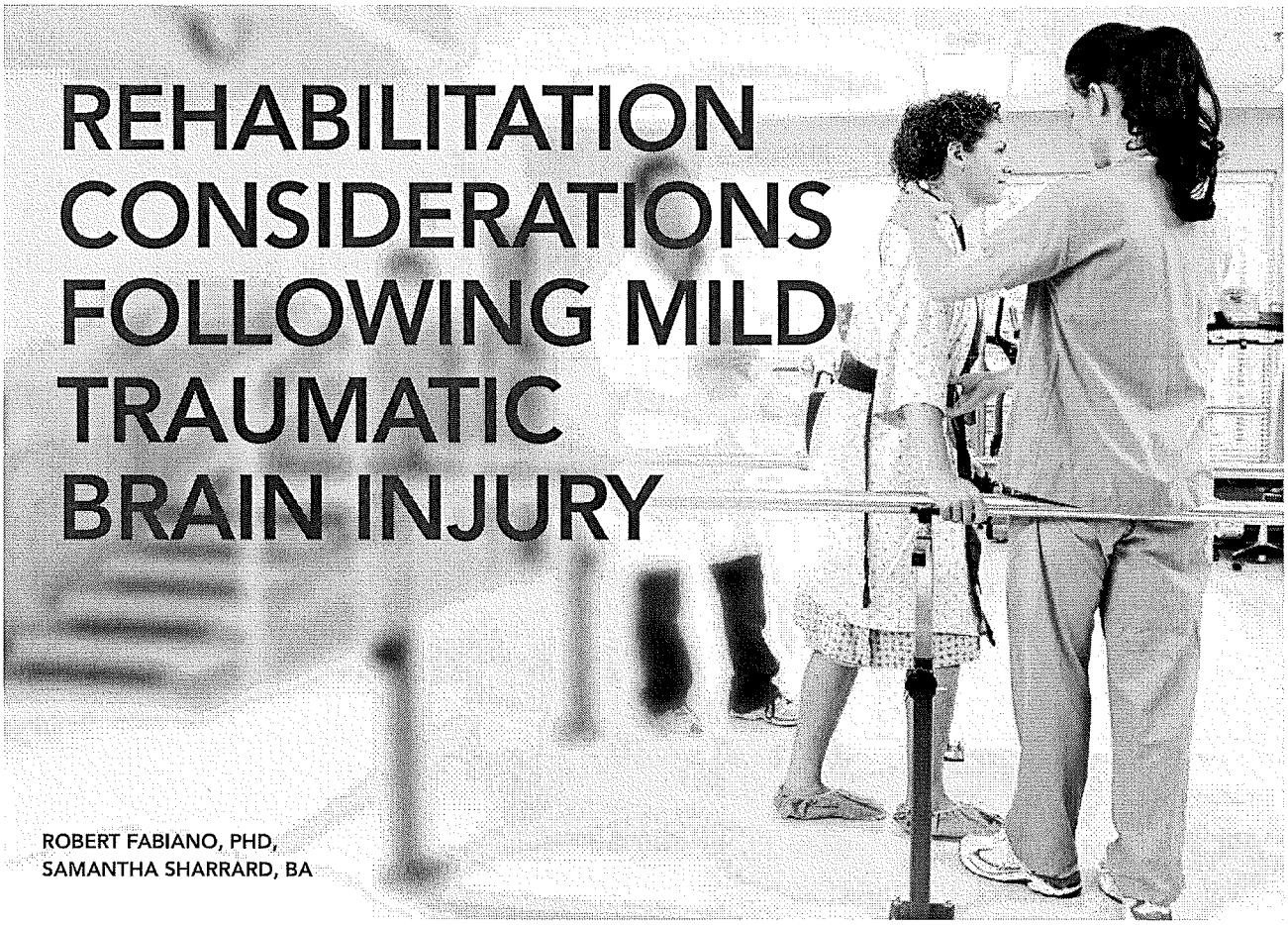

REHABILITATION CONSIDERATIONS FOLLOWING MILD TRAUMATIC BRAIN INJURY

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Introduction

Traumatic brain injuries (TBIs) occur at epidemic rates with annual estimates in the United States exceeding 1 million (Faul, et. al. 2010). Annually, over 275,000 people with TBIs are hospitalized and over 52,000 die from their TBI (Faul, et. al. 2010). Roughly 75% of all TBIs are classified as mild in severity (Centers for Disease Control and Prevention, n.d.; Gamboa, 1994). These individuals show a very good prognosis with the vast majority returning to independent living and competitive employment (Fabiano & Daugherty, 1998; McCrea, 2008). However, given the complexity of changes in neurocognitive functioning in concert with changes in psychosocial and behavioral functioning, these individuals can present as challenging cases when developing the Life Care Plans. Challenges to health care providers include issues related to accurate diagnosis, treatment plan development and compliance, and employment.

While the majority of those who have incurred mild traumatic brain injuries (MTBIs) will return to work, one-third will experience difficulties such as reduced productivity, frequent job changes, and lowered levels of responsibility that often culminate in considerable costs to businesses (Gamboa, 1994; McMahon & Flowers, 1987). The estimated economic costs related to TBIs are between $48.3 billion to $76.5 billion annually ($63.4-$79.1 billion in 2013 dollars) (Corso, Finkelstein, Miller, Fiebelkorn, & Zaloshnja, 2006, 2015; Ma, Chan, & Carruthers, 2014).

One way to reduce these staggering costs is for rehabilitation professionals to improve their understanding of, and ability to, efficiently rehabilitate persons with MTBIs. Delayed diagnosis can result in a greater exacerbation of symptoms due to the development of psychological problems (Clements, 1997). The purpose of this article is to provide an overview of rehabilitation following MTBIs. Emphasis includes the contributions of neuropsychological assessment to the rehabilitation process, the types of rehabilitation services to employ for persons with MTBIs, and the critical role of vocational rehabilitation.

Definition and Clinical Features

The two parameters utilized to

establish the severity of TBIs include the depth of alteration in mental status and the length of disrupted mental status (Fabiano, 2016). The standard for measurement of the depth of alteration in mental status is the Glasgow coma scale (GCS) (Balestreri, et al., 2004; Teasdale & Jennett, 1974). In brief, the GCS assesses three categories of functioning: spontaneous eye opening, best verbal response, and best motor response. The grades of the three categories are from a low score of one to four points for spontaneous eye opening, one to five points for best verbal response, and one to six points for the best motor response. The resulting GCS scores range from three, for those who are entirely unresponsive, to 15, for those who are fully oriented and capable of following simple commands (McCrea, 2008). Based upon the GCS rating, persons with a GCS of 13 to15 have sustained a MTBI. Scores ranging from 9 to12 are considered moderate in severity. Those with a GCS at or below eight have a severe TBI (Teasdale & Jennett, 1974).

The second parameter involves the length of disruption of mental status. The two measures include loss of consciousness (LOC) and period of post-traumatic amnesia (PTA). Post-traumatic amnesia includes the period in which the production of memories is disrupted from the impact until the retention of active memories is restored (Levin, O'Donnell, & Grossman, 1979). Stein & Spettell (1995) indicate that those who demonstrate a LOC at 20 minutes or less and a period of PTA of less than 24 hours meet criteria for MTBI. Those who have LOC of 30 minutes to 24 hours and/or PTA of one to seven days are considered moderate in severity (McCrea, 2008). Those who have LOC exceeding 24 hours and/or PTA exceeding seven days have sustained a severe TBI (McCrea, 2008).

There are several alternative measures to the GCS. The full outline of unresponsiveness (FOUR) is a coma scale that offers promise. The FOUR scale is used to assess patients incapable of providing a valid verbal response due to intubation and also offers additional brain stem measures (Wijdicks, Bamlet, Maramatton, Manno, & Mcclelland, 2005).

Common Symptoms Associated with Mild Traumatic Brain Injury

It is commonly understood and well documented that a significant number of the individuals with MTBIs will have continued symptoms well beyond the first several days from the time of the accident (Alves, Macciocchi, & Barth, 1993; Dikmen, Machamer, Winn, & Temkin, 1995; Fabiano & Daugherty, 1998; McCrea, 2008; Stoler & Hill, 2013). Reductions in cognitive functions including attention, concentration, memory, mental speed, and higher-level problem solving are frequently reported (Gasquoine, 1997; McGrath, 1997). Attention processes, often disrupted following MTBIs, permeate all aspects of behavior, often resulting in adverse effects in the ability to demonstrate other important cognitive functions (Wood, 1992). Many of the cognitive changes of MTBIs are nonspecific and may fall into the categories of what have been referred to as disorders of executive functioning (Posthuma & Wild, 1988). These include the capacity for planning and organization, problem-solving skills, mental flexibility, abstract reasoning, initiation, motivation, and regulation of behavior. Alterations in mood, including irritability, reduced frustration tolerance, anxiety, and depression; are frequent sequelae of MTBIs. Survivors of MTBIs who had no previous history often present with symptoms of depression. Advancing research suggests that depression may result from neurochemical changes following TBIs in addition to psychological reactions (Dixon, Taft,

Table 1. *Common Symptoms Associated with Mild Traumatic Brain Injury*

75% of all traumatic brain injury
Little or no loss of consciousness

Acute Symptoms	Long-Term Symptoms
Post-traumatic amnesia	Memory
Nausea	Concentration
Vertigo	Mental efficiency
Headaches	Distractibility
Acute Confusion	Mood swings
	Problem solving
	Attention
	Fatigue
	Irritability
	Depression

Note. Fabiano, R. J. & Daugherty, J. (1998). Rehabilitation Considerations Following Mild Traumatic Brain Injury. *Journal of Rehabilitation,* 10-15.

& Hayes, 1993; Jorge, et al., 1993). Finally, physiologic changes, including disruption in sleep, headaches, imbalance, and fatigue contribute to the overall level of debilitation that can occur following concussions and MTBIs (see Table 1).

Contributions of Neuropsychological Assessment

The primary goals of a neuropsychological assessment usually includes a history of the client's problems, including a review of past and current medical conditions; a description of the client's intellectual, cognitive, sensory, and psychomotor skills; a description of the client's emotional and behavioral status; and a description of family and social support systems and their value to the client. The information contained in the neuropsychological report is intended to facilitate and enhance rehabilitation treatment planning and goal setting (D'Amato & Hartlage, 2008). The main challenge to the neuropsychologist is to extract and integrate all of the above information in order to develop a coordinated treatment plan that incorporates the client's unique neuropsychological profile. Because persons with head injuries constitute a diverse group, the assessment process should be tailored to meet the unique needs of the client and answer the questions most important to the professionals who treat them (Bergquist, et al., 1994; Stoler & Hill, 2013). The assessment and descriptive report should address referral questions pertaining to the client's intellectual, cognitive, sensory, psychomotor, and emotional skills. Questions may be diagnostic in nature, asking for information concerning the nature of the client's symptoms and complaints in terms of their etiology and prognosis (see Table 2). Questions may also be descriptive, inquiring into the characteristics of the client's condition, such as asking how the client's problems are expressed (Lezak, 1983). Referral questions may be prognostic in nature with an estimated forecast of functional outcome. TBI can result in a wide variety of symptoms. Therefore, it is important to evaluate clients using diverse tests that are indicative of a wide variety of abilities and to communicate the results in a manner that is useful for other rehabilitation professionals (Kreutzer, Leininger, & Harris, 1990).

In analyzing and interpreting neuropsychological test results, the neuropsychologist is asked to make three important judgments for each skill area assessed (Kreutzer, Leininger, & Harris, 1990). First, clients' performance within a given functional domain is determined by comparing their performance to that of the normative sample. This comparison should be made to those of a similar sex, age, and level of education (Lezak, 1983). Second, a determination is made about how the client's performance has been affected by the injury. The clinician should use knowledge of common TBI sequelae, reported symptoms, estimation of the premorbid level of ability, and review of academic and vocational history to determine which functional skills are impaired relative to pre-injury status. Lastly, the neuropsychologist estimates whether a client's functioning in each skill area has declined, improved, or remained the same. Information is analyzed by direct comparisons with prior test scores, self and family report, subsequent injury or disease, recovery, medication, emotional and personality data.

Pre-Injury Factors

As part of a presentation over 20 years ago when the topic of MTBI was still in its infancy, a nurse offered the following observation: "It's not just the injury to the brain, but also the brain that was injured". She was brilliantly referring to the pre-existing factors, or premorbid personality, of the injured person. Pre-existing factors including depression,

Table 2. Neuropsychological Evaluation

Cognition	Executive Functions	Personality
Visual Perception	Complex Attention	Psychiatric Disturbance
Language	Speed of Processing	Personality Disorder
Memory	Psychomotor Efficiency	Depression
Attention	Mental Flexibility	Anxiety
Concentration	Problem Solving	Impulsivity
Intellectual Functioning	Initiation	Post-Adjustment Disorder
Academics	Planning	Feigning/Malingering
Sensory-Motor		

Note. Fabiano, R.J. (1998). An Overview of Traumatic Brain Injury Rehabilitation. A one-day seminar sponsored by Kalamazoo Mental Health, Kalamazoo, Michigan.

Table 3. Neuropsychological Evaluation

Pre-Existing Personality Disorders	Specific Organic Factors	Post-Adjustment Disorders
Substance Abuse	Cognitive Impairment	Adjustment Disorder
Psychiatric Disturbance	Organic Personality Disorder	Post-Traumatic Stress Disorder
Personality Disorder	Severity of Injury	Depression
Learning Disability		Anxiety
		Malingering
		Hysterical Reactions

Note. Fabiano, R.J. (1998). An Overview of Traumatic Brain Injury Rehabilitation. A one-day seminar sponsored by Kalamazoo Mental Health, Kalamazoo, Michigan.

substance abuse, and personality disorder can manifest symptoms that can often be misconstrued as those of MTBI or aggravate what are otherwise mild and treatable MTBI symptoms. Many studies have implicated a history of substance abuse as exerting an adverse effect on outcome following TBIs (Andelic, et al., 2010; Corrigan, 1995). Studies indicate that nearly 50% of those incurring a TBI had consumed alcohol with up to 45% legally intoxicated at the time of the injury (Andelic, et al., 2010).

Pre-existing health concerns including prior TBI, stroke, a history of heart disease, and various neurological disorders can contribute to the effects of MTBI in a cumulative manner (Cifu, 2014). In fact, the cumulative effects of multiple concussions have given rise to the term chronic traumatic encephalopathy, with many of these patients experiencing long-term chronic changes in cognitive and neurobehavioral functioning (U.S. Department of Veteran Affairs, 2015). There are indications based in part upon post-mortem examinations that cumulative concussions can result in morphological and neurobehavioral symptoms similar to dementia (Fazzini, 2016). The effects of aging following MTBIs can have adverse effects on recovery (Testa, Moessner, & Brown, 2005). As with any bodily injury, those of advanced age often show much greater and adverse effects in neurocognitive functioning following MTBIs. A thorough biosocial history and careful examination of pre-existing symptoms are essential in accurate diagnosis.

Post-injury psychiatric disorders can further challenge the pursuit of an accurate diagnosis. Depression, anxiety, post-traumatic stress disorders, and in more rare instances, conversion disorders and malingering can also be manifested following traumatic events and assumed accidents (American Psychiatric Association, 2013; Perry, et al., 2016). The ability to differentiate the competing explanations of post-injury symptoms places added importance on the neuropsychological evaluation (see Table 3).

In conclusion, the neuropsychological evaluation provides unique and critical information in the overall diagnosis, treatment, and outcome of persons with MTBI/concussions. The comprehensive assessment should address the client's strengths and weaknesses in functional areas, learning style, psychosocial adjustment and personality style, value system, and ethnic/cultural considerations. Furthermore, it should establish a communicative link with the rehabilitation counselor and other rehabilitation team members.

Rehabilitation Following Mild Traumatic Brain Injury

Despite the complexity of diagnostic issues related to MTBI/concussions, with appropriate treatment the prognosis for individuals to approach gross levels of premorbid functioning remains favorable. Group studies indicate that 65-90% of those who have suffered MTBIs are able to return to competitive employment (Denny-Brown, 1942, 1945; Fraser, Dikmen, McLean, Miller, & Temkin, 1988; Sander, Kreutzer, Rosenthal, Delmonico, & Young, 1996; Van Zomeren & Van Den Berg, 1985). In contrast, the unemployment figures approaches 70% for those who have suffered severe TBIs (Fabiano, Crewe, & Goran, 1995). Furthermore, rehabilitation efforts need not be excessive or drawn out, such that overall costs are relatively "mild" in contrast to severe injuries if provided in an appropriate manner. This recommended approach is the result of intense scrutiny concerning the efficacy and cost-effectiveness of rehabilitation for those who have suffered TBIs (Hall & Cope, 1995). The question of efficacy becomes even more obscured as much of literature on rehabilitation effectiveness has been obtained on individuals with severe TBIs.

Nursing Diagnoses to Consider

Acute confusion (Domain 5, Perception/Cognition; Class 4, Cognition)

Impaired memory (Domain 5, Perception/Cognition; Class 4, Cognition)

Risk for disturbed personal identity (Domain 6, Self-Perception, Class 1, Self-Concept)

Ineffective activity planning (Domain 9, Coping/Stress Tolerance, Class 2, Coping Responses)

A number of studies have indicated the benefits of rehabilitation for those who have incurred TBIs. Prigatano et al. (1984) found modest levels of improvement in employment and neuropsychological functioning with subjects who suffered severe TBIs and had completed a comprehensive rehabilitation program compared to a control group. Aronow (1987) found that a treatment group of TBI survivors achieved a better cost outcome than those who did not complete rehabilitation. Cope and Hall (1982) found that TBI patients who received rehabilitation following a longer interval from onset required a longer period of rehabilitation services. Hall and Cope (1995) replicated these findings in a separate study of individuals who received early or late admission for rehabilitation. Ruff and Baser (1990) reported findings of significant improvement in memory and attention following completion of a neuropsychological treatment program.

Rehabilitation following MTBI places emphasis on the treatment of cognitive, psychosocial, and behavioral issues. Specific cognitive rehabilitative activities in attention, concentration, memory, language comprehension, and higher-level problem solving provide an appropriate component of rehabilitation (Sohlberg & Mateer, 1989). Instruction and training in compensatory strategies provide the foundation for a portion of rehabilitation efforts.

A significant component of MTBI is the overall reduction in spontaneous mental efficiency and the resultant need for greater emphasis on the adherence to a more structured approach to daily living (Lezak, 1995, 2012; Sohlberg & Mateer, 1989). Strategies for implementing a more structured lifestyle include developing daily routines, creating structured time for rest, and using daily planners and calendars. Other strategies aimed at producing greater mental efficiency include utilizing recording systems (e.g. cell phones) to compile complex exchanges of information (e.g. meetings) and deconstructing robust tasks into more basic components. The development of and compliance with the above mentioned strategies create environmental modifications to reduce distractions, which place greater emphasis on external assistance, thereby reducing overall cognitive demands to manage large amounts of competing information.

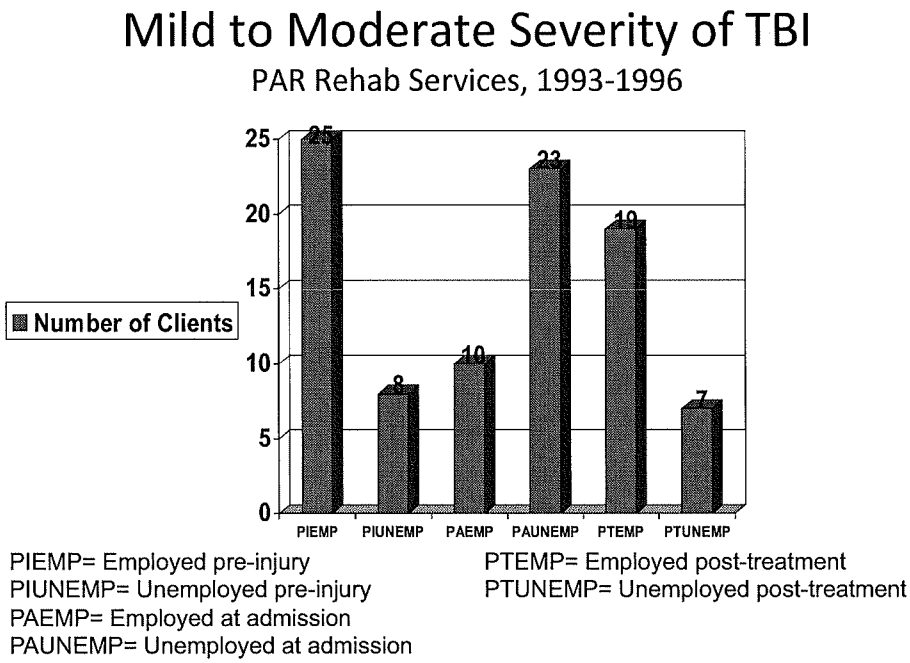
Finally, addressing the psychological issues related to alterations in cognitive functions and affective changes is paramount to the rehabilitation process. Many individuals have been undiagnosed or misdiagnosed before coming to the attention of appropriate health care specialists. The process of healing begins by providing education regarding MTBI symptomatology, which allows individuals to accurately understand their symptoms (Aniskiewicz, 2007). Over time, by providing support for psychosocial needs while simultaneously beginning to empower the individual to manage the condition in an adaptive manner, the majority of these individuals are gradually able to regain confidence in their mental abilities, albeit with the assistance of the compensatory strategies learned in therapeutic sessions. Psychological interventions may be augmented with specific pharmacological agents to treat disorders of depression, anxiety, fatigue, and other symptoms. Offering a favorable prognosis to return to many of their premorbid activities can facilitate the ability to assist clients in regaining their confidence (Kay, 1991). The result is a gradual return to many premorbid activities, school, and employment. Certain activities may be more difficult and persons with TBIs will often have to work harder and in a more organized and systematized manner.

The complex interaction between pre-injury psychiatric disorders, injury effects, and post-injury adjustment reactions can often make achieving a successful outcome challenging for a small percentage of MTBI patients. Issues of treatment compliance and unintended iatrogenic effects can interfere with treating otherwise mild changes in neurocognitive functioning resulting in a protracted or poor outcome.

Vocational

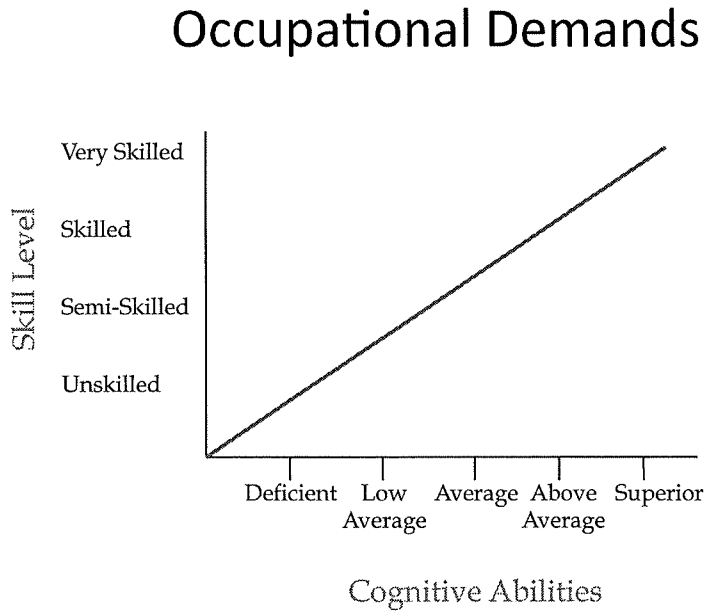
Vocational rehabilitation services are a critical component in the rehabilitation process. While the majority of individuals with MTBIs can return to competitive employment, one-third or more will demonstrate reduced productivity resulting in frequent job changes (Gamboa, 1994; McMahon & Flowers, 1987). By working closely with an interdisciplinary team, the vocational rehabilitation counselor can implement many compensatory strategies at the job site as reasonable accommodations under the provisions of the Americans with Disabilities Act (Sachs & Redd, 1993). Employer education can be a crucial component to the process. By providing appropriate accommodations, reinforcing compensatory strategies, and increasing employer education, many of the problems encountered in the workplace can be reduced. As part of vocational rehabilitation plan development, the rehabilitation professional should assess the client's premorbid employment and occupational history, post-injury neurocognitive status, and psychosocial adjustment to the effects of the MTBI. Developing a premorbid employment history should include a review of educational attainment,

Table 4. Mild to Moderate Severity of TBI – PAR Rehab Services, 1993-1996



Note. Fabiano, R.J. (1998). Vocational Assessment and Planning Following Traumatic Brain Injury. Presented at Ninth Annual Independent Living Conference About Traumatic Brain Injury, Battle Creek, Michigan.

Table 5. Occupational Demands



Note. Fabiano, R.J. (1998). Vocational Assessment and Planning Following Traumatic Brain Injury. Presented at Ninth Annual Independent Living Conference About Traumatic Brain Injury, Battle Creek, Michigan.

any vocational training, the types of occupations held, and further details regarding an individual's employment history. Occupational history should include the number and duration of jobs held, specific occupations, and specific job demands and tasks associated with each occupation.

Consultation with rehabilitation professionals including a physician, neuropsychologist, physical therapist, occupational therapist, and speech and language therapist can provide valuable assistance in identifying strengths and weaknesses related to specific occupational demands and developing compensatory strategies enacted as reasonable accommodations at the work site. These professionals can assist in educating employers about the specific characteristics related to MTBIs, as well as provide consultation within the work environment to implement specific compensatory strategies.

The author's clinic tabulated data related to return-to-work rates following neurorehabilitation with those who had sustained primarily MTBIs from a motor vehicle accident (see Table 4).

The average length of treatment was 10 weeks with the rehabilitation team. Each client had an individually customized program which, depending upon the symptoms, may include physical therapy, occupational therapy, speech and language therapy, physical medicine, psychiatry, social work, and neuropsychology. The average cost was under $10,000 that, even when accounting for 20 years of inflation, indicates that the costs of rehabilitation were often below the costs of repairs to the damaged automobile. The data shows that those who completed rehabilitation had return-to-work rates that were commensurate with employment rates prior to the injuries (76% pre-injury, 73% post-injury). The data also demonstrates the efficacy of rehabilitation in reducing unemployment from 70% to 27%.

As indicated by Fabiano and Daugherty (1998), although return-to-work rates with those who sustain MTBIs are estimated to be as high as 90%, a closer inspection of these individuals indicate higher rates of reduced work performance, reduced job advancement, and reduced job satisfaction. The effects of MTBI are likely most disruptive when work complexity increases, when cognitive and psychosocial functioning demands are greater. Since increased job complexity, as determined by occupational skill level, requires increased cognitive functioning (see Table 5), MTBIs complicate job performance and challenge employability. As such, the level of job complexity based upon skill level likely has a negative correlation with increasing cognitive difficulties posing a threat to successful employment.

Accommodations

Mild traumatic brain injuries are neurologic disabilities and the disability symptoms are frequently cognitive. Specific accommodations involve various systems and strategies designed to reduce, organize, and retrieve information. Structuring routines, providing tasks and deadlines in writing, developing organizational structures, such as filing systems and daily schedule books all assist in reducing the effects of an individual's neurological disability and are reasonable accommodations. Using recording features on cell phones or laptops to record meetings or other information can assist in the retention of information necessary to perform a job.

Monitoring an individual's performance, providing corrective actions, and maintaining contact with the employer can assist in the successful retention of employment. The goals are to achieve an appropriate balance between the physical and cognitive demands of a job and the ability of the individual to meet these demands effectively, often with the assistance of accommodations and environmental modifications.

Conclusion

Despite the controversy regarding the diagnosis of MTBI/concussions for over a century, the unfortunate truth is that the disorder exists and occurs at epidemic proportions. The more favorable news is that with an accurate diagnosis, including a comprehensive neuropsychological evaluation and appropriate treatment by an interdisciplinary rehabilitation team that specialize in the treatment of MTBIs, the vast majority of individuals can restore their lives, stabilize their families, and return to many premorbid activities including employment.

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