



Special Feature:

# The Causes and Consequences of Traumatic Brain Injuries

Awareness surrounding traumatic brain injuries (TBIs) and chronic traumatic encephalopathy (CTE) has grown over the last decade. Dr. John S. Gaal, a longtime construction educator, and Cal Beyer, a management consultant in the construction risk/insurance industry, explain that construction workers are among the employees at higher risk for these conditions and, therefore, employee benefit funds, apprenticeship funds and employers should be aware of the risks and implications. Gaal and Beyer interviewed a panel of experts on TBIs and CTE, and their responses are reflected in this article.

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**John S. Gaal, Cal Beyer:** According to the Centers for Disease Control and Prevention (CDC), approximately 150 people die each day from the effects of traumatic brain injuries (TBIs).<sup>1</sup> TBIs most frequently result from slips, trips and falls from various heights. These falls can occur while working on both elevated and ground-level surfaces. Falls can likewise occur on a variety of surface materials and conditions, including dry, wet, oily, and icy or snowy. Other common causes of TBIs are motor vehicle accidents and “struck-by incidents” on

construction jobsites, which may occur when untethered tools are dropped or where protective systems are not in place. TBIs can occur in the workplace or at home while people are engaged in daily activities or household chores or during recreational activities. Importantly, TBIs can happen to anyone.

TBIs pose a growing safety risk to the physical and mental health and well-being of construction workers. A 2009 study noted “that greatest number of serious work-related injuries involving a TBI were in the construction industry.”<sup>2</sup> Moreover, the construction industry actively recruits and hires workers whose prior work background may have exposed them to concussions and other forms of TBI, namely military veterans and former high school and collegiate athletes.

The remainder of the article is presented in an interview format. A panel of medical and research professionals representing various specialty disciplines was asked interrelated questions to provide a deeper understanding of the complexity of TBIs.

Employers and employee health benefit plan administrators and trustees should learn the importance of prevention, prompt and proper treatment, and recovery protocols for known or suspected TBIs.

### Mental Health and TBIs

**Gaal/Beyer:** According to CDC (2016), the construction industry had the most fatal and nonfatal TBIs among U.S. workplaces.<sup>3</sup> More than 2,000 construction workers died—

from 2003 to 2010—representing approximately 25% of all construction fatalities. Describe the types of TBIs and whether they can lead to mental health issues (i.e., depression, post-traumatic stress disorder (PTSD) and suicide).



**Cary Gunther:** TBIs are common, costly and sometimes devastating. TBIs are categorized based on severity since this helps predict the

degree of recovery, i.e., how well patients will perform months or years after sustaining a TBI. The neurological status of the TBI patient upon presentation to medical care, the duration of loss of consciousness, the degree of memory loss and the presence of findings such as intracranial blood on CT scans or MRIs are all factors in determining severity. When there have been many instances of head contact, even “minor” traumas that do not reach medical attention contribute to long-term neuropsychiatric risk.

Between 25% and 50% of TBIs will be followed by major depression in the first year after the event. Loss of independence, changes in relationships and financial burdens that arise after head trauma all contribute to this risk. Furthermore, disruption of endocrine function, which can be an unrecognized consequence of head trauma,

causes symptoms that closely resemble those of depression.

*Pseudobulbar affect (PBA)* is another possible outcome and is best described as a discrepancy between the way emotion is displayed and the way it is experienced. Inappropriate or excessive laughter, anger and crying can occur. It is often transient in concussion but can be longer lasting in more severe TBIs. PBA is associated with impulsive and risky behaviors.

Generalized anxiety disorder and obsessive-compulsive disorder double-up in incidence after TBI. PTSD is a special challenge; PTSD overlaps with TBI in symptoms and can occur even in people who lost consciousness. Restricted enjoyment or tolerance of usual activities, social isolation and loss of coping outlets increase the chances of these conditions. Substance abuse disorders pose a risk for TBI and also are a possible outcome.

Mental health issues are thus quite common in individuals who have experienced TBIs. Mood disorders, substance abuse and PTSD are independent risk factors for suicide. A large population study recently found that people who died by suicide were twice as likely to have sustained TBIs. Individuals with more severe injuries and larger numbers of TBIs were at greater risk. Suicide risk and prevention should be routinely addressed in people who have sustained TBIs.

*experience PTSD-like symptoms while more than 300,000 have been diagnosed with TBIs since 2001. How does your research assist returning service members in dealing with the impact of PTSD and/or TBIs while trying to assimilate into society and the workplace?*



**Eric Hart:** The co-occurrence of PTSD and TBIs is a very significant concern for researchers and clinicians working with active-duty sol-

diers and military veterans. While such injuries are often unavoidable, understanding the mechanisms that predict both positive and negative functional outcomes will be essential for optimizing recovery, mitigating long-term effects and hopefully facilitating successful community reintegration. Individual differences have been found to play some role in determining recovery from injury.

My interest involves examining baseline, or preinjury, factors, such as biological influences—including neurohormonal status, cognitive reserve and psychological coping—as either individual or composite predictors for outcomes. Understanding the interactions of these variables, we hope, will result in ultimately establishing comprehensive and individualized interventions. By developing individualized assessments and multimodal treatments tailored to address one’s unique biological and psychological characteristics, we hopefully can have a dramatic impact on short- and long-term recovery outcomes.

## learn more

### Education

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### PTSD and TBIs

**Gaal/Beyer:** *Amidon and Lu (2017) posit that the invisible wounds of war include both physical trauma (i.e., TBIs) and psychological trauma (i.e., PTSD).<sup>4</sup> In fact, upwards of 540,000 service members who served in Iraq and Afghanistan*

### Changing Views on Concussion and Sports

**Gaal/Beyer:** *In a study by Kerr et al. (2019), where athletic trainers reported*



*weekly injuries, it was found that high school boys football had the highest rates of concussions followed by girls soccer and boys ice hockey.<sup>5</sup> Nearly 64% of the concussions occurred during competition; however, girls cheerleading was the only sport to report a higher concussion rate during practice than in competition. Share how your personal experience of playing rugby at the university level has informed your research on TBIs, chronic traumatic encephalopathy (CTE) and suicide.*



**Adam J. White:** As a researcher, I love sport. I played sport and have worked in sport all my life. It has many great aspects that many of us

enjoy. That said, we need to be honest about the risks and problems associated with sport, particularly those that have a risk of hitting your head. In my case, it was rugby. But we could easily be talking about contact football, soccer, ice hockey, lacrosse, the fight sports and more. I have become concerned about the issues around concussion, TBIs and neurodegeneration in contact sports, particularly in youth contact sport in the education context in the United Kingdom. Most boys are required to participate in contact sport as part of school physical education in Britain and therefore are being subjected to the repetitive head impacts that we are all concerned about.

As my research work has progressed, I have become increasingly interested in the longer term aspects of concussion, particularly CTE. But while the focus of scientists to date has been on understanding more about CTE in the brain, I have been particularly interested in the stories, the people and the families. I want to know how CTE affects people's

lives—and not only the athlete but also the loved ones, the friends, the brothers, sisters, parents, children and more. I want to hear about their experiences, their memories and their advice.

By doing this, we hope that we can raise people's understanding of concussion and CTE, so that people can see and feel what it means to have CTE and the impact that concussions have on people's lives. We also want to be able to share people's stories to allow others who are currently living with the condition to better cope and manage the challenges. Each story gives us another insight into the condition and how we can tackle it.

To put it bluntly, hearing concussion statistics now makes me feel sick. Because behind each head knock, there is an athlete's brain and a life that may be irreversibly about to change. I want to stop that grief, sadness and loss.

### Accelerating Research

**Gaal/Beyer:** *In a recent Policy Vet podcast (2021), you provide the background of how and why the Concussion Legacy Foundation (CLF) was created over a decade ago out of your need for answers related to concussions you suffered as a college football player and professional wrestler.<sup>6</sup> In the past couple of years, CLF widened its research efforts to include athletes in Australia and Brazil. Share what the impetus was to expand CLF's research work beyond that of sports-related TBIs in the U.S.*



**Chris Nowinski:** When we founded CLF in 2007, we were primarily focused on sports-related TBIs, but we suspected there was a deeper problem with the long-term effects of repeated head impacts. We partnered

### Getting Involved: Concussion Legacy Foundation HelpLine

Readers can get involved in the work of the Concussion Legacy Project by joining CLF's clinical research registry or by pledging their brain to the CLF brain bank at [www.PledgeMyBrain.org](http://www.PledgeMyBrain.org). If you or a loved one is fighting the effects of concussions or suspected CTE, reach out to the CLF HelpLine at [www.ConcussionFoundation.org/HelpLine](http://www.ConcussionFoundation.org/HelpLine).

with Boston University to start a brain bank to investigate those effects, including CTE, a little-known disease we used to call "punch drunk" because it was only thought to exist in boxers.

CTE and other brain diseases related to brain trauma can be studied only through brain donation, so we began an outreach program for the brain bank. After studying 1,000 donors, we have proved that, for some, concussions and repetitive head impacts have lifelong repercussions. Scientific breakthroughs have only been possible thanks to families who have donated the brain of a loved one.

CTE is a degenerative brain disease caused by repetitive head impacts that can cause neurobehavioral dysregulation and impaired cognition. It can cause dementia by a person's 50s or derail a life in one's teens or 20s. Now that we understand the devastation of the disease, we realized we need to recruit the global scientific community to the fight.

In 2018, we launched the CLF Global Brain Bank to accelerate research by collaborating with leading scientists at



brain banks around the globe, where we often identify the first cases of CTE in those countries. The CLF Global Brain Bank is now active in Australia, Brazil, Canada and New Zealand. In Australia, we have already identified the first cases of CTE in Australia Rules Football and Rugby League, which has started a national conversation on brain trauma in sports.

We have also shown that CTE affects military veterans. Thus, we launched Project Enlist to encourage brain donation among veterans to ensure that we can better solve the invisible wounds of war, including TBI, PTSD and CTE.

### Concussion Management for Apprentices

**Gaal/Beyer:** *In 2009, you started a pediatric concussion management program called REAP (remove/reduce, educate, adjust/accommodate and pace) for all students after a Colorado high school football player died following back-to-back TBIs/concussions in 2004.<sup>7</sup> Briefly explain how educators might transfer lessons learned from your “Return to Learn” and “Return to Play” models by applying these toward schooling and work (vs. play), respectively, in their postsecondary apprenticeship training programs.*



**Karen McAvoy:** The focus of the REAP booklet is to make sure that all four teams work together—the family team, the school physical team, the school academic team and the medical team. While all teams have crucial roles, not all teams are supporting the person

with a concussion in the same way or at the same time. The school physical team (the coach/athletic trainer) and the medical team may be instrumental in the initial diagnosis and subsequent clearance of a concussion. The family team and the school academic team are instrumental in the day-to-day “management” of the concussion throughout the weeks in between injury and clearance. This model is applicable to persons returning to school, to work or to postsecondary apprenticeship training programs throughout the first to fourth weeks of recovery.

Practical approaches for applying the REAP model to the workplace and apprenticeship training programs include the following.

- Being able to manage symptoms is the first hurdle. If persons with a concussion struggle with intense symptoms, they will not feel well enough to even be at a work, school or an apprenticeship setting. A job,

### Quick Tip for Supervisors

Seek proper medical help for a worker who recently may have experienced a head injury if any of these symptoms arise:

- Irritability
- Light sensitivity
- Confusion
- Forgetfulness.

### Fatigue and TBIs

According to Dumsa and Spears (2021),\* reports have shown that nearly 98% of the people who suffer traumatic brain injuries (TBIs) also experience some form of fatigue. These forms of fatigue are often referred to as *mental*, *cognitive* or *neuro-fatigue*. Unfortunately, these people are sometimes mistaken as lazy or unwilling to participate in daily activities. It is important to note that many of these individuals have motivation but lack the energy to keep up with daily demands.

\*[www.biausa.org/public-affairs/public-awareness/challengemagazine/health-challenges](http://www.biausa.org/public-affairs/public-awareness/challengemagazine/health-challenges) (pp. 12-14).

school or apprenticeship program needs to first provide a “soft landing” for persons with symptoms by providing frequent, short rest breaks.

- Once a person can keep symptoms at bay, the amount of mental exertion needs to be removed and reduced. Just like we ask teachers to remove nonessential in-class/homework and reduce semiessential in-class/homework for students with a concussion at school, bosses, supervisors and instructors must be mindful about the amount of work expected in a work or training setting during recovery.
- Finally, the essential elements of a job, lesson and/or training need to be met for the person with a concussion to get a fair paycheck or grade or certificate. Supervisors need to ask: What level of mastery needs to be demonstrated, and how should the person with a concussion show that mastery? If there are alternative ways for a person to show they are meeting the requirements of the job, lesson or training (albeit perhaps on a smaller scale, temporarily), progress can continue at work, at


school and in an apprenticeship training program even during recovery from a concussion.

The sidebar “Quick Tip for Supervisors” provides a list of symptoms to look for immediately following a head injury. The sidebar “Fatigue and TBIs” explains how fatigue caused by TBIs can be misinterpreted as laziness.

## Conclusion

Employers as well as employee benefits plan administrators and/or trustees should be aware of the significant human toll TBIs take on the quality of life for affected employees and families. This toll can reduce life expectancy and result in premature death, physical disability, cognitive impairment and mental health conditions including depression, PTSD and even suicide.

Likewise, TBIs exact a major financial impact on employers in terms of workers’ compensation as well as on plan sponsors and participants in multiemployer plan or employer-based disability management and health benefits programs. It is important for all employees in all industries to recognize the risks of TBIs and take measures to pre-

vent and properly manage known or suspected TBIs sooner rather than later. 

**Editor’s note:** Author Dr. John S. Gaal has devoted significant time and energy to increase understanding of TBIs. His son, John Jr., lost his life to suicide in 2017 after suffering the effects of TBIs sustained from multiple concussions while playing high school football and soccer. A research team at the CTE Center at Boston University along with the Concussion Legacy Foundation determined—as Gaal had suspected—that his son’s brain showed CTE.<sup>8</sup>

## Endnotes

1. [www.cdc.gov/mmwr/volumes/68/wr/pdfs/mm6846a2-H.pdf](http://www.cdc.gov/mmwr/volumes/68/wr/pdfs/mm6846a2-H.pdf).
2. <https://doi.org/10.1080/02699050903036033>.
3. <https://blogs.cdc.gov/niosh-science-blog/2016/03/21/constructiontbi>.
4. <http://gwbcenter.imgix.net/Resources/gwbi-addressing-invisible-wounds.pdf>.
5. <https://pediatrics.aappublications.org/content/144/5/e20192180>.
6. <https://podcasts.apple.com/us/podcast/s1e008-dr-chris-nowinski-talks-about-the-brain-bank/id1560985214?i=1000522611979>.
7. [www.invw.org/2019/01/15/colorados-concussion-approach-combines-education-medicine-a-team-approach/?fclid=IwAR2fg6DQRD](http://www.invw.org/2019/01/15/colorados-concussion-approach-combines-education-medicine-a-team-approach/?fclid=IwAR2fg6DQRD) GQ14hzezgda\_Xe5w4UTxDkx3ppiVN6HhWioCah6QILkv\_C5gk.
8. <https://constructionexec.com/article/the-dangers-of-invisible-injuries>.