

Personality and Behavior Changes Subsequent to Traumatic Brain Injury: A Review of the Literature

Sarah M. Rieger

California School of Professional Psychology, San Francisco, California, USA

ABSTRACT: *Alterations in personality and behavior following traumatic brain injury (TBI) are examined in a review of the literature. Research suggests that changes in personality and behavior could be caused by the injury at an organic level, as well as the patient's response to the injury and the subsequent deficits that are experienced. Currently, various treatment options are available and practitioners would serve patients best by sampling from many areas of psychological and medical interventions in order to create custom rehabilitation programs to suit the individual patient's needs. Future research into the level of permanency of the personality changes, compensatory skill building for affect deficits, and increased involvement of social supports in treatment are suggested.*

INTRODUCTION

In the last decade, traumatic brain injury (TBI) has become a buzz word among researchers, therapists, psychologists, social workers, medical professionals and the United States military. Although this form of injury has piqued the interest of the medical and psychological world since the mid-1800s with the famous injury of Phineas Gage (Macmillan & Lena, 2010), until the 1970s, research into the injury's negative influence on social, emotional, and behavioral functioning had been a rare occurrence (Lezak, 1987).

A traumatic brain injury can occur in any number of ways. Some of the most common causes of a TBI are motor vehicle accidents, falls, and assaults (Joseph, & Linley, 2008; Summers et al., 2009). Other medical causes of TBI include stroke, cerebral hypoxia (resulting from heart attack or near drowning), hypoglycemia, carbon monoxide poisoning, cerebral infections such as meningitis or encephalitis, or subarachnoid hemorrhage, usually due to an aneurysm (Joseph & Linley, 2008). Among military personnel, a staggering 79-98% (Hoge et al., 2008; Summers et al., 2009) of TBIs are due to concussive blast waves from an improvised explosive device (IED) blast (Slone & Friedman, 2008). The second highest rates of TBI are from penetrating head injuries resulting from bullets and shrapnel (Slone & Friedman, 2008).

Among military personnel, TBI rates are seen in epidemic proportions since Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF). Between the years 2000 and 2014, the military reported 313,816 new TBI injuries amongst its members (DVBIC, 2015). However, it is difficult to determine what the actual rates are for TBI; it can often be misdiagnosed as Posttraumatic Stress Disorder (PTSD) as the symptoms can be similar or not diagnosed at all. It is estimated that of service members who incur injuries from a blast attack, 60 to 80% of them mostly likely suffer from some degree of TBI (Slone & Friedman, 2008), and approximately 44% of them will also develop PTSD (Hoge et al., 2008).

Traumatic brain injuries, as noted above, are not a military-specific injury, with civilians experiencing them a great deal as well. It is estimated that approximately 1.7 million Americans suffer from a TBI each year (Waldron-Perrine et al., 2011), while the Centers for Disease Control and Prevention noted that in 2010 alone there were approximately 2.5 million new cases and that TBI is responsible for approximately 50,000 deaths per year (Centers for Disease Control and Prevention, 2015). Another research article estimated that

TBIs occur in approximately 30% of the general population (Burg, Williams, Burrigh, & Donovick, 2000). This injury tends to occur most often in males between the ages of 15 and 24 (Burg et al., 2000; Centers for Disease Control and Prevention, 2015). On a global scale, TBIs occur in approximately seven to ten million people annually (Crowe, 2008; Hyder et al., 2007). As noted above among military personnel, these statistics are most likely low, as most mild traumatic brain injuries (mTBI) go undiagnosed, as individuals do not seek treatment for them.

As stated earlier, until recently, most research and treatment of mTBI and TBI has been to address cognitive deficits resulting from injury. It was posited that any alterations in behavior were most likely in response to the cognitive deficits and not necessarily due to the injury itself. More often than not, the deficits in affect and personality were much more detrimental to the patient than any cognitive deficits they experienced following the injury (Lezak, 1987; Lezak, & O'Brien, 1988). However, before it can be determined whether a TBI can cause changes in personality, it is best if a definition of personality is put forth.

Personality is defined as patterns of emotional and motivational responses that develop over the life of the organism; are highly influenced by early life experiences; are modifiable, but not easily changed, by behavioral or teaching methods; and greatly influence (and are influenced by) cognitive processes (Prigatano, 1992). In people, these patterns of emotional and motivational responses are in part self-recognized, but they may remain outside the individual's realm of conscious awareness.

Personality changes are attributed to a TBI when the injury causes obvious and marked changes in the patient's pre-injury characteristic behavior (Prigatano, 1992); these changes in personality can be temporary or permanent. Others who are familiar with the individual's daily behavioral characteristics may recognize emotional and motivational responses that the person may not be fully aware of or able to report subjectively. Most often, permanent changes are attributed to damage to the limbic and frontal cortex systems of the brain and most often involve affective deficits.

The DSM-5 includes a diagnosis of Personality Change Due to a General Medical Condition (diagnostic code 310.1). It states that the change in personality is a marked difference in the patient's previous characteristic behavior patterns (APA, 2013). The diagnostic features include affective instability, poor impulse control, outbursts of aggression or rage that are disproportional to the stressor, suspiciousness or paranoia, and apathy. The DSM notes

*Correspondence regarding this article should be directed to: sarah.marie.rieger@hotmail.com

that these symptoms are found in a variety of medical diagnoses including central nervous system neoplasms (tumors), head trauma, and epilepsy (APA, 2013).

The purpose of this literature review is to examine the relationship between TBI and subsequent personality and behavior changes in patients. There has been much research in the last 30 years, but there have been few comprehensive and recent reviews of this literature specifically. The link between personality changes and TBI will be explored and a discussion of whether personality changes following a TBI are due to organic reasons, or if the personality changes are the patient's reaction to the injury and subsequent cognitive deficits. Finally, recommendations will be made for possible avenues of treatment and suggestions for future research considering the findings will follow.

METHOD

A search using PsycINFO with the search terms "personality change" and "traumatic brain injury*" was conducted with the parameter that all results be in English, yielded 90 results. Additional articles were gathered from the reference list of the book, *The Behavioural and Emotional Complications of Traumatic Brain Injury* (Crowe, 2008). In total, 23 articles were retained based on the relevance for this review.

A further search was done using the Puget Sound World Cat system using "personality change and TBI." This search yielded 581 results, 24 of which were books and a majority of the articles were duplicates of the articles found in the previous search. Four of the books were retained due to the more comprehensive information that they offered. Two additional books were found through the references lists in journal articles that were pertinent to TBI implications and treatment for military personnel. Along with these six books, the DSM-5 was included for diagnostic criteria and the major traumatic brain injury website resources (brainline.org, cdc.gov, dvbic.dcoe.mil, and who.int) were used for statistics.

The information in these sources proved to be invaluable to this literature review. Below is a detailed review of the information and key themes that were discovered upon review of the source material.

RESULTS

Premorbid Conditions

Premorbid conditions may play a part in personality changes following a TBI. There were several studies which suggested that social and/or emotional deficits or personality variations may be explained by preexisting susceptibilities and characteristics (Joseph, & Linley, 2008). One personality trait in particular, premorbid substance abuse, was noted to have an association with post-injury behavior. It was found that in patients who had a history of substance abuse issues, their post-injury substance abuse behavior would either increase or decrease significantly, while those who did not have a history of substance abuse before the TBI did not begin to abuse following the injury (Crowe, 2008). It was not mentioned whether this information may have been skewed because substance abusers are much more likely to be involved in accidents that result in a TBI; in fact, approximately 30% of civilian adults were intoxicated at the time of their injury (Brainline.org, 2015a).

A study on impulse aggression following TBI was conducted in 2001 (Greve et al., 2001). The researchers defined impulse aggression as "a hair trigger response" to stimuli that results in aggressive behavior. The researchers conducted the study with 45 (26 in the impulsive aggression group and 19 in the non-aggressive control) residents at a brain injury rehabilitation facility. The researchers found that a large majority of the individuals in the impulse aggression group had premorbid personality traits of aggression and

behavior that would be categorized as impulsive; these traits were determined via The Lifetime History of Aggression questionnaire. They posited that the TBI did not cause the impulse aggression but rather exacerbated premorbid characteristics in the now disinhibited patients; these outcomes were associated with frontal lobe damage.

A study that suggested that premorbid conditions may not be the full explanation was also found (Tate, 2003). In the study, 45 patients at a brain injury rehabilitation facility were given two batteries, the Eysenck Personality Questionnaire - Revised and the Current Behavior Scale, at approximately eight weeks, six months, and 12 months post-injury. There were marked changes in personality, particularly neuroticism, addiction, criminality (heightened), and extroversion (decreased). There was no evidence to suggest that premorbid characteristics had any impact on specific changes in personality post-injury (Tate). There was also no association found between the area of the brain damaged (frontal damage versus nonfrontal) and the noted characterological changes. These findings suggest that the injury itself may be responsible for the changes in the patients' behavior in at least in some cases.

Psychopathology

Depression

Depression among TBI patients has received much attention. While increased vulnerability to depression is associated with TBIs of all severity levels (both in civilian and military populations) (Burg et al., 2000; Crowe, 2008; Lezak, 1987; Lezak, & O'Brien, 1988; Perlick et al., 2011; Prigatano, 1992; Rush et al., 2006; Weddell & Leggett, 2006) there is disagreement about whether the TBI is the organic cause of the depression, or if the depression is the response to lowered function following a TBI.

The cognitive deficits that tend to follow TBI require the patient to go through lengthy rehabilitation to possibly regain some lost functioning. The time and energy spent on rehabilitation with slow improvement could leave some patients feeling depressed or hopeless. Patients who experience memory problems post-injury tend to have higher instances of depression than individuals without memory deficits (Prigatano, 1992). Similarly, as a patient becomes more aware of cognitive deficits, the likelihood that the patient will become depressed increases (Rush et al., 2006; Weddell & Leggett, 2006). Furthermore, the social isolation and increased dependency on friends and family that many patients experience may also lend itself to the development of depression (Prigatano, 1992; Rush et al., 2006; Weddell & Leggett, 2006).

There is also some research that suggests that, organically, TBIs may be the culprit of depression. The frontal and temporal lobes of the brain are especially susceptible to a TBI. It is this area of the brain, along with the limbic system, that is responsible for much of our mood and behavior. Damage to these areas of the brain could be responsible for depression (and other changes in personality) at an organic level (Burg et al., 2000; Crowe, 2008).

Anxiety

As is the case with depression, it is likely that anxiety will follow a TBI, but may be due to the awareness of developed deficits, and not solely the injury (Burg et al., 2000; Crowe, 2008; Lezak, 1987; Lezak, & O'Brien, 1988; Prigatano, 1992). While depression seems to be highly correlated with memory deficits, anxiety appears to be associated with difficulties in attention and focus (Prigatano, 1992). There are cases in which damage to the amygdala and frontal lobes are associated with the development of anxiety and anxiety disorders (Crowe, 2008).

Posttraumatic Stress Disorder

In addition to depression and anxiety being likely to develop following a TBI, much of the research suggests many patients suffering from TBI may also develop PTSD. Among veterans,

this comorbidity tends to have a high rate of occurrence (Dausch & Saliman, 2009; Ruzek et al., 2011) as high as 71% in one study (Perlick et al., 2011). This connection is contrary to the belief that one cannot develop PTSD without a recollection of the traumatic event; quite the contrary, PTSD can occur even if there is no memory of the event due to posttraumatic amnesia associated with TBI (Joseph & Linley, 2008; Ruzek et al., 2011; Slone & Friedman, 2008).

Suicidality

Although all the aftereffects of TBI should be closely monitored, one in particular that clinicians should screen for is suicidality. Suicide risk among TBI civilian patients is approximately two to four times greater than those without a TBI (Brainline.org, 2015b). A study of 42 patients with severe TBIs (Crowe, 2008) showed that at one year post-injury, 10% had suicidal ideation and 2% had made suicide attempts since the injury. By five years post-injury, 15% of the patients had made suicide attempts. Completed suicides among patients with a TBI were up to 4.12 times the rates of the general population (Engberg & Teasdale, 2001). In a study of 650 TBI patients, five individuals had completed suicide (Harris & Barraclough, 1997), which puts the rate of suicide among this population at approximately three times the United States national average.

Oquendo et al. (2004) studied 325 patients who fit criteria for either Major Depressive Disorder or Bipolar I Disorder; 109 of them had experienced a mTBI (Oquendo, 2004). They found that the patients with mTBI were much more likely to attempt suicide than the patients with no history of mTBI. Considering only the patients with TBI, the researchers found that 80% of the individuals who had attempted suicide did so subsequent to the injury. Their results suggested that the best predictors of suicide attempt following a TBI are increased aggression or hostility in the patient post-injury.

Substance Abuse

While substance use or abuse tends to account for a significant proportion of TBIs, the rates of substance abuse before and after the injury are somewhat hopeful. Rates of substance use and abuse following a TBI decreased significantly in one study (Kreutzer, Wehman, Harris et al., 1991). The researchers conducted a study involving 74 patients with a history of TBI. Each participant was given the Michigan Alcohol Screening Test and pre-injury substance use levels were obtained by way of interviews from the patients' primary caretaker. The patients were categorized into five levels of drinking: Abstinent went from a pre-injury proportion of 20% to 51%, post-injury; Infrequent moved from 4% pre-injury to 7% post-injury; Light had a pre-injury proportion of 8% to 10% post-injury; Moderate had a pre-injury proportion of 30% to 19% post-injury; and lastly, heavy dropped from 38% pre-injury to an impressive 13% post-injury. These findings dispute the common misconception that TBI leads to heavy substance use; the levels of abstinent drinkers following TBI were at much higher proportions than the general population, and the proportion of heavy drinkers was much lower than the general population.

Another study conducted in 2002 showed similar declines in substance abuse following TBI (Kolakowsky-Hayner et al., 2002). In their study, they compared the substance use between spinal cord injury patients and TBI patients. The researchers discovered that out of those TBI patients who were classified as heavy drinkers before their injury, only 29% remained so, with 23% decreasing to a moderate level, six percent became infrequent drinkers and over 40% became abstinent. The results also showed that all the TBI patients who were abstinent before the injury remained so post-injury, with 75% of the infrequent drinkers and 25% of the moderate drinkers became abstinent following the injury.

Changes in Sexual Behavior

A change in sexual behavior following TBI is a topic that has not received much attention. Among research that has been done, researchers have found that alterations in sexual desire and performance can be seen among TBI patients (Crowe, 2008). Other changes that are seen post-injury are the development of hyposexuality (decreased libido), hypersexuality (increase in libido), and paraphilias that were not present pre-injury. Changes in sexual preference and orientation following TBI have been documented (Miller, Cummings, McIntyre et al., 1986), though this is not a typical occurrence.

There are several different things that may be contributing to changes in sexual behavior following TBI (Crowe, 2008). There are several areas of the brain that are responsible for the maintenance of healthy sexual behavior including the cerebral cortex, subcortex, peripheral nervous system, brain stem, and the neuroendocrine system and injuries to these areas may cause differences in sexual behaviors or preferences. Lesions found in the limbic system and cortex have been associated with dysfunctional sexual behavior. Furthermore, damage to the frontal lobes, which are especially susceptible to TBI, has also been linked to altered sexual behavior including higher instances of sexual cognitions or fantasies and sexual disinhibition following TBI. Changes in sexual orientation, while rare, are most often associated with lesions on the limbic system, hypothalamus, and temporal lobe (Miller et al., 1986).

Personality Changes

Bigler (1989) put forth an illustrative case study in which she asked a spouse of a severe TBI patient to compare her husband's personality and behavior pre- and post-injury. Following his injury, the wife noted that there were marked changes in his confidence, drive and energy, self-esteem, self-image, sense of humor, and temper and anger control (Bigler, 1989).

After collecting this information from the spouse, an MMPI was administered and compared it to one that the husband had taken 15 months earlier (Bigler, 1989). The author noted that in the first MMPI, there were no indications of abnormal behavior; however, on the subsequent MMPI, there were significant changes in personality with several elevated subscales.

Research into the area of personality changes following TBI has found similar trends to the above case study. Alterations in initiative, loss of social competency, loss of interest in premorbid recreation (Crowe, 2008; Lezak & O'Brien, 1988), loss of empathy (Joseph & Linley, 2008; Slone & Friedman, 2008), increased anger (Crowe, 2008; Golden & Golden, 2003; Lezak, 1987; Prigatano, 1992; Slone & Friedman, 2008), increased isolating behavior, increased irritability (Brooks & McKinlay, 1983; Crowe, 2008; Greve et al., 2001; Tate, 2003; Weddell & Leggett, 2006), social disinhibition, insensitivity, paranoia (Crowe, 2008; Prigatano, 1992; Weddell & Leggett, 2006), increased immaturity (Crowe, 2008; Prigatano, 1992), lack of motivation, loss of spontaneity, increased agitation (Prigatano, 1992), loss of confidence in oneself, loss of drive, lowered self-esteem, increased social isolation (Bigler, 1989), increased neuroticism, decreased extroversion, increased impulsivity (Rush et al., 2006; Tate, 2003), loss of religious faith or spirituality (Calhoun & Tedeschi, 1999), apathy, lost initiative, impatience, loss of trust in others, delusions, disordered eating, narcissism, lost or decreased desire for intimacy, homicidal ideation (Crowe, 2008), and impaired self-awareness (Rush, Malec, Brown, & Moessner, 2006) have all been documented. In addition to these consequences of TBI, all the above cited authors note that depression and anxiety are also very highly correlated with mTBI and TBI as discussed earlier in this review.

In 2006, a study was conducted to evaluate personality changes following TBI as perceived by close relatives of the patients (Weddell & Leggett, 2006). The researchers conducted the study with 72 patients who had suffered a TBI (ranging in severity) within the previous four years. They administered the WAIS-R Full Scale IQ, the WMS Logical Memory and Visual Reproduction, the University of Pennsylvania Small Test, the Spielberger Trait Anxiety, Zung Depression scale, and the Anger towards the Relative scale to the patients as well as in-depth interviews with the relatives of each patient. The results supported the theory that personality changes are associated with frontal lobe damage. Something that the researchers did not anticipate was that the results indicated that while personality changes were correlated with the injury itself, the damage was not entirely responsible; when the patient's social network was not supportive and there were high degrees of criticism and stress, the personality changes that were noted were more pronounced than in patients who had supportive relatives, indicating that personality changes may not have a purely organic origin following brain injuries.

A longitudinal study conducted in 1988 added to the body of evidence of personality changes following TBI (Lezak & O'Brien, 1988). Forty-two patients with a recent TBI (ranging in severity) were examined over the course of the five-year study. At the check-in each year, the Portland Adaptability Inventory was administered to the patients. The results showed that between the first and second year post-injury, there was marked impairment in functionality which was attributed to increased levels of depression and anxiety, though this seemed to improve by the third or fourth year. By the end of the fifth year, approximately 40% of the subjects still had severe difficulty in anger control, which made it difficult for the patients to obtain and maintain employment and interpersonal relationships, which then furthered their anger and depression.

Although a majority of the research into TBI and personality change suggests that there is a correlation between the two, there is also research that indicates that personality may not be affected. In a study involving 106 patients with moderate to severe TBI, 87 with mTBI, and 82 patients with orthopedic injuries (control) (Rush, Malec, Brown, & Moessner, 2006). The researchers administered the Galveston Orientation and Amnesia Test, the Neuroticism, Extraversion, Openness, Conscientiousness and Agreeableness scale, the Independent Living Scale, and the Mayo-Portland Adaptability Inventory to each patient. The researchers stated that they found no evidence of permanent, long-term personality changes due to TBI, regardless of severity. They did find evidence to suggest that depression is a likely outcome of TBI, and that in the short-term, the patients did experience increases in neuroticism. The researchers noted that they do not argue that pervasive personality changes don't result when the frontal lobes are severely damaged in a TBI; however, they believe that this is a rare occurrence. Rush and her colleagues suggested that rather than stating that patients experience changes in personality post-injury, that stating that the patients having changes in behavior would be more accurate (Rush, Malec, Brown, & Moessner, 2006).

However, there has also been research that highlights some positive outcomes to TBI. A study of 82 TBI patients in which the patients were each asked "how have you been feeling (emotionally) over the last week?" The researchers noted that out of the 101 responses, 35 of them were entirely positive (Joseph & Linley, 2008). The researchers noted that there were several areas in which there was positive change following a traumatic event, namely a TBI: appreciation for life, relating to others, and personal strength. Following a TBI (and other traumatic experiences) patients can experience positive growth, including a greater appreciation for life and an alteration in priorities (Calhoun & Tedeschi, 1999; Calhoun & Tedeschi, 2006; Weddell, & Leggett, 2006).

Indications for Treatment

Treatment options for patients with TBI appear to be as varied as the patients themselves. Psychoeducation concerning the nature of TBI as well as rehabilitation and prognosis are recommended by several researchers (Burg et al., 2000; Dausch & Saliman, 2009; Weddell & Leggett, 2006). Psychoeducation is stated to be useful so that patients, caretakers, and family have a clear idea about realistic expectations considering the extent of their injuries and for rehabilitation.

Psychotherapy, which may include CBT, art therapy, music therapy, or biofeedback, is also highly recommended; Goals of particular importance in psychotherapy are steps towards self-reliance, stress reduction, mindfulness (Calhoun & Tedeschi, 2006), the development of compensatory strategies to offset cognitive deficits (Ruzek et al., 2011; Weddell & Leggett, 2006) goal-oriented and solution-focused activities, and self-efficacy (Crowe, 2008; Joseph & Linley, 2008). It is also suggested the use of trauma-focused form of psychotherapy to ensure that components of avoidance are addressed (Joseph & Linley). Biofeedback has been shown to be helpful in treating TBI patients with headaches, stress-related disorders, attention deficit/hyperactivity disorder (ADHD), and cognitive deficits. Alternative therapies such as music therapy can be useful for patients who experience, loss of language or speech as a result of their injuries (Murrey, 2006). Along with individual psychotherapy, several authors suggest that group therapy may be helpful for those who need additional social skill building or peer support (Crowe, 2008; Dahlberg et al., 2007; Joseph & Linley, 2008).

In order to assist patients in achieving the best results possible post-injury, traditional psychotherapy should be altered to accommodate any cognitive deficits the patients may be experiencing. Due to the high comorbidity level of TBI and PTSD, clinicians must be aware of the possible overlap in patient symptomology. Normal courses of treatment for PTSD should be modified to take into account the cognitive and emotional impairments associated with TBI in order for the interventions to be successful.

It is also worth mentioning that because most TBIs involve damage to the frontal and temporal lobes, disinhibition in some patients may be more dangerous than others. In instances in which patients were suicidal prior to the TBI, they may become even more likely to attempt suicide post-injury, even more so than patients with a history of suicide attempts that have not experienced a TBI. Clinicians should be sure to screen thoroughly for suicidal ideation in their TBI patients.

Brain injury rehabilitation should be tailored to the patient's unique needs. Typically brain injury rehabilitation includes providers from many different specialties including nursing, psychiatry, neuropsychology and psychology, neurology, counseling, occupational and physical therapy, speech therapy, and education (Ruzek et al., 2011).

For patients who are dealing with substance abuse issues, substance abuse treatment programs are encouraged (Crowe, 2008; Murrey, 2006). Both authors suggest that the programs be tailored to fit the needs of the TBI patients, taking into account any deficits in cognitive abilities. Furthermore, the authors urge that the patients' families be involved in the treatment process, as social and familial support are crucial to rehabilitation and substance abuse treatment.

Another key theme in the treatment research is family involvement. Patients of all TBI severity levels who have supportive family involvement in rehabilitation tend to fair much better and have more successful rehabilitation than those patients without family support (Brooks & McKinlay, 1983; Dausch & Saliman, 2009; Perlick et al., 2011; Prigatano, 1992; Ruzek et al., 2011; Slone & Friedman, 2008). Poor family or social support can have negative effects on treatment outcomes. In cases in which there is

much dysfunction among the patient's family, steps should be taken to alleviate family stress and build cohesiveness to ensure the best possible outcome for the patient. Furthermore, if it is possible to help the client maintain consistent exposure to supportive interpersonal relationships, this can help combat the feelings of isolation and loneliness that many TBI patients experience, which may help to offset depression. This key factor, regardless of treatment modality, results in better rehabilitation outcomes among TBI patients.

Apart from therapy and alternative treatment approaches, several of the authors suggest that medication may be useful in managing some of the patients' more severe symptomatology. Depending on the diagnoses and severity of a patient's symptoms, a psychiatrist could prescribe selective serotonin re-uptake inhibitors (SSRIs), anticonvulsants, antipsychotics, lithium salts, cholinesterase inhibitors (for memory issues), Buspirone (anxiety stabilizer), Trazodone (for sleep difficulties), Prazosin (to manage nightmares) (Ruzek et al., 2011), beta-blockers, Ritalin or Adderal (Crowe, 2008; Ruzek et al., 2011), antidepressants (Prigatano, 1992) and narcotic pain relievers (Crowe, 2008).

There are several points that therapists and psychologists should keep in mind when working with TBI patients (Calhoun & Tedeschi, 2006). Therapists need to have an understanding on working through the impact of trauma and challenging unhealthy beliefs or schemas. Therapists should be wary of not focusing so intently on negative effects of TBI that they overlook positive growth, as these observations can help motivate patients to continue the difficult rehabilitation process.

DISCUSSION

Although research into personality and behavior changes following TBI is relatively new, there was a wealth of knowledge to be gained from exploring this topic. While there remains to be some discrepancies in whether or not the personality changes are a function of the TBI or if they are in response to the injury, there seems to be agreement that personality and behavior changes can happen following mTBI and TBI.

The research gathered for this literature has three major themes. The first theme is that traumatic brain injuries happen across populations. While men aged 15-24 do make up a majority of the injuries, this does not exclude females and males outside this age range from experiencing this type of injury. Furthermore, the research negates the notion that this type of injury is specific to certain professions. Civilians and military personnel alike in the United States experience high levels of TBI. As of yet, it remains to be seen if pervasive personality changes following TBI and mTBI are truly permanent or if patients may eventually return to baseline, barring any severe and permanent damage to the brain. The lengthiest longitudinal study found in the research for this literature was only five years (Lezak & O'Brien, 1988), and a longer follow-up study would be a beneficial for future research.

Secondly, while TBI can damage any portion of the brain, the frontal and temporal lobes appear to be the most susceptible to damage and the most likely to be damaged when personality or behavioral changes are noted. Clinicians working with TBI patients who have had this area of their brain damaged in the injury, would do well to keep in mind that the personality or behavioral changes may be permanent in these instances. While the limbic system has been named as another area in which damage could cause serious and permanent personality or behavioral changes, the frontal and temporal lobes seem to be named a majority of the time. Potential future research in this area could examine whether there could be any compensatory skills building for emotional deficits that are a normal outcome of TBI to this area of the brain, much like there are skill building interventions used to compensate for cognitive deficits that occur following TBI.

Thirdly, despite the type of intervention or treatment modality used in brain injury rehabilitation, a supportive social network is the highest predictor of successful outcomes in rehabilitation (Dausch & Saliman, 2009; Perlick et al., 2011; Prigatano, 1992; Ruzek et al., 2011; Slone & Friedman, 2008). Close family members in particular appear to help patients significantly in affect rehabilitation as well as increased cognitive function. In the future, researchers should examine spousal/partner relationships exclusively to determine if these relationships are an indicator of outcomes rather than looking at a social or familial support as a whole.

CONCLUSION

While many TBI patients do experience drastic personality and/or behavioral changes, it is still not clear whether these changes are permanent or if the patient will eventually return to their pre-injury characteristic functioning. These outcomes appear to depend on a variety of factors, including familial and social support and pre-morbid functioning and pathology. New research is being conducted constantly to discover new and more concrete methods to treat this population and address the many changes and deficits that they are struggling to overcome. What can be said for certain is that no one intervention or area of treatment is going to be satisfactory in TBI rehabilitation, rather, it will take the cooperation of many different health care providers and care givers to establish a well-rounded and complete rehabilitation program that is tailored to the individual patient's needs and focuses not only on developed skill deficits but any subsequent behavioral or personality changes as well.

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