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# Traumatic Brain Injury: Short, Long, and Very Long-Term Vocational Outcomes

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## 1. Introduction

Traumatic brain injury (TBI) has proven to be a major public health problem with an annual incidence of over 1.5 million people (Langlois, Rutland-Brown, & Thomas, 2006). Medical advances have contributed to increasing the survival rate of TBI allowing many individuals with varying severities of TBI to receive treatment from the ER and be discharged immediately to their home or receive additional hospitalized treatment, but with a greater possibility to return to the community at a later time. Prevalence statistics reveal that over 3.17 million people live with TBI-related long-term disability and almost three-fourths are working-aged adults between 20 and 69 years old (Zaloshnja, Miller, Langlois, & Selassie, 2008). The statistics by Zaloshnja and colleagues indicate that a large percentage of individuals who sustain TBI will more than likely return to their community, not truly cognizant of the residual physical, cognitive, and emotional deficits that often disrupt pursuit of employment or return to productive living. This chapter provides a narrative review of research that reports short, long, and very long-term vocational outcomes for persons with brain injury and any influence of demographic and injury-related factors. Specifically, the areas to be covered are the definitions of short, long, and very-long term with regards to functional recovery from TBI, report of vocational outcomes from 3 months to 15 years post-TBI, specific demographic variables known to significantly influence vocational outcomes after TBI (e.g. age, gender, race/ethnicity, marital status, education and pre-injury employment), specific injury-related variables known to significantly influence vocational outcomes after TBI (e.g. cause of injury, injury severity, and functional status), update of disability legislation, summary of health professionals and what they contribute to the enhancement of vocational skills for individuals following TBI, and community-based interventions to improve vocational outcomes after brain injury.

## 2. Vocational and employment outcomes

In considering literature about vocational and employment outcomes after TBI, it is important to delineate vocation from employment to clearly understand why vocation and employment will be used synonymously throughout this chapter. The definition for vocational outcomes is typically broader than employment and employment is often included in most definitions related to vocational outcomes. From a societal perspective, vocation is considered the capacity to work and participation in work to promote full

integration and participation in society (Parker, Szymanski, & Patterson, 2005). The definition by Parker et al. indicates that employment is the primary focus, but not the only one and other aspects of vocation should be taken into consideration, such as education, training and non-competitive employment. Research literature about vocational rehabilitation after traumatic brain injury note that a narrower definition of employment is necessary to produce more apparent unemployment rates than an inclusive definition. Some researchers have concluded that a true indicator of work includes only full-time and part-time employment in a competitive workforce (Kendall, Muenchberger, & Gee, 2006). However, information asserted by Kendal et al. is not the consensus of all researchers that study employment after TBI and many include competitive and non-competitive employment, and other productive activities within the definition of employment. Thus, vocational outcomes and employment outcomes are operationalized within this chapter and will be used interchangeably throughout review of the research literature.

### **3. Significance of employment**

Prolonged consequences of TBI are typically less understood and recognized and present a substantial obstacle to recovery and community integration following an injury. The longer-term issues after TBI that are related to community integration are educational attainment, establishing a vocation, and developing and maintaining relationships. One of the most recognized long-term challenges is finding and maintaining employment and return-to-work is typically an important outcome to determine rehabilitation success post-TBI (McCrimmon, & Oddy, 2006). Productive lifestyle is a major problem area for many individuals following TBI and employment is a significant aspect of productivity and especially important to American society. Additionally, approximately 75% of survivors with TBI who suffer long-term disability are considered working-aged (e.g., between 20 and 69 years old; Zaloshjna, Miller, Langlois, & Selassie, 2008). Therefore, vocational outcomes, short and long-term, will be a major issue to address and primarily concern for a large proportion of people with TBI while re-integrating into community settings. In fact, employment is significantly related to quality of life (QOL), financial well-being, and social integration.

#### **3.1 Employment and Quality of Life (QOL)**

Employment or establishing a vocation after brain injury is intricately associated with quality of life (QOL). A study exploring the effect of employment on perceived QOL reported a strong and consistent relationship between the two variables (O'Neil et al., 1998). Similarly, life satisfaction, a concept closely related to QOL, was significantly related to the productivity domain of the World Health Organization's (WHO) International Classification of Impairments, Disabilities and Handicaps (ICIDH) in persons with TBI (Heinemann & Whiteneck, 1995). These studies suggest that employment status is highly relevant for individuals with TBI and warrants careful consideration in TBI research.

#### **3.2 Employment and finances**

Of course, one of the most essential connections is the link between employment and financial issues. Because many people with TBI experience an immediate work stoppage, financial and employment concerns are usually a major consideration. TBI necessitates a loss in the current job after returning to work, modification of the current job, etc. In

addition, the loss of income for people with TBI often adds to the survivors' and caregivers' stress and threatens their economic well-being. Johnstone and colleagues (2003) concluded that during the first year after injury, TBI is associated with an estimated \$642 million in lost wages. In addition, TBI has a major economic impact on society. TBI is associated with an estimated \$96 million in lost income taxes and \$353 million in increased public assistance (Johnstone, Mount, and Schopp, 2003). While TBI can wreck havoc on finances and employment, the residual money loss because of a TBI is further complicated by the loss in income taxes impacting more than people with TBI in the United States.

### **3.3 Employment and social integration**

Employment has a positive effect on social integration in the community, another life dimension that contributes to the value of an individual's life. Using the Craig Handicap Assessment and Reporting Technique (CHART), researchers identified a significant positive correlation between employment and social integration for individuals with TBI that had returned to full or part-time work (O'Neill et al., 1998). Research has also measured productivity, specifically employment-related productivity, following TBI to determine its influence on societal participation, a broader concept than social integration. Whiteneck, Gerhart, and Cusick (2004) found a significant correlation between societal participation and employment/school, i.e., as productivity at work decreases, people with TBI also experience less societal participation. Clearly, the association between employment and social integration has been well established for people with TBI.

### **4. Short, long, and very long term category for employment**

We have broadly categorized employment after TBI into short, long, and very long outcomes. This broad category is useful in organizing the large amount of research that has been published on employment post-TBI. With the inclusion of mild TBI, recovery can be rapid compared to more severe forms of this injury. Chance of good recovery for individuals who sustained mild TBI with relatively brief period of disturbed consciousness and amnesia are predicted to be as short 6 months post-injury (Stulemeijer, van der Werf, Born & Vos, 2008). However, as greater severities of TBI are taken into account, the time related to better recovery, on a relatively short-term basis, usually increases. Powell, Machamer, Temkin, and Dikmen (2001) reported that most individuals with predominately moderate TBI perceived themselves as making good recovery by 1 year post-injury. The chances of a good functional recovery after predominantly severe TBI are less likely for the first year post-injury. For example, at one year post-injury, less than one-third of 846 cases with severe TBI had good recovery, which was defined as mild or no disability and able to return to work or school (Jiang, Gao, Li, Yu, & Zhu, 2002). Given that recovery for TBI can vary widely based on a number of factors (e.g., severity, age, etc.), we categorized short vocational outcome as occurring from six months to less than 2 years post-injury. Typically by year two post-TBI, a large percentage of people with mild TBI report full recovery, suggesting that people with mild TBI resumed normal pre-morbid functional activity, although various symptoms tend to persist (e.g., headaches, dizziness, fatigue, etc.). In a meta-analysis of over 400 studies on mild TBI, noted that most studies reported good outcome short and long-term, which was by 12 months post-injury. However, there is mounting evidence that people with mild TBI have issues with memory, dizziness,

headaches, and fatigue up to five years after injury (Carroll, Cassidy, Peloso et al., 2004). The evidence by Carroll et al. provides an impetus to continue research on mild TBI for functional outcome in time periods definitely considered long-term for the mild TBI population. The years between two and ten for people who have TBI are also the time periods that many researchers use for follow-up when investigating functional outcomes after moderate to severe TBI (Dikmen, Mackamer, Powell, & Temkin, 2003; O'Connor, Colantonio, & Polatajko, 2005; Hammond, Grattan, Sasser et al., 2004). As such, we categorized long-term employment outcomes from year two to less than ten post-injury.

After ten years post-injury ten years, TBI continues to have varying effects on functional outcomes, particularly with moderate and severe injuries. Colantonio et al. (2004) defined 10 years or longer as very long term when examining functional outcomes of people with moderate to severe TBI. Her study's follow-up ranged from 10 to 24 years post-injury and found a significant amount of the study population had impairment in cognition and limitation in complex tasks related to community integration. This and other research warrant the need to investigate very long term employment outcomes after TBI.

## **5. Overview of employment outcomes three months to past 10 years**

There is a preponderance of research exploring numerous aspects of employment in various time periods for people who have TBI. Employment outcomes after TBI have been reported starting at 3 months to 20 years post-injury. The burgeoning of research documenting employment outcomes after TBI is intuitive and statistically represents the challenges that individuals with TBI face as they attempt to enter or reenter the workforce. Summary of studies covered in the review is presented in Table 1.

### **5.1 Short-term employment outcomes (three months to less than two years)**

Within the first year after injury, research suggests that persons with TBI have persistent difficulties returning to employment. Individuals who were not hospitalized and had mild severity of TBI generally began work one to three months after injury and a majority of those with moderate TBI typically did not begin work until six months post-injury (Boake et al., 2005). Besides the productive time (e.g. defined as time at work) that is lost immediately after injury, there are many who do not return to employment by the first year at all. Employment rates assessed at one year post-TBI with varying definitions of employment suggest that returning to employment soon after injury is challenging even with mostly mild to moderate TBI. Benedictus et al. (2010) indicated that 50% of their sample (n=434) were able to return to previous vocational activities, which consisted of work or study after final follow-up at 12 months. Similarly, Wagner et al.'s (2002) sample had a large proportion of mild to moderate injuries (64%) found that 71% of sample was able to return to work within one year; however, the inflated rate is likely due to the use of a broader definition of work, which was return to pre-injury comparable work including full-time school and homemaking. Walker and colleagues (2006) reported 39% of a substantially larger multicenter sample (n=1,341) that was previously competitively employed were able to return to competitive employment at one year post-injury. Even when using a relatively unique statistical approach not consistently used in TBI and employment research, employment rates are not drastically higher or lower than previous research. Shönberger et al. (2011) found using a structural equation modeling approach that with their definition of employment (e.g., competitively employed, paid work trial, or student) 66% of a



| Short-term Employment Outcome |             |                        |  |  |
|-------------------------------|-------------|------------------------|--|--|
| Studies                       | Sample Size | Severity               | Employment Definition  | Findings   |
| Benedictus et al. (2010)      | 434         | Mild, Moderate, Severe | Resumption of previous work or study.                                  | 50% were able to resume previous vocational activities completely after 1, 3, 6, and 12 month follow-up. |
| Boake et al. (2005)           | 210         | Mild, Moderate         | Return to employment.  | 56% began work within 6 months after injury and 61% were working at 6 months follow-up.                  |
| Johnstone et al. (2003)       | 35          | Moderate, Severe       | Competitively employed full or part-time.                              | 31% were employed at 1 year post-injury.   |
| Mammi et al. (2006)           | 80          | Mild, Moderate, Severe | Work, or work with adaptations.  | 30% were able to return to work at 1 year follow-up.   |
| Shönberger et al. (2011)      | 949         | Moderate, Severe       | Competitive employment, paid work trial, or student.                   | 66% were employed post-injury at 1 year follow-up  |
| Wagner et al. (2002)          | 105         | Mild, Moderate, Severe | Return to pre-injury comparable work, full-time school, or homemaking. | 71% were able to return to work within one year.   |
| Walker et al. (2006)          | 1,341       | Moderate, Severe       | Competitively employment at any occupation full-time or part-time.     | 39% were able to return to competitive employment at 1 year post-injury.                                 |
| Long-term Employment Outcomes |             |                        |  |  |
| Cattelani et al. (2002)       | 35          | Severe                 | Employed in competitive working or studying.                           | 54% were able to return to competitive working on studying by 20 months post-injury.                     |
| Felmingham et al. (2001)      | 55          | Mild, Moderate, Severe | Full-time or part-time competitive employment.                         | 34% were employed at 6 months post-injury and 46% at 2 years post-injury.                                |

|                                   |      |                              |  |   |
|-----------------------------------|------|------------------------------|--|---|
| Fleming et al.<br>(1999)          | 208  | Severe                       | Returned to work<br>(remained<br>employed) and/or<br>in a<br>school/training<br>program.   | 46.5% of those<br>employed pre-injury<br>were working at<br>follow-up of mean<br>3.5 years.                   |
| Fraser et al.<br>(2006)           | 140  | Mild,<br>Moderate,<br>Severe | Working half-time<br>or more at three to<br>five years post-<br>injury.  | 61% were working at<br>3-5 year follow-up.  |
| Gollaher et al.<br>(1998)         | 99   | Mild,<br>Moderate,<br>Severe | Competitively<br>employed or<br>student.   | 36% were employed<br>at 1 to 3 post-injury.   |
| Parks et al.<br>(2010)            | 572  | Severe                       | Employed full-<br>time (40) hours a<br>week or part-time<br>( $< 40$ hours a<br>week).   | 52% were employed<br>year 1, 54% years 2,<br>and 57% year 3.  |
| Ponsford et al.<br>(1995)         | 74   | Moderate,<br>Severe          | Employed full-<br>time or part-time.   | 40% were employed<br>at 2 years post-injury.  |
| Sherer et al.<br>(1998)           | 66   | Mild,<br>Moderate,<br>Severe | [Productivity]<br>Competitively<br>employed;<br>Modified jobs; In<br>school making<br>progress towards<br>competitive<br>employment. | 67% were productive<br>at follow-up an<br>average of 30.2<br>months post-injury.                              |
| Shigaki et al.<br>(2009)          | 49   | Moderate,<br>Severe          | Competitively<br>employed<br>full or<br>part-time.   | 38% were employed<br>2 year post-injury.  |
| Whitnall et al.<br>(2006)         | 549  | Mild,<br>Moderate,<br>Severe | Employed   | 56% were employed<br>5-7 years follow-up.   |
| Very Long-term Employment Outcome |      |                              |  |   |
| Avesani et al.<br>(2005)          | 353  | Severe                       | Reentered<br>competitive<br>employment   | 53% of those<br>previously working<br>had returned to<br>competitive work<br>between 2-10 years<br>follow-up. |
| Franulic et al.<br>(2004)         | 2002 | Moderate,<br>Severe          | Employed   | 53.5% employed at 2<br>years, 55.6% at 5, and<br>69% at 10 years<br>follow-up.                                |

|                          |    |                     |  |   |
|--------------------------|----|---------------------|--|---|
| Hoofien et al.<br>(2001) | 76 | Moderate,<br>Severe | Regular<br>employment in<br>the free market,<br>family business, in<br>sheltered<br>employment,<br>volunteers, or as<br>housekeepers for<br>at least 4 months. | 60% employed at<br>time of follow-up at<br>mean 14.1 years post-<br>injury.         |
| Johnson et al.<br>(1998) | 64 | Severe              | Returned to work<br>and remained<br>continuously<br>employed 1 year.   | 43.5% employed in<br>full-time or part-time<br>employment at 10<br>years follow-up. |

Table 1. Return to Work Rates for Short, Long, and Very Long Term Periods of Time Post-TBI

substantially large sample (n=949) were able to return to employment at one year post-injury. Other studies representing mild to severe injuries and with a clearer definition of employment reported rates ranging from approximately 30% to 61% (Mammi, Zaccaria, & Franceschini, 2005; Boake et al., 2005; Johnstone, Mount, & Schopp, 2003). Although employment rates vary one year after TBI, those with more accurate definitions of employment note a significant percentage of people with TBI not returning to employment 1 year after injury.

5.2 Long-term employment outcomes (two years to less than 10 years)

Since recovery for TBI, particularly for moderate to severe injuries, has shown to continue beyond one year than looking at employment outcomes during the second year presents a more realistic picture of outcome. Research, however, examining employment outcomes beyond one year and up to two years post-TBI did not look markedly different than results from year one. For example, in a study about financial and vocational outcomes regarding people with TBI, 68% (n= 49) were employed pre-injury, but only 38% reported being employed at year two follow-up (Shigaki, Johnstone, & Schoop, 2009). A longitudinal study had follow-up at 6 months and two years with interesting results. Felmingham, Baugley, and Crooks (2001) predicted employment outcome for 55 patients with mild, moderate and severe TBI and found at six months, 41% of those previously employed with TBI had regained employment and at two years the percentage had only increased to 46 percent. Ponsford et al. (1995) indicated that of the 74 participants primarily with mild and moderate injuries who were working at time of injury, 30 (40%) had returned to full-time or part-time work at two years. It appears that as the years increase, individuals with TBI continue to face challenges in a major area of productivity.

Examining employment data beyond two years and up to five years post-injury provides a unique opportunity to assess long-term employment outcomes in later stages of the recovery process. In a longitudinal study, Parks et al. (2010) had a substantially large sample (n = 572) of individuals with severe TBI and found 52% were employed at year 1, 54% at year 2, and 57% at year 3. Another study with a relatively sizeable sample (n= 290) examined employment outcomes and found 46.5% of those employed pre-injury were



working 3.5 (mean/average) years post-injury follow-up. Additionally, 23 (13.5%) of people with TBI had returned to work immediately after inpatient rehabilitation but were no longer working at time of follow-up (Fleming, Tooth, Hassell, & Chan, 1999). Results in other studies with similar or slightly smaller sample sizes, which were alike in terms of analyses showed 36% to 67% employment rates for two to five years post-injury (Gollaher et al., 1998; Cattelani, Tanzi, Lombardi, & Mazzucchi, 2002; Fraser, Machamer, Temkin, Dikmen, & Doctor, 2006; Sherer et al., 1998). It is important to note, however, that samples were not always comparable, with varying degrees of severity and some including students in return to work (RTW) estimates. As the follow-up gets closer to 10 years post-injury, employment rates slightly improved. Whitnall, McMillan, Murray, and Teasdale (2006) assessed 219 young adults five to seven years after mild, moderate, and severe brain injury and indicated pre-injury 78% were in some type of working situations and that number had decreased to 56% at follow-up. However, the authors defined employment as working or seeking employment and a smaller percentage of both numbers reported that their jobs were not appropriate. The numbers presented by Whitnall and colleagues indicated that even though individuals may be further along in the post-inpatient rehabilitation process, it is not guaranteed that employment outcomes will significantly improve for people who have TBI.

### **5.3 Very long-term employment outcomes (ten years or greater)**

There are a few studies examining employment status beyond seven years post- injury of a TBI. While some include survivors injured in earlier years, the primary objective was to assess employment in the very late stages of recovery. In fact, some researchers believe that subjects who did not return to work in the first five years were less likely to go back at all (Ip et al., 1995). When looking at employment outcomes so late post-injury, one might assume that the passage of time brings greater potential for spontaneous recovery from the injury and a possibility that the person with a TBI has had more rehabilitation and community assistance. Additionally, one might think that longer periods of ten years or more after TBI would lead to higher RTW rates when compared to follow-up periods beginning at five years or less. However, studies indicate that rates of very long-term employment are also discouraging.

Avesani et al. (2005) studied 353 patients with severe TBI that were consecutively admitted to an intensive rehabilitation unit and followed from 2-10 years post-trauma and 53% of those previously employed had returned to competitive work. Likewise, a similar study investigating employment outcomes at 2,5, and 10 years post-TBI found that over half of the sample (n = 275) returned to employment with 53.5% at 2 years, 55.6% at 5 years and 69% at 10 years), respectively (Franulic, Carbonell, Pinto, & Sepulveda, 2004). The research on TBI and employment that has had the longest follow-up to date, investigated psychosocial functioning from 10 to 20 years post-injury for 76 people with severe TBI and results revealed 46 (60.5%) were employed at time of follow-up for at least 4 months (Hoofien, Gilboa, Vakil, & Donovanick, 2001). The variation in percentages may again be due to variations in sampling and sample inclusion criteria, for example, only examining the most severe cases of TBI, having relatively small samples sizes, or not distinguishing competitive from non-competitive employment. While the nature of very long-term employment for people with TBI appears uncertain, the research suggests that consequences from TBI persist and significantly affect employment even up to 20 years post-injury.

In summary, there have been many outcomes relative to people with TBI. We understand that terminology in using vocational outcomes and employment can be confusing and need

clarification in the TBI literature. It is also likely that vocational outcomes relative to short and long-term time periods will be a major issue to address and a primary concern for a large proportion of people with TBI while re-integrating into community settings. Research also supports that employment is significantly related to quality of live (QOL), financial well-being, and social integration with people who may have TBI in the United States. Moreover, research supports the association between employment and social integration for people with TBI. Although employment rates vary one year after TBI injury, those with more accurate definitions of employment note a significant percentage of people with TBI not returning to employment 1 year after injury. There is much work to be done in looking at time sequence vocational and employment outcomes of people who have TBI in the United States.

6. Demographic variables that significantly influence employment outcomes

Empirical evidence suggests that various demographic variables like age, gender, race/ethnicity, marital status, education, and pre-morbid employment status significantly predict employment after TBI. When demographic variables are defined or categorized different in studies, it can significantly alter employment outcomes. Since a large majority of TBI studies covered in this review are conducted at the TBI Model Systems, the demographic variables will be definitions mostly used by their researchers (Gary et al., 2009; TBIMS National Data and Statistical Center, 2006):

| Demographic Predictors of Employment Post-TBI |  |
|---|--|
| Variables                                     | Definition   |
| Age   | Continuous variable categorized as age in years at time of injury primarily between 16 and 65  |
| Gender  | Dichotomous variable categorized as male and female  |
| Race/Ethnicity                                | Self-reported as African American (Black), White , Hispanic, Asian/Pacific Islander  |
| Marital Status                                | Status of long-term union/partnership categorized as single, divorced, separated, and widowed  |
| Education                                     | Level of education primarily categorized as eight grade or less, grades 9 through 11, GED/high school trade school, high school diploma, some college, Associate’s degree, Bachelor’s degree, Master’s degree, and Doctoral degree |
| Employment                                    | Work status as part-time and full time competitively employed, in school progressing towards employment, and modified jobs.  |

Table 2. List of Demographic Predictors of Employment Post-TBI

6.1 Age

The majority of research studies investigating the relationship of age to employment after TBI have found that younger individuals post-injury have a higher probability of returning to work than those who are older. For instance, Schönberger, Ponsford, Olver, Ponsford, and Wirtz (2011) used structured equation modeling in a sample of 949 individuals with predominantly moderate to severe TBI to predict functional and employment outcome one year post-injury. They found age was a direct predictor of post-injury employment outcome;

however, age was not related to other demographic variables. Even when employment outcome have been examined 10 years post-TBI in a representative sample (n=382), younger adults are nearly 1.5 times more likely to be competitively employed than older adults (Gary et al., 2010). Some studies specified certain ages when comparing employment outcome. For example, Keyser-Marcus et al. (2002) conducted a large multiple center study where 538 subjects with moderate to severe TBI in a nationally representative sample were followed-up for return to employment at 1, 2, 3, 4, and 5 years post-injury and identified a specific age that predicted employment. Using logistic regression analyses, they found age was the most reliable predictor of RTW; whereas, individuals 40 years and older are less likely to RTW than those younger at all follow-up years. The results from other research agree younger people with TBI, are more likely to RTW compared to those who are older but studies are inconsistent and identify the cut-off age to be between 30 and 50 when predicting better employment outcome post-injury (Atchison et al., 2004; Dikman et al., 1994; Felmingham et al., 2001; Nakase-Richardson, Yablon, & Sherer, 2007). However, the larger more stringent studies identify the age of 40 as a good demarcation for predicting RTW after TBI.

## 6.2 Gender

The influence of gender on employment following TBI has been relatively consistent throughout the literature with males more likely to be unemployed post-TBI as opposed to females. A strong research study on RTW and occupational status one year post-TBI for a sample of over 1,300 subjects with generally moderate to severe injuries revealed that being female made significant contributions to RTW (Walker et al., 2006). In fact, the majority of studies that explored gender as a predictive factor of RTW following TBI concur that males fare worse than females post-TBI (Doctor et al., 2005; Fraser, Machamer, Temkin, Dikmen, & Doctor, 2006; Parks, Diaz-Arrastia, Gentilello, & Shafi, 2010). One large study with a significantly large sample (2,487 men vs. 957 women) with minor to severe TBI as classified by the Abbreviated Injury Score (AIS), however, has results that run counter to the majority of existing research. When considering employment as part of a multifactorial analysis, it was suggested that when other measured influences known to effect employment are held constant, women are more likely to have decreased hours of employment one year post-TBI compared to men (Corrigan et al., 2007). Although there are relatively few studies that have found gender to be predictive of RTW after TBI, most find that men are employed at lower rates than women.

## 6.3 Race/ethnicity

While a decade ago, there was a paucity of evidence about influence of race and ethnicity on employment outcomes after TBI, in the past ten years studies primarily about African Americans and Hispanics have surfaced. The majority of studies were conducted using the TBI Model Systems database consisting of a nationally representative and diverse sample. Rosenthal et al. (1996) examined a substantial number of minorities and whites for employment outcomes at one year post-TBI. Of 109 white persons employed full time and competitively at injury, 45% were employed at 1 year post injury; for 50 minorities, 26% were similarly employed. It was noted that 20% of whites and 42% of minorities were unemployed pre-injury, and of those, 44% of whites and 69% of blacks did not return to competitive employment. Kreutzer et al. (2003) studied and found that minorities compared to non-minorities were significantly less stably employed (19% vs. 43%) and unemployed (50% vs. 31%). Although this study's primary purpose was to examine several factors that

could moderate RTW and job stability (e.g., demographic and injury characteristics), it was clear that ethnicity negatively influenced employment and job stability after TBI. Arango-Lasprilla et al. (2009) extended the findings from Kreutzer and colleagues (2003) with a larger sample ( $n=627$ ) and a more detailed examination of the influence of minority status on job stability. There was a clear definition of employment status with employment being dichotomized into competitively employed vs. not competitively employed. In addition, job stability was further classified as stable (competitively employed at all three follow-up visits), unemployed (not competitively employed at all three follow-up visits) and unstable (employed at any point in follow-up visit but not all). After adjusting for age, gender, marital status, education, cause of injury, pre-injury employment, length of stay, and discharge FIM scores, the odds of being unemployed in comparison to being stably employed were nearly five times greater for minorities. Additionally, minorities' odds of being unstably employed vs. stably employed and unemployed vs. unstably employed were over two times greater compared to whites.

Arango-Lasprilla et al. (2008) investigated racial (e.g., minority vs. Whites) difference in employment outcomes after TBI ( $n=5259$ ) and found that controlling for a host of variables (e.g., age, marital status, gender, education, etc.), that whites are more likely to be employed compared to racial and ethnic minorities at 1 year post injury after adjusting for employment status at admissions and several controlled demographic variables. In asking questions relative to the findings, Arango-Lasprilla and his colleagues asked about the possible relationship between race, TBI, and long-term vocational retention. They also reported that "long-term employment outcomes are also not likely to be favorable for minorities" (p. 994), but that was at one year post-injury, which is not necessarily long-term as defined in this chapter. Gary et al. (2009), however, extended the findings of Arango-Lasprilla et al. (2008) with an exclusively African American sample ( $n=2022$ ) taking a cross-sectional and longitudinal look at employment outcomes post-TBI. Results indicated that after adjusting for demographic and injury characteristics, the odds of not being competitively employed versus being competitively employed are 2.61, 2.10, and 3.15 times greater at years one, two, and five years, respectively for African Americans compared to whites. Although this study was the first to specifically examine employment outcomes for minorities post-TBI, the downfall is the sample was homogeneous, consisting of one minority group. Gary et al. (2010), however, examined employment outcome 10 years after TBI in a multiracial and ethnic sample ( $n = 382$ ; black, Hispanic, Asian/Pacific Islander, or other) and found minorities were 2.37 times more likely to not be competitively employed versus competitively employed compared to their white counterparts. Clearly, racial and ethnic minorities are two to five times more likely to be unemployed compared to whites. The evidence is mounting, but primarily for African Americans and Whites. More research is warranted for other racial and ethnic groups and delineating the differences within ethnic groups (e.g. White Latinos vs. Black Latinos).

#### **6.4 Marital status**

Marital status has not been extensively examined after TBI. Most studies that investigated marital status and its relationship to employment post-TBI have found that being married has a positive effect on employment outcomes. For example, Walker and colleagues (2006) found, like gender, being married made a significant unique contribution to predicting RTW one year after TBI. Likewise, other studies with adequately sized nationally representative samples confirm that being married increased the likelihood of RTW and maintaining stable employment one year post-TBI (Arango-Lasprilla et al., 2008; 2009; Gary et al., 2009). While



marital status has not been investigated extensively regarding people who have TBI, a consensus is beginning to emerge that being married has a positive effects on employment outcomes if you are a person with a TBI.

### 6.5 Education

As with many variables, education is viewed as having some effects on vocational outcomes. Gollaher and colleagues (1998) noted that education is one of the most important predictors of employment post-injury, and those with higher education were more likely to experience vocational reentry following TBI. The research confirms that employment after mild to severe injury is more likely for those who have received at least a high school education (Doctor et al., 2005; Girard et al., 1996; Sherer, Bergloff, High, & Nick, 1999; Keyser-Marcus et al., 2002; Wagner et al., 2002). Educational status also affects employment rates studied longitudinally. In a study of employment 2, 5, and 10 years after mild to severe TBI, the 10-year employed group had the highest educational attainment as well as the highest rate of job re-insertion to the same or a similar position (Franulic et al., 2004). Similarly, those with the highest levels of education were significantly more likely to sustain employment from one to three years post-TBI (Arango-Lasprilla et al., 2009; Kreutzer et al., 2003). Sherer et al. (2003) considered education to be one of the most prominent confounding factor in that it ameliorated distinct differences between racial and ethnic minorities and whites when comparing productivity outcomes that include employment.

### 6.6 Pre-injury employment

Among all demographic factors, pre-injury employment appears to be the most reliable predictor of RTW, and the failure to factor pre-injury employment into predictive models will likely to produce less accurate employment outcomes. A study that measured the complex interplay between various factors predicting employment after TBI at 1 year post-injury found pre-injury employment was a direct predictor of employment outcomes (Shönberger, Ponsford, Olver, Ponsford, & Wirtz, 2011). People employed prior to moderate to severe TBI were three to five times more likely to RTW than those unemployed pre-injury (Keyser-Marcus et al., 2002). Fleming et al. (1999) showed a strong influence of pre-injury unemployment and employment variables on post-injury employment. They found that only one out of 38 subjects who were unemployed prior to injury was working at follow-up; whereas, 79 out of 170 of those employed pre-injury was working post-injury. Other studies support pre-injury employment as a crucial factor for employment outcome post-TBI (Atchison et al., 2004; Arango-Lasprilla et al., 2008; Gary et al., 2010).

Some unique information is revealed when different aspects of pre-injury employment are explored in relation to post-injury, indicating the importance of considering specific characteristics of the pre-injury work experience. For example, individuals who failed to maintain stable uninterrupted employment following mild to severe TBI had pre-injury jobs that did not provide benefits. Additionally, people who were professionals or managers pre-injury were nearly three times more likely to RTW by one year post-TBI than those in manual labor positions (Machamer et al., 2005; Walker et al., 2006).

In summary, research indicates that various pre-injury demographic variables are associated with employment outcomes after TBI. Those over 40 are more likely to be unemployed post-TBI than younger individuals. Generally, males fare worse than females and those not married have less likelihood of being employed. Lower educational status is highly associated with worse employment outcomes. The strongest pre-injury predictor of



employment post-TBI is pre-injury employment; those not employed pre-injury are less likely to be employed after sustaining a TBI.

7. Injury characteristics that significantly influence employment outcomes

How a TBI occurs, what severity level has the TBI been classified, and the level of disability or functional status one achieves prior to release from rehabilitation can have a significant influence on an individual with a TBI and their ability to obtain employment after injury. A large percentage of research that examines post-injury variables and of employment after TBI indicates variables for cause of injury, injury severity, and functional status as measured by valid assessments. Since a large majority of the TBI studies covered in this review are conducted at the TBI Model Systems, the injury-related variables will be definitions mostly used by their researchers (Gary et al., 2009; TBIMS National Data and Statistical Center, 2006):

| Injury-related Predictors of Employment Post-TBI |   |
|--|---|
| Variables  | Definition  |
| Cause of Injury                                  | Categorical variable dichotomized as violent and non-violent.   |
| Injury Severity (GCS/PTA)                        | (GCS) Combination of eye opening, verbal, and motor response when emerging from coma from 3 (lowest) to 15 (highest); (PTA) Duration of being disoriented in days.  |
| Functional Status (DRS/FIM)                      | (DRS) Measure to assess change in function over course of recovery from coma to community ranging from 0 (no disability) to 29 (vegetative state); (FIM) Measure of independence ranging from 1 (total assist) to 7 (completely independent). |

Table 3. List of Injury-related Predictors of Employment Post-TBI

7.1 Cause of injury

Regarding cause of injury, Hanlon, Demery, Martinovich, and Kelly (1999) classified type of injury into motor vehicle collision, motor vehicle-pedestrian collision, falls, assaults, injury from falling objects, and sports/recreation injuries. Results revealed that patients who experienced mild TBI from falls and those injured by falling objects had significantly worse vocational outcomes than the motor vehicle collision group. A similar study found that patients who experienced motor vehicle accidents had more positive productive outcomes than those injured from falls, other types of vehicles, motor vehicle-pedestrian accidents, and assaults (Girard et al., 1996). When classifying injuries as either intentional or unintentional, those injured intentionally were significantly more likely to be unemployed at one year post-TBI (Greenspan et al., 1996). Intentional injuries are usually violent injuries (e.g., assaults), and studies found that those who sustain TBI through violent means are less likely to be employed or productive one year post-injury compared to other etiologies of TBI (Arango-Lasprilla et al., 2008; Gary et al., 2009; Wagner et al., 2002). When violent etiology is not compared to non-violent etiology, it is not clear in TBI literature what specific cause of injury is a significant predictor of employment outcome. However, once violence is

introduced in the analyses more studies concur that those who sustain TBI through violence as opposed to non-violence have worse employment outcomes.

## 7.2 Injury severity

Several studies have found severity of injury, as measured by GCS and PTA, predicts employment post-TBI. Scores on the GCS range from 3 to 15. Scores between three and eight indicate severe injury; 9 to 12 is moderate, and 13 to 15 is mild (Teasdale, & Jennett, 1974). PTA is considered the time elapsed from injury until recovery of full consciousness and the return of ongoing memory; it relates to severity by detailing the continued level of consciousness following the injury (Grant & Alves, 1987). GCS taken at admission and length of PTA were found to be significant predictors of employment at one year post-TBI (Cifu, et al., 1997). The GCS scores of those employed were an average of 8.9 compared to 7.6 for those unemployed, and the employed group was in PTA for an average of 25.7 days compared to 44 days for the unemployed group. Another investigation of employment one year following TBI noted that the GCS had a reliable and powerful effect; where only 25% of patients with a GCS score of eight or less returned to work by one year after injury, compared to 80% of those with scores of 13-15 (Dikmen et al., 1994). Additionally, Sherer et al. (2002) noted that when patients with shorter PTA were included in the analyses, the duration of PTA had significant and unique predictive capability of employment post-TBI. One strong comparison study of acute confusion severity with duration (measured by PTA), however, found that severity of confusion was a stronger predictor of employment outcomes 1 year post-TBI, but they still reported that PTA duration continues to be a powerful predictor (Nakase-Richardson et al., 2007).

At two years post-injury and beyond, GCS and PTA continued to contribute to employment prediction. Felmingham et al. (2001) concluded that GCS scores successfully predicted employment at two years post-injury in 72% of cases. Similarly, at three years post-injury, PTA was the strongest acute clinical predictive factor for those returning to competitive employment (Cattalani et al., 2002). Two to five years post-injury, Fleming et al. (1987) noted that shorter durations of PTA were one of the best predictors for distinguishing between those who return to work and those who do not. Vogenthaler, Smith, and Goldfader (1989) assessed RTW at four to seven years post-injury and found a strong positive correlation between the best GCS scores in the first 24 hours and employment outcomes. Severity has been shown to be a significant predictor in studies even up to 10 years post-injury (Avesani et al., 2005; Johnson, 1998; Brown, Maleck, Mandrekar et al., 2010).

## 7.3 Functional status

Functional status can also have a major affect on RTW outcome after TBI. Some research studies indicate that both FIM and DRS scores significantly predict employment outcomes. Walker et al. (2006) agreed that FIM discharge scores were robust RTW variables one year after moderate to severe TBI, demonstrating that those with higher discharge FIM scores were over three times more likely to RTW than those with longer lengths of stay (LOS) in rehabilitation. This study also indicated that the FIM is a better predictor of employment status than length of stay. Cifu et al. (1997) indicated that both the FIM and DRS measures at both admission and discharge influenced subsequent RTW one year after moderate to severe TBI. When exploring functional status as assessed by the FIM only, researchers found

that over half of the 127 who did not return to work at one year had significant cognitive and motor limitations (Greenspan et al., 1996).

The DRS is often chosen in TBI literature to accompany or replace the FIM when measuring functional status. Gollaher and colleagues (1998) suggested that both admission and discharge DRS scores significantly predict employment one to three years after mild to severe TBI, with discharge scores being better predictors than admission scores. DRS and FIM scores from admission, discharge, and one year post-injury were investigated to determine job stability from one to four years post-TBI. DRS scores at one year after primarily moderate to severe TBI proved to be the most impressive predictor; 78% of those with no impairment and none with severe impairment were stably employed (Kreutzer et al., 2003). Other studies concur that DRS and FIM are strong injury-related variables that predict employment post-TBI, but the discharge scores should be used instead of admission scores (Sherer, Sander, Nick et al., 2002; Kosch, Browne, King et al., 2010).

In summary, primarily, injury-related variables, including etiology, severity of injury, and functional status are significantly related to RTW post-TBI. Additionally, the most prominent cause of injury related to employment after TBI is violent etiology. Severity of injury has been shown to be a powerful predictor of employment up to 10 years post-injury; typically those with a GCS of eight or less and PTA of 26 days or more have worse outcomes. Furthermore, functional status can significantly predict employment several years post-TBI with discharge FIM and DRS scores proven to be better predictors than admission scores.

## 8. Disability legislation

Since TBI often results in cognitive and emotional deficits that are not always apparent to the physical eye, there can be misconceptions about the capability of those who sustain the injury. These misconceptions can come from those in the general public and even professionals that do not have the expertise to deal with TBI. For example, in a qualitative exploratory study about misconception after brain injury, participants reported that because their cognitive disabilities were not easily recognizable they were not really expected to have long-term consequences or received more active pressure from friends, family, and work to perform to standards that they could not realistically achieve (Swift, & Wilson, 2001). Given that many individuals with TBI that recover well from acute problems and could likely enter or reenter the workforce, this population can be prone to various forms of employment discrimination. McMahon et al. (2005) found in an US Equal Employment Opportunities Commission (EEOC) study with a sample of 2,037 individuals with TBI that employment discrimination for this group is more likely to occur after employment has been obtained as opposed to during the hiring process. This evidence is why disability legislation is imperative for people with TBI who have aspirations to be employed with the same rights and benefits as the non-injured general population. The American Disabilities Act (ADA) of 1990 (Public Law 101-336), is such legislation, that is the result of federal legislators' efforts to ensure employment rights, advocacy, and support for people with brain injury and other disabling conditions (109 United States. Office of Disability Employment Policy, 1992). Title 1 of the ADA protects people with brain injury who were employed prior and wish to return to their previous position or be reassigned in another area. In addition, the ADA provides protection for those with brain injuries who were never employed prior to injury, but wish to pursue a job after the injury has occurred. The ADA

covers individuals with brain injury that meet essential job functions, which is being qualified for the job and has a declared disability from brain injury as established by law (109 United States. Office of Disability Employment Policy 1992). Once the person with a brain injury is covered and the employer falls into the category in which they must adhere to ADA guidelines (e.g., employers with 15 or more employees), they are protected in the following areas:

- Unfair treatment because of your disability.
- Harassment by managers, co-workers, and others in the workplace because of your disability.
- Denial of reasonable workplace accommodation that you need.
- Retaliation because you complained about job discrimination.

The ADA was also amended in 2008 (effective January 1, 2009) and the changes have major implications for people with disabilities resulting from brain injury. The amended ADA law still retains the former definition of disability, which is “a physical or mental impairment that substantially limits one or more life activities; a record of such impairment; or being regarded as having such impairment”, but it expands the definition meaning so it can be applicable to those with impairment that were not covered in the earlier interpretation of disability (Thomas, & Gostin, 2009).

Since research suggests that persons with TBI are more likely to be discriminated against after the employment occurs compared to other aspects of employment discrimination (e.g., hiring, harassment, etc.; McMahon et al., 2005), a major issue for the employees with TBI is the retention of employment. It has been documented that challenges for individuals with TBI are not just subject to returning to or obtaining employment, but having a significant degree of job stability (Kreutzer et al., 2003; Pössl et al., 2001; Mackamer et al., 2005). As such, one of the most important strategies covered under the ADA, that could assist with the retention of individuals with TBI in employment settings is the right to reasonable accommodations. It is important to note that the ADA *only* requires an employer to provide reasonable accommodations that would not cause undue hardship (e.g., lack of financial resources by employer to provide accommodations). Such accommodations that would benefit individuals with TBI at work are the following (Program on Employment and Disability, 2000).

- Memory aids
- Timers
- Wheelchair accessibility
- Visual aids
- Work task modification
- Environmental changes

These accommodations can enhance productivity for people with brain injury on the job. It can make work tasks easier and more amenable for individuals with disabilities.

## 9. Health professions in preparing people with brain injury for employment

There are a myriad of health professionals that work across the continuum of service delivery systems who are directly and indirectly involved in treatment of individuals with TBI that ultimately will lead to enhanced vocational outcome. Service providers vary coming from the acute stages of the rehabilitation process to community-based settings.

However, each profession has a unique set of skills that addresses the physical, cognitive, and emotional sequelae that primarily results from TBI and potentially interfere with productivity. Table 4 list health professionals who are prominent in acute care to community-based settings.

Physiatrists and rehabilitation nurses who specializes in physical medicine and rehabilitation typically provide services in acute care and rehabilitation settings right after initial trauma of individuals with TBI has occurred. The effect of early rehabilitation by specialized medical staff can be paramount in recovery and functional outcomes of people with TBI. This presents a case for better chances to achieve greater long-term function, such as employment and other areas of productivity. Studies have indicated that there is a positive effect on the functional outcome and discharge disposition of those with TBI who receive early specialized physical medicine and rehabilitation care as opposed to less formal specialized medical care (Mackley, 1994; Wagner, Fabio, Zafonte et al., 2003; Zhu, Poon, Chan, & Chan, 2007).

| Health Professionals Involved in Return to Work after TBI |   |
|---|---|
| Profession  | Related Roles   |
| Physiatrists  | Specialize in medical services and can perform independent medical evaluations in area of physical medicine and rehabilitation with emphasis on restoration of function.  |
| Rehabilitation Nurses                                     | Gives specialized nursing care to individuals with physical disabilities and/or chronic conditions and help promote restoration and optimal health.   |
| Social Workers  | Provides resources specialized for brain injury, be a liaison between healthcare system and family, and facilitate discharge planning by linking to community based services.                                   |
| Occupational Therapists                                   | Use specialized skills to focus on reengaging in meaningful activities and address barriers to participation in work environment through home and workplace modification and strategies for independent living. |
| Physical Therapists                                       | Use specialized skills to overcome debilitating physical deficits resulting from brain injury and promote functional mobility and use of physical modalities and assistive technology.                          |
| Speech Therapists   | Use specialized skills to address communication and cognitive deficits that would enhance productive and functional living.   |
| Vocational Rehabilitation Counselors                      | Uses specialized skills to be directly involved in the education, employment training, and consistent progress of vocational placement after brain injury.  |

Table 4. List of Health Professional Involved in Return to Work after TBI



Since social work has numerous roles related to education, resource allocation, and being a liaison between health setting and caregivers and their specialized services is vital to the care, support and transition of individuals with TBI. Although social work services may not seem directly linked to enhancing skills related to employment, they can, in fact, provide important information and referrals that would assist with transition of individuals with TBI back into employment settings (Wagner, Fabio, Zafonte et al., 2003).

The majority of therapeutic teams that service individuals with TBI in physical medicine and rehabilitation settings consist of occupational and physical therapists, and speech and language pathologists. These professions are essential to the rehabilitation process and to progressing individuals with TBI towards employment. For example, research notes the effectiveness of the specialized assessments and interventions delivered by therapy professions that would assist clients with brain injury transition and obtain meaningful occupation (Duff & Proctor, 2002; McCullah, 2007; Phipps, 2007).

One most the important professionals directly related to enhancing the vocational outcomes of people with brain injury are vocational rehabilitation counselors. The specific roles of vocational counselors are to educate, train, educate, and monitor those with disabilities in vocational situations. This profession is very useful for many individuals with TBI who may desire to enter the workforce after an unexpected injury and alteration of functional skills. It has been found that vocational rehabilitation services were positive predictors of job placement and employment status for individuals with TBI (Gamble & Moore, 2003).

In summary, numerous health professionals work to improve the life and well being of persons with TBI. Although some work more in multidisciplinary settings in acute and inpatient care and some work more in the community based settings, collectively their efforts assist in progressing individuals with TBI towards vocational goals, which helps improve overall quality of life.

## **10. Intervention to increase employment for people with brain injury**

The majority of this chapter has focused on employment rates and factors that predict employment, but emphasis should not only be placed on the research that report statistics related to employment post-TBI, but also research that is attempting to rectify the problems related to obtaining and maintain employment post-injury. Interventions are particularly needed due to the residual problems related to brain injury that typically interferes with successful return to work and the maintenance of employment. Ideally, interventions both post-rehabilitation and community-based can be designed to address and ameliorate problems with return to work and educate the employee with brain injury and employer so that the work environment can be amenable to this population and more efficient for all those involved. In addition, there must be research to evaluate and report the efficacy of utilizing these interventions. There are quite a few studies that employ vocational services to intervene and assist people with brain injury return to employment, but few actual interventions have been specifically developed and evaluated in research to address problems of employment in this population. One such intervention was developed in an outpatient rehabilitation setting. Guérin et al. (2006) developed an intervention for individuals with mild TBI to enhance vocational outcomes in Québec, Canada. Primarily, their intervention starts by indentifying the over-arching problem that seems to affect daily life after injury. Next, short-term objectives are developed by the treatment team and client, followed by development of a framework for return to work involving the client and

employer. Constant encouragement and advice is given to assist person in maintaining contact with employer and creating an employment milieu until the client is able to return to work. Likewise, another intervention was developed that indirectly addressed employment through goal attainment, which included sustaining employment. Muenchberger et al. (2011) developed a structured community-based intervention called Skills to Enable People with brain injury in their communities (STEPS). This was a 6 week program that was delivered in a group setting involving person with brain injury and family. A workbook was used that covered 6 sessions related to education about brain injury, setting goals, maintaining relationships, identifying and working through problems, and exploring activities. The problem with the STEPS program and the intervention for mild TBI is that both were developed and implemented in countries outside the US (Australia and Québec, respectively). These settings are different than the US and may be less applicable to people who live in the US due to resources and service provisions. However, Niemeier et al. (2010) were very successful at implementing a community based intervention specifically designed for improving productivity and employability following brain injury. Using a 20 session manualized approach; the Virginia Clubhouse Vocational Transitions (VCVTP) program was implemented in six clubhouses in the state of Virginia to transition severely injured people with brain injury living in the community to working as a volunteer, in competitive employment full or part-time, or an education or training program. The program had modest significant treatment effect for employment status and productivity. Overall, there is a dearth of interventions for employment after brain injury that is being adequately evaluated and published in the research literature. There is distinct need to continue development and research in this area.

## 11. Future research

This chapter has reviewed the majority of employment research conducted on individuals with TBI in the last 15 years. Clearly from this review, there is continued need for longitudinal research with multiple follow-up periods to elucidate expected employment trends and changes to employment over time with the same co-hort of participants. Additionally, more prospective research that examines employment 10 to 20 years post-injury with a large enough sample that attrition will not significantly bias results. Research with mixed methodology will help to identify challenges to employment and additional variables, after brain injury by understanding the breadth of the issues in more explicit detail. With additional knowledge about employment after brain injury, more interventions can be developed that will address identified issues and make transition back to employment settings after TBI more successful.

## 12. Conclusion

In summary, TBI can have a devastating effect on employment and vocational skills that potentially will extend for many years post-injury. Although employment rates vary due to numerous pre-injury and post-injury factors (e.g., severity, cause of injury, pre-injury employment status), the majority of research using different definitions of employment identify rates to be around 40-60%. The enactment of solid federal legislation that aims to protect individuals with disabilities resulting from brain injury and a variety of health professionals especially skilled to adequately treat this population makes the climate right

for unique employment interventions and continued research to profoundly affect the quality of life for those living with brain injury.

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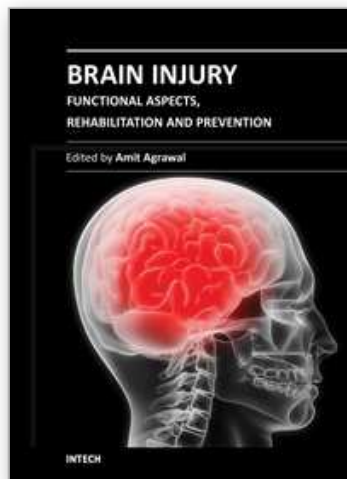


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The present two volume book "Brain Injury" is distinctive in its presentation and includes a wealth of updated information on many aspects in the field of brain injury. The Book is devoted to the pathogenesis of brain injury, concepts in cerebral blood flow and metabolism, investigative approaches and monitoring of brain injured, different protective mechanisms and recovery and management approach to these individuals, functional and endocrine aspects of brain injuries, approaches to rehabilitation of brain injured and preventive aspects of traumatic brain injuries. The collective contribution from experts in brain injury research area would be successfully conveyed to the readers and readers will find this book to be a valuable guide to further develop their understanding about brain injury.

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