helped them to understand the participants' experiences. In Donelly et al.'s (2019) study, only one of the researchers was present in the interview and data-collection processes, and the other two were responsible for the data analysis. The limitation is that the two researchers who analysed the data might have missed key components or the essence of the participants' experiences because they were not directly involved in the data collection. It is important that qualitative researchers be involved in as many ways as possible.

The roles of researchers are important in quantitative and qualitative research even though there are major differences between them. On one hand, the researchers of quantitative studies must remain separate from the participants and data collection to be able to replicate the study and find similar results (Fink, 2000), whereas qualitative researchers' role is to construct a picture from an etic (outsider) viewpoint and an emic (insider) viewpoint to understand a specific phenomenon or event (Fink, 2000).

Recruitment and Sampling Procedures

Participant recruitment in research takes many forms, and researchers must give the potential participants information on their studies. The purpose of this step is to gain their interest in participating in the research study and to find suitable candidates to participate (Creswell & Creswell, 2018). Recruitment can take many forms, such as through posters/flyers, social media, or other types of advertising in specific centres where ideal participants might be located. It is therefore important that researchers present the information on their studies clearly and accurately so that the potential participants understand the goals of the studies and important details (Patel et al., 2003). It is also important that they adhere to ethical consideration during this process.

In the 11 studies, the researchers recruited participants who had experienced a TBI at some time through posters/advertisements, emails, phone calls, and searches of healthcare databases. For example, Graff et al. (2017) recruited participants form the Copenhagen University Hospital who had been admitted between January 2010 and December 2014 and who showed signs of mild, moderate, or severe TBIs. Fadyl et al. (2019) recruited participants who had been part of a TBI-incident study or a TBI patient-support program and from referrals from TBI healthcare providers in the Hamilton and Auckland regions of New Zealand. Other researchers such as Borgen et al. (2020), Fann et al. (2015), Shirvani et al. (2021), and Theadom et al. (2018) used similar methods to recruit potential eligible participants, including from previous studies or healthcare facilities. These means of recruitment were positive because the researchers recruited based on a specific criterion: having experiencing a TBI.

However, although this recruitment process has strengths, the sample populations also lacked variability. Because not everyone who experiences a TBI accesses medical services, searching for participants who had utilised medical services was a limitation with regard to understanding the full scope of TBIs outside these services. This was the most significant limitation of the recruitment processes. The researchers of only 1 of the 11 studies utilised community resources and distributed posters in the community to recruit participants outside the medical setting.

Sampling in research refers to the selection of individuals to participate; they are known as the *sample* (Creswell & Creswell, 2018). Sampling methods fall into two categories, probability and nonprobability sampling. Probability sampling consists of different techniques to select participants, all of whom have an equal chance of being included in the sample (Taherdoost, 2016). An example is simple random sampling, in which researchers give potential participants numbers, split them into different groups, and give everyone an equal chance of inclusion in any sample. Nonprobability sampling refers to the inclusion of participants based on the relevance of their experiences to the topic of study; purposive sampling is a category within nonprobability sampling where researchers select smaller samples specific to the topic of focus to collect data (Taherdoost, 2016).

The sampling techniques that the researchers used included both probability and nonprobability sampling. The researchers of all four qualitative studies used purposive sampling to gather information relevant to their specific areas of interest, such as severity of the injury, level of recovery, ethnicity (Fadyl et al., 2019); age; and language (Graff et al., 2017). In their qualitative study, Donelly et al. (2019) also included a convenience sample, which means that they recruited participants from an available and accessible population. Even though convenience samples can be cost effective and easily accessible, they also have limitations, such as the inability to generalise the findings to the broader population because of selection bias and the failure of samples to fully represent the researchers' intentions in their studies (Taherdoost, 2016). For example, Donelly et al.'s sampling was very specific to one small population (in a yoga studio), which impacted the generalisability of their findings because they recruited their participants from only a very small population. Therefore their sampling was biased towards individuals with similar experiences.

The majority of the quantitative studies involved probability sampling: The researchers of four of the six quantitative studies used randomised sampling, and those of the other two used convenience sampling. The researchers of the one mixed-methods design utilised probability sampling, which included randomised sampling. These sampling methods were sufficient to select appropriate samples for the research studies. The use of more probability methods rather than convenience sampling to select clients from different populations rather than one specific source would have improved the studies because it would have ensured the generalisability of the findings to the greater population

The samples in the research studies that I analysed represented the populations of interest to the researchers. They specifically studied the population of survivors of TBIs. However, the main limitation was the size of the samples. Qualitative studies commonly include smaller sample sizes, as the qualitative studies that I reviewed show; their sample sizes ranged from 13 to 52 participants. Given the nature of qualitative research, these sample sizes were sufficient. However, the sample sizes in the quantitative and mixed-methods studies were smaller than 50 participants. This is concerning because smaller sample sizes in quantitative research make it difficult to generalise the findings and can create false premises that the reader might construe as true (Faber & Fonseca, 2014) because the researchers have collected and analysed data from only a few participants. In fact, the sample sizes in two of the six studies were smaller than 50, and in another study the sample size was barely sufficient as it included 100 participants.

Another limitation of the samples for the research studies was the lack of variability. Six of the 11 studies that I reviewed included mainly male participants, and another study included solely female participants. This limited the generalisability of the findings from the qualitative and quantitative studies to the broader population because most of the findings are based on the male population and therefore do not represent the entire population (Kukull & Ganguli, 2012). This would not be an issue if the researchers of the studies that I reviewed had focused on the impact of TBIs on males, but this was not the case. Because their focus was on TBIs as a whole and the participants were mainly male, the researchers could not confidently generalise their findings to the experiences of the broader population.

Selection Process

The selection process that researchers use to recruit appropriate participants is essential to their data gathering. It involves screening potential participants to ensure that they are a good fit for the research (Creswell & Creswell, 2018). The selection process is based on specific inclusion and exclusion criteria to recruit suitable participants (Garg, 2016). These criteria also impact the internal validity (which means that the inferences that researchers make from the population whom they are studying are accurate) and external validity (the inferences that they make from the study sample to the broader population are accurate; Creswell & Creswell, 2018). This demonstrates the importance of selecting appropriate participants to represent the population under study, because it influences researchers' confidence in their results.

The selection processes in the studies that I reviewed all included inclusion and exclusion criteria to ensure that the potential participants were eligible to participate. The criteria in each study ranged from being very broad to very descriptive in nature, and some presented challenges or limitations. For example, Theadom et al.'s (2018) inclusion criteria required that their participants have had an TBI and at least one of the following: a dazed or confused feeling after incident, loss of consciousness for 30 minutes or less, and the inability to remember the accident.

This is a very broad approach to inclusion because it does not account for other factors such as depression, mental health disorders, physical disabilities, and so on that could skew the results.

The exclusion factors must reduce the probability of confounding variables to increase the external validity of the findings. The lack of exclusion factors leaves room for errors in the interpretation of the results, which also reduces the significance of the findings. Graff et al.’s (2017) inclusion criteria were broad: (a) a mild, moderate, or severe TBI; (b) 18-60 years of age; (c) admission to hospital; and (d) the ability to speak Danish. This is also a very broad spectrum of inclusion criteria, which can also result in similar errors or limitations. Subramaniam et al.’s (2020) inclusion criteria also contained similar errors: (a) 13-18 years of age (b) athletic, and (c) participation in at least one of the following sports: rugby, volleyball, cricket, softball, football, and/or water polo. Once again, the inclusion and exclusion criterion does not fully apply to the population under study and leave room for errors in interpreting the results.

Some of the researchers offered little detail on their inclusion and exclusion criteria. For example, Shirvani et al.’s (2021) inclusion criteria was more descriptive and specific. Their criteria for recruitment were (a) 18-50 years of age (b) a rating of 13-15 on the Glascow Coma Scale (c) posttraumatic amnesia present for more than 1 hour (d) brain damage from mechanical force (e) brain images that revealed skull fracture or acute brain injury (f) no history of substance abuse or previous psychiatric disorders, and (g) informed consent. Shirvani et al. also presented exclusion criteria, which resulted in sound recruitment: (a) a lack of willingness to continue (b) participation in other therapies during the study (c) absence from more than one session, or (d) the use of substances other than caffeine and alcohol. Because their inclusion and exclusion criteria were much richer and more descriptive, the researchers could have confidence in the reliability and significance of their results.

Data Collection

Data collection in quantitative research is the process of using instruments, tests, checklists, and surveys to gather information from participants; the qualitative method involves site visits, observations, and interviews (Creswell & Creswell, 2018). The purpose of gathering information is to answer research questions, test hypotheses, and determine the outcomes of situations, phenomena, or events. The researchers of both the quantitative and the qualitative studies that I analysed used different forms of data collection. The limitation of the data collection in these studies was the lack of variability in the methods, surveys, and specific population of focus.

The researchers of the six quantitative studies used a variety of different tools, tests, and surveys to gather information (Fann et al., 2015; Gupta & Taly, 2012; Shirvani et al., 2021; Spreij et al., 2021; Theadom et al., 2018; Willer et al., 2019). Surveys were the most common means of gathering data, although the types of surveys varied considerably. These researchers administered surveys to assess the initial impact of TBIs on their respondents, which demonstrates the lack of consistency in the assessment process. Researchers use specific assessment tools such as the Patient Reported Symptoms Checklist, which involves the use of a Likert scale to measure the severity of specific symptoms that patients experience; the Post-Concussion Symptom Scale, which also uses a self-reporting method to rate symptom severity but focuses on different symptoms that are associated more with TBIs; Becks Anxiety and Depression Scales, which helps researchers to understand the severity of depressive and anxiety symptoms; the Patient Health Questionnaire, which is a self-rated general questionnaire that focuses on overall health: physical, social, and mental; and the Hamilton Depression Rating Scale, which is a questionnaire that helps researchers to understand depressive symptoms. The researchers of the studies that I reviewed commonly used these tools in the assessment process to collect data. In the six quantitative studies, I found no consistent means of data collection. The researchers used different surveys to collect data to understand the symptoms and impacts of TBIs on survivors, which is concerning because the lack of consistency in gathering information makes it difficult to repeat the studies and achieve similar results in that some methods of data collection are more valid than others. The challenge that TBI survivors face in the assessment, treatment, and recovery process is also a lack of consistency. Therefore, a major limitation of the data-collection processes in the quantitative studies was the lack of consistency in the methods of collecting data on a specific phenomenon such as TBI.

Another limitation in the data-collection process was the surveys that the researchers use to collect data. Because the participants' answers were based on their personal beliefs, this involved a certain degree of subjectivity, which can potentially skew the answers because of social desirability, in which the participants do not answer truthfully to project a favourable image of themselves to the researchers (Bertrand & Mullainathan, 2001). The participants could potentially have exaggerated or downplayed the severity of their symptoms, which would impact the internal and external validity of the study. Responder bias and responder dishonesty are two major threats to external validity.

The researchers also failed to collect demographic data from the participants. Only Theadom et al. (2018) and Spriej et al. (2021), the researchers of two of the six quantitative studies, used surveys and other means to collect sociodemographic data and the history of TBIs. This information is vital to ensure confidence in the results, because the more information that researchers collect on their participants, the more generalisable the results are (Kukull &

Ganguli, 2012). Information that is helpful includes factors related to age, gender, SES, and their effect on TBI survivors during the assessment, treatment, and recovery process.

Methods of data collection specific to qualitative research include the process of interviewing and/or observing the participants (Creswell & Creswell, 2018). The researchers of the four qualitative studies that I analysed all used similar means of data collection. The main form that they used was semi structured interviews of their participants. The main differences were in the means of conducting the interviews, the type of data that they collected, their detail of the structure of the interviews, and the actual interviewers themselves. The researchers conducted most of the interviews in person at a location of the participants' choice (most were in the participants' home), but they also conducted telephone interviews. The researchers of only one of the qualitative studies gave a rich description of the interview process, whereas in the other three studies the descriptions of the frameworks of the interviews were very vague and contained little information on the structure and location of the interviews and the types of questions that the researchers asked. Graff et al.'s (2017) study is an example of rich detail of the interview process: The interviewer captured the essence of the participants' experiences throughout their illness and recovery process. Graff et al. also separated the interviews into three sections to understand the impacts on TBI survivors in (a) the acute phase of recovery; (b) the stable phase of recovery, including the rehabilitation facilities and discharge home; and (c) the return home to understand the participants' occupations and living conditions before and after their injuries. This was the only qualitative study in which the researchers stated that they wrote field notes that included their reflections on the interviews and helped them to understand their own thoughts. This method of conducting qualitative research was positive, whereas the researchers of the other three studies failed to discuss any aspects of field notes, highlighting the potential limitations of their methods. They provided only brief descriptions of the type of interview that they conducted and did not elaborate. This is concerning because the types of questions that they asked are unclear, which is potentially a limitation of their collection of relevant information.

The core qualitative studies that I analysed demonstrated the limitations of the interviewers. In only two of the four studies the same researchers interviewed the participants, whereas in the other two studies a team of interviewers collected data. The use of different interviewers potentially compromised the consistency even though the interview questions were structured. This created the potential for different answers and interpretations of the questions from the participants based on the researchers' approaches to conducting the interviews. According to Creswell and Creswell (2018), researchers' presence can bias the interviewees' responses, and different interviewers can potentially lead to skewed results due to their influence of the interviewees. This wouldn't be as big of a factor if there was a debrief and discussion between the interviewers Debriefing after the interviews would have enabled the researchers to ensure that their identification of themes and coding were consistent and compare their findings. However, the researchers of only one of the four studies created a discussion group to review the interview notes and the findings to ensure consistency.

Another limitation was the use of interviews as means of gathering information. Because TBIs have severe impacts on cognition, function, and mental health (Theadom et al., 2018), it is important that researchers note that their interview processes might be skewed, depending on the level of coherence to the interview process presented by the participants. It is hard to interpret all of the information as sound and true because of the potential limitations of the participants as a result of the impacts of TBIs. Accurate recall of certain events and experiences depends on the severity of the TBI survivors’ injuries and their progress in the recovery process. Because the information that researchers collect is essentially indirect and filtered through the perspectives of the participants, it is their subjective truth. The ability to fully recall all aspects of their experience is a potential limitation of the information that they offer in interviews because it might not represent the full experience. This could lead to potential problems in analysing the data.

Data Analysis

Data analysis is the process of reviewing and analysing the data that researchers collect for their studies (Creswell & Creswell, 2018). Typically, the data-analysis procedures consist of different methods to help them to understand and interpret the data that they collect. The process differs in qualitative and quantitative research. In quantitative data analysis researchers compare data and make statistical inferences, whereas in qualitative data analysis they focus on understanding the rich detail of the experiences of their participants and create themes within the collected data (Creswell & Creswell, 2018). The researchers of the core studies that I reviewed used multiple different means of data analysis.

The quantitative researchers used analysis of variance (ANOVA); analysis of covariance; Chi-square tests; SPSS-23, version 15.0, for statistical analyses; Fisher’s exact test, the Mann-Whitney U test, and the Wilcox nonparametric test. The most common data analysis tools that all of the researchers used were the ANOVA, Chi-square test, Mann-Whitney U test, and the SPSS-23 test. The researchers of three of the six quantitative studies used the ANOVA test, which analyses variances among the variables. It was a strength of these studies because it is a reliable and valid tool. The researchers of another study utilised the ANCOVA method of testing covariances. The other most commonly used analysis tools were the SPSS-23 and the Mann-

Whitney U test. The researchers of most of the quantitative studies that I reviewed explained their reasoning for using these tools; however, a limitation is their failure to report the results of the tests that they used. For example, Willer et al. (2019), Spreij et al. (2021), and Shirvani et al. (2021), all explained why they used the ANOVA but failed to clearly describe the results. Similarly, Theadom et al. (2018) also explained why they chose the ANCOVA to identify differences between the groups in symptom severity and community participation, but they also failed to detail the breakdown of their results. More information on the actual results would have fostered a better understanding of the conclusions in these studies. The researchers of only two of the six quantitative studies that I reviewed presented information in their findings such as the alpha and beta values.

Another area of concern in the quantitative researchers' data-analysis processes is that most of the analysis tools yielded inferential statistics to enable them to draw conclusions from their samples and apply them to the broader population. This is a limitation, especially because the sample sizes in the two quantitative studies that I analysed (Gupta & Taly, 2012; Shirvani et al., 2021) were small (fewer than 50 participants). Smaller sample sizes can decrease the significance of the results and generalisation to the larger population more difficult. The researchers of two studies used descriptive statistics to provide context to the inferential statistics. They included statistics on age, gender, occupation, and SES to create connections between TBI survivors and the challenges that they faced.

Qualitative data analysis differs in a few ways. The first is that the aim is to understand the experiences of the participants; it does not involve statistical inferences. The second difference is that in qualitative analysis researchers search for themes in the data that they collect. The researchers of the four qualitative studies that I reviewed used appropriate means to analyse their data. They transcribed and analysed the audio recordings of the interviews and used thematic analysis, which Clarke and Braun (2017) described. The researchers of all four qualitative studies also used inductive content analysis to interpret their data from the bottom up (drawing conclusion from the information received) and make inferences from the experiences of the participants (Tubey et al., 2015). The goal of all of these researchers was to use specific coding techniques to sort their information into subthemes. However, none of the qualitative researchers reported which coding software they used. Even though it was not necessary for them to include this information, it would have been helpful to understand how they created their codes and identified the themes. This could be a limitation of these studies because the researchers did not describe how the identified specific themes. The only detail that the researchers of one of the studies presented was the use of manual mapping techniques to understand the relationships among the codes and themes. I believe that this was insufficient and that they should have described their analysis process in more detail.

Last, the researchers of only one of the qualitative studies that I reviewed presented information on the analysis process and who conducted it. Fadyl et al. (2019) gave a detailed description of their data analysis: the team who conducted it, their specific goals, and the procedures that they used to analyse the information. This study was interesting because it included a multidisciplinary team of different professionals (sociologists, psychologists, and nurses). This resulted in a wide range of knowledge and resulted in an effective analysis because they cross-compared the findings, used group audits, and disseminated the findings to ensure that the themes that they had identified were consistent across the team. Fadyl et al. also stated their specific goals, which the researchers of the other three qualitative studies did not: (a) to synthesise patients’ experiences at different points in time and (b) to explore their insights into the journey over time. These might be simple goals, but setting them might have ensured consistency within the team of analysts. However, these specific goals might also have been a limitation in the sense that they might have impacted the analysis procedure because the team would have tried to fit the data into these goals; the researchers might also have overlooked other important themes that were present. The researchers of the other qualitative studies (Donnelly et al., 2019; Graff et al., 2017; Subramaniam et al., 2020) failed to provide information on the specific focus of their data collection and on their analysis procedures, which involved the use of a research team. A description of how the members of the research team worked together to understand the data that they collected, the analysis procedures, and the meaning behind the data would have helped to clarify the procedures in these studies.

Evaluative Criteria

Qualitative data collection often involves processes such as triangulation and member-checks to ensure that the data that researchers collect is in fact the truth of the matter. The researchers of the qualitative studies conducted member checks to verify that they understood the information that they received from their participants. After the interviews, other processes confirm the validity of the information. In the process of triangulation, the researchers involved in the study ensure that they have identified the same themes and occurrences and that they are valid and understood. Only Donelly et al. (2019) used triangulation, and the researchers of only one study verified the themes across the researchers; rather than triangulation, they held an open discussion. This was a limitation that I identified in two of the four qualitative studies. The researchers of half of the studies did not discuss or comb through the findings from their interview notes, which impacted the validity of the studies to some degree. Researchers need to ensure saturation of their data from interviews to understand the breadth of the topic they studied, which was the experiences of TBI survivors.

Research Findings

In analysing and synthesising the findings, discussions, and conclusions of these studies, I identified specific themes by using a manual mapping technique to review each core research study and develop codes. I created these codes by searching for specific words or phrases in the studies that were relevant to the topic of reducing the challenges that TBI survivors face. I then grouped similarly coded data to create themes on the TBI survivors and reducing the challenges they experience throughout the assessment, treatment, and recovery process. I identified a total of three major themes: (a) the benefit of individualised treatment plans for TBI survivors; (b) the use of a multidisciplinary team in the assessment, treatment, and recovery process; and (c) the need for support and connection throughout the recovery process.

The Benefits of an Individualised Recovery Plan

The benefit of individualised recovery plans to treat TBIs, refers to specific modalities and interventions based on survivors’ needs for recovery. I identified it in the findings and conclusions of five of the core studies that I analysed. Theadom et al. (2018), Borgen et al. (2020), Fann et al. (2015), Spreij et al. (2021), and Gupta and Taly (2012), all noted that the impacts of TBIs on survivors are very complex given the different personal, social, and environmental factors that are present before and after the injury. A challenge TBI survivors potentially face is managing these complexities, especially when it comes to symptom management and accessing appropriate interventions. The use of an individualised treatment plan is important because it reduces these potential challenges that TBI survivors face regarding appropriate assessment and treatment strategies for recovery. As Theadom et al. noted in their findings, TBI survivors often learn inappropriate recovery strategies that do not address their areas of need because they are not accessing medical services soon enough following a TBI. Early intervention is critical to develop an individualised treatment plan and reduce challenges that TBI survivors face as there are differences in the presentation and severity of the symptoms from person to person; thus, TBI survivors will not require the same approaches and interventions for recovery (Fann et al., 2015; Gupta & Taly, 2012). Currently, there is very little focus on the development of treatment plans for TBI survivors based on their specific injuries, impairments, and needs. This suggests the need for more individualised treatment and recovery plans that therapists adapt for each individual and that target the specific areas of impairment necessary for recovery (Borgen et al., 2020). Spreij et al. shifted from the standard assessment procedures that involve pen-and-paper methods to more technologically advanced means of assessing neurological impairments to demonstrate this in their findings. The use of modern assessment tools that are more technologically advanced enable researchers to create deeper understandings of the connections between specific areas of impairment in the brain. leads to developing more specific interventions to treat the impacts of TBIs, which ultimately reduces the challenges and impact on survivors' mental health and quality of life.

Fann et al. (2015) focused on the benefits of CBT to treat the depression of TBI survivors and mentioned similar aspects regarding treatment plans. They found that even though CBT reduces the symptoms of depression, psychosocial factors significantly impact the degree to which CBT is effective. Fann et al. noted that this speaks to the benefit of individualised treatment plans, because understanding biopsychosocial factors can help to understand TBI survivors more deeply and enable the use of other interventions that are beneficial.

A challenges that TBI survivors may face during the recovery process is the cost of accessing and the time spent in these services. The use of an individualised approach to assessment, treatment, and recovery may help to reduce these challenges by decreasing the costs to survivors and the amount of time that they spend recovering. Borgen et al. (2020) explained that individualised approaches to recovery can reduce the costs if the interventions are appropriate in the first step of recovery. Reducing the number of unnecessary services and addressing the main areas of concern in a timely manner reduce the costs to treat TBI survivors. Similarly, Gupta and Taly (2012) presented their findings and argued that an individualised approach shortens the amount of time required to recover from TBIs, because if healthcare providers understand and guide the treatment and recovery in the right direction from the beginning, TBI survivors will receive the help that they need faster, and it will benefit them more.

The Use of a Multidisciplinary Team

The term *multidisciplinary* refers to different healthcare providers who specialise in different areas to ensure that TBI survivors can access the services that they need for recovery. This theme is relevant because it suggests a shift towards a more well-rounded approach to treatment, whereas TBI survivors usually have minimal options for interventions. The minimal options for recovery presents challenges to TBI survivors, and so, utilizing a multidisciplinary approach could help to reduce those challenges. A multidisciplinary approach would lead to a reduction of these challenges by giving TBI survivors more access to the specific services that they need. I identified this theme in the findings and conclusions of five of the core studies that I reviewed. Borgen et al. (2020), Fann et al. (2015), Gupta and Taly (2012), Shirvani et al. (2021), Subramaniam et al. (2020), all mentioned aspects of a multidisciplinary approach to assessment, treatment, and recovery. The research findings and conclusions reveal a consistent concern with current approaches to recovery, and the researchers of all five studies demonstrated the necessity of multifaceted care for TBI survivors. The main findings were that TBI injuries are too complex for one specific discipline or recovery modality to fully address all impairments and symptoms (Fadyl et al., 2019; Gupta & Taly, 2012). The findings from the studies of Fadyl et al., and Gupta et al. suggest that a multidisciplinary team has a greater knowledge base and therefore that different professionals can identify the best strategy for recovery. Subramaniam et al. (2020) reported similar findings on protocols in sports with regard to mild TBI and understanding when TBI survivors are ready to return to play. The conclusion of this study suggested the use of a medical team to evaluate and understand when athletes are able to return to play. The concept with this being that having a combined understanding and agreement from multiple healthcare professionals can increase confidence of sending athletes back into sport. Currently, this decision is left to the coaches, who are not properly trained to understand the potential impacts associated with TBIs. The use of a medical team would help to reduce challenges with returning to play as well as symptom management within the athletes themselves.

Shirvani et al. compared different interventions such as transcranial stimulation and the use of mindfulness, also referring to the benefits of multidisciplinary teams. Their findings show that either of these interventions is beneficial, but the results depend on the injury itself. Furthermore, Shirvani et al. noted in their discussion that TBIs present challenges to the survivors’ regarding the complex physical, cognitive, and psychological impairments. Incorporating other interventions to address all impacted areas can help to reduce the challenges associated with the complexities of TBIs. The findings of these studies show that a multidisciplinary approach to recovery from TBIs will identify interventions that are more helpful to TBI survivors. Together, the findings from these five studies point to the benefits of multiple knowledgeable healthcare providers coming together to provide guidance and support throughout the recovery process.

The Importance of Support and Connection Throughout Recovery

Another theme that the findings of Donelly et al. (2019), Fadyl et al. (2019), Graff et al. (2017), and Theadom et al. (2018) generated is TBI survivors' need for support and connection to others. This refers to the formation and maintenance of relationships with others, whether they be family, romantic relationships, friendships, or connections with others who have had similar experiences. A challenge that was noted with the research studies was feeling secluded and alone (Donelly et al., 2019). This theme is related to the research problem, because the findings from these four studies show that support throughout the recovery process can help to reduce the feelings of being alone and secluded, while boosting recovery and enable survivors to reintegrate into the community and society. Fadyl et al.'s finding also reveal the common occurrence and challenge of TBI survivors' feeling of being isolated, misunderstood, and alone in their experience. Because their injuries impact their identities, it is not uncommon for them to lose touch with friends and other community connections. Donelly et al.'s findings demonstrate that being connected has a positive impact on TBI survivors' recovery because it reduces stress, fosters understanding, and creates a sense of support, which reduces the feeling of isolation. The idea of support and connection can be broken down into two main categories.

Friends and Family

Donelly et al. (2019) and Graff et al. (2017) demonstrated the importance of feeling supported and, even more, the importance of others' understanding of TBI survivors' experiences. This has significantly more meaning with regard to friends and family members of survivors, because a lack of understanding of survivors' experiences leads to the feeling of isolation (Graff et al., 2017). A major finding in the studies of Donelly et al. and Graff et al. is the benefit of psychoeducation and its role in fostering support from others. The main reason that support from friends and family is often lacking is their lack of understanding of the impacts of TBIs on survivors. This creates challenges throughout the recovery process, so it is positive to see that increased support and psychoeducation can reduce these challenges. The number of changes and shifts that are required in survivors' day-to-day routines can also make them feel that they are a burden to friends and family. Psychoeducation for friends and family members, as well as TBI survivors themselves, tremendously benefits the treatment and recovery process, because it helps them to understand the impacts of the experience, the roles of others, and the necessary direction for recovery, which Graff et al. noted in their study. Psychoeducation also reduces the amount of stress in relationships with friends and family for the same reason: It promotes understanding and the ability to offer the required support for recovery. This could have a significant positive impact on the challenges and hurdles that TBI survivors face throughout the recovery process and on reducing them.

Community

The importance of support from friends and family is evident throughout the research, but connection to the community is just as important. This refers to connections to different groups in the community, with jobs, and with appropriate resources in the community to foster recovery. Connection to others in the community is related to the research problem because it is another means of gaining support and being understood, which are often challenges for TBI survivors, as research findings of Fadyl et al. (2019) and Donelly et al. (2019), demonstrate. Reducing these specific challenges has the potential for good recovery. Donelly et al. gave an example of the benefit of being connected to support groups in the community through interactions with others who share the experience. They studied a yoga group specifically designed to help TBI survivors. The results of this study are interesting because the TBI survivors made significant strides toward recovery. Even though exercise such as yoga is beneficial in recovery from TBIs, it is not the most important factor in change. Donelly et al. demonstrated that the use of yoga and mindfulness techniques resolves the symptoms of fatigue and problems with mood, concentration, and physical pain. Even more important is that they showed that the most significant positive impact on TBI survivors and their recovery process is their ability to connect with others who have had a similar experience. This connection to others who share the experience fosters motivation and resiliency, reduces challenges TBI survivors face such as the feeling of isolation, and replaces it with a sense of belonging, which is the most powerful of the positive changes that occur.

Fadyl et al. (2019), also found that becoming connected to the community has tremendous benefits in the recovery process. The sense of belonging creates a sense of unity with others when they discuss the specific challenges that TBI survivors face and can relate to them. It dramatically reduced the stress of the survivors in their study and fostered connections that remained even after they had completed the program. This speaks to the power of being connected to others and within the community and the importance of developing support groups with specific injuries such as TBIs to reduce some of the challenges that survivors’ face and must overcome.

Ethical Concerns

Research is the forefront in advancing current knowledge and practices. However, research can also be very sensitive in nature when it involves human participants. Because of this, ethics in research are very important to ensure the safety and autonomy of the participants. With this in mind, I noted that the researchers of all of the studies that I reviewed gained approval from appropriate ethics boards, which is a requirement of the *Tri-Council Policy Statement* (Canadian Institutes of Health Research et al., 2018). Researchers are obliged to adhere to these guidelines, which are connected to the *Canadian Code of Ethics for Psychologists* (Canadian Psychological Association, 2017). The researchers of most of the complied with these ethical standards in conducting their research. With regard to the Canadian code of ethics and its four guiding principles of respect for the dignity of persons, responsible caring, integrity in relationships, and responsibility to society, a few ethical concerns stood out in my review of the 11 core research studies.

Respect for the dignity of persons refers to their inherent worth and moral rights and emphasises the need for social and natural justice toward all persons (Canadian Psychological Association, 2017). Most of the researchers whose studies I reviewed presented information on the protection of their participants’ confidentiality and privacy. They assigned numbers to them to protect their identify. However, not all of the researchers clarified that they met the ethical requirements to protect privacy and confidentiality. An ethical concern with the research studies that I reviewed is the informed-consent process. The researchers of all but one of the studies reviewed the process and reported that they received informed consent from their participants. section I.20 of the *Canadian Code of Ethics for Psychologists* (Canadian Psychological Association, 2017) states that it is necessary to obtain informed consent for all research activities that involve observations or measurements, invasions of privacy, and the risk of harm. Willer et al. (2019) did not mention having received informed consent from their participants, which is concerning because the study included adolescents aged 13-18 years, and it was important that they gain informed consent from their guardians or caregivers to include the younger participants. Willer et al. might have neglected to discuss informed consent for specific reasons but might still have taken the appropriate steps; however, the lack of information raises questions about their fulfilment of this ethical requirement.

An ethical concern that was seen was the vulnerable populations whom the researchers studied. Given the focus on TBI survivors in the core studies that I reviewed, the researchers should have discussed the potential risks in conducting research with these populations. Sections I.33 and I.34 of the Canadian Code of Ethics for Psychologists (Canadian Psychological Association, 2017) state that when researchers include vulnerable populations or groups, it is essential that they obtain informed consent from the appropriate individuals who are appointed or responsible for the individuals who participate in the research. This raises a question regarding the informed-consent process and the ability of participants to give full consent on their own. Furthermore, according to these sections, not only must researchers receive informed consent, but they must also ensure that their research activity directly benefits the participants.

Another ethical concern with the interviews of vulnerable populations in the qualitative studies is the risk of recall bias, which results from differential responses to interview questions in which the recollection of past experiences might be skewed or inaccurate (Everson & Marsit, 2020). Creswell and Creswell (2018) also explained the need for researchers to respect power imbalances to ensure that they do not influence their participants’ responses during the interview process associated with qualitative studies. This is a concern because they could potentially impact the findings of the research. Given the traumatic nature of the injuries that some of the research participants sustained, the researchers should have discussed this and how they reduced the risk of recall bias.

The second guiding principle, “Responsible Caring” presented concerns regarding the risk/benefit analysis and maximizing benefits of the research being done. All of the researchers in the studies that I reviewed presented information to the participants on their inclusion and exclusion criteria during the informed consent process. However, the concern is that the inclusion criteria in these studies specified participants who had sustained a TBI and showed signs of impairment from injuries or specific symptoms. Simply put, although the participants in all of these studies had some degree of impairment, the researchers did not thoroughly discuss them, which raises the question of the risk of harm and the degree of potential benefit from their participation in the research. According to the *Tri-Council Policy Statement* (Canadian Institutes of Health Research et al., 2018), it is necessary that the potential benefits of research outweigh the risks. However, this policy also states that the potential risks and benefits might differ from person to person. This points to variances in the view of research as ethically sound, which is concerning given the vulnerable populations whom these researchers studied. More information on the risks and benefits of the research would have been helpful. Likewise, it would have been helpful to identify the population as vulnerable and clarify that the participants were in fact able to coherently provide informed consent. Information regarding the younger participants and gaining appropriate informed consent from parents or guardians would have also been helpful to see.

I found no major ethical concerns regarding the third and fourth guiding principles of integrity in relationships and responsibility to society. The researchers within the qualitative studies utilized member checks and triangulation to limit potential biases that could interfere with the research findings and ensure the data collected represented the participants experiences. This helped to solidify the integrity within the relationships. Regarding the fourth principle, responsibility to society, the authors of the research studies reviewed contributed to the development of knowledge in a particular area and evaluated and presented their findings appropriately. Overall, there were contributions to society that were made given the nature of the studies and the findings within them.

Application to Clinical Practice

The answers to my research question "What can be done to reduce the challenges TBI survivors expereince during the assessment, treatment, and recovery process?" are valuable to healthcare professionals, community programs/supports, and society. The answers to this question enable revision of the approaches to managing TBI; more specifically, the assessment and treatment protocols to help TBI survivors to recover. They also open many doors to new discoveries to help TBI survivors to deal with their personal experiences with TBIs, their impacts, and the recovery process. Understanding the challenges that TBI survivors face will lead to improvements in this process and help to restore the mental health and quality of life of those impacted by this phenomenon.

Conceptualising the Issue Locally

According to Alberta Health Services (2021), roughly 5,000 Albertans experience TBIs annually. With regard to Alberta's current legislation on TBIs, advancements are evident in the supports for TBI survivors. The government has recently introduced new legislation, the Alberta Brain Injury Initiative, to provide TBI survivors and their families with proper supports and information on specific brain-injury centres that are spread throughout Alberta in cities such as Red Deer, Medicine Hat, Lethbridge, High Prairie, Peace River, Grande Prairie, Edmonton, and Calgary (Alberta Health Services, 2021). Even though the growth of healthcare centres that deal with TBIs is positive, there are still some concerns. One of the main concerns is accessibility, which in many cases requires a referral to access the centres and the services that they offer. This leaves a high number of TBI survivors without access to these supports who need to find ways to recover and cope with the impairments on their own. Aside from the specific cities that have brain-injury centres, supports and services to deal with TBIs, the recovery process are still very limited. In many cases, the services that survivors access to recover from TBIs are private health care clinics that usually specialise in only specific professional area such as chiropractic care, physiotherapy, psychology, or physical therapy (Gupta & Taly, 2012). This makes it difficult to address all of the areas of impairment necessary for a full recovery. If Alberta continued to expand on the current legislation on TBIs and implement new supports and services while educating TBI survivors, the government might be able to reduce the challenge of accessing these supports in the future. However, until this happens, access to appropriate resources in Alberta to help survivors to recover from TBIs is still a concern and needs continued attention to reduce the impacts on them, their families, and their friends.

Integrating the Research Findings Into Clinical Practice

The findings that I have generated throughout this paper are interesting with regard to concerns about recovery from TBIs in the province of Alberta. The main findings centred on the complexity of TBIs, challenges that occur through the assessment, treatment, and recovery process such as accessibility, cost, and lack of clear guidelines, and how to reduce these challenges. It was discovered that individualisation of treatments to each TBI survivor based on his or her needs for recovery and the benefits of utilising a multidisciplinary approach and increasing support from families, friends, and the community can help to reduce the associated challenges TBI survivors experience. These findings strongly correlate with the concerns in Alberta about the need to increase supports/services and improve accessibility to them. The findings offer insights into improvements to medical services by increasing the focus on treatment plans to meet the needs of TBI survivors and incorporating a team of healthcare providers into the treatment. As I noted in the previous section, many of the medical services that TBI survivors access usually offer only one specialisation, which leaves two options: to utilise the single specialisation in the hope of finding some relief from specific symptoms, whether they be physical, psychological, or cognitive impairments; and to access different medical facilities so to focus appropriately on each area of impairment. However, these options can be very costly and time consuming and, given the impact of TBIs on survivors, very difficult to manage (Gupta & Taly, 2012). The findings I have noted all point to the need to improve the current system that deals with recovery from TBIs to improve protocols and reduce the challenges and hurdles that survivors face.

Recommendations

In this research paper I have highlighted many concerns and challenges that TBI survivors face throughout the assessment, treatment, and recovery process. I will therefore make recommendations that might be helpful at the professional, community, and national levels. The first recommendation at the professional level is to create connections among the different healthcare specialisations. This recommendation would potentially result in a multidisciplinary framework in which healthcare providers work together as a team to address the impacts and impairments that TBI survivors face. My recommendation at the community level is to increase the supports for TBI survivors within the community and others who are involved in the journey to recovery. Support groups that enable connection and sharing with others who have had similar experiences could reduce survivors’ feeling of being alone. Other supports such as education on TBIs and the appropriate actions to take would also be of benefit. My last recommendation, at the national level, is to create legislation to deal with TBIs; more specifically, the development of more protocols and guidelines for assessment and treatment plans to meet the needs of each survivor. Guidelines and protocols that address recovery from TBIs would result in clarity and consistency in the assessment, treatment, and recovery process and would benefit TBI survivors, healthcare providers, communities, and society.

Recommendations For Future Research Practice

Future research on TBI survivors and reducing the challenges that they face throughout the assessment, treatment, and recovery process is still necessary. It would be of great benefit to understand specific treatment interventions and their impact on the recovery process. Even though researchers have studied treatment modalities, they have also demonstrated the need for further research to form sound conclusions. This includes larger sample sizes to make the findings more generalizable to the larger population would also be of benefit.

More qualitative research to capture the essence of TBI survivors’ experiences throughout the injury and recovery process would also be beneficial for many reasons. I found very few qualitative studies that provided this type of contextual information. Qualitative research would be beneficial because it would foster a deeper understanding of the specific challenges that TBI survivors face and identify the differences in those experiences. Based on their personal experiences, qualitative research on TBI survivors and their experiences would also identify which interventions are of the most benefit as well as foster understanding around how to reduce the challenges TBI survivors face.

Future Research Questions

After I analysed the findings of the core studies that I reviewed, specific research questions emerged, and the answers will help to inform best practices for TBI survivors throughout the assessment, treatment, and recovery process. The answers to these questions will offer more direction to future researchers with regard to studying TBIs and the challenges that survivors have to overcome. The first question stems from deficiencies within the literature reviewed, regarding challenges in addressing all impaired areas associated with TBIs. There was a lack of understanding around which specific services or interventions would be most beneficial for recovering from TBIs, leading to the following question: “What combination of healthcare providers is best suited to form a multidisciplinary team to address the impacts of TBIs on the survivors?” The answers to this question will provide a context for which specialists are needed throughout the assessment and treatment process to stimulate and guide recovery and ensure that survivors use appropriate services. The answers can also help to identify essential early interventions for recovery from TBIs that incorporate different healthcare specialists.

The second question looks to address deficiencies noted in the literature about a lack of support and connections with others and within communities. This lead to the question of: “How can we increase supports and connections in personal relationships and the community to help address the impacts of TBIs on the survivors?” This question is relevant given the findings from a few of the studies that I reviewed. According to Donelly et al. (2019), a support group whose members participate in yoga and share experiences will benefit TBI survivors because they will feel more connected to others who can relate to their experiences. Because the benefits of support and connection during recovery are significant, more supports and opportunities to connect with others who share the same experiences are required. Coming together and creating a community connected by a specific phenomenon in which the members can share openly without being judged will benefit healing and recovery. The concept of support and connections has great potential and requires further exploration.

Conclusion

In this research paper I answered the question “What can be done to reduce challenges TBI survivors face throughout the assessment, treatment, and recovery process?” The answers are relevant given the increasing numbers of TBIs and their impacts on survivors. As I have demonstrated, many TBI survivors are unsure about what to do or what services to access to recover from their injuries. I therefore thoroughly analysed 11 core studies that had relevant and valuable information on TBIs and survivors that highlighted the ways to reduce the challenges that TBI survivors face which presented potential solutions to challenges such as the impact and complexity of symptoms, the lack of access to appropriate resources, and the lack of supports for TBI survivors and their families. I identified and analysed themes from these studies on the potential solutions: individualised treatment plans for TBI survivors, the benefits of a multidisciplinary approach, and the need to increase support from family, friends, and the community. These themes strongly correlate with some of the main concerns in Alberta about the process of recovery from TBIs.

Conceptualising the issue locally, I found that a great deal of work is still required in Alberta to provide the necessary supports and services to TBI survivors. Although progress in the provision of proper information, treatment, and supports to TBI survivors is evident, it is still difficult to access them. The findings I have generated throughout this paper offer insights into the need for improvements in current legislation and protocols at a professional, community, and national level. The findings also encourage further reflection on the assessment, treatment, and recovery process and suggest the need for a new structure to meet TBI survivors’ needs, teams to guide them through recovery, and increasing access to supports. My reflection on the findings and how to apply them to current clinical practice led to recommendations to enhance recovery from TBIs and reduce the challenges that TBI survivors must overcome throughout their journey to recovery; they consist of shifting current practices to a more well-rounded approach to recovery. More specifically, implementing these recommendations will connect healthcare providers, improve the treatment outcomes, help to create specialised treatment plans for TBI survivors and more accessible supports within communities, leading to the development of more solid and consistent protocols and guidelines to follow at the national level.

Throughout this paper I have also identified certain areas that might be valuable to explore more in depth, such as potential interventions that could be of benefit in treating TBIs. Understanding which interventions more effectively treat specific impairments has the potential to result in more guidelines and protocols based on effective and efficient interventions. Qualitative research on TBI survivors' experiences throughout their assessment, treatment, and recovery journey would also be helpful. Understanding their experiences will lead to valuable insights into the challenges that they face and allow for reflection of what could be done to reduce them.

References

Aggarwal, S., Ott, S., Padhye, N., & Schulz, P. (2020): Sex, race, ADHD, and prior concussions as predictors of concussion recovery in adolescents. *Brain Injury, 34*, 1-9. https://doi.org/10.1080/02699052.2020.1740942

Alberta Health Services. (2021). Brain Injury Supports. https://www.alberta.ca/brain-injury-supports.aspx. Retrieved on, September, 20, 2021.

Barman, A., Chatterjee, A., & Bhide, R. (2016). Cognitive impairment and rehabilitation strategies after traumatic brain injury. *Indian Journal of Psychology Medicine*. 38. 172-81. DOI: 10.4103/0253-7176.183086

Belanger, H., Kretzmer, T., Vanderploeg, R., & French, L. (2009). Symptom complaints following combat-related traumatic brain injury: Relationship to traumatic brain injury severity and posttraumatic stress disorder *Journal of the International Neuropsychological Society, 16*, 194-199. https://doi.org/10.1017/S1355617709990841

Berlucchi, G. (2010). Neuropsychology: Theoretical basis. In L. R. Squire (Ed.), *Encyclopedia of neuroscience* (pp. 1001-1006). https://doi.org/10.1016/B978-008045046-9.00996-7

Bertrand, M., & Mullainathan, S. (2001). Do people mean what they say? Implications for subjective survey Data. *Economics and Social Behavior, 91*(2), 67-72.

Block, C., West, S., & Goldin, Y. (2015). Misconceptions and misattributions about traumatic brain injury: An integrated conceptual framework. *Physical Medicine and Rehabilitation, 8*(1), 1-15. https://doi.org/10.1016/j.pmrj.2015.05.022

Bogdanova, Y., Yee, M., Ho, V., & Cicerone, K. (2017). Computerized cognitive rehabilitation of attention and executive function in acquired brain injury: A systematic review. *Journal of Head Trauma Rehabilitation, 31*(6), 419-433. https://doi.org/10.1097/HTR.0000000000000203

Borgen, I., Lovstad, M., Andelic, N., Hauger, S., Sigurdardottir, S., Soberg, H., Sveen, V., Forslund, M., Kleffelgard, I., Lindstad, M., Witer, L., & Roe, C. (2020). Traumatic brain injury: Needs and treatment options in the chronic phase: Study protocol for a randomized controlled community-based intervention. *Trials, 21*(294), 1-14. https://doi.org/ https://doi.org/10.1186/s13063-020-4195-5

Burke, M., Fralick, M., Nejatbakhsh, N., Tartaglia, M., & Tator, C. (2015). In search of evidence-based treatment for concussion: Characteristics of current clinical trials. *Brain Injury, 29*(3), 300-305. https://doi.org/10.3109/02699052.2014.974673

Canadian Institutes of Health Research, Natural Sciences and Engineering Research Council of Canada, and Social Sciences and Humanities Research Council. (2018) *Tri-Council policy statement: Ethical conduct for research involving humans.*

Canadian Psychological Association. (2017). *Canadian code of ethics for psychologists* (4th ed.).

Centers for Disease Control and Prevention. (2021). *Get the facts about TBI*. https://www.cdc.gov/traumaticbraininjury/get_the_facts.html

Cifu, D., Cohen, S., Lew, H., Jaffee, M., & Sigford, B. (2010). The history and evolution of traumatic brain injury rehabilitation in military service members and veterans. *American Journal of Physical Medicine & Rehabilitation, 89*. 688-694. https://doi.org/10.1097/PHM.0b013e3181e722ad

Clarke, V. & Braun, V. (2017) Thematic analysis. *The Journal of Positive Psychology. 12*(3), 297-298, https://doi.org/10.1080/17439760.2016.1262613

Creswell, J., & Creswell, J. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). Sage.

Dietch, J., & Furst, A. (2020). Perspective: Cognitive behavioral therapy for insomnia is a promising intervention for mild traumatic brain injury. *Frontiers in Neurology, 11* (530273), 1-8. https://doi.org/10.3389/fneur.2020.53027

Donnelly, K., Goldberg, S., & Fournier, D. (2019). A qualitative study of LoveYourBrain Yoga: A group-based yoga with psychoeducation intervention to facilitate community integration for people with traumatic brain injury and their caregivers. *Disability and Rehabilitation*, *42*(17), 2482-2491. https://doi.org/10.1080/09638288.2018.1563638

Echemendia, R. (2006). *Sports neuropsychology: Assessment and management of traumatic brain injury*. Guilford Press.

Eghbali, M., Khankeh, H., & Ebadi, A. (2020). The importance of early rehabilitation in traumatic brin injury. *Nursing Practice Today*, *7*(2), 84-86. https://doi.org/https://doi.org/10.18502/npt.v7i2.272

Elder, G., Ehrlich, M., & Gandy, S. (2019). Relationship of traumatic brain injury to chronic mental health problems and dementia in military veterans. *Neuroscience Letters*, *707*, 134294. https://doi.org/https://doi.org/10.1016/j.neulet.2019.134294

Everson, T., & Marsit, C. (2020). Epidemiological concepts in environmental epigenetics. *Environmental Epigenetics in Toxicology and Public Health, 22*, 89-105. https://doi.org/https://doi.org/10.1016/C2019-0-00127-6

Faber, J., & Fonseca, L. (2014). How sample size influences research outcomes. *Dental Press Journal of Orthodontics, 19* (4), 27-29. https://doi.org/http://dx.doi. org/10.1590/2176-9451.19.4.027-029.ebo

Fadyl, J., Theadom, A., Channon, A., & McPherson, K. (2019). Recovery and adaptation after traumatic brain injury in New Zealand: Longitudinal qualitative findings over the first two years. *Neuropsychological Rehabilitation, 29*(7), 1095-1112. https://doi.org/10.1080/09602011.2017.1364653

Fann, J., Bombardier, C., Vannoy, S., Dyer, J., Ludman, E., Dikmen, S., Marshall, K., Barber, J., & Temkin, N. (2015). Telephone and in-person cognitive behavioral therapy for major depression after traumatic brain injury: A randomized controlled trial. *Journal of Neurotrauma, 32,* 45-57. https://doi.org/10.1089/neu.2014.3423

Fink, S. (2000). The role of the researcher in the qualitative research process: Potential barrier to archiving qualitative data. *Forum: Qualitative Social Research, 1*(3), 1-14.

Frost, R., Farrer, T., Primosch, M. & Hedges, D. (2013). Prevalence of Traumatic Brain Injury in the general adult population: a meta-analysis. *Neuroepidemiology, 40(3),* 154-159. https://doi.org/10.1159/000343275.

Garg, R. (2016). Methodology for research I. *Indian Journal of Anaesthesia, 60(9),* 640-645. https://doi.org/10.4103/0019-5049.190619.

Germann, D., Marshall, C., & Kazemi, M. (2020). Multi-modal management of sport and non-sport related concussion by chiropractic sports specialists: A case series. *Journal of Canadian Chiropractic Association, 64*(3), 214-226.

Gorgoraptis, N., Zaw-Linn, J., Feeney, C., Tenerio-Jimenez, C., Niemi, M., Malik, A., Ham, T., Goldstone, P., & Sharp, D. (2019). Cognitive impairment and health-related quality of life following traumatic brain injury. *Neurorehabilitation, 44,* 321-331. https://doi.org/10.3233/NRE-18261

Graff, H., Christensen, U., Poulsen, I., & Egerod, I. (2017): Patient perspectives on navigating the field of traumatic brain injury rehabilitation: A qualitative thematic analysis. *Disability and Rehabilitation, 40*(8), 926-934. https://doi.org/10.1080/09638288.2017.1280542

Gray, S. (2017). An overview of the use of neurofeedback and biofeedback for the treatment of symptoms of traumatic brain injury in military and civilian populations. *Medical Acupuncture, 29*(4), 215-219. https://doi.org/10.1089/acu.2017.1220

Greenshields, S. (2019). Neurological assessment in children and young people. *British Journal of Nursing, 28*(16), 1056-1059. https://doi.org/10.12968/bjon.2019.28.16.1056

Grubenhoff, J., Kirkwood, M., Gao, D., Deakyne, S., & Wathen, J. (2010). Evaluation of the Standardized Assessment of Concussion in a pediatric emergency department. *Pediatrics, 126*(4), 688-695. https://doi.org/10.1542/peds.2009-2804

Gupta, A. Summerville, G., & Senter, C. (2019). Treatment of acute sports-related concussion. *Current Reviews in Musculoskeletal Medicine, 12,* 117-123. https://doi.org/10.1007/s12178-019-09545-7

Gupta, A., & Taly, A. (2012). Functional outcome following rehabilitation in chronic severe traumatic brain injury patients: A prospective study. *Annals of Indian Academy of Neurology, 15*(2), 120–124. https://doi.org/10.4103/0972-2327.94995: 10.4103/0972-2327.94995

Hamson-Utley, J., & Arvinen-Barrow, M. (2017). Managing mental health aspects of post-concussion syndrome in collegiate student-athletes. *Athletic Training & Sports Healthcare, 9* (6), 263-270. https://doi.org/10.3928/19425864-20171010-05

Hellgren, L., Lundqvist, A., Börsbo, B., Levi, R., & Samuelsson, K. (2019) Mindfulness and aerobic exercise as an intervention for cognitive dysfunction following an acquired brain injury: A pilot study. *Open Journal of Therapy and Rehabilitation, 7*, 12-24. https://doi.org/https://doi.org/10.4236/ojtr.2019.71002

Hiployee, C., Dufort, P., Davis, H., Wennberg, R., Tortaglia, M., Mikulis, D., Hazrati, L. & Tator, ,C. (2017). Longitudinal study of post-concussion syndrome: Not everyone recovers. *Journal of Neurotrauma, 34*, 1511-1523. https://doi.org/10.1089/neu.2016.4677.

Iverson, G. (2019) Network analysis and precision rehabilitation for the post-concussion syndrome. *Frontiers of Neurology, 10*(489), 1-10. https://doi.org/10.3389/fneur.2019.00489

Kaltiainen, H., Liljestrom, M., Helle, A., Hietanen, M., Renvall, H., & Forss, N. (2019). Mild traumatic brain injury affects cognitive processing and modifies oscillatory brain activity during attentional tasks. *Journal of Neurotrauma, 36*, 2222–2232. https://doi.org/10.1089/neu.2018.6306

Katti, G., Ara, S. & Shireen, A. (2011). Magnetic Resonance Imaging (MRI) – A review. *International Journal of Dental Clinics, 3(1)*, 65-70.

Kim, K., & Priefer, R. (2020). Evaluation of current post-concussion protocols. *Biomedicine & Pharmacotherapy, 129*(110406), 1-9. https://doi.org/https://doi.org/10.1016/j.biopha.2020.110406

Kukull, W., & Ganguli, M. (2012). Generalizability: The trees, the forest, and the low-hanging fruit. *Neurology, 78*, 1886-1891.

Leddy, J., Hinds, A., Sirica, D., & Willer, B. (2015). The role of controlled exercise in concussion management. *Physical Medicine & Rehabilitation, 8*(35), 1-10. https://doi.org/10.1016/j.pmrj.2015.10.017

Levin, H., Benton, A., & Grossman, R. (1982). *Neurobehavioral consequence of closed head injury.* Oxford University Press.

Malec, J., Hammond, F., Corrigan, J., Dams-O’connor, K., Hart, T., Novack, T., Dandah, M., Whiteneck, G., & Bogner, J. (2019). Longitudinal effects of medical comorbidities on functional outcome and life satisfaction after traumatic brain injury: An individual growth curve analysis of NIDILIRR traumatic brain injury model system data. *Journal of Head Trauma Rehabilitation, 34*(5), 25-34. https://doi.org/10.1097/HTR.0000000000000459

McCrea, M., Kelly, J., Kluge, J., Ackley, B., & Randolph, C. (1997). Standardized assessment of concussion in football players. *Neurology, 48*, 586-588.

McLeod, T., Lewis, J., Whelihan, K., & Bacon, C. (2017). Rest and return to activity after sport-related concussion: A systematic review of the literature. *Journal of Athletic Training, 52*(3), 262-287. https://doi.org/10.4085/1052-6050-51.6.06

Mennella, R., Patron, E., & Palomba, D. (2017). Frontal alpha asymmetry neurofeedback for the reduction of negative affect and anxiety. *Behavior Research and Therapy, 92*, 32-40. https://doi.org/10.1016/j.brat.2017.02.002

Milders, M. (2019) Relationship between social cognition and social behaviour following traumatic brain injury. *Brain Injury, 33*(1), 62-68. https://doi.org/10.1080/02699052.2018.1531301

Morse, A., & Garner, P. (2018). Traumatic brain injury, sleep disorders, and psychiatric disorders: An underrecognized relationship. *Medical Sciences, 6*(15), 1-16. https://doi.org/10.3390/medsci6010015

Namjoshi, P., Good, C., Cheng, W., Panenka, W., Richards, D., Cripton, P., & Wellington, S. (2013). Towards clinical management of traumatic brain injury: A review of models and mechanisms from a biomechanical perspective. *Disease Model and Mechanism, 6*, 1325-1338. https://doi.org/10.1242/dmm.011320

Ng, S., & Lee, A. (2019). Traumatic brain injuries: Pathophysiology and potential therapeutic targets. *Frontiers in Cellular Neuroscience, 13*(528), 1-23. https://doi.org/10.3389/fncel.2019.00528

Patel, M., Doku, V., & Tennakoon, L. (2003). Challenges in recruitment of research participants. *Advances in Psychiatric Treatment, 9*, 229–238.

Prince, C., & Bruhns, M. (2017). Evaluation and treatment of mild traumatic brain injury: The role of neuropsychology. *Brain Sciences, 7*(105), 1-14. https://doi.org/10.3390/brainsci7080105

Rao, D., McFaull, S., Thompson, W. & Jayaraman, G. (2017). Trends in self-reported traumatic brain injury among Canadians, 2005-2014: A repeated cross-sectional analysis. *CMAJ OPEN, 5(2),* 301-307. http://doi.org/10.9778/CMAJO.20160115.

Schneider, K., Leddy, J., Guskiewics, K., Seifert, T., McCrea, M., Silverberg, N., Fedderman-Dumont, N., Iverson, G., Hayden, A., & Makdissi, M. (2017). Rest and treatment/rehabilitation following sport- related concussion: A systematic review. *British Journal of Sports Medicine*, 1-7. https://doi.org/10.1136/ bjsports-2016-097475

Shenton, M., Hamoda, H. Scheiderman, S., Pasternak, O., Rathi, Y., Purohit, M., Helmer, K., Koerte, I., Lin, A., Kikinis, R., Kubicki, M., Stern, R., & Zafonte, R. (2012). A review of magnetic resonance imaging and diffusion tensor imaging findings in mild traumatic brain injury. *Brain Imaging Behavior, 6*(2), 137-192. https://doi.org/10.1007/s11682-012-9156-5

Shirvani, S., Davoudi, M., Shirvani, M., Koleini, P., Panah, S., Shoshtari, F., & Omidi, A. (2021). Comparison of the effects of transcranial direct current stimulation and mindfulness-based stress reduction on mental fatigue, quality of life and aggression in mild traumatic brain injury patients: A randomized clinical trial. *Research Square, 20*(33), 1-18. https://doi.org/https://doi.org/10.21203/rs.3.rs-73580/v1

Spreij, L., Gosselt, I., Visser-Meily, J., Hoogerbrugge, A., Kootstra, T., & Nijboer, T. (2021). The journey is just as important as the destination: Digital neuropsychological assessment provides performance stability measures in patients with acquired brain injury. *PLoS ONE, 16*(7), 1-18. https://doi.org/https://doi.org/ 10.1371/journal.pone.0249886

Stone, J. (2014). Functional neurological disorders: The neurological assessment as treatment. *Clinical Neurophysiology*. 1-11. https://doi.org/http://dx.doi.org/10.1016/j.neucli.2014.01.002

Subramaniam, A., Tan, R., Chan, D., Ng, Z., Dong, C., Feng, J., & Chong, S. (2020). Assessment of the understanding of concussion and care protocols amongst student athletes and coaches: A qualitative study. *Frontiers in Pediatrics, 8*, e526986. https://doi.org/10.3389/fped.2020.526986

Suleiman, A., Lithgow, B., Dustgheib, Z., Mansouri, B. & Moussavi, Z. (2017). Quantitative measurement of post-concussion syndrome using Electrovestibulography. *Science Report, 7(1637)*, 1-10. http://doi.org/10.1038/541598-017-15487-2.

Taherdoost, H. (2016). Sampling methods in research methodology: How to choose a sampling technique for research. *International Journal of Academic Research in Management, 5*(2), 18-27.

Theadom, A., Starkey, N., Barker-Collo, S., Jones, K., Ameratunga, S., & Feigin V. (2018) Population-based cohort study of the impacts of mild traumatic brain injury in adults four years post-injury. *PLoS ONE, 13*(1), 1-13. https://doi.org/https:// doi.org/10.1371/journal.pone.0191655

Tsaousides, T., & Gordon, W. (2009). Cognitive rehabilitation following traumatic brain injury: Assessment to treatment. *Mount Sinai Journal of Medicine.* 76. 173-181. https://doi.org/10.1002/msj.20099

Tubey, R., Rotich, J., & Bengat, J. (2015). Research paradigms: Theory and practice. *Research on Humanities and Social Sciences, 5*(5), 224-228.

Vella, M., Crandall, M., & Patal, M. (2017). Acute management of traumatic brain injury. *Surgical Clinic of North America*, *97*(5), 1015-1030. https://doi.org/10.1016/j.suc.2017.06.003

Willer, B., Haider, M., Bezherano, I., Wilber, C., Mannix, R., Kozlowski, K., & Leddy, J. (2019). Comparison of rest to aerobic exercise and placebo-like treatment of acute sport-related concussion in male and female adolescents. *Archives of Physical Medicine and Rehabilitation, 100*(12): 2267-2275. https://doi.org/10.1016/j.apmr.2019.07.003.

Xiong, Y., Mahmood, A., & Chopp, M. (2009). Emerging treatments for traumatic brain injury. *Journal of Expert Opinion of Emergency Drugs, 14*(1), 67-84. https://doi.org/10.1517/14728210902769601

Yaribeygi, H., Panahi, Y., Sahraei, H., Johnston, T., & Sahebkar, A. (2017). The impact of stress on body function. *EXCLI Journal, 16*, 1057-1072. https://doi.org/10.17179/excli2017-480