Pediatric Concussion: *What BH providers need to know*

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What is a Concussion?

Concussion Definition

Concussion is a mild traumatic brain injury (mTBI)

1) caused by a direct or indirect transmission of energy/force to the head
2) Resulting in an immediate and transient dysfunction of the brain characterized by at least one of the following : a) Loss of consciousness, b) loss of memory, c) altered mental status, d) neurological signs
3) possibly followed by one or more functional complaints/concussion symptoms (concussion syndrome)
4) Not explained by another cause

Concussion Symptoms

- Must be present in first 24 hours

Physical	Cognitive	Emotional
• Headache • Dizziness • Balance problems • Sleep disturbance • Fatigue • Visual disturbance	• Slowed thinking • Memory problems • Attention problems • In a fog	• Sadness • Irritability • Anxiety • More emotional

Youth may under-report symptoms

- Lack of awareness/knowledge of signs/symptoms
- •Belief that concussion is not serious
- •Not wanting to be withheld from participation
- Not wanting to let team/coach/parents down
- Pressure to remain in play

Returning to Play

- Important to minimize additional concussion risk while still symptomatic
  - Data shows that consecutive concussions can be associated with prolonged outcomes
  - Can be at higher risk for additional injury if play while still symptomatic (slower reaction, balance problems, etc.)
  - Possible suggestion of “second impact syndrome”- but not clear phenomenon in literature
- Graded “return to play” progression is standard
  - Step-wise exercise progression with monitoring of symptoms

Ohio Concussion "Return to Play" Law (2013)

- Refs and coaches must have a permit and have concussion training
- Students can't practice/play until parents sign concussion form (reviewed and understand information)
- Coach/ref must remove students from play who show signs of a concussion
  - Can't return to play the same day
  - Can't return to play until assessed and cleared by a physician

Concussion Epidemiology

- Lifetime prevalence of at least one concussion up to ~25%
- Sports-related concussion rates
  - Highest numbers in football
  - Girls in comparable sports have higher likelihood of concussion
  - Previous concussions increase rate of subsequent concussions

Concussion: Myth vs. Fact?

Concussion: Myth vs. Fact?

- You have to get “knocked out” to be diagnosed with concussion

Concussion: Myth vs. Fact?

MYTH

- If you don't get "knocked out" its not a concussion

FACT

- 90% of people don't lose consciousness with a concussion

Concussion: Myth vs. Fact?

- Concussions cause brain damage you can see on an MRI brain scan

Concussion: Myth vs. Fact?

MYTH

- Concussions cause brain damage you can see on an MRI brain scan

FACT

- An MRI does not show changes with concussion, but in some cases, can be helpful to rule out other problems

Concussion: Myth vs. Fact?

- You should never go to sleep after a concussion

Concussion: Myth vs. Fact?

MYTH

- You should never sleep right after a concussion

FACT

- Sleeping/rest can help with healing in the first 24-48 hours

Concussion: Myth vs. Fact?

- You should rest in a dark room until your concussion symptoms go away

Concussion: Myth vs. Fact?

MYTH

- You should rest in a dark room until your concussion symptoms go away

FACT

- Doctors usually recommend a short period of rest, then a gradual return to activity and active rehabilitation

Concussion: Myth vs. Fact?

- Having a concussion places kids at risk for “CTE”

Concussion: Myth vs. Fact?

MYTH

- Having a concussion places kids at risk for "CTE"

FACT

- "CTE" is a hypothesized degenerative brain disease associated with repeated sub-concussive blows

Concussion: Myth vs. Fact?

- Once you have 3 concussions you need to stop playing contact sports

Concussion: Myth vs. Fact?

MYTH

- Once you have 3 concussions you need to stop playing contact sports

FACT

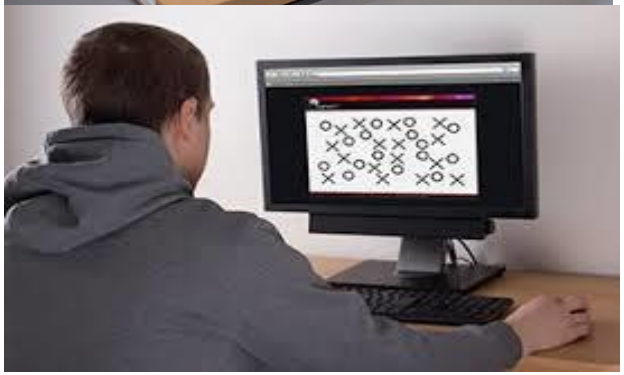
- There is no formula or absolutes; several risks/benefits should be weighed on a case-by-case basis

Cognitive Changes

- In first hours to weeks

  Objective neurocognitive deficits can be seen:

  - Attention/working memory
  - Processing speed
  - Memory
  - Executive Functions



Uncomplicated, pediatric concussion is not associated with measurable, long-term neuropsychological problems

- Well-controlled individual studies (e.g. Babikian et al 2011; Fay et al., 1993; Maillard-Wermelinger et al. 2009; Ponsford et al. 1999; McCrea et al. 2008; Bijur et al. 1990)
- Meta-analyses (Babikian & Asarnow 2009; Vu et al. 2011; Belanger & Vanderploeg, 2005)
- Systematic reviews of literature (Caroll et al 2004; Hung et al 2014; Satz et al, 1997, 2001)
- Same finding in adult literature (Belanger et al, 2005; Binder et al 1997; Cassidy et al, 2014; Dikmen et al 2009; Schretlen & Shapiro, 2003; Rohling et al 2011)

Neurocognitive Outcomes and Recovery After Pediatric TBI: Meta-Analytic Review of the Literature

Talin Babikian and Robert Asarnow
David Geffen School of Medicine at UCLA

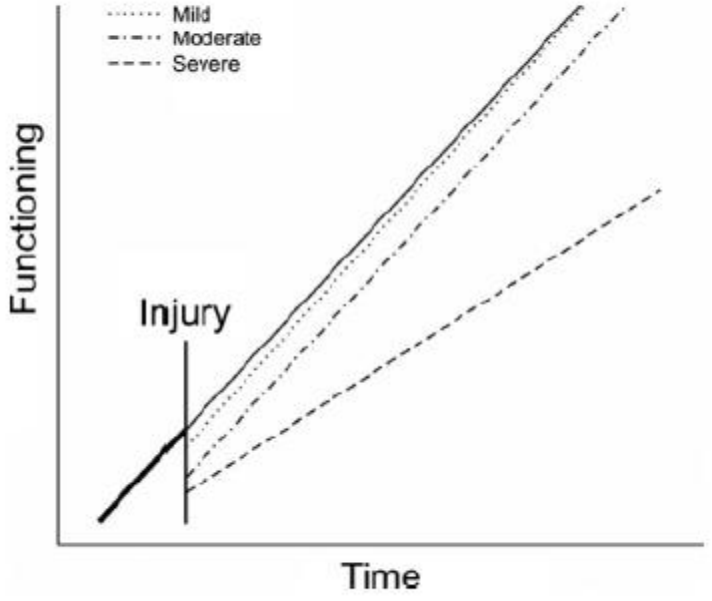


Figure 2. Summary diagram of trends in neurocognitive outcomes and recovery over time.

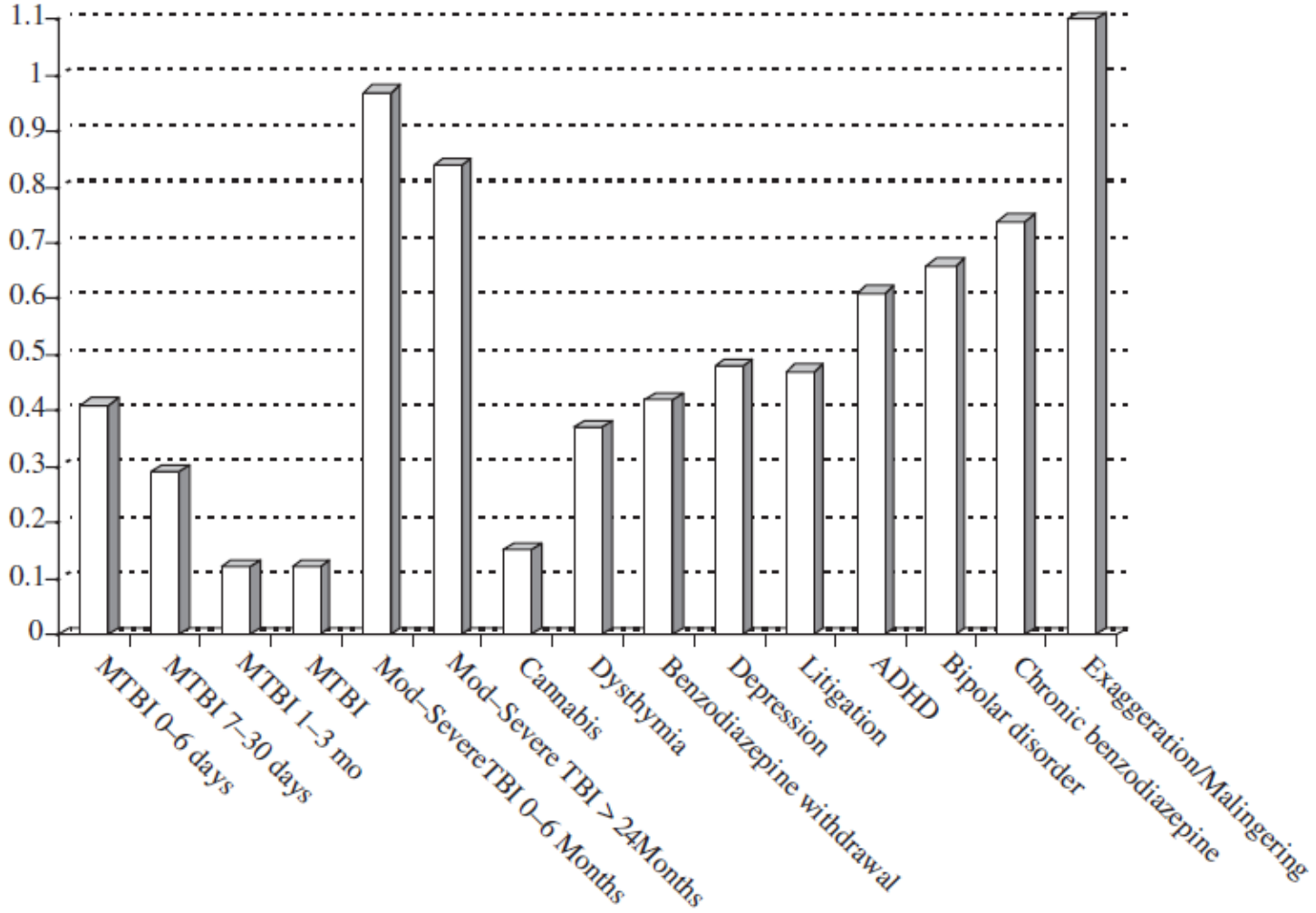


Figure 3 Effect sizes of MTBI on overall neuropsychological functioning. Effect sizes typically are expressed in pooled, weighted standard deviation units. However, across studies there are some minor variations in the methods of calculation. By convention, effect sizes of .2 are considered small, .5 medium, and .8 large. This is from a statistical, not necessarily clinical, perspective. In this figure the overall effect on cognitive or neuropsychological functioning is reported. Effect sizes less than .3 should be considered very small and difficult to detect in individual patients because the patient and control groups largely

Formal Neuropsychological Eval: not needed for most

- Cognitive problems are temporary
- Why test those with persistent cognitive complaints?
  - Is brain-injury contributing to problems (i.e. cases of more severe or multiple injuries)?
  - What non-concussion factors are contributing to problems?
  - Were there pre-injury issues now coming to light?
  - Provide psychoeducation
  - Develop management plan

Performance Validity Testing

- ~20% of children evaluated for concussion show “non-credible” effort
- Performance Validity Indicators
  - Tests designed to measure effort/validity and not a true test of memory (or other) function
  - Other indicators of implausible performance
- What does a failed PVT mean?
  - Not engaged, malingering, exaggeration, psychological distress, other?

Post-concussion symptoms

- Objective neurocognitive problems resolve relatively quickly
- But, a sizable minority of patients report prolonged PCS
  - In majority of cases, symptoms resolve in 0-3 weeks
  - 20-30% of children report symptoms lasting 4 weeks +

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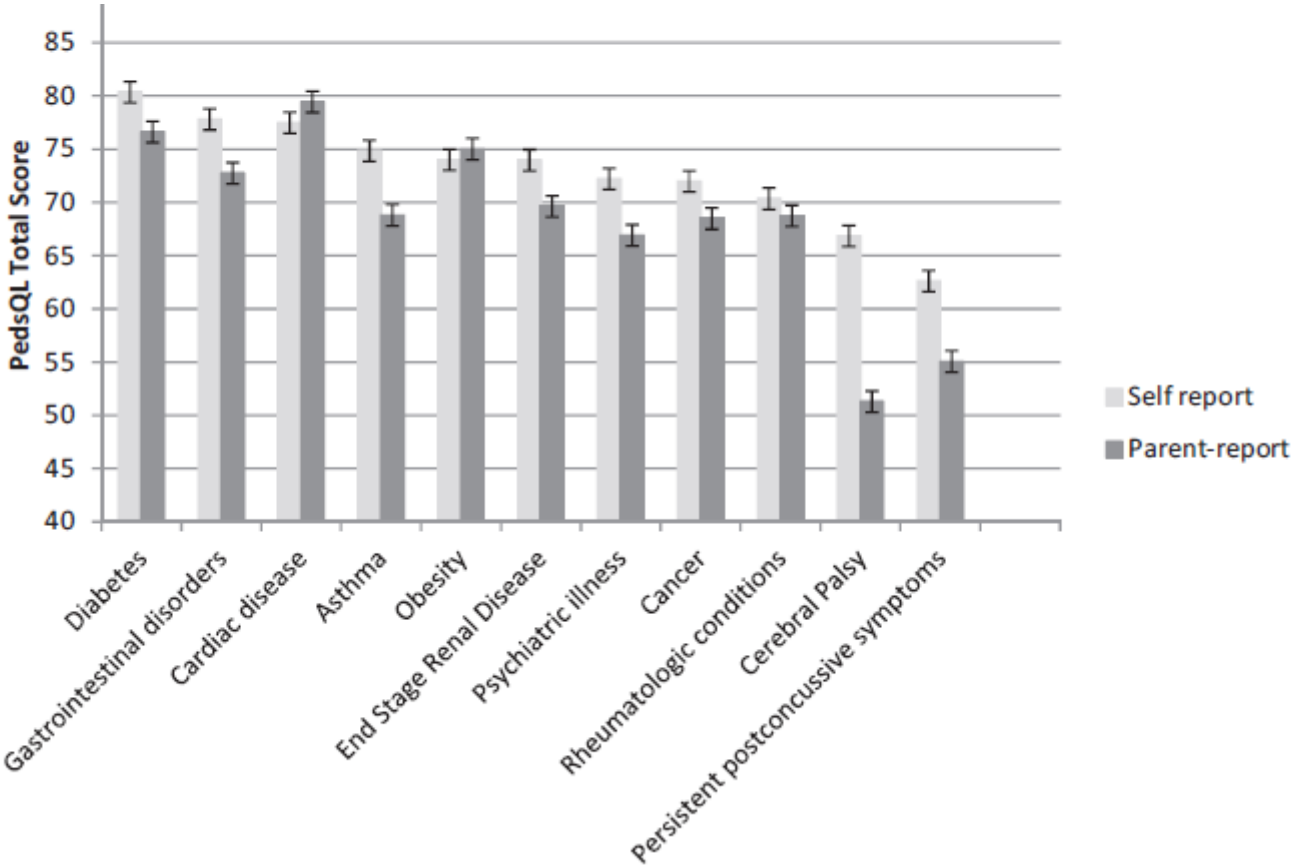
Quality of Life for Youth With Persistent Postconcussive Symptoms Following Mild Traumatic Brain Injury

Tess S. Simpson, Robin L. Peterson, Derek S. Mason, Amy K. Connery, David A. Baker, and Michael W. Kirkwood
University of Colorado School of Medicine and Children's Hospital Colorado, Aurora, Colorado



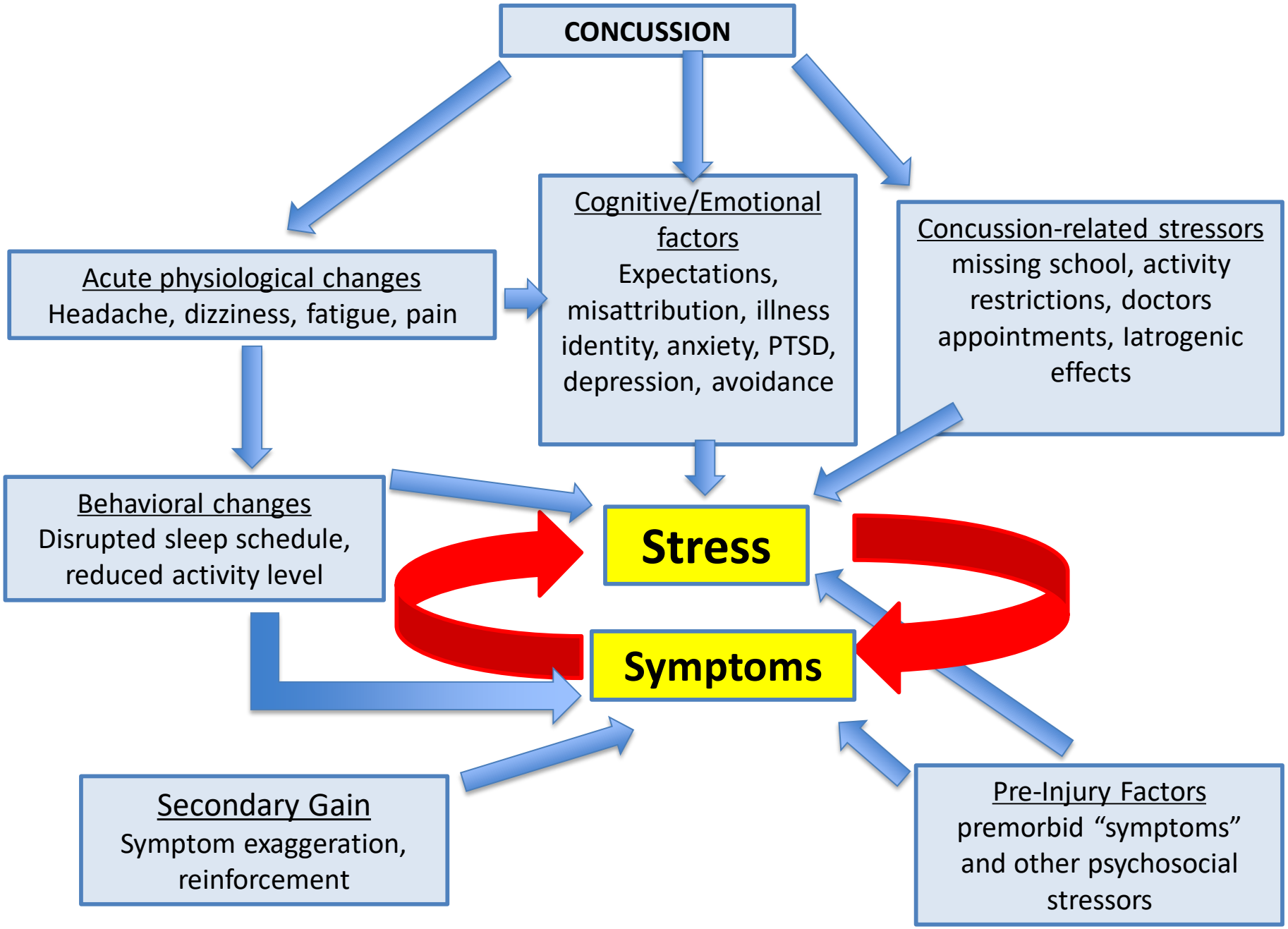
A Case Example

- 17 yo (Sara), no significant past medical history, high-achieving student, competitive swimmer, many other activities, history of mild anxiety
- Concussion during swim practice approximately 3 months ago (flip turn; head to wall)
    - No loss of consciousness or PTA, MRI negative
    - Did strict rest for 2 weeks ("dark room")
    - Was told to rest until symptoms go away, no extracurricular activities, no sports, no working out, no tests at school
    - Missed 16 days of school, now attendance is variable due to headaches and fatigue
    - Current symptoms: headache, difficulty concentrating, sleep problems
- Life context/stressors
    - High stress about making up missed school work (lots of AP classes)
    - Feeling pressure from teammates and coach to return; has been accused of "faking"; not seeing friends/teammates
    - Grandma in hospital with cancer
- Health Behaviors
    - Napping during the day; can't sleep at night
    - Tried exercising once; triggered headache hasn't attempted in several weeks

Post-concussion symptoms: Biopsychosocial Framework

- Biological, psychological, and social systems interact
  - Injury occurs in pre-existing psychosocial context
  - Injury → temporary neurochemical and metabolic changes in the brain, pain, sleep disruption, etc.
  - Psychological and emotional reactions →physiologic stress response
  - Changes in behavior, social participation, and reinforcement

"Vicious Cycle" of PCS Maintenance

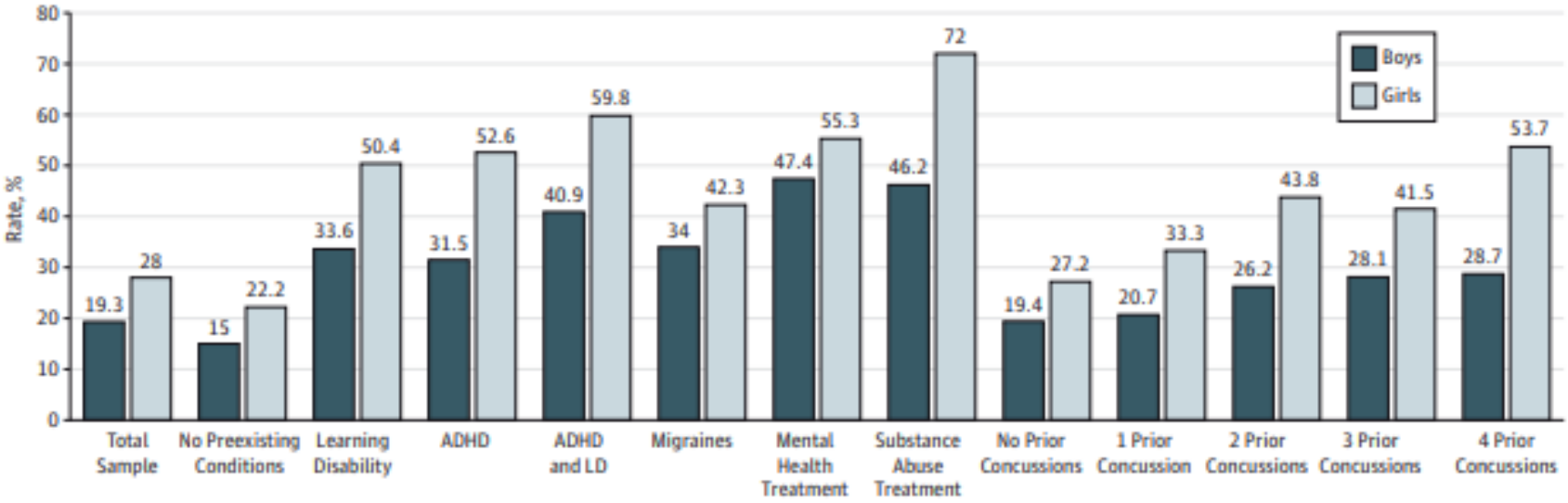


Original Investigation

Factors Associated With Concussion-like Symptom Reporting in High School Athletes

Grant L. Iverson, PhD; Noah D. Silverberg, PhD; Rebekah Mannix, MD, MPH; Bruce A. Maxwell, PhD; Joseph E. Atkins, PhD; Ross Zafonte, DO; Paul D. Berkner, DO

Figure. Rates of *International Classification of Diseases, 10th Revision* (*ICD-10*), Postconcussional Syndrome Classification in High School Athletes With No Recent Concussion (Mild or Greater Symptoms in Each Domain)



No athlete in this study reported sustaining a concussion in the past 6 months. ADHD indicates attention-deficit/hyperactivity disorder; LD, learning disability.

- PCS are non-specific to concussion
- Common in general population

Interventions for Persistent PCS

- Many treatments used that aren't supported by research
  - Neurofeedback
  - Hyperbaric oxygen chamber
  - Light therapies
  - Cognitive training
  - Etc.

**Treatments that focus solely on physiology unlikely to be effective for PPCS, given role of non-injury factors*

Interventions for Persistent PCS

- Promising interventions for PPCS in children
  - Multi-disciplinary treatment approaches (e.g. Rivera et al)
  - Neuropsychological Evaluation as intervention (e.g. Kirkwood et al)
  - Exercise intervention (e.g. Gagnon et al.; Leddy et al.)
  - Cognitive Behavioral Therapy (e.g. McNally et al)

C-STEP: Concussion Symptom Treatment and Education Program

- For patients actively rehabbing from concussion (but taking longer than typical)
- Brief, symptom focused treatment (4-6 sessions)
- Multi-faceted in approach given multiple factors that can contribute
- Grounded in Cognitive Behavioral Therapy
  - Psychoeducation
  - activity scheduling
  - sleep hygiene
  - relaxation training
  - cognitive restructuring

What do you do when you see a patient with a remote concussion history?

- Don't automatically assume that concussion is the cause of current problems (quite rare)
- Consider as a possible contributing factor when:
  - Injury was less than 3 months ago and changes in behavior or school performance are suspected
  - History of multiple concussions (if injuries were close in time to one another or lack of full recovery between injuries)
  - Injury was more severe (mod-severe TBI, brain imaging changes, prolonged hospitalization, etc.)
- Use typical recommended evidence-based treatments for presenting symptoms

What do you do if your patient has a new/recent concussion?

- Make sure they are linked with medical treatment
  - PCP, Sports Medicine, Physical Medicine concussion clinics
- Provide reassurance and normalize symptoms
  - *Its not a question of "If" symptoms will get better, just a matter of "when"*
- Increased monitoring and consider repeating ASQ more frequently during recovery
- Help facilitate communication with school
  - Typically expect to miss just a few days of school
  - Temporary accommodations may be needed (usually concussion clinics will provide school letters)

What do you do if your patient has a new/recent concussion?

- Promote healthy habits
  - Nutrition/hydration
  - Maintain good sleep hygiene
  - Follow physician recommendations for gradual return to exercise and activity- don't reinforce "dark room" therapy
  - Encourage positive thinking about recovery
- Identify "Red flags" for considering specialty referral to neuropsychology
  - Prolonged school absences
  - Significant drop in grades (after able to return and make up work)
  - Significant withdrawal from activities
  - High family focus on concussion and symptoms/illness

Questions??