

From Concussion to Consequence: A Primer on Traumatic Brain Injury



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Traumatic Brain Injury (TBI)

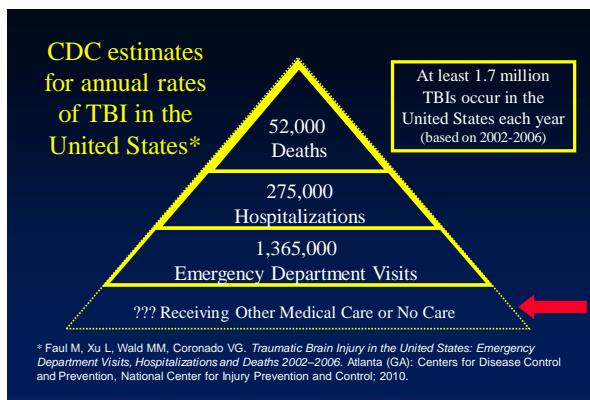
“...an **insult to the brain** caused by an external force that results in an altered state of consciousness and one or more impairments of brain functioning. Effects may be temporary or permanent.”

TBI's Vary in Severity

	Mild	Moderate	Severe
Glasgow Coma Scale Score	13-15	9-12	3-8
Length of Loss of Consciousness	less than 30 minutes	30 minutes to 24 hours	more than 24 hours
Length of Post-traumatic Amnesia	up to 1 day	1 day to 1 week	more than 1 week

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American Academy of Neurologists Guidelines	Grade I: < 15 minutes of symptoms	Grade II: > 15 minutes of symptoms	IIIa secs loc	IIIb mins loc



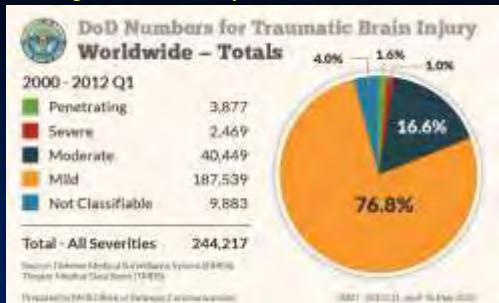
CDC Estimates Applied to Ohio (weighted by 2010 population)

- 2,000 die each year due to TBI
- 11,000 are hospitalized each year with a TBI
- 54,000 emergency room visits each year
- 3,000 over the age of 15 each year survive moderate to severe TBI
- 5,000 each year continue to experience disability one year after hospitalization for TBI
- 125,000 live with a permanent TBI-related disability

Civilian Risk Factors for any TBI

- Males 2:1 more than female
- Very young and very old due to falls
- Adolescents and young adults due to intentional injuries and moving vehicle crashes
- Greatest behavioral risk factors:
 - violence prone or exposed to those who are
 - misuse substances or exposed to those who do
- More likely in lower socio-economic groups

TBI Diagnosed in Military Personnel (combat & non-combat)



TBI among U.S. Military Populations

- during peacetime, over 7,000 annually admitted to military and veterans hospitals with diagnosis of TBI (IOM, 2009)
- 80% of TBIs since 9/11/01 have been non-combat related
- more common among non-combat military personnel than in the general population:
 - high concentration of service members in the highest incidence age groups (18-44)
 - greater risk for injury associated with non-combat military duties
 - greater consumption of alcoholic beverages by military personnel

TBI during OEF & OIF

- During Vietnam War, 12%-14% of combat casualties included a TBI vs. at least 22% for OEF/OIF—IEDs are the primary reason for the difference
- not all TBI diagnosed in theater—estimates range from 10%-20% of combatants may have had mild TBIs (suggesting more than 300,000 service members)
- caution necessary because identification based on subjective experience of both exposure and symptoms

Mild TBI in U.S. Soldiers Returning from Iraq (Hoge et al., 2008)

- 2,525 Army infantry surveyed post-deployment
- 4.9% reported TBI with loss of consciousness (loc)
 - 10.3% reported TBI without loc
 - 17.2% reported other injuries
 - “dose effect” for co-occurrence of TBI and PTSD:
 - TBI with loc: 43.9%
 - TBI without loc: 27.3%
 - Injury without TBI: 16.2%
 - All other soldiers: 9.1%

Symptoms of Mild TBI (concussion)

- Headaches or neck pain
- Light-headedness, dizziness, or loss of balance
- Difficulty remembering or concentrating
- Feeling tired, having no energy or motivation
- Changes in sleep patterns (sleeping a lot more or having a hard time sleeping)
- Mood changes (feeling sad or angry for no reason)
- Increased sensitivity to lights, sounds, or distractions
- Blurred vision or eyes that tire easily

If symptoms do not resolve — “Post-Concussive Syndrome”

Post-concussive Syndrome (PCS) vs. PTSD

<u>PCS</u>	<u>PTSD</u>
Insomnia	Insomnia
Impaired memory	Impaired memory
Poor concentration	Poor concentration
Depression	Depression
Anxiety	Anxiety
Irritability	Irritability
Fatigue	Emotional Numbing
Headache	Hypervigilance
Dizziness	Flashbacks/Nightmares
Noise/Light intolerance	Avoidance

Source: Lisa Brenner, PhD

TBI due to Blasts—the “signature injury” of OEF & OIF



- Can blast forces alone cause mild TBI?
- If so, is it the same pathology as TBI caused by mechanical forces?
- What about multiple blasts?

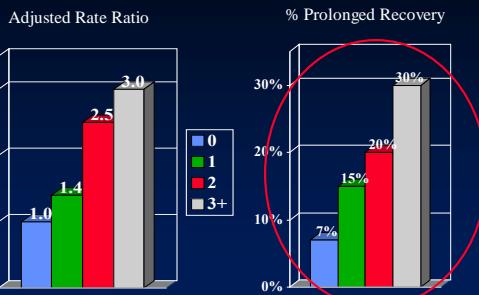
Civilian Groups Who Have Multiple Mild TBI's

- Athletes, particularly boxers, football players & hockey players
- Victims of intimate partner violence and childhood physical abuse
- People who misuse and abuse substances
- People who are homeless

Cumulative Effects of Concussion

- In 15,300 high school and college football player/seasons, those with a history of concussion were almost 6 times more likely to have another, almost twice as likely it would include loss of consciousness (Zemper, 2003).
- In 2,900 college football players, those with ≥ 3 concussions were 3 times more likely to have another; history of concussion was associated with slower recovery (Guskiewicz, et al 2003).

Cumulative Effects of Concussion (Guskiewicz et al, 2003)



Colorado Injury Research Center funded by CDC

- Random digit dialed 2,700 Colorado residents and administered a computer assisted telephone interview based on OSU TBI-ID
- 200 called back no sooner than 6 months later

TBI with loss of consciousness, compared to adults without head injuries only, were:

- almost 3 times more likely to have problems with learning or memory;
- greater than 3 times more likely to have a disability.

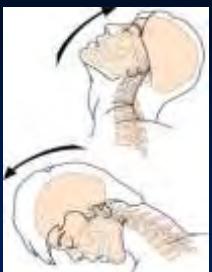
TBI with loss of consciousness, continued:

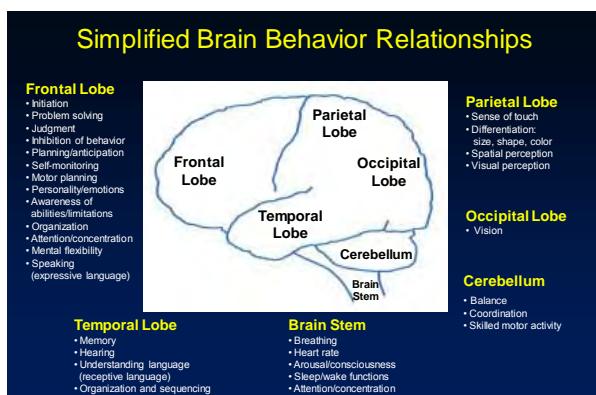
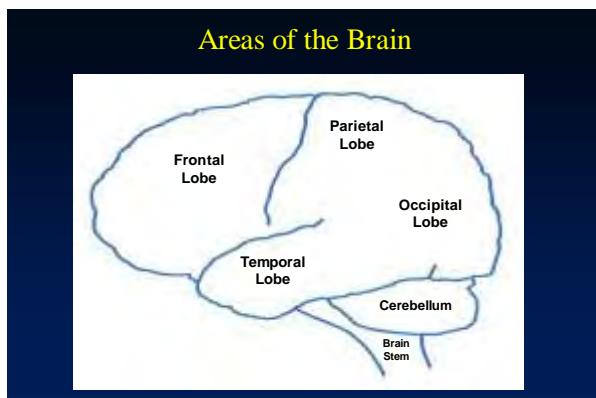
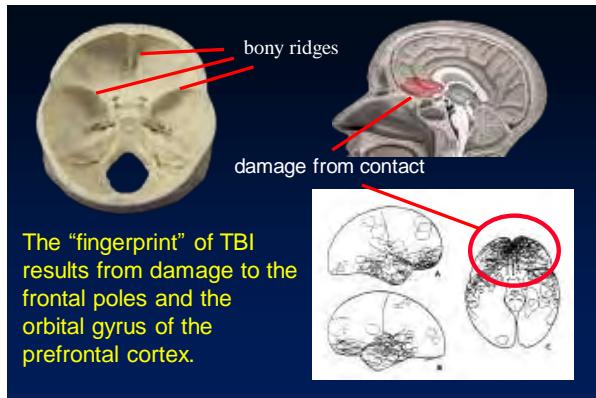
- 1.5 times more likely to be **misusing alcohol**;
- almost 2 times more likely to be in **fair or poor health**;
- greater than 2 times more likely to have a **work-related limitation**;
- greater than 2 times more likely to have **any limitation due to physical, mental or emotional problems**; and
- 2.5 times more likely to be **dissatisfied with their life**.

The “Fingerprint” of TBI

Frontal areas of the brain, including the frontal lobes, are the most likely to be injured as a result of TBI, regardless the point of impact to the head

The brain is set into motion along multiple axial planes





Neurobehavioral Impairments

- Attention deficits
- Memory problems
- Poor planning
- Impulsivity/disinhibition
- Unawareness of deficits

Ability to “Self-Regulate”

Being human is all about self-regulation

“...[we] tend to view impulsiveness as a problem or deficit, yet for most species that have a nervous system that learns from contingencies of reinforcement, there actually is not a ‘problem’ of impulsiveness—it is their default state. The ‘problem’ posed by impulsiveness is relatively unique to humans...” Russell Barkley (2001)

The “A-B-C’s” of Self-Regulation

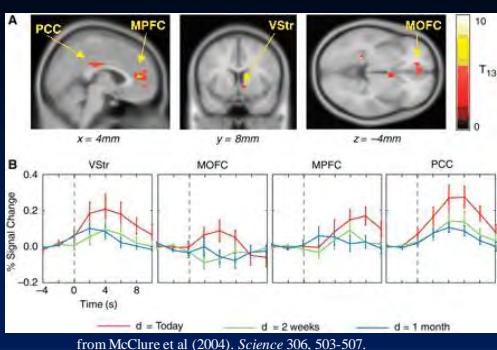
- Affective modulation
- Behavioral planning
- Cognitive resource allocation

Delay Discounting:



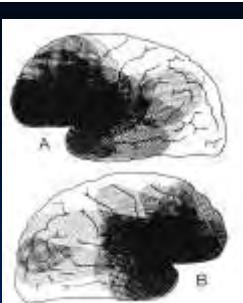
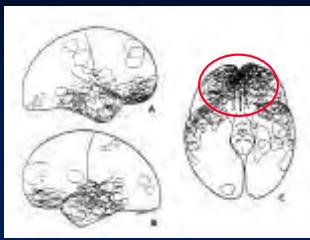
the value of immediate vs. delayed rewards

Regions of greater activation when considering immediate rewards



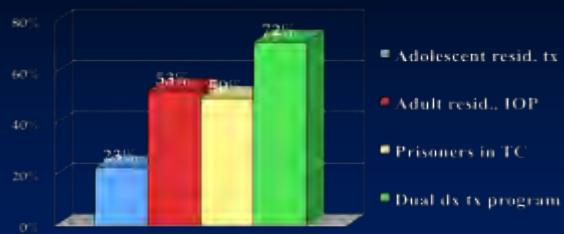
from McClure et al (2004). *Science* 306, 503-507.

Areas of contusion in 40 consecutive cases of closed head injury (Courville, 1950)



Overlay of 100 consecutive CT scans of patients with closed head injuries (Bigler, 1984)

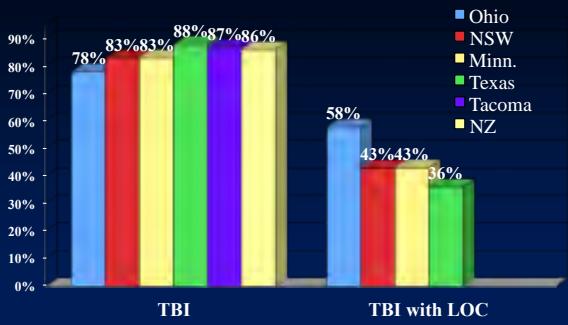
Substance Abuse Treatment Clients Who Have Had a TBI with Loss of Consciousness



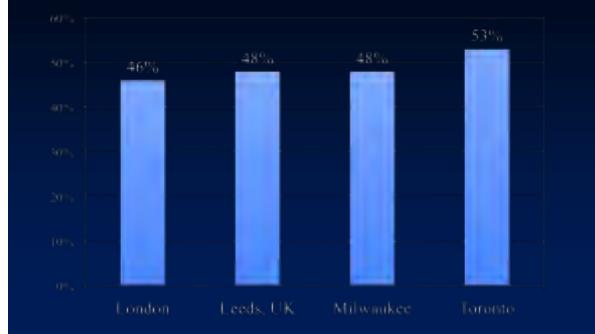
TBI and Psychiatric Disorders

- Childhood TBI doubles likelihood of psychiatric disorder by early adulthood.
- Depression frequent following TBI; depressed clients with TBI more likely suicidal.
- Higher rates of anxiety disorders (generalized, OCD and PTSD)
- Higher rates of psychosis among persons with TBI
- Some studies have found higher rates of personality disorders among persons with TBI.

Rates of TBI in Prison Studies



Rates of TBI among the Homeless



Further Resources

www.OhioValley.org

www.BrainLine.org

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