

Mild Traumatic Brain Injury

Muskaan Sachdeva

Abbreviations:

- **mTBI:** mild Traumatic Brain Injury
- **CIS:** concussion in sports
- **LOC:** loss of consciousness

Introduction

Concussion in Sports (CIS), also known as mild Traumatic Brain Injuries (mTBI), was not deemed to be a hot topic in research two decades ago. As a result, there had been a poor management of mTBI symptoms, such as headaches and concentration difficulties, which served to be an impediment to the physical, social and mental functioning of affected athletes. Recently, recurrent concussions to several athletes, some of whom were forced into retirement, have increased awareness amongst sports personnel and general public. Since 1999, many researchers have focused their attention on concussions resulting from sports and uncovered various long-term cognitive and emotional disturbances associated with mTBI. The literature primarily outlines management of students' return to their respective elementary and high schools following an mTBI; however, research on the management of post-mTBI symptoms for students returning to post-secondary school has also recently gained attention amongst

researchers. Persistent symptoms following mTBI, labelled as post-concussive disorder, include headache, fatigue, disordered sleep, dizziness, irritability, anxiety, depression and changes in personality. These can result in substantial functional disability interfering with patients' ability to return to work or school and can result in low levels of satisfaction with quality of life. The following article will detail the current state of knowledge on the symptom management guidelines for students upon their return to post secondary school in two defining categories: those who arrive at post-secondary school already having suffered an mTBI, and students who suffer mTBI while attending post-secondary school.

Definition of Concussion

Concussion and mTBI are separate entities wherein concussion is a sub-set of TBI. Four international symposia on CIS were held in the Committee on Head Injury Nomenclature of Congress of Neurological Surgeons: Austria in 2001, Czech Republic in 2004, Switzerland in 2008 and Zurich in 2012 respectively. The consensus statement that emerged from the third symposium defined concussion as "a complex pathophysiological process affecting the brain, induced

by traumatic biomechanical forces”. Moreover, the consensus definition proposed five major features that help identify the nature of a concussive head injury:

1. Concussion may be caused by a direct blow to the head, face, neck, or elsewhere on the body with an “impulsive” force (sudden large force acting for short time) transmitted to the head.
2. Concussion typically results in the rapid onset of short-lived impairment of neurological function that resolves spontaneously.
3. Concussion may result in neuropathological changes, but the acute clinical symptoms largely reflect a functional disturbance rather than structural injury.
4. Concussion results in a graded set of clinical syndromes that may or may not involve loss of consciousness. Resolution of the clinical and cognitive symptoms typically follows a sequential course.
5. Concussion is typically associated with grossly normal structural neuroimaging studies.

It has also been taken into account that post-concussive symptoms can prevail for prolonged periods. Alternatively, DSM-5 categorizes concussion as, “Major or Mild Neuro-cognitive Disorder Due to Traumatic Brain Injury” and distinguishes between two categories based on the severity of impairment in language, attention and memory.

Epidemiology

There are 300,000 cases of CIS reported annually. Students in post-secondary schools, primarily the 18 year olds, have a higher incidence rate of CIS than 13-14 year olds and high school students combined. The reported rate of concussion injuries is 0.5-3 injuries per 1000 athlete exposures at collegiate level compared to 0.14-3.66 injuries per 100 player seasons at high school

level. Football, a very popular sport in post-secondary education, has the highest incidence of concussion. However, CIS injuries are often underreported due to inaccuracy in self reporting and the varying definitions of mTBI. This is primarily due to the likely absence of clinical symptoms in most cases and also because of the myth that concussions do not require medical intervention. People often identify concussions after the occurrence of loss of consciousness (LOC); however, only 10% of CIS cases involve LOC. Hence, 300,000 annual cases of CIS just represent the tip of the iceberg! Apart from sports, TBI in children and adolescents can occur following motor vehicle accidents, crashes, falls, and physical abuse and can leave them with long lasting and significant alterations everyday functioning, including social, physical, behaviour, and cognitive functioning/aspects.

Effects of mTBI

CIS can be difficult to diagnose because the majority of concussions that occur in sports occur without loss of consciousness. CIS involves a constellation of cognitive, physical, emotional and social effects in affected athletes and can follow a long and protracted course. Emotional and social effects of CIS have not been extensively investigated due to their subjective nature, making these variables harder to quantify.

Physical

Post concussion syndrome (PCS), a condition resulting after a mild or moderate head injury, may lead to headaches, nausea, vomiting, dizziness, fatigue, migraines, sensitivity to noise, and vision problems. The most frequently reported out of these symptoms are headaches.

Cognitive

Cognitive effects include problems in general intellectual function, memory and attention, reaction

time, and visual and motor abilities. Additionally, there can be significant impairments to the ability to organize, concentrate, and plan and monitor behaviour. Bassett and Slater reported residual cognitive deficits in verbal learning, abstraction and reasoning, with relatively intact cognition in other domains. Surprisingly, students who suffer an mTBI as children do not show cognitive symptoms until they reach adolescence. As a result, such students may suffer from academic difficulties as they enter post-secondary education even though their high school academic life remained unaffected by their CIS.

Emotional

Students in post-secondary school with a history of mTBI show increased emotional distress compared to their peers without a history of mTBI. The limited literature on students who arrive at postsecondary school already having suffered a TBI suggests that while academic and cognitive issues may be resolved, it is likely that these students will still have significant emotional problems such as anxiety, depression, apathy, aggression, irritability, frequent mood swings or emotional symptoms for several years afterwards. Often times, emotional symptoms resulting from an acquired CIS go unnoticed by physicians due to their subjectivity and lack of guidelines for diagnosis. Also, psychological symptoms may be hard to distinguish from psychological reactions secondary to being kept out of sports or school. Ewing-Cobbs and Fletcher in 1987 stressed that emotional and behavioural effects of childhood and adolescent mTBI need further investigation.

Social

TBI adversely affects leisure and recreation, social relationships, functional status, quality of life, and independent living.

Due to the physical, cognitive and emotional deficits after CIS, individuals having suffered CIS might face social implications including fears of being scrutinized, judged or embarrassed in public. As a result, they might avoid social activities such as public speaking and attending social gatherings. The individual may also feel isolated from peers and social networks leading to many emotional effects such as feeling lonely, sad and frustrated.

The physical, cognitive, emotional and social effects are interlinked and occur simultaneously in a cyclic manner. Given this inter-relationship, concussion effects can vary across students demanding that academic adjustments are tailored to each student's particular circumstances.

mTBI: A growing issue gaining attention

In 1987, Ewing Coobs and Flescher stressed the need for more research in childhood and adolescent mTBI. Compared to adults, the effects of TBI in children may be long lasting and widespread due to the role that developmental changes in physical (puberty, body image and sexuality), interpersonal (family functioning, peers and self-concept) and environmental (transition to post-secondary education) domains play in the recovery from TBI. Many other moderator variables such as psychiatric history and family functioning impact the severity of signs and symptoms caused by CIS in post-secondary students. However, these variables are difficult to evaluate due to their subjective nature. Therefore, it might not be appropriate to predict functional outcomes of CIS in adults based solely on objective results; other variables (such as social, emotional, cognitive) and their interlinks should also be taken into account.

A remarkable increase in the awareness of mTBI resulting from sports has been witnessed since 1999.

Before that time, children and adolescents were allowed to resume their regular academic and recreational activities immediately after their symptoms subsided. The issue of returning to school and recommencing play was not discussed until the 3rd International Conference on CIS held recently in 2008. The consensus panel in the fourth international symposium on CIS agreed that concussion is one of the most complex sports injuries to diagnose, assess and manage. Since then, multiple researchers have been focusing on the symptomatic course of CIS, primarily the prolonged cognitive and emotional effects on the individual's brain. Post concussion symptoms may not manifest until return to work. Increasing knowledge about the risks of CIS has yielded better strategies and guidelines of managing students' return to their respective elementary and high schools. However, the studies pertaining to CIS in adolescents and their return to post-secondary school still remains an area that has not been thoroughly explored.

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