



Traumatic Brain Injury (TBI): A Beginners Guide for Education Professionals

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Abstract

Traumatic Brain Injury (TBI) is one of the leading causes of disability and death in children. Each year many children experience and receive treatment for a TBI. Traumatic Brain Injury effects are multifaceted and may change over time affecting personality, cognition, emotions, academic functioning, and social interaction. Educators in elementary, middle and high school settings work closely with children and youth on a daily basis and observe, first hand, the effects of TBI. Educators are pivotal in young people's lives and have a tremendous impact on their psychosocial and academic functioning, yet few educators are well versed in TBI effects and how to work with children who have sustained a brain injury. In order to provide a basic understanding and guide to educators, this paper provides definitions and descriptions and details relevant to comprehending TBI. This paper also offers educators recommendations for interventions to support student success as they return to the academic settings post-TBI.

Keywords: Traumatic brain injury (TBI); Educators; Brain injury; School interventions; Student performance

Traumatic-Brain Injury (TBI)

The Centers for Disease Control and Prevention, CDC, defines a traumatic brain injury (TBI) as a disruption in the normal function of the brain that can be caused by a bump, blow, or jolt to the head, or penetrating head injury [1]. Throughout childhood, there is an increased likelihood for children to sustain TBIs as a result of falls, accidents, sport injuries, or assault. The CDC reports that between 2006 and 2010, 13,475 children ages 5 to 14 had TBI related hospitalizations and from 2001 to 2010, emergency department visits for this age group have doubled [2]. These visits include motor vehicle accidents, assaults, and various other causes; with the highest number of injuries being caused by falls, which include most sports related injuries. Sports related activities have become a major source of juvenile concussions. From 2001 to 2012, emergency department visits for sports related concussions (mild traumatic brain injury), alone or in combination with other injuries, more than doubled among children ages 19 or younger [3]. By the start of high school, 53% of student athletes report a history of at least one concussion [4]. These injuries can result in a broad range of difficulties that may impact their emotional regulation, cognitive abilities, social and interpersonal interactions, as well as academic functioning either temporarily or long-term. Since the majority of school aged children who experience a TBI return to school after such an injury, it is important for educators to be aware of key considerations for successful reentry into the academic setting and monitoring of student performance. Many times, students return with sometimes subtle, almost undetectable, changes to their prior cognitive, social, or behavioral status.

Linden, Braiden, and Miller [5] conducted research with educators on their knowledge of traumatic brain injury. Of the educators polled, 29.4% reported that the majority of children, if knocked unconscious due to injury, would have no lasting effects and another 43.8% reported they did not know the potential outcome. Due to the growing prevalence of concussion in school aged children, it is vital that educators learn about the effects and symptoms of TBI. Education professionals need to be cognizant of the possibility of differences displayed when students return to school after a TBI.

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It is important for educators to be aware of signs, symptoms, side effects, and cues to potential problems or deficits that the student may display. Additionally, because the pediatric brain is in a constant process of development throughout childhood, effects often occur, or may become more observable, over time. New and evolving symptoms may develop days, weeks, or months after an injury. Changes in academic performance, cognition, social and emotional behavior must be recognized and addressed in order to assist students in functioning effectively in school and other settings. Educators have an opportunity to be informed of the available interventions, programs, and pathways for these students to obtain the assistance they need to be successful. Definitions, key aspects related to TBIs, as well as effective interventions are presented as a resource for educators in supporting children with TBIs.

Definition

Traumatic Brain Injury (TBI) can occur after any trauma to the head. This may be the result of car accidents, sports injuries, falls, self-injurious behaviors, violence, risky behavior, and other related acts. Whether the head injury is closed (no open wound) or open (perforation of the skull), such trauma has a wide range of impact which can be short or long-term in its duration of effects. Traumatic brain injury results not only in problems with the brain but also TBIs can affect impacted individuals physically, cognitively, emotionally, and behaviorally. The brain is the control center for all of the body systems, and consequently, a traumatic brain injury can cause impairment or disability to any of the body's systems. Functional issues with the urinary, endocrine, nervous, cardiovascular, circulatory, gastrointestinal, and auditory systems can occur after a TBI. Vision, hearing, speech, physical movement, and sexual impairments can develop as well. It is important to understand the potential consequences and outcomes of TBI, especially when there have been multiple occurrences [6,7].

Although research has demonstrated that one TBI can have a significant effect on an individual, multiple TBIs can create increased difficulties in functioning and development [8,9], especially in children. Additionally, the potential exists for delayed onset of symptoms, so impairments may not be apparent immediately and may be subtle. The Diagnostic and Statistical Manual of Mental Disorders, 5th edition [10], categorizes the severity of TBI as mild, moderate, or severe, based on several factors which include: the nature and extent of the injury, how long consciousness was lost, and any posttraumatic amnesia (PTA), or immediate loss of memory following the injury. A diagnosis of concussion, or mild traumatic brain injury, can lead to mild or moderate forms of these impairments. Severe traumatic brain injuries, brain trauma resulting in an extended period of unconsciousness (more than 24 hours) can lead to more severe deficits. Pediatric brain trauma can cause any combination of these symptoms to emerge immediately or delayed onset of up to years later post-injury. Identifying the extent of the injury can assist in determining program planning and support ongoing assessment of its effects to the child.

Identification

Many students with brain injury are often not appropriately identified for educational and academic accommodations. This is because deficits sometimes do not appear immediately or are not obviously visible. Children, who have sustained severe traumatic brain trauma during the development years of ages 3 to 8, are at the greatest risk for long-term cognitive and emotional deficits [11].

Young age, particularly 5 to 12 years of age, at the time of injury is a significant predictor of long term deficits in intellectual functioning, attention/focus, language skills, memory, executive functioning, mental flexibility, impulse control, and motor skills [12]. Subtle changes and difficulties are sometimes attributed to factors other than the brain injury, such as missing school for a period of time, and thus, effects of a TBI may be undervalued in terms of the effect on the child's return to school.

It is imperative that students who sustain trauma to the head be observed for changes in cognitive, communication, physical, emotional or behavioral changes. Collaboration between the school, family, and medical professionals is important in assisting in the identification and treatment planning process. If academic deficits continue after educational intervention, the student may need to be referred for school based screening and assessment. This formal process can be initiated by the teacher, school counselor, or administrator in the school. If indicated, a referral can be made to the special education department. Medical records can help support the purpose and necessity of the referral for testing as TBI is an eligibility category under the Individuals with Disabilities Act (IDEA). Outcomes of testing may provide helpful interventions to support a child's continued development. Some students with TBI may need a 504 plan or special education services with an Individual Education Plan (IEP) in order to succeed in school.

TBI related deficits

Effects of a TBI need to be appreciated as those unique to the individual and, while there are some similarities among children, there is a high degree of differential outcomes; thus, symptoms and effects vary by person and can be extremely complicated. Challenges that result from a TBI are also common in students with other disabilities, such as the emergence of learning disabilities, but the identifying characteristic of traumatic brain injury is a sudden brain injury that interrupts the development of the child's brain. Consequently, for those with a TBI, there may be noticeable or subtle "before and after" changes in physical, academic, and social skills. Some results of a TBI may not appear for months or years after the injury, in these instances, effects of a TBI may manifest as academic tasks become more complex and require higher level thinking skills. Deficits and symptoms of a child with TBI can include any number of the following challenges: cognitive difficulties, communication problems, adaptive functioning deficits, emotional/behavioral challenges, and/or physical and sensory effects.

In working with students who have a TBI, it is helpful to determine their level of self-awareness regarding the TBI and its effects by identifying any changes in relationships with family and friends. Any loss or change of social skills and abilities and any personality changes that occur should be recognized and addressed. Additionally, it is imperative to determine if evidence exists to indicate a loss of previously learned skills or a reduction of academic performance based on a history of performing at a higher level. Finally, identification of any difficulties that began after an event that may have caused a TBI should be determined and documented. These considerations will assist educators and school personnel in helping students who have a TBI to maximize their potential and obtain needed accommodations and supports within the school setting.

Cognitive: Students with traumatic brain injuries often show significant differences in their abilities, doing well in some areas and poorly in others. These discrepancies in skills and performance can

make progress more unpredictable and difficult to determine. When cerebral development is traumatically interrupted, this influences brain regions that are required for the maturation and execution of functional skills. Students with a TBI can have difficulty following complex directions, comprehending commands or directions, taking tests, learning new skills, making connections between learning, concentrating, and meeting deadlines. Children who have sustained a traumatic brain injury score significantly lower than other children on intelligence tests and in the reading, mathematical, and language portions of academic testing [13]. Problems may also occur which include disorientation, confusion, concentration, information processing difficulties, short and long-term memory, multi-tasking abilities, attention, organization, and ability to follow directions. Middle aged and adolescent children generally struggle with reading comprehension and retention as injury to the brain after the skills have developed can cause impairment and/or slowing to the frontal and temporal lobes [14]. In turn, this creates issues with cognitive expression when relaying and using what they have heard or read. Depending on the severity of the injury, this may improve over time as the brain heals. Often unrecognized is that TBIs, dependent on the area of the brain involved, can interrupt executive function development, which occurs in the prefrontal cortex. This impacts the child's ability to regulate emotion and the student may appear more impulsive, less socially adept compared to previous ability, have difficulty with shifting from one topic to another, or exhibit challenges in flexibly adjusting or coping with multiple stimuli in their environment.

Fatigue: Mental fatigue, or neurofatigue, is common after a traumatic brain injury in children and causes a reduced capacity for educational and social activities. It is estimated that 30% of traumatic brain injury victims live with severe neurofatigue for more than six months after injury [15]. This extreme fatigue can be devastating to a student who is trying to get through an entire school day. Children with post-traumatic neurofatigue will be capable of performing activities requiring mental effort for short periods of time and then become exhausted. Regaining the energy to continue activities, either physical or cognitive, take a longer period of time than normal. Recovery times can reach up to twenty-four hours before a child is sufficiently mentally rested to continue with activities that require concentration, organization, focus, and mental processing abilities. Post-traumatic neurofatigue is related to decreased neuronal efficiency within the brain after a traumatic injury with extreme taxation to mental and concentration capabilities [15]. Fighting this chronic fatigue can cause children to become irritable and have increased symptoms such as headache and cognitive difficulty. Getting back into a demanding school schedule with this level of mental exhaustion is difficult at best. Consequently, students may need a reduced paced schedule and/or extra time allotted for assignments while weathering this condition. The effects of fatigue following a TBI vary in duration, and it is essential that educator and others involved in teaching and supervising children's activities be aware and responds with understanding, empathy and compassion. The child may experience frustration with their own change in abilities, which can impact their esteem and communication or interaction with others.

Communication: Nonverbal and verbal language can be impacted in students with TBI. Impaired communication skills can affect children with traumatic brain injury at all ages; however, young children injured between ages 0-7 are more likely to have expressive and receptive language deficits [16]. In this particular age group,

it is difficult for these children to express themselves effectively due to the injury occurring before the brain could complete its developmental processes [17]. They may have pragmatic and/or expressive communication impairments ranging from mild to severe. Students may perseverate in their communication and have difficulty interpreting social cues. They may experience difficulty initiating and sustaining conversation, in addition to misusing or misreading facial expression, tone of voice, and body language.

At times, students may engage in socially unacceptable or inappropriate communication post-injury when none of these symptoms were present prior to the head injury [18]. These students often display impaired social skills, including lack of empathy, impaired ability to recognize social cues, lack of emotion, dysregulation of emotions, inability to display appropriate reactions, and/or lack of self-esteem. These deficits cause disruptions to social functioning and can contribute to psychological distress, social isolation, and reduced self-esteem, leading to a significantly reduced quality of life [19]. Students with traumatic brain injury often have difficulty following directions, and understanding abstract concepts leading to problems in verbal, expressive, and written communication. These difficulties can create stress for the child, and cause negative emotional and social interactions with peers as well as the adults in their environments.

Adaptive functioning: Students with TBI frequently show deficits in adaptive functioning (e.g., daily living skills, communication, decision making, problem solving) [20,21]. When students have sustained a traumatic brain injury, any tasks that require organization, planning, decision making, judgment, memory, time management, and flexible thinking are often affected. Adaptive functioning deficits can contribute to student's having issues with learning new skills and making positive behavioral choices. Many students will attempt to hide or compensate for their difficulties, causing further decline in their academics without educator and parental interventions [22]. As a result, it is highly recommended that assessment procedures explore the presence of adaptive functioning impairments, particularly its impact on educational capabilities. Throughout this process, educators must keep in mind what resources are needed and available for students impacted by TBI who experience deficits in adaptive functioning.

Emotional/Behavioral challenges: Changes in emotional expression, management, as well as behavior are sometimes evident following a traumatic brain injury but may also become apparent over time. This can stem from frustration, anger, fear, or just the inability to express themselves effectively. Poorly controlled behavior in these children has been linked to difficulty in family, educational, vocational, and social settings [23]. Such challenges vary and may include a range and combination of: aggression, anger, anxiety, decreased motivation, depression, frustration, impulsivity, irritability, problems with peer relations, withdrawal, and difficulty understanding social interactions. Students with a TBI often exhibit social difficulties among peers and sometimes with authority figures, including teachers, administration, school officials, and school counselors. Pediatric brain trauma has been linked to various psychiatric disorders including personality, anxiety, conduct, and/or mood disorders, Attention-Deficit-Hyperactivity Disorder (ADHD), and depression [24]. Children living with a TBI can display emotional lability, or rapid changes in mood, changing from laughing to crying, or withdrawn to aggressive within a few minutes as a result of brain trauma.

Pediatric TBI can cause changes in personality, and to the extreme, may cause personality disorders; most commonly aggressive, disinhibited, or apathetic features [24]. These children can show apathy, or disinterest, in possessions and/or activities that gave them pleasure prior to their injury. In some cases, it is possible for aggressive or disinhibited behavior to occur. Some children living with a TBI can develop a lack of personal restraint and disregard for social norms. These behaviors are usually seen in the more severe, early pediatric injuries. In some cases, mood and behavioral problems may resolve within the first year after injury; however, these conditions may persist or even worsen as the child ages. Students with TBI often experience difficulty with self-regulation and making appropriate choices. For those children living with a TBI who exhibit impulsivity and difficulty making appropriate choices, the potential exists for problems related to self-medication and/or non-compliance in taking prescription medications which can lead to secondary issues of possible drug abuse. Early intervention for behavioral disturbances is critical to minimize the impact on the educational process and the potential for self-medication and substance abuse [25].

Physical impact: Following a traumatic brain injury, damage to the nerve cells in the brain may occur. This may cause changes in the physical abilities of students who have sustained a TBI. Motor deficits may include weakness, difficulty with balance, difficulty with coordination or mobility, loss of muscle strength, experiencing headaches, hearing and vision changes, fatigue, and sleep disturbance. Students with TBI may also experience chronic pain and an average of 19% of children after suffering a moderate to severe TBI will experience posttraumatic seizures [26]. Hence, communication with families and their medical professionals is important in recognizing the potential for these possible symptoms. Sometimes physical effects will resolve quickly and other times, they may not resolve fully. Children with chronic illness or physical disability have lower self-esteem than their peers and when tested, children with chronic headaches or chronic fatigue syndrome (two common side effects of pediatric TBI) have shown the lowest levels of self-esteem [27]. As noted, effects of traumatic brain injury are individual and case specific. Consideration in the classroom must involve modifications to the environment and accommodations in an effort to address any physical accommodation needs resulting from a TBI. Educators who are cognizant of such potential complications can plan the classroom environment accordingly. Furthermore, structuring the schedule and classroom to allow for frequent breaks and refocusing efforts will be of benefit for these students.

Long-term: While many children who sustain a TBI at a young age will recover to baseline within one year, there are some who will continue with lifelong symptoms and cognitive impairment. Injury severity is a strong predictor of the likelihood of issues lasting longer than 12 to 24 months [28]. Children with moderate to severe traumatic brain injuries are more predictive of long term personality and behavior changes, impaired cognition, communication and memory deficits, and decreased executive functioning ability. Brain trauma during critical periods of brain development can stunt the child's ability to mature emotionally [19]. For example, if a child suffers a severe traumatic brain injury at age 11, their emotional maturity will likely be stunted, and be less likely to develop past that age level; resulting in impaired ability to express and understand higher level emotional functioning in adulthood. If these impairments are left untreated, or are not supportively nurtured, mental health disorders and/or possible maladaptive behaviors can continue well into the

child's adult life. Those who suffered a pediatric brain injury are more likely to have lowered IQ, decreased quality of life and educational and employment problems [29].

Strategies and interventions

Identifying deficits: Before educators can define strategies and interventions for an impaired child that will truly benefit their learning, specific deficits and limitations must be identified. No one plan for all students with impairments from traumatic brain injury will be adequate or effective. Neuropsychological testing analyzes a wide range of cognitive, attentional, problem solving, language, processing speed, memory, behavioral, social, and organizational functioning to define deficits and create a blueprint of the child's needs. A battery of tests is administered, and the results are compared to peers of the same age. The outcome of the testing is a comprehensive mapping of the child's abilities to assist in planning for therapeutic interventions at school and home. The first round of testing can be completed within three months of the initial injury; when this occurs is an individual process depending on the severity of the injury. A child's neuropsychological profile may not necessarily be stable within the three-month post-acute period after a severe TBI, thus a comprehensive neuropsychological evaluation may not yet be indicated until weeks later [30]. Each case requires prudent judgment by the child's medical and educational team. This collaborative team will determine where testing should occur, whether within the school district, if possible, or with a neuropsychologist of the doctor's choosing. This comprehensive testing is a vital first step to successful educational planning and execution of beneficial interventions.

Concentration/Attention strategies: Students who have sustained a traumatic brain injury often display attentional problems. To address such difficulties, educators will want to take a developmental approach to teaching intervention strategies and, thus, break down tasks into smaller steps and communicate each step clearly. To assist students in retrieval and retention of information, students can be asked to repeat oral directions after each step is delineated which helps the student with practicing recall, and builds confidence in learning settings. Cueing the student can aid in focusing attention on the task at hand, this promotes focus and provides the opportunity for positive feedback and reinforcement in learning settings [31]. Providing large print text books or copies of notes can also benefit some students who may experience vision and/or attentional difficulties. At times, a note-taker, or recorded lesson content may be of benefit to students so that they may preview or review information from classes at home. It is also helpful to reduce distractions whenever possible, in some cases it may be supportive to the child to have a separate room for test taking and examination completion. Educators can help to minimize extraneous stimulation by organizing the classroom to accommodate small groupings, allow preferential seating, and limit schedule interruptions.

Organization strategies: Organization is critical to academic success and students will benefit when offered strategies focused upon organization and time management. Providing written checklists and assignment information is helpful to address organizational needs. Of benefit is to teach sequencing of tasks so that students can eventually plan their own task completion schedule. Breaking larger assignments or complex tasks down into smaller, simple steps will aid students in structuring their work leading to effective prioritizing and result in more efficient task completion [31]. Students can be encouraged to complete one step, or task, in a series of steps, which helps the student

re-learn how to sequentially complete tasks successfully. Using color-coded materials for each class, such as pencils and notebooks, can assist with organization and memory. Moreover, providing a written daily schedule and noting transition changes should be provided whenever possible. It is important to consider the child may experience distress with changes and preparation so planning the changes with the student can enhance their comprehension and willingness to adjust to the change. Additionally, time extensions on assignments may be warranted as an academic accommodation and when possible, it may be helpful to allow reduction in written work required [32].

Following directions strategies: Providing instructions in oral and written format can assist students in understanding academic tasks. It can be helpful to ask student to repeat oral directions to ensure that understanding is clear. Teaching students how to highlight relevant information will encourage comprehension and focus. Breaking assignments and complex tasks into manageable steps offers clarity for students [32]. It is also beneficial to provide immediate frequent repetition and positive reinforcing feedback about their efforts and progress when possible. Sometimes, change in curriculum or assignment content or a slower learning pace may be warranted to meet the child at their current developmental level and offer students an opportunity to be successful.

Memory strategies: Repeating and summarizing information provided to the student will result in better comprehension and increases the potential for lasting impact. Thereafter, inviting the student to summarize what was stated or questioning the student about the information shared in order to be sure information was interpreted clearly can aid them in assignment clarification and completion as well as aid in metacognition and insight. The use of written reminders such as assignment sheets, calendars, and graphic processes such as outlines, mind maps, models, or progress notes will assist in memory consolidation and retention. A written daily schedule or class lesson can benefit students who experience memory difficulties [32]. Teaching students to organize information into categories will assist them in remembering content. Another effective strategy is linking new information to previously learned material as it can help in storing new information and recalling it when needed. Finally, the use of assistive devices such as computers, calculators, or other devices may be important to be considered to facilitate learning for children who exhibit memory difficulties [33].

Applied behavioral analysis: Applied Behavioral Analysis (ABA) has been successfully utilized to help children with TBI related behavior or anxiety problems reacclimate to their home and school environments [34]. ABA is a multidimensional treatment that can be used to target communication deficits, anxiety, aggression, social interactions, and activities of daily living [35]. The intention of ABA is to use techniques geared to increase prosocial, useful behaviors and reduce behaviors that may interfere with learning. Both one-on-one and group instruction can be utilized with this method and students are encouraged to learn and practice skills in structured as well as unstructured settings. With participation in high-quality ABA programs, students have experienced significant improvements in learning, reasoning, communication, interpersonal interactions, and adaptability. The intervention involves identification of desired goals, skill breakdown into manageable steps, and ongoing measurement of progress. ABA helps to promote effective behaviors through the use of frequent reinforcement of preferred skills or behaviors [34]. Using

this method of treatment within the classroom can assist children with anxiety and behavioral problems to ease symptoms and get the most out of their classroom experience.

Conclusion

Educators have a unique responsibility and opportunity to assist in addressing the needs of students returning to school after experiencing a traumatic brain injury. Due to the wide variability of impact and possible challenges, it is crucial for school professionals to have an understanding of TBI so that student needs can be effectively identified and addressed. With an understanding of what injury occurred and awareness of its effects, educators can be instrumental in designing classroom interventions addressing individual student needs. Educators are tasked with ensuring that proper assessment and instructional strategies are implemented to ensure successful reintegration into the school setting. Through collaborative efforts with families and medical professionals, such educational planning can offer students with TBI an opportunity for accommodations and modifications geared to meet their learning needs. Information combined with effective interventions will ultimately assist the student, family, and school personnel in planning for positive student learning and prosocial outcomes.

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