Protecting our Future: Assessment & Management of Pediatric Concussion

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Disclosure Statement

Psychological Assessment Resources, Inc.

- Test Author (royalties)
  - Behavior Rating Inventory of Executive Function (BRIEF)
  - PostConcussion Executive Inventory (PCEI)
  - PostConcussion Symptom Inventory-2nd Ed (PCSI-2)

Many other tests & measures (no royalties)

- Acute Concussion Evaluation (ACE) – office, ED
- ACE Care Plan; Home/School Instructions
- Children’s Exertional Effects Rating Scale (ChEERS)
- Concussion Learning Assessment & School Survey (CLASS) – Parent, Self-Report
- Progressive Activities of Controlled Exertion (PACE)-Self Efficacy (Child, Parent)
- Multimodal Assessment of Cognition & Symptoms (MACS)
- Concussion Recognition & Response (CRR) – Parent/Coach app
- Concussion Assessment & Response (CARE)- Medical app
Objectives

This session will help participants:

1. Articulate unique foundational elements in concussion of the developing child
2. Describe (sub)types of clinical/symptom presentations
3. Identify evidence-based tools for the assessment of concussion
4. Describe the active rehabilitation approach across the developmental age span, with a particular focus on school return and supports
Concussion’s Medical Neighborhood
Connected Care

**Point of Entry**
- Parents/Coaches/
  Group Leaders/
  Peers (R&R)
- Emerg Dept
  Urgent Care
  Primary Care
  Athletic Trainers

**Continued Care**

**“Typical”**
- Primary Care

**“Atypical”**
- Specialty Care
  Incl. Rehabilitation Services

**School Return**
1. Safety
2. Managed, monitored, gradual return to academic, social, physical activity
Evolution of Concussion Knowledge
What is the difference in concussion management in children as compared with adults? A systematic review

Gavin A Davis, Vicki Anderson, Franz E Babl, Gerard A Gioia, Christopher C Giza, William Meehan, Rosemarie Scolaro Moser, Laura Purcell, Philip Schatz, Kathryn J Schneider, Michael Takagi, Keith Owen Yeates, Roger Zemek

ABSTRACT
Aim To evaluate the evidence regarding the management of sport-related concussion (SRC) in children and adolescents. The eight subquestions included the effects of age on symptoms and outcome, normal and prolonged duration, the role of computerised neuropsychological tests (CNTs), the role of rest, and strategies for return to school and return to sport (RTSp).
Design Systematic review.

...statement on the management of SRC in 2001, but this paper did not include any child-specific recommendations. The CISG meeting in Prague in 2004 briefly referred to the paediatric population, and the Zurich 2008 meeting expanded the consensus statement to include a section devoted to ‘the child and adolescent athlete’. This statement included an age limit of 10 years for application of the recommendations, recommended a conserv...
What is the difference in concussion management in children as compared to adults? A systematic review

Gavin A. Davis, Vicki Anderson, Franz E BABL, Gerard A GIOIA, Christopher C Giza, William Meehan, Rosemarie Scolaro Moser, Laura Purcell, Philip Schatz, Kathryn J Schneider, Michael Takagi, Keith Owen Yeates, Roger Zemek

What are the new findings?
- Children and adolescents are expected to take up to 4 weeks to recover following sport-related concussion.
- The widespread routine use of baseline computerised neuropsychological testing is not recommended in children and adolescents.
- A brief period of cognitive and physical rest following sport-related concussion in children and adolescents should be followed with gradual symptom-limited physical and cognitive activity.
- All schools be encouraged to have a concussion prevention and management policy and should offer appropriate academic accommodations and support to students recovering from sport-related concussion.
Centers for Disease Control and Prevention Guideline on the Diagnosis and Management of Mild Traumatic Brain Injury Among Children

Angela Lumba-Brown, MD; Keith Owen Yeates, PhD; Kelly Sarmiento, MPH; Matthew J. Breiding, PhD; Tamara M. Haegerich, PhD; Gerard A. Giola, PhD; Michael Turner, MD; Edward C. Benzel, MD; Stacy J. Suskauer, MD; Christopher C. Giza, MD; Madeline Joseph, MD; Catherine Broomand, PhD; Barbara Weissman, MD; Wayne Gordon, PhD; David W. Wright, MD; Rosemarie Sciarro Moser, PhD; Karen McAvoy, PhD; Linda Ewing-Cobbs, PhD; Ann Christine Duhaime, MD; Margot Putukian, MD; Barbara Holshouser, PhD; David Paulk, EdD; Shari L. Wade, PhD; Stanley A. Herring, MD; Mark Halstead, MD; Heather T. Keenan, MD, PhD; Meeryo Choe, MD; Cindy W. Christian, MD; Kevin Guskiewicz, PhD, ATC; P. B. Raksin, MD; Andrew Gregory, MD; Anne Mucha, PT, DPT; H. Gerry Taylor, PhD; James M. Callahan, MD; John DeVitt, PT, DPT, ATC; Michael W. Collins, PhD; Michael W. Kirkwood, PhD; John Ragheb, MD; Richard G. Ellenbogen, MD; Theodore J. Spinks, MD; Theodore G. Ganiats, MD; Linda J. Sabelhaus, MLS; Katrina Altenhofen, MPH; Rosanne Hoffman, MPH; Tom Getchius, BA; Gary Gronseth, MD; Zoe Donnell, MA; Robert E. O’Connor, MD, MPH; Shelly D. Timmons, MD, PhD

**IMPORTANCE** Mild traumatic brain injury (mTBI), or concussion, in children is a rapidly growing public health concern because epidemiologic data indicate a marked increase in the number of emergency department visits for mTBI over the past decade. However, no evidence-based clinical guidelines have been developed to date for diagnosing and managing
What is a concussion?

- A bump, blow or jolt to the head or body that causes the brain to move rapidly back & forth
- Causes stretching of brain, causing chemical changes, and cell damage
- Causes change in how brain works (signs & symptoms)
- Once these changes occur, brain is more vulnerable to further injury and sensitive to increased stress
Many Causes

Motor Vehicle Collisions
Falls
Struck By/ Against
Assaults
Sports & Recreations
Pathophysiological Basis

- Stress and strain of force:
  - cell wall
  - diffuse axonal injury

- Massive ionic flux of potassium and calcium.

- Metabolic demands on cells exposed to ionic flux results in injury-induced diaschisis
  - loss of coupling between neuronal activation and cerebral blood flow,
  - Produces energy crisis
  - Mitochondrial dysfunction

Giza & Hovda, 2001; 2014
Anatomical Timeline of a Concussion
Defining the Key Factors

A. Injury Characteristics

- LOC <10%
- Antero-grade Amnesia 25-40%
- Retro-grade Amnesia 20-35%

B. Symptom Assessment

- Sec-Min
- Sec-Hrs
- Hours - Days - Weeks+

C. Risk Factors

- Pre-Injury Risks
- Neurocog dysfx & Post-Concuss Sx’s

Children’s National
Signs of a Concussion
(what you observe)

Cognitive
- Appears dazed/stunned
- Confused about events (assignment or position)
- Answers questions more slowly
- Repeats questions/ forgets instruction or play
- Can’t recall events prior to or after the hit/fall

Physical
- Vomiting
- Loses consciousness
- Balance problems
- Moves clumsily
- Drowsy

Behavior/Emotion
- Behavior or personality changes
Symptoms of a Concussion
(what they feel and report)

**Physical**
- Headache
- Fatigue
- Visual problems (blurry/“double”)
- Nausea/vomiting
- Balance problems/dizziness
- Sensitivity to light/noise
- Numbness/tingling

**Cognitive**
- Mental fogginess
- Difficulty concentrating
- Difficulty remembering
- Feeling slowed down

**Emotional**
- More emotional
- Irritable
- Sad
- Nervous

**Sleep**
- Sleeping more/less
- Trouble falling asleep
- Drowsiness
Research literature still limited understanding of concussion recovery outcomes across full age range, and for boys and girls (IOM, 2013; CDC 2016; Berlin, 2016; NIH, 2016).

Largest pediatric-adolescent study (Zemek et al., 2016; n>3,000; age 5-18) indicates 70 +/-% symptom recovery within 4 weeks.

And – Age, sex, injury type/severity matter!

Don’t expect “7-10 days” for recovery!

Recovery of Child/ Adolescent: Our Best Guess
Further Defining Concussion: Symptom Subtypes

- Headaches
- Vestibular
- Ocular-motor
- Cognitive
- Anxiety/ mood problems

Associated conditions
- Sleep
- Cervical strain
Concussion Guidelines Step 2: Evidence for Subtype Classification

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Masaru Teramoto, PhD, MPH,
PStat®
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David Brody, MD, PhD★
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James R. Clugston, MD, MS♯
Michael Collins, PhD★★
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Anthony Kontos, PhD★★★★
Avtar Lal, PhD★★★★
Allen Sills, MD★★
Jamshid Ghajar, MD, PhD★★★★

BACKGROUND: Concussion is a heterogeneous mild traumatic brain injury (mTBI) characterized by a variety of symptoms, clinical presentations, and recovery trajectories. By thematically classifying the most common concussive clinical presentations into concussion subtypes (cognitive, ocular-motor, headache/migraine, vestibular, and anxiety/mood) and associated conditions (cervical strain and sleep disturbance), we derive useful definitions amenable to future targeted treatments.

OBJECTIVE: To use evidence-based methodology to characterize the 5 concussion subtypes and 2 associated conditions and report their prevalence in acute concussion patients as compared to baseline or controls within 3 d of injury.

METHODS: A multidisciplinary expert workgroup was established to define the most common concussion subtypes and their associated conditions and select clinical questions related to prevalence and recovery. A literature search was conducted from January 1, 1990 to November 1, 2017. Two experts abstracted study characteristics and results independently for each article selected for inclusion. A third expert adjudicated disagreements. Separate meta-analyses were conducted to do the following: 1) examine the prevalence of each subtype/associated condition in concussion patients using a proportion,
<table>
<thead>
<tr>
<th>Concussion subtype or associated condition</th>
<th>Classification</th>
<th>Measurements used for prevalence ratio</th>
<th>Measurements used for SMD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concussion subtype</td>
<td>Cognitive</td>
<td>Concentration, remembering, retrograde amnesia, anterograde amnesia, posttraumatic amnesia, cognitive problems, feeling slow</td>
<td>ImPACT—verbal memory, ImPACT—visual motor speed, ImPACT—reaction time, ImPACT—impulse control, verbal learning test—immediate memory, verbal learning test—delayed recall, verbal learning test—recognition, trail making test A, trail making test B, Stroop word, Stroop color, Stroop word-colors test, controlled oral word association test, symbol digit, symbol digit recall, digit symbol substitution test, learning trial, Wechsler digit span test forward, Wechsler digit span test backward, letter-number sequencing, total sentences, concentration, remembering, Sternberg task—percent accuracy, Sternberg task—reaction time (ms)</td>
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<tr>
<td>Ocular-motor</td>
<td>Visual problems, blurred vision, visual changes, sensitivity to light, double vision</td>
<td>Antisaccade (errors), antisaccade (latency), remembered saccade (errors), remembered saccade (latency), visual problems, visual acuity, sensitivity to light, King-Devick (K-D) test</td>
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<tr>
<td>Headache-migraine</td>
<td>Headache, sensitivity to light, sensitivity to light or sound, sensitivity to noise, neck pain, vomiting, nausea, nausea/vomiting, nausea, nausea/vomiting, abnormal coordination</td>
<td>Headache, sensitivity to light, sensitivity to noise, vomiting, nausea</td>
<td></td>
</tr>
<tr>
<td>Vestibular</td>
<td>Dizziness, balance problem, tinnitus, fogginess, disequilibrium, confusion/disorientation, disorientation, vomiting, nausea, nausea/vomiting, abnormal coordination</td>
<td>BESS, mBESS, dizziness, balance problem, fogginess, vomiting, nausea</td>
<td></td>
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<tr>
<td>Anxiety-mood</td>
<td>Depression, irritability, emotional problem, nervousness, confusion/disorientation, confusion, sadness, slow down, photophobia, personality changes, numbness, tingling, numbness/tingling</td>
<td>Anxiety, depression, irritability, emotional problem, nervousness, sadness, slow down, stress, numbness</td>
<td></td>
</tr>
<tr>
<td>Associated condition</td>
<td>Sleep disturbance</td>
<td>Drowsiness, sleeping more than usual, sleeping less than usual, trouble falling asleep, sleepiness</td>
<td>Drowsiness, sleep symptoms</td>
</tr>
<tr>
<td>Concussion subtype/associated condition</td>
<td>Population</td>
<td>Study N (Sample N)</td>
<td>Proportion (95% CI)</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>------------</td>
<td>--------------------</td>
<td>---------------------</td>
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<tr>
<td>Cognitive</td>
<td>Pediatric</td>
<td>10 (654)</td>
<td>0.32 (0.21, 0.43)</td>
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<tr>
<td></td>
<td>Adult</td>
<td>16 (1233)</td>
<td>0.40 (0.25, 0.55)</td>
</tr>
<tr>
<td>Ocular-motor</td>
<td>Pediatric</td>
<td>8 (600)</td>
<td>0.34 (0.27, 0.41)</td>
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<td></td>
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<td>6 (438)</td>
<td>0.34 (0.18, 0.53)</td>
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<tr>
<td>Headache/migraine</td>
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<td>Adult</td>
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<tr>
<td>Vestibular</td>
<td>Pediatric</td>
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<td>15 (975)</td>
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<td>Sleep disturbance</td>
<td>Pediatric</td>
<td>4 (156)</td>
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</tr>
<tr>
<td></td>
<td>Adult</td>
<td>7 (600)</td>
<td>0.34 (0.18, 0.51)</td>
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</tbody>
</table>

CI = confidence interval
Evidence-Based Assessment
Evidence-based Assessment

- In essence, we want our clinical assessment tools/data to help predict outcomes
  - Likelihood of diagnosis
  - Time to recovery
  - Likelihood of prolonged/complicated recovery
  - Need for treatment
  - Return to school, necessary accommodations
  - Return to physical activity/sports/recreation

- Examine set of clinical factors that are predictive of current status, or treatment needs
Evidence-based assessment:

- Refines the predictive capability of known risk factors, clinical measures, functional impairment to the likelihood of post-injury problems.

- Improves our understanding of probabilities for specific outcomes, allows better targeting of individualized treatments.

- Identifies when clinically important change has occurred beyond chance.
Clinical Questions

- Is this student’s symptom pattern consistent with a likely concussion?
- Is the student at high risk for prolonged recovery?
- Is this student at high risk for problems with academics?
- Has the student made clinically significant change in their functioning?
Predicting & Preventing Persistent Post-Concussion Problems in Pediatrics (5P)

Clinical Risk Score for Persistent Postconcussion Symptoms Among Children With Acute Concussion in the ED

Roger Zemek, MD; Nick Barrowman, PhD; Stephen B. Freedman, MDCM, MSc; Jocelyn Gravel, MD; Isabelle Gagnon, PhD; Candice McGahern, BA; Mary Aglipay, MSc; Gurinder Sangha, MD; Kathy Boutis, MD; Darcy Beer, MD; William Craig, MDCM; Emma Burns, MD; Ken J. Farion, MD; Angelo Mikrogianakis, MD; Karen Barlow, MD; Alexander S. Dubrovsky, MDCM, MSc; Willem Meeuwisse, MD, PhD; Gerard Giola, PhD; William P. Meehan III, MD; Miriam H. Beauchamp, PhD; Yael Kamil, BSc; Anne M. Grool, MD, PhD, MSc; Blaine Hoshizaki, PhD; Peter Anderson, PhD; Brian L. Brooks, PhD; Keith Owen Yeates, PhD; Michael Vassilyadi, MDCM, MSc; Terry Klassen, MD; Michelle Keightley, PhD; Lawrence Richer, MD; Carol DeMatteo, MSc; Martin H. Osmond, MDCM; for the Pediatric Emergency Research Canada (PERC) Concussion Team

**IMPORTANCE** Approximately one-third of children experiencing acute concussion experience ongoing somatic, cognitive, and psychological or behavioral symptoms, referred to as persistent postconcussion symptoms (PPCS). However, validated and pragmatic tools enabling clinicians to identify patients at risk for PPCS do not exist.

**OBJECTIVE** To derive and validate a clinical risk score for PPCS among children presenting to the emergency department.
<table>
<thead>
<tr>
<th></th>
<th>No. of Risk Points for PPCS</th>
<th>Odds Ratio (95%CI)</th>
<th>P Value</th>
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<td>Age group, y</td>
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<td>5-7</td>
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<tr>
<td>8-12</td>
<td>1</td>
<td>1.54 (1.09-2.19)</td>
<td>&lt;.001</td>
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<tr>
<td>13-&lt;18</td>
<td>2</td>
<td>2.31 (1.62-3.32)</td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
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<tr>
<td>Male</td>
<td>0</td>
<td>1 [Reference]</td>
<td>&lt;.001</td>
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<tr>
<td>Female</td>
<td>2</td>
<td>2.24 (1.78-2.82)</td>
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<td>Prior concussion and symptom duration</td>
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<td>.01</td>
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<td>Prior concussion; symptom duration ≥1 wk</td>
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<td>1.53 (1.10-2.13)</td>
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<td>Physician-diagnosed migraine history</td>
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<td>Yes</td>
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<td>1.73 (1.24-2.43)</td>
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<td>Answering questions slowly</td>
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<td>Yes</td>
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<td>1.37 (1.08-1.74)</td>
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<td>Balance Error Scoring System tandem stance</td>
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<td>No. of errors</td>
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<td>0-3</td>
<td>0</td>
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<td>≥4 or Physically unable to undergo testing</td>
<td>1</td>
<td>1.31 (1.04-1.66)</td>
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<td>Headache</td>
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<td>Yes</td>
<td>1</td>
<td>1.66 (1.11-2.48)</td>
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<td>Sensitivity to noise</td>
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<td>No</td>
<td>0</td>
<td>1 [Reference]</td>
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<tr>
<td>Yes</td>
<td>1</td>
<td>1.47 (1.15-1.87)</td>
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<tr>
<td>Fatigue</td>
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<tr>
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<td>1 [Reference]</td>
<td>&lt;.001</td>
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<tr>
<td>Yes</td>
<td>2</td>
<td>1.84 (1.37-2.46)</td>
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<tr>
<td>PPCS Risk Category</td>
<td>Total No. of Risk Points</td>
<td>Estimated Risk of PPCS, % (95% CI)</td>
<td>No. With PPCS/Total No. of Patients (%)</td>
</tr>
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<td>Low risk</td>
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<td>5.8 (3.9-9.5)</td>
<td>6/37 (16.2)</td>
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<td>2</td>
<td>8.3 (6.0-13.2)</td>
<td>11/98 (11.2)</td>
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<td>3</td>
<td>11.8 (8.5-17.8)</td>
<td>15/165 (9.1)</td>
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<td>4</td>
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<td>5</td>
<td>22.3 (16.7-29.7)</td>
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<td>6</td>
<td>29.7 (22.7-37.9)</td>
<td>90/299 (30.1)</td>
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<td>7</td>
<td>38.2 (30.1-46.9)</td>
<td>96/243 (39.5)</td>
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<td></td>
<td>8</td>
<td>47.6 (38.9-57.1)</td>
<td>80/172 (46.5)</td>
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<td>Medium risk</td>
<td>9</td>
<td>57.1 (48.2-65.6)</td>
<td>58/103 (56.3)</td>
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<td>10</td>
<td>66.1 (57.2-74.4)</td>
<td>30/43 (69.8)</td>
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<td>11</td>
<td>74.1 (65.8-81.5)</td>
<td>9/13 (69.2)</td>
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<td>12</td>
<td>80.8 (74.6-88.3)</td>
<td>3/3 (100)</td>
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</table>
PPCS indicates persistent postconcussive symptoms. The area under the curve was 0.71 (95% CI, 0.69-0.74) for the derivation cohort and 0.68 (95% CI, 0.65-0.72) for the validation cohort.
Applying an Evidence-Based Assessment Model to Identify Students at Risk for Perceived Academic Problems following Concussion

Danielle M. Ransom,¹ Alison R. Bums,²,³ Eric A. Youngstrom,⁴ Christopher G. Vaughan,²,³ Maegan D. Sady,²,³
AND Gerard A. Gioia²,³

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²Children's National Health System, Washington, DC
³George Washington University School of Medicine, Washington, DC
⁴University of North Carolina, Chapel Hill, North Carolina

(RECEIVED March 14, 2016; FINAL REVISION October 10, 2016; ACCEPTED October 10, 2016)
Predicting Academic Outcomes

- ROC modeling of academic outcome
- Predicting “good” vs “challenged” academic outcomes (CLASS)
- Predictors: Post-concussion sx (PCSI), executive dysfunction (BRIEF), exertion (ChEERS)
**Predicting Academic Outcome (and likely need for service)**

### Evidence based assessment of concussion

**Table 3.** AUC from ROC analyses identifying students reporting school problems at visit 1 with index tests and moderators

<table>
<thead>
<tr>
<th>Index test</th>
<th>Area under curve</th>
<th>Standard error</th>
<th>p-Value</th>
<th>Lower</th>
<th>Upper</th>
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<tr>
<td>Modified BRIEF Self-Report</td>
<td>.84</td>
<td>.03</td>
<td>&lt;.001</td>
<td>.78</td>
<td>.91</td>
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<td>PCSI Self-Report</td>
<td>.80</td>
<td>.04</td>
<td>&lt;.001</td>
<td>.73</td>
<td>.87</td>
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<td>PCSI Parent Report</td>
<td>.79</td>
<td>.04</td>
<td>&lt;.001</td>
<td>.72</td>
<td>.87</td>
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<td>Modified BRIEF Parent-Report</td>
<td>.74</td>
<td>.04</td>
<td>&lt;.001</td>
<td>.66</td>
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<td>.04</td>
<td>&lt;.001</td>
<td>.61</td>
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<td>Cognitive performance:</td>
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<td>.22</td>
<td>.47</td>
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<td>.57</td>
<td>.05</td>
<td>.17</td>
<td>.47</td>
<td>.66</td>
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</tbody>
</table>

**Note.** Benchmarks provided by Rice and Harris (2005) indicate that AUCs in the mid .50s are small and not clinically useful; AUCs in the mid .60s are medium in size and may provide some incremental clinical value, but are not sufficient in isolation; AUCs in the low to mid .70s reflect large, clinically informative values; AUCs in the low .80s are excellent; AUCs in the high .80s are exceptional under clinically rigorous designs and are often highly informative; while AUCs in the .90s are extraordinary.
### Table 2. RCIs for PCSI Total Symptom Score

<table>
<thead>
<tr>
<th>Measure</th>
<th>SD1</th>
<th>SD2</th>
<th>SEM1</th>
<th>SEM2</th>
<th>r</th>
<th>Sdiff</th>
<th>0.80 CI</th>
<th>0.90 CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCSI 5-7 (5 items)</td>
<td>1.9</td>
<td>2.0</td>
<td>1.4</td>
<td>1.5</td>
<td>0.5</td>
<td>2.0</td>
<td>2.6</td>
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<tr>
<td>PCSI 8-12 (17 items)</td>
<td>6.0</td>
<td>6.2</td>
<td>2.7</td>
<td>2.7</td>
<td>0.8</td>
<td>3.8</td>
<td>4.9</td>
<td>6.3</td>
</tr>
<tr>
<td>PCSI 13-18 (21 items)</td>
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<td>4.7</td>
<td>0.6</td>
<td>6.5</td>
<td>8.3</td>
<td>10.7</td>
</tr>
</tbody>
</table>

Sdiff = SQRT [(SEM1^2 + SEM2^2) + (SEM1*SEM2)]

80% confidence interval = Sdiff * 1.28

SEM1 = SD1 [SQRT(1-r12)]

90% confidence interval = Sdiff * 1.645

SEM2 = SD2 [SQRT(1-r12)]
## Table 3. RCIs for Postconcussion Symptom Inventory Age 13-18

<table>
<thead>
<tr>
<th>Subtype</th>
<th>n</th>
<th>SD1</th>
<th>SD2</th>
<th>SEM1</th>
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<th>Sdiff</th>
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<th>0.90 RCI</th>
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<td>102</td>
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<td>3.3</td>
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<td>1.3</td>
<td>1.2</td>
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<td>1.4</td>
<td>1.7</td>
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<tr>
<td>Ocular Motor</td>
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<td>0.8</td>
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<tr>
<td>Subtype</td>
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<td>SD1</td>
<td>SD2</td>
<td>SEM1</td>
<td>SEM2</td>
<td>r</td>
<td>Sdiff</td>
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<td>0.90 RCI</td>
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<tr>
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<td>1.2</td>
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<td>0.7</td>
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<td>Emotional</td>
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<tr>
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</table>
Critical Importance of History in Concussion Diagnosis & Mgt

- Concussion occurs within the context of the person’s developmental, medical, social and emotional/psychiatric history.
- A number of concussion “symptoms” mimic pre-existing behaviors or “symptoms” and must be distinguished.
- This must occur at the time of establishing the diagnosis as well as at the time of recovery.
1. Was there a definite reported mechanism of injury?
   - Yes (There was a discrete event with force to the head or rapid head movement without impact)
   - No (There was no discrete event)

2. Was there an onset of typical symptoms within 24-48 hours of the injury event?
   - Yes (Typical concussion symptoms AND onset < 24-48 hrs)
   - No (Atypical concussion symptoms, delayed onset)

3. Has there been gradual recovery or stability of symptoms over the first week of the injury?
   - Yes (There have been improving symptoms over the first week)
   - Yes (There have been stable symptoms over the first week)
   - No (There have been worsening symptoms over the first week)

4. Was there an alternative explanation for the symptoms?
   - Yes (comorbid conditions: migraine, exacerbation of current concussion, anxiety, ADHD, etc)
   - No (concussion is the only likely cause for the current symptoms)
Assessment & Management of Concussion
Processes, Pathways & Tools
Symptom Assessment

Acute Concussion Evaluation (ACE)  Post-Concussion Symptom Inventory (PCSI)  Post-Concussion Executive Inventory (PCEI)

Acute Concussion Evaluation (ACE)

Patient Name: ____________________________
DOB: ______________________  Age: ________ Date: __________

A. Injury Description
- [ ] Head injury
- [ ] Face or mouth injury
- [ ] Eye injury
- [ ] Upper body injury
- [ ] Lower body injury
- [ ] Spine injury
- [ ] Limb injury
- [ ] Other

B. Symptoms Checklist

1. Headache
2. Nausea
3. Balance problems
4. Dizziness
5. Visual problems (double vision, blurring)
6. Sensitivity to light
7. Sensitivity to noise
8. Trouble with memory
9. Trouble concentrating
10. Trouble remembering
11. Trouble with visual tracking
12. Feeling tired even after rest
13. Feeling depressed
14. Feeling irritable
15. Feeling anxious
16. Trouble sleeping
17. Feeling very nervous
18. Feeling very emotional
19. Feeling very angry
20. Feeling very peaked

C. Risk Factors for Protracted Recovery

- [ ] Loss of consciousness
- [ ] Amnesia
- [ ] Seizures
- [ ] Pupil abnormalities
- [ ] Neurological deficits
- [ ] Other

D. ACE tool: Rate the following symptoms:

<table>
<thead>
<tr>
<th>Symptom</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<td>Nausea</td>
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<td>Dizziness</td>
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<td>Visual problems</td>
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<td>Sensitivity to light</td>
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<td>Trouble concentrating</td>
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<td>Trouble remembering</td>
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</tbody>
</table>

E. Conclusion: [ ] Concussion  [ ] Not Concussion

ACE Completed by: ____________________________  © Copyright 2012

Post-Concussion Symptom Inventory (PCSI)

Patient Name: ____________________________
DOB: ______________________  Age: ________ Date: __________

Ages 13-18 (PCSI-SR13)

Pre/Post Version

Today’s date: ____________________________

Instructions: If you have any of these symptoms before your injury, please indicate how much of a problem they have been for you in the past two weeks. For each injury you have had in the past two weeks, please indicate how much of a problem these symptoms have been for you in the past two weeks.

Before the injury

<table>
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<tr>
<th>Symptom</th>
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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<tbody>
<tr>
<td>Headache</td>
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<td>Nausea</td>
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<td>Balance problems</td>
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<td>Dizziness</td>
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<td>Visual problems</td>
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<td>Sensitivity to noise</td>
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Current Symptoms

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<th>3</th>
<th>4</th>
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<td>Nausea</td>
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<td>Balance problems</td>
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<td>Dizziness</td>
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PCSI Total Symptom Score:

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</thead>
</table>

Post-Concussion Executive Inventory (PCEI)

Patient Name: ____________________________
DOB: ______________________  Age: ________ Date: __________

Ages 13-18 (PCEI-SR13)

Pre/Post Version

Today’s date: ____________________________

Instructions: If you have any of these symptoms before your injury, please indicate how much of a problem they have been for you in the past two weeks. For each injury you have had in the past two weeks, please indicate how much of a problem these symptoms have been for you in the past two weeks.

Before the injury

<table>
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<tr>
<th>Symptom</th>
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<td>Nausea</td>
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Current Symptoms

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PCEI Total Symptom Score:

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<th>5</th>
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</table>
Acute Concussion Evaluation (ACE)

- ACE is a clinical protocol to assist diagnosis of mTBI/ concussion in medical/school settings
- Ages 4-adult
- Elements of clinical assessment protocol are evidence-based
- Link to follow-up care via ACE Care Plan
Acute Concussion Evaluation (ACE) Key Elements

A. Define Injury Characteristics
B. Assess for Symptoms (22) (Lovell & Collins, 1998)
C. Identify Risk Factors for Prolonged Recovery
D. Red Flags for Neurological Deterioration
E. Establish the Diagnosis
F. Plan Follow-Up Action / Referral
Tracking Symptom Status/Recovery
Post-Concussion Symptom Conceptualization

- “Static” symptom manifestation: symptoms that are present over period of time (days, weeks)
  - Assessed by traditional graded symptom scales

- “Dynamic” symptom manifestation: symptom presentation (and change) in response to stimulation/ activity → Exertional effects
  - Assessed by dynamic symptom scale (using ecological momentary assessment-EMA)
Concussion Symptom Assessment Toolkit

- **Post-Concussion Symptom Inventory (PCS),**
  - Physical
  - Sleep/Fatigue
  - Cognitive
  - Emotional

- **Post-Concussion Executive Inventory**
  - Working Memory
  - Task Initiation/Completion
  - Emotional Control
Concept of RAPID score

- Retrospective-Adjusted Post-Injury Difference (RAPID) score is central, unique feature
- Addresses two essential questions of whether:
  - there is change from pre to post injury functioning
  - if there has been change (recovery) over post-injury time
- Employ reliable change metrics to answer these questions
Interpreting Reliable Change (Evidence-driven)

When interpreting change, ask two fundamental questions.

1. Are the postinjury symptom ratings clinically different from the RBL (retrospective baseline) ratings?
   - RAPID score indicates change from preinjury to post-injury status, reveals clinically significant problems relative to the preinjury state
   - Answer directs intervention strategies for clinically significant problem
Interpreting Reliable Change
(Evidence-driven)

Two fundamental questions.

2. Is there a significant change in symptom ratings relative to previous assessment?
   • Compare RAPID scores between the two visits to reveal recovery gains over time
   • Answer indicates recovery progress, whether interventions require adjustment
Post-Concussion Symptom Inventory (PCSI)

Child Report
- Age 5-7 – 5 items
- Age 8-12 – 17 items
- Age 13-18 – 21 items

Parent Report
- Age 5-18 – 20 items

Assesses:
- 4 symptom categories
- Pre- and Post-Injury ratings to identify injury-specific effects
- Developmentally sensitive
- Psychometric support
- Included in the NIH CDE toolkit
- Used worldwide

Psychometric Characteristics of the Postconcussion Symptom Inventory in Children and Adolescents

Maegan D. Sady*, Christopher G. Vaughan, Gerard A. Gioia
Division of Pediatric Neuropsychology, Children’s National Health System, Rockville, MD 20850, USA
*Corresponding author at: Division of Pediatric Neuropsychology, Children’s National Health System, 15245 Shady Grove Road, Suite 350, Rockville, MD 20850, USA. Tel.: +1-301-765-5454; fax: +1-301-765-5497.
E-mail address: msady@childrensnational.org (M.D. Sady).
Accepted 11 March 2014
Assessing & Monitoring Key Executive Functions

- Problems with executive functions are common following brain injuries (Chapman et al., 2010; Isquith, Roth, & Gioia, 2013)
- Routinely assessed in an ecologically valid manner (Gioia, Kenworthy, & Isquith, 2010).
- The BRIEF is most widely used measure of the executive functions following brain injury in children/adolescents
Assessing & Monitoring Key Executive Functions

- BRIEF has demonstrated sensitivity to executive function deficits associated with TBI of all severity levels
- We modified the BRIEF to include scales sensitive to concussion
  - Working Memory
  - Emotional Control
  - Task Initiation/Completion
Post-Concussion Executive Inventory (PCEI)

Description

- Originally, component in 2003 CDC mTBI outcomes grant
- Two forms: Parent (18 items), Self (16 items)
- Focused domains: Working Memory, Task Initiation/Completion, Emotional Control
- Ratings of pre-injury status (Retrospective Baseline (RBL), post-injury status)
Post-Concussion Executive Inventory (PCEI) Description

- Central score is the **Retrospective Adjusted Post-Injury Difference (RAPID)** score (Post-Pre)
- Detect change in executive function domains/items from pre to post-injury, and across recovery.
- Guides intervention supports across recovery
Post-Concussion Executive Inventory (PCEI) Psychometrics

- **Samples**: Asymptomatic, symptomatic mTBI; ages 5-18
  - Completed RBL, Post-Injury ratings
  - Across 3 assessment time points

- **Reliability**
  - Internal consistency of scales
  - Stability

- **Validity**
  - Construct
  - Relationship to other measures
  - Sensitivity to clinical condition
RCIs applied to the Post-Concussion Executive Inventory

<table>
<thead>
<tr>
<th>Scale</th>
<th>Visit 1</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RAPID score</td>
<td>ns</td>
<td>80%</td>
<td>90%</td>
</tr>
<tr>
<td>Working Memory</td>
<td>8</td>
<td>0-2</td>
<td>3</td>
<td>4+</td>
</tr>
<tr>
<td>Emotional Control</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2+</td>
</tr>
<tr>
<td>Task Completion</td>
<td>4</td>
<td>0-3</td>
<td>4</td>
<td>5+</td>
</tr>
<tr>
<td>Total</td>
<td>13</td>
<td>0-6</td>
<td>7-8</td>
<td>9+</td>
</tr>
</tbody>
</table>
Dynamic Symptom Assessment & Tracking
Exertional “Effects” Response
As Target of Interest/ Intervention

• Exertional Effects = symptom exacerbation following physical, cognitive, emotional activity
• Possible signal that brain’s neurometabolism pushed beyond tolerable limits
• Child’s sensitivity to symptom exacerbation / exertional effects hypothesized as indicator of injury status.
• Possible treatment/ management implications (i.e., Controlled Exertion)
### Cognitive & Physical Intolerance (% Reporting Exertional Effects)

<table>
<thead>
<tr>
<th></th>
<th>Elementary (n=88)</th>
<th>Middle (n=138)</th>
<th>High School (n=206)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demand</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Cognitive</strong></td>
<td>47.7</td>
<td>52.5</td>
<td>62.5</td>
</tr>
<tr>
<td><strong>Physical</strong></td>
<td>12.5</td>
<td>20.3</td>
<td>16.5</td>
</tr>
</tbody>
</table>

Degree of intolerance/ exertional effects indicates need to manage activity demands at school.

Gioia, 2010
Measuring Dynamic Symptom Response in Concussion: Children’s Exertional Effects Rating Scale

Maegan D. Sady, PhD; Christopher G. Vaughan, PsyD; Gerard A. Gioia, PhD

1. Headache

2. Fatigue

3. Sensitivity to Light

4. Dizziness

Children’s Exertional Effects Rating Scale (ChEERS)
Psychosocial Impact

- Invisible injury
  - TBI not appreciated
  - Look “normal”
- Cut off from social group (team)
- Loss of identity
- Pressures to be “normal”, return & contribute
- Pressure of schoolwork
Assessing Academic Effects

- How does concussion affect school learning and performance?
- What kinds of problems?
  - Symptom-specific
  - General
- What kinds of stresses is the student feeling?
- What subjects are affected?
- What supports are needed? Are they getting?
Concussion Learning Assessment & School Survey (CLASS) Self-report – Initial Appointment

Your Name: ___________________________________________  DOB: _______  Age: _______  Today’s Date: ________________

General (pre-injury) school performance (Circle ALL grades that apply):  A’s  B’s  C’s  D’s  E’s/ F’s

1. *Since your concussion*, how concerned have you been about this injury affecting your school learning and performance? CHECK ONE:  □ Not Concerned  □ Mildly  □ Moderately  □ Very Concerned

2. Think about the past few days and tell us whether the following school problems are worse because of your concussion.

<table>
<thead>
<tr>
<th></th>
<th>Not Worse/ Not a problem</th>
<th>A little Worse</th>
<th>Somewhat Worse</th>
<th>A lot Worse</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Difficulty taking notes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>Difficulty understanding new material</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>In class, work taking longer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d</td>
<td>Homework taking longer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e</td>
<td>Difficulty studying for tests or quizzes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f</td>
<td>Trouble remembering what was studied</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>g</td>
<td>Trouble reading</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>h</td>
<td>Easily distracted during classwork</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i</td>
<td>Easily distracted during homework</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>j</td>
<td>Headaches interfering with classwork</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>k</td>
<td>Headaches interfering with homework</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>l</td>
<td>Tiring easily during the school day</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>m</td>
<td>Tiring easily during homework</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n</td>
<td>Easily bothered by lights/ screens or noise</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3. What is currently stressful or overwhelming for you *because of your concussion*? Indicate your level of stress.

<table>
<thead>
<tr>
<th></th>
<th>Missing time with friends and/or social activities</th>
<th>Not Stressful</th>
<th>A Little Stressful</th>
<th>Moderately Stressful</th>
<th>Very Stressful</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Not being allowed to play sports/recreation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>Not having enough support from teachers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>Not having enough support at home from parents/siblings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d</td>
<td>More stressed out/overwhelmed with the schoolwork piling up</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. Please check one column for each of the following supports to indicate which supports you need and/or are receiving *because of your concussion*.

<table>
<thead>
<tr>
<th>Support</th>
<th>Do you need it?</th>
<th>Do you have it?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Shortened day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shorter classes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rest breaks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extra time to complete work</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No tests</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modified tests (shorter length, more time, no screens, etc.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current work reduced or waived</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Makeup work reduced or waived</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coordinated plan for makeup work</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
TREATING CONCUSSION/MILD TBI
Concussion management

The cornerstone of concussion management is physical and cognitive rest until the acute symptoms resolve and then a graded programme of exertion prior to medical clearance and RTP. The current published evidence evaluating the effect of rest following a sports-related concussion is sparse. An initial period of rest in the acute symptomatic period following injury (24–48 h) may be of benefit. Further research to evaluate the long-term outcome of rest, and the optimal amount and type of rest, is needed. In the absence of evidence-based recommendations, a sensible approach involves the gradual return to school and social activities (prior to contact sports) in a manner that does not result in a significant exacerbation of symptoms.
Historic Approach(es) to Concussion Treatment

- REST
- REST
- REST

TIME

(CISG, AAP, etc.)
General Principles of Recovery

- No additional forces to head/brain
- Get good sleep

**Managing Activity – Exertion Relationship**
- Not over-exerting body or brain
- Not under-exerting body or brain
- Avoid activities that produce symptoms

**Ways to over-exert**
- Physical
- Cognitive! (concentration, learning, memory)
- Emotional
Managed Activity

Concussion in Sports: Postconcussive Activity Levels, Symptoms, and Neurocognitive Performance

Cynthia W. Majerske, MD, MS*; Jason P. Mihalik, MS, CAT(C), ATC†; Dianxu Ren, PhD*; Michael W. Collins, PhD*; Cara Camiolo Reddy, MD*; Mark R. Lovell, PhD*; Amy K. Wagner, MD*

Objective: To examine the role postinjury activity level plays in postconcussive symptoms and performance on neurocognitive tests.

Setting: University-based sports concussion clinic.

Patients or Other Participants: Ninety-five student-athletes (80 males, 15 females; age = 15.88 ± 1.35 years) were retrospectively assigned to 1 of 5 groups based on a postinjury activity intensity scale.

Results: Level of exertion was significantly related to all outcome variables ($P < .02$ for all comparisons). With multivariate analysis, activity intensity remained significant with respect to visual memory ($P = .003$) and reaction time ($P < .001$).

Conclusions: Activity level after concussion affected symptoms and neurocognitive recovery. Athletes engaging in high levels of activity after concussion demonstrated worse neurocognitive performance. For these tasks, those engaging in moderate levels of activity demonstrated the best performance.
Progressive Activities of Controlled Exertion (PACE)

1. Set the Positive Foundation for Recovery
2. Define the Parameters of the Activity-Exertion Schedule
3. Skill Teaching: Activity-Exertion Monitoring/Management
4. Reinforcing the Progressive Path to Recovery
Active Recovery Management (ARM)

Key Messages

You will get better.
You will improve and recover.
You have control of your activity.
Your efforts to control your activity and time will pay off.
Find your “sweet spot” of activity.
Return to Learn

Life in School

School:

- Kid's Major “Job” is *new* learning/*acquiring* knowledge
- Practicing *incompletely* learned knowledge (HW)
- Mental and physical *exertion* is essential to new learning/practice

ALSO:

- Social with peers
- Interacting with teachers
- Managing the environment
- Academic pressure
What factors must be considered in ‘return to school’ following concussion and what strategies or accommodations should be followed?
A systematic review

Laura K Purcell,¹ Gavin A Davis,² Gerard A Gioia³

**Conclusions**  Schools should have a concussion policy and offer individualised academic accommodations to students recovering from SRC on RTS; a medical letter should be provided to facilitate provision/receipt of academic accommodations; students should have early, regular medical follow-up following SRC to help with RTS and monitor recovery; students may require temporary absence from school after SRC; clinicians should assess risk factors/modifiers that may prolong recovery and require more intensive academic accommodations.
Objective: The aim of this work is to study the nature and extent of the adverse academic effects faced by students recovering from concussion.

Method: A sample of 349 students ages 5 to 18 who sustained a concussion and their parents reported academic concerns and problems (e.g., symptoms interfering, diminished academic skills) on a structured school questionnaire within 4 weeks of injury. Postconcussion symptoms were measured as a marker of injury severity. Results were examined based on recovery status (recovered or actively symptomatic) and level of schooling (elementary, middle, and high school).

Results: Actively symptomatic students and their parents reported higher levels of concern for the impact of concussion on school performance ($P < .05$) and more school-related problems ($P < .001$) than recovered peers and their parents. High school students who had not yet recovered reported significantly more adverse academic effects than their younger counterparts ($P < .05$). Greater severity of postconcussion symptoms was associated with more school-related problems and worse academic effects, regardless of time since injury ($P < .001$).

Conclusions: This study provides initial evidence for a concussion’s impact on academic learning and performance, with more adverse effects reported by students who had not yet recovered from the injury. School-based management with targeted recommendations informed by postinjury symptoms may mitigate adverse academic effects, reduce parent and student concerns for the impact of the injury on learning and scholastic performance, and lower the risk of prolonged recovery for students with active postconcussion symptoms.
### What kinds of school problems are you having SINCE YOUR INJURY?

* Ransom et al. (2015)

<table>
<thead>
<tr>
<th>Type of Problem</th>
<th>Elementary (n=42)</th>
<th>Middle (n=78)</th>
<th>High School (n=120)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headaches interfering</td>
<td>53%</td>
<td>73%</td>
<td>71%</td>
</tr>
<tr>
<td>Can’t pay attention</td>
<td>47%</td>
<td>58%</td>
<td>66%</td>
</tr>
<tr>
<td>Feeling too tired</td>
<td>53%</td>
<td>61%</td>
<td>52%</td>
</tr>
<tr>
<td>Homework taking much longer</td>
<td>35%</td>
<td>48%</td>
<td>63%*</td>
</tr>
<tr>
<td>Difficulty understanding material</td>
<td>29%</td>
<td>46%</td>
<td>54%</td>
</tr>
<tr>
<td>Difficulty studying for tests</td>
<td>18%</td>
<td>36%</td>
<td>53%*</td>
</tr>
<tr>
<td>Difficulty taking Notes</td>
<td>18%</td>
<td>17%</td>
<td>35%*</td>
</tr>
<tr>
<td>Average # reported Mn (SD)</td>
<td>2.53 (2.1)</td>
<td>3.37 (1.7)</td>
<td>3.92 (2.1)</td>
</tr>
</tbody>
</table>

* Significant (p<.05) difference across grade level
Predicting Academic Outcomes

Applying an Evidence-Based Assessment Model to Identify Students at Risk for Perceived Academic Problems following Concussion

Danielle M. Ransom,1 Alison R. Burns,2,3 Eric A. Youngstrom,4 Christopher G. Vaughan,2,3 Maegan D. Sady,2,3 and Gerard A. Gioia2,3

1University of Miami Miller School of Medicine, Miami, Florida
2Children’s National Health System, Washington, DC
3George Washington University School of Medicine, Washington, DC
4University of North Carolina, Chapel Hill, North Carolina

(Received March 14, 2016; Final Revision October 10, 2016; Accepted October 10, 2016)
Who is on the School Team?

Concussion Management Team
- Medical Monitor
- Academic Monitor

School nurse, psychologist, athletic trainer
Guidance counselor
Administrator
Teacher(s)
Healthcare Provider(s)
Family
School Pathway (suggested)

School is notified of injured student

Concussion Management Team

Student Evaluation
- Symptoms, Exertion
- Academic Effects
- Psychological Effects

Assessment Tools
- Broad-based symptoms: ACE, PCSI
- Specific Sx (cog/emot): PCEI
- Exertional effects: ChEERS
- Academic effects: CLASS

Academic Planning
- Symptom Targets & Supports
- Academic Management
- Activity Management

Social-Emotional Support
- Irritability/ Emotional Control
- Anxiety/ Stress
- Mood
- Self-Efficacy (Recovery Control)
## Symptom Targeted Academic Management Plan (STAMP)

Below, please see the symptoms they are currently experiencing. To promote recovery, the student will be provided with the following classroom accommodations that support their academic learning and performance:

<table>
<thead>
<tr>
<th>Symptom (check)</th>
<th>Functional school problem</th>
<th>Accommodation/management strategy (select)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cognitive Symptoms</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attention &amp; concentration difficulties</td>
<td>Short focus on lecture, classwork, homework</td>
<td>Shorter assignments (odd/even problems, requiring outline or bullet points instead of full written responses)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Break down tasks and tests into chunks/segments</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lighter work load: Max. nightly homework (including studying): ____ min</td>
</tr>
<tr>
<td>Working memory (short-term memory)</td>
<td>Trouble holding instructions, lecture, reading material, thoughts in mind</td>
<td>Repetition</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Written instructions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Provide student with teacher generated class notes</td>
</tr>
<tr>
<td>Memory consolidation/retrieval</td>
<td>Accessing learned information</td>
<td>Smaller chunks/segments to learn, repetition</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Recognition cues</td>
</tr>
<tr>
<td><strong>Physical Symptoms</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Headaches</td>
<td>Interferes with concentration Increased irritability</td>
<td>Intersperse rest breaks, shortened day if symptom does not subside</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Allow for short naps in quiet location (e.g., nurse’s office)</td>
</tr>
<tr>
<td>Light/ noise sensitivity</td>
<td>Symptoms worsen in bright or loud environments</td>
<td>Wear sunglasses/hat, seating away from bright sunlight</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Limit exposure to SMART board, computers, provide class notes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Avoid noisy/crowded environments such as lunchroom, assemblies, chorus/music class, and hallways. Leave class early.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Allow student to wear earplugs as needed</td>
</tr>
<tr>
<td>Dizziness/ balance/nausea</td>
<td>Unsteadiness when walking Nausea or vomiting</td>
<td>Elevator pass</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Class transition before bell</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shortened day or rest breaks</td>
</tr>
<tr>
<td>Sleep disturbance</td>
<td>Decreased arousal, shifted sleep schedule, trouble falling asleep</td>
<td>Later start time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shortened day or rest breaks</td>
</tr>
<tr>
<td>Fatigue</td>
<td>Lack of energy</td>
<td>Periodic rest breaks, short naps in quiet location</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Passive participation</td>
</tr>
</tbody>
</table>
Tools for School Management

**Acute Concussion Evaluation (ACE) Care Plan**
Gerard Gioia, PhD¹ & Micky Collins, PhD²
¹Children's National Medical Center ²University of Pittsburgh Medical Center

**Concussion Management**
Policy and Resource Handbook

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**BrainSTEPS**
Strategies Teaching Educators, Parents, & Students
A BRAIN INJURY RE-ENTRY CONSULTING PROGRAM

---

**Changes You Can Make Based on Type of Concussion Symptoms**

**Thinking/Remembering** (such as having difficulty thinking clearly or concentrating, feeling slowed down)
- Reduce class assignments and homework to key tasks only and base grades on adjusted work.
- Provide extra time to work on class assignments.
- Provide written instructions and help with homework and coursework.
- Allow extra time to take tests. Limit tests to one per day, and/or provide study guides.
- Allow your students to show they understand a concept orally instead of in writing.
- Provide class notes and/or resources for students to use a computer or tape recorder to record classroom information.

**Fatigue/Sleep and Physical** (such as feeling tired, having no energy, having headaches or dizziness)
- Allow time to visit the school nurse for treatment of headaches or other symptoms.
- Provide rest breaks.
- Give your students extra time to go from class to class, to avoid crowds.
- If bothered by light, allow your students to wear sunglasses or sit in a place that is less bright (e.g., draw blinds, sit away from window).
- If bothered by noise, provide a quiet place for your students to study, take a test, or spend lunch or recess.
- Do not substitute concentration activities for physical activity (e.g., do not assign reading instead of PE).

**Emotional** (such as feeling sad, irritable, anxious)
- Develop an emotional support plan for your students (e.g., identify an adult to whom they can talk if feeling overwhelmed).
- Locate a quiet place for your students to go to if they feel overwhelmed. Provide information on how they can safely get to this quiet location.
- Students may benefit from continued involvement in certain extracurricular activities during their recovery. Identify student and family preferences and consider these activities, approved by their health care provider, in relation to rest time and academic work.
Summary

• Most children & adolescents recover from concussion within 1-4 weeks
• Concussions can have a significant effect on the injured student’s school learning

NEW TREATMENT APPROACH:
• Day 1-3 (5-7*): Initial restriction of activity with good nighttime sleep
• Day 4+ (8+*): Individualized progressive cognitive and physical activity with monitored symptom management
• Return to School requires medical-school teamwork
• Schools need Concussion Management Teams to provide systematic, coordinated support services

*More significant symptom load
Concussion care is a team sport. Communication, collaboration, coordination!

Implement the Berlin/CDC rec’s for Return to School!

Medical & school expertise must be coordinated & collaborative

Systematic Return to School policy and pathway is critical!

Understanding student’s unique symptom profile is critical to delivering effective support (STAMP).

Regular monitoring of student’s symptoms, adjusting types & intensity of supports is critically important.
Summary

• **School psychologists** can play an important role in supporting the student with concussion.
• Apply your **assessment expertise** to define symptom targets to support
• Use your **skills with interventions** to understand, accommodate, monitor & readjust supports based on student’s symptoms
• Get in the Game!
Concussion/ mTBI
CDC Educational Materials

www.cdc.gov/headsup

Heads Up: Concussion in High School Sports
Heads Up: Concussion in Youth Sports
Heads Up: Concussion in Your Practice
Heads Up to Schools: Know Your Concussion ABCs
References


