Assessment and Monitoring of Cognitive and Emotional Functioning in Students following Concussion

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Objectives
This session will help participants:

- State common effects of concussion on student functioning
- Describe the expected course of recovery and complicating risk factors
- List common assessment tools and describe their use
- Describe methods for detecting meaningful change in scores
- Use newer assessment & monitoring tools to track executive functions

Disclosure Statement
Psychological Assessment Resources, Inc.
- Test Author (royalties)
- Behavior Rating Inventory of Executive Function (BRIEF)
- Tasks of Executive Control (TEC)

Many other tests & measures (no royalties)
- Acute Concussion Evaluation (ACE) – office, ED
- ACE Care Plan, Home/School Instructions
- Post-Concussion Symptom Inventory (PCSI) 5-7, 8-12, 13-18, Parent
- BRIEF – Concussion Monitoring – Parent, Self-Report
- Children’s Exertional Effects Rating Scale (ChEERS)
- Concussion Learning Assessment & School Survey (CLASS) – Parent, Self-Report
- Progressive Activities of Controlled Exertion (PACE) – Self-Guided (Child, Parent)
- Multimodal Assessment of Cognition & Symptoms (MACS)
- Concussion Recognition & Response (CRR) – Parent/Coach app
- Concussion Assessment & Response (CARE) – Medical app

Concussion as ADHD in 1980

ADHD
- 1980: Most kids were evaluated and treated by specialists – or not at all

Concussion
- 2001: Most kids are evaluated and treated by specialists – or not at all
- 2018: Most kids are evaluated/ treated by pediatricians and within schools
  - Refer Complex Cases

Injury
“Typical” Recovery
“Atypical” Recovery (>4 wks)

Concussion as the “new” ADHD

Common Symptoms
- “Typical” Recovery
- “Atypical” Recovery (>4 wks)

Primary “Care” *
Primary “Care” *

Specialty Care **
“School as a “primary care” setting
“School psychologist as a “specialist”

Relevance:
- Knowledge of varied models and methods of assessment and data collection for identifying strengths and needs
- Systematically collecting data form multiple sources and using ecological factors as context for all assessment & intervention decisions
- Using assessment data to understand students’ problems and implement evidence-based instructional, behavioral & mental health services
- Measuring progress & outcomes
- Evaluate effectiveness and need for modification to school-based interventions
Concussion's Medical Neighborhood

Connected Care

Point of Entry
Parents/Coaches
Group Leaders
Peers (R&R)

Injury
Emergency Dept
Urgent Care
Primary Care
Athletic Trainers

Continued Care
"Typical"
Primary Care
Specialty Care
Incl. Rehabilitation Services

Continued Care
"Atypical"

School Return
1. Safety
2. Managed, monitored, gradual return to academic, social, physical activity

Rewards of Working with Concussion

Typically:
- Not a long-term issue
- Not a lot of testing
- Intervention/consultation oriented
- Kids get better! In direct proportion to:
  - How early their needs are identified
  - How early interventions are put in place
  - Their needs being monitored regularly and interventions modified through recovery

BIJSM 2017

Vienna/Prague/Zurich/Berlin

What is the difference in concussion management in children as compared with adults? A systematic review

Gavin A Davis,1 Vicki Anderson,1 Franz E Babi,1 Gerard A Gioia,2 Christopher C Goa,3 William Meehan,1 Rosemarie Sciarro Moses,1 Laura Percut1 Philip Schultz,4 Kathryn J Schreiber,1 Michael Ialagi,1 Keith Owen Heated,5 Roger Zemek6

ABSTRACT

Aim: To evaluate the evidence regarding the management of sport-related concussion (SRC) in children and adolescents; the eight subcategories included: the effects of age on symptoms and outcome, normal and prolonged duration, the role of computerized neurocognitive tests (CNT), the role of sex, and strategies for return to school and return to sport (RTS).

Design: Systematic review.

Conclusion: There is no evidence to support most of the management of SRC in children as different from adults. Children may take longer to recover from sport-related concussion than adults. Children should be followed with gradual symptom-limited physical and cognitive activity. All schools should 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.

JAMA Pediatrics 2018

CONCUSSION 101:
THE FOUNDATIONS

October 27, 2018 Peter K. Isquith
Concussion = Traumatic Brain Injury

Concussion, or mild TBI, is:
- A TBI induced by traumatic biomechanical forces secondary to direct or indirect forces to the head.
- Produces disturbance of brain function secondary to disruption of neurometabolism with normal structural neuroimaging
- Typically results in symptoms in physical, cognitive, emotional and sleep domains that may last minutes to weeks or, or sometimes longer

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

TBI in US Children

<table>
<thead>
<tr>
<th>Cause</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor Vehicle Collisions</td>
<td>90%</td>
</tr>
<tr>
<td>Falls</td>
<td></td>
</tr>
<tr>
<td>Struck By/ Against</td>
<td></td>
</tr>
<tr>
<td>Assaults</td>
<td></td>
</tr>
<tr>
<td>Sports &amp; Recreations</td>
<td></td>
</tr>
</tbody>
</table>

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; Hovda, in press
Neurometabolic Cascade Following Traumatic Brain Injury

(Giza & Hovda, 2001)

Anatomical Timeline of a Concussion
Defining the Key Factors

C. Risk Factors
A. Injury Characteristics
B. Symptom Assessment

CONCUSSION

Pre-Injury Risk
Retrograde Amnesia 20-40%
Anterograde Amnesia 20-40%
Neurocog dysfx & Post-Concuss Sx’s

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

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

Sleep
- Sleeping more/less
- Trouble falling asleep
- Drowsiness

Cognitive
- Mental fogging
- Difficulty concentrating
- Difficulty remembering
- Feeling slowed down

Emotional
- More emotional
- Irritable
- Sad
- Nervous

Recovery of Child/Adolescent:
Our Best Guess

- 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!

Persisting Symptom Culprits

- Headaches
- Fatigue
- Vestibular (dizziness, balance)
- Cognitive problems (attention, memory, executive function, speed)
- Anxiety/ mood problems
Assessment & Management of Concussion
Processes, Pathways & Tools

Symptom Assessment

Acute Concussion Evaluation (ACE)

Post-Concussion Symptom Inventory (PCSI)
Post-Concussion Executive Inventory (PCEI)

Multimodal Assessment of Cognition & Symptoms (MACS)
Children’s Exertional Effects Rating Scale (CHEERS)

Concussion Learning Assessment & School Survey (3rd) CLASS-3
Symptom Targeted Academic Management Plan (STAMP)
Online Treatment Recovery Assistance for Concussion in Kids (OnTRACK)

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

Pediatric Assessment and Management of Concussions

Concussions and mild traumatic brain injuries have become more widely recognized and understood during the past 5 to 10 years. Early and intensive evaluation and management of this brain injury is necessary to mitigate risks to the developing child and adolescent. Pediatricians play a critical role in the evaluation and management of concussions and should develop a toolkit of assessment techniques to identify current and long-term effects of the injury and its impact on well-being.

Accurate diagnosis and management of the pediatric concussion requires development of a strategy to define the characteristics of the injury, conduct a full assessment of post-concussion symptoms, and define any risk for chronicity or recovery.

This evaluation forms the basis of concussion treatment, which involves the active management of the child’s knowledge of the patient’s post-injury status. Without the pediatrician’s active and informed involvement, service coordination can falter, to the detriment of further care.

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

Acute Concussion Evaluation (ACE)

A. Injury Characteristics

Cause
Amnesias (retrograde, anterograde)
Loss of Consciousness (LOC), Seizures

Early Signs

- Headache
- Memory difficulties
- Dizziness
- Visual disturbances
- Drowsiness
- Nausea
- Difficulty concentrating
- Confusion
- Balance problems
- Early Signs
- Memory loss
- Seizures
- LOC

Basketball
Sept. 7, 2008
Fell to ground, hit head on ground, kneed in right temporal region; dazed initially but continued to play with bad headache. Felt sluggish and confused.

Acute Concussion Evaluation (ACE)

B. Symptom Checklist

Acute Concussion Evaluation (ACE)

C. Risk Factors for Protracted Recovery

Research findings have linked these risk factors to longer periods of recovery

Acute Concussion Evaluation (ACE)

D. Red Flags for Neurological Deterioration

Physicians and parents/patients need to be aware of signs that signal the need for emergency care.

Tracking Symptom Status/Recovery

Post-Concussion Symptom Inventory
Post-Concussion Executive Inventory
Use RAPID scores

- Retrospective-Adjusted Post-Injury Difference (RAPID) score is central, unique feature
- Use Reliable Change metrics to answer questions:
  - Is there a change from pre- to post-injury?
  - Is there change (recovery) over time?

Reliable Change Index (RCI)

- Is change in score beyond what expected given variability in the instrument and effects of repeated ratings?
- RCI metrics incorporate measure’s normal variability (SD) with stability (reliability), producing SEM and \( Se_{\text{diff}} \) and establishing confidence intervals
- RCI provides helpful guideline for determining when changes from two scores are beyond expectation based on measure’s stability and expected change for two ratings
- RCIs of RAPID score indicate clinically meaningful difference beyond 80% or 90% CI range.

Interpreting Reliable Change (Evidence-driven)

When interpreting change, ask two fundamental questions.
1. Are post-injury 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
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

Concussion Symptom Assessment Toolkit

- Post-Concussion Symptom Inventory (PCSI)
  - Physical
  - Sleep/Fatigue
  - Cognitive
  - Emotional
- Post-Concussion Executive Inventory
  - Working Memory
  - Task Initiation/Completion
  - Emotional Control

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
**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 executive functions following brain injury in children/adolescents.

**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

**PSCI Discriminates between injured and non-injured children**

<table>
<thead>
<tr>
<th></th>
<th>Ages 13–18</th>
<th>Ages 8–12</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Self</td>
<td>Parent</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>0.51</td>
<td>0.80</td>
</tr>
<tr>
<td>Specificity</td>
<td>0.89</td>
<td>0.89</td>
</tr>
<tr>
<td>PPV</td>
<td>0.62</td>
<td>0.67</td>
</tr>
<tr>
<td>NPV</td>
<td>0.64</td>
<td>0.71</td>
</tr>
<tr>
<td>Likelihood</td>
<td>4.63</td>
<td>35.00</td>
</tr>
<tr>
<td>Likelihood</td>
<td>0.55</td>
<td>0.40</td>
</tr>
<tr>
<td>Odds ratio</td>
<td>8.35</td>
<td>86.74</td>
</tr>
<tr>
<td>Classification</td>
<td>70%</td>
<td>79%</td>
</tr>
<tr>
<td>Area under the</td>
<td>0.71</td>
<td>0.88</td>
</tr>
</tbody>
</table>

**Post-Concussion Executive Inventory (PCEI)**

<table>
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**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)**

- 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
- Measure progress across recovery
- Guide intervention supports across recovery

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October 27, 2018  Peter K. Isquith
RCIs applied to the Post-Concussion Executive Inventory

Score Summary Table

<table>
<thead>
<tr>
<th>Scale</th>
<th>Visit 1 RAPID Score</th>
<th>80%</th>
<th>90%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working Memory</td>
<td>8</td>
<td>0-2</td>
<td>3</td>
</tr>
<tr>
<td>Emotional Control</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Task Completion</td>
<td>4</td>
<td>0-3</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>13</td>
<td>0-6</td>
<td>7-8</td>
</tr>
</tbody>
</table>

Change over Time

Concentration recovery subscales between Visit 1 and Visit 2

<table>
<thead>
<tr>
<th>Scale</th>
<th>Visit 1 RAPID Score</th>
<th>Visit 2 RAPID Score</th>
<th>m</th>
<th>80%</th>
<th>90%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working Memory</td>
<td></td>
<td></td>
<td>8</td>
<td>5-6</td>
<td>7+</td>
</tr>
<tr>
<td>Emotional Control</td>
<td></td>
<td></td>
<td>9</td>
<td>3</td>
<td>6+</td>
</tr>
<tr>
<td>Task Completion</td>
<td></td>
<td></td>
<td>10</td>
<td>7-8</td>
<td>15+</td>
</tr>
</tbody>
</table>

Concentration recovery subscales between Visit 2 and Visit 3

<table>
<thead>
<tr>
<th>Scale</th>
<th>Visit 2 RAPID Score</th>
<th>Visit 3 RAPID Score</th>
<th>m</th>
<th>80%</th>
<th>90%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working Memory</td>
<td></td>
<td></td>
<td>8</td>
<td>5-6</td>
<td>7+</td>
</tr>
<tr>
<td>Emotional Control</td>
<td></td>
<td></td>
<td>9</td>
<td>3</td>
<td>6+</td>
</tr>
<tr>
<td>Task Completion</td>
<td></td>
<td></td>
<td>10</td>
<td>7-8</td>
<td>15+</td>
</tr>
</tbody>
</table>
Parent ratings on PCEI over 3 Post-Injury Visits

N = 99

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 over time
- Validity
  - Construct
  - Relationship to other measures
  - Sensitivity to clinical condition

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

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

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### 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

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### 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?
Test-Based Assessment

- Concussion can produce impairment of neuropsychological function in children and adults
  - Attention, memory, speed, executive function
- Strengths: Assessment of neuropsychological function provides measurable outcome of injury
- Limitations: Other factors can influence performance and reporting; findings do not stand alone
- Test findings are best understood as one tool within a multidimensional, multidisciplinary model
- Training in the proper administration is critical to obtain valid results (Vaughan et al., 2014; Moser et al., 2011)
- Interpretation of findings requires higher level of training/experience

Treatment (Zurich)

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 RT.[1] 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
- TIME
- REST

(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 M. Weirich, MD, MS, Jason F. Bihorak, MS, CAT(OC); Grace A. Kuhr, PhD; Michael W. Cohen, PhD; Carol Cameron Reddy, MD; Mark R. Lovett, PhD; Amy R. Wagen, MS

**Objective:** To examine the risk postinjury activity level plays.

**Not too Little, Not too Much**

**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.**

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**Effect of Concussion on School Learning & Performance**

**Effect of School Learning & Performance on Concussion Recovery**

**Epidemiology of Recovery**

**Our Best Guess**

- Research literature is still limited with respect to understanding concussion recovery outcomes across full age range, and for boys and girls (IOM, 2013).
- Perhaps 70 +/-% recovery within 4 weeks (Zemek et al, 2016).

Recovery Supports must plan for a window from several days to several months (school, physical, social).
Defining Academic Outcomes

- Ransom et al. (2015) define types of academic challenges in concussed students 5-18 years.

- Results: Non-recovered (RC-) group reported higher levels of concern, more school-related problems than RC+ group.

- High school students report higher levels of problems.

- Higher symptom burden associated with greater reported academic problems.

- Significantly greater impairment on cognitive testing in RC- group.

- Summary: empirical evidence of concussion's impact on learning/performance reported by students. Identifies academic effects to target interventions.

### 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=72)</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 Min (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

### Which classes/subjects are you having trouble with SINCE YOUR INJURY?

**Elementary (n=42) Middle (n=72) High School (n=120)**

<table>
<thead>
<tr>
<th>Type of Problem</th>
<th>Elementary</th>
<th>Middle</th>
<th>High School</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading</td>
<td>33.3</td>
<td>37.0</td>
<td>46.3</td>
</tr>
<tr>
<td>Math</td>
<td>29.5</td>
<td>54.3</td>
<td>59.2</td>
</tr>
<tr>
<td>Science</td>
<td>14.8</td>
<td>29.7</td>
<td>46.3</td>
</tr>
<tr>
<td>Social Studies</td>
<td>14.8</td>
<td>23.1</td>
<td>36.1</td>
</tr>
<tr>
<td>Foreign Language</td>
<td>7.4</td>
<td>33.7</td>
<td>32.0</td>
</tr>
<tr>
<td>Art</td>
<td>0.0</td>
<td>5.5</td>
<td>3.4</td>
</tr>
<tr>
<td>None</td>
<td>14.8</td>
<td>16.3</td>
<td>12.9</td>
</tr>
</tbody>
</table>

### Predicting Academic Outcomes

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

- Gioia, 2010

#### Cognitive & Physical Demands & Symptoms (% Reporting Exertional Effects)

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

Degree of exertional effects indicates need to manage activity demands during school day (w/ accommodations)

---

### And don’t forget the Psychosocial Issues!

- 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

---

October 27, 2018  Peter K. Isquith
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

Emotional
- More emotional
- Irritable
- Sad
- Nervous

Sleep
- Sleeping more/less
- Trouble falling asleep
- Drowsiness

(Today) A Student is Identified with a Mild TBI/Concussion

What Do You Do (Tomorrow)?

School and the Concussed Youth: Recommendations for Concussion Education and Management

Building Statewide Infrastructure for the Academic Support of Students With Mild Traumatic Brain Injury

Assessing & Monitoring Executive Function in Concussion

What Berlin has to say about School Return (Purcell et al, 2018)

Five factors influence return to school post-concussion:
1. **Age**: Adolescents tend to take longer to recover and return to school; adolescents more concerned about the negative academic effects of concussion than younger children.
2. **Symptom load/severity**: Students with greater number/severity of symptoms tend to take longer to return to school, require more academic accommodations, longer to recover
3. **Course load**: Certain subjects pose greater problems for students returning to school: math (#1) reading/language arts (#2), then science, social studies.

Berlin & School (cont.)

4. **Medical follow-up**: Students who receive RTS letter in ED, medical follow-up after ED more likely to receive academic accommodations
5. **School resources**: Schools with concussion policies that include student/parent concussion education tend to:
   - provide more accommodations and greater variety of accommodations to students
   - be more likely to form concussion management teams at school to facilitate return to school
   - have students and parents who are more knowledgeable about concussion (Glang et al. 2014)
15A. To assist children returning to school following mTBI, medical and school-based teams should counsel the student and family regarding the process of gradually increasing the duration and intensity of academic activities as tolerated, with the goal of increasing participation without significantly exacerbating symptoms. (Level B)

15B. Return to school protocols should be customized based on the severity of postconcussion symptoms in children with mTBI as determined jointly by medical and school-based teams. (Level B)

15C. For any student with prolonged symptoms that interfere with academic performance, school-based teams should assess the educational needs of that student and determine the student’s need for additional educational supports, including those described under pertinent federal statutes (eg, Section 504, IDEA). (Level B) [see 15F]

15D. Postconcussion symptoms and academic progress in school should be monitored collaboratively by the student, family, healthcare provider, and school teams, who jointly determine what modifications or accommodations are needed to maintain an academic workload without significantly exacerbating symptoms. (high; Level B)

15E. The provision of educational supports should be monitored and adjusted on an ongoing basis by the school-based team until the student’s academic performance has returned to preinjury levels. (moderate; Level B)

15F. For students who demonstrate prolonged symptoms and academic difficulties despite an active treatment approach, healthcare providers should refer the child for a formal evaluation by a specialist in pediatric mTBI. (moderate; Level B) [see 15C]

Connecting Medical & Schools

Medical-School Partnership in Guiding Return to School Following Mild Traumatic Brain Injury in Youth

Gerard A. Gioia, PhD

Expertise within the Team

Medical System Role in Setting Up School Return

CDC “Discharge” Education

Key Components

1. Educate about concussions (definition, risks)
2. Reasons to go/return to Emerg. Dept. (red flags)
3. Safety restrictions: sports, other risk activities
4. Activity restriction & management
5. School/ work return guidance
6. Medical follow up

Assessing & Monitoring Executive Function in Concussion

October 27, 2018 Peter K. Isquith
School-based Concussion Management Team

Roles

– Medical monitor:
  • monitors the symptom status of the student, using standardized symptom scale
  • Liaisons with community medical provider
  • Reports status to academic monitor

– Academic monitor:
  • oversees & guides academic support process - Day 1 to recovery
  • Links student symptom status with accommodations
  • Liaisons with, student, teachers and medical monitor

School Psychologist Pathway (suggested)

School is notified of injured student

Assessment Tools
-Broad-based symptoms - ACE, PCSI
-Specific Sx (e.g. mood) - PCEI
-Exertional effects - CHEERS
-Academic effects

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

Social-Emotional Support
- Irritability/ Emotional Control
- Anxiety/ Stress
- Mood
- Self-Efficacy (Recovery Control)

How long do students need support?

- Perhaps 70 +/-% with symptom recovery within 4 weeks (Zemek et al, 2016)
- Therefore, 30% beyond 4 weeks.

Recovery Supports must plan for a window from several days to several months (school, physical, social).
JT - 14 year old 9th grade male; plays soccer, basketball, lacrosse; no hx of LD, ADHD, emotional dx. One previous concussion (age 8, riding bike).  
Injured yesterday (10/18) skateboarding, fell and struck the back of his head; no LOC but does not recall the fall or 5-10 minutes prior; 10 minutes of PTA; confusion.  
Pediatrician evaluation: ACE identifies physical, cognitive, emotional and sleep symptoms; concussion diagnosed  
Recommends 2 days off school; Return To School letter provided

JT – School Evaluation & Support Plan  
- Presents to school Day 3 post-injury; RTS letter provided  
- Symptom & Academic Effects evaluation  
  - Acute Concussion Evaluation (ACE)  
  - Post-Concussion Symptom Inventory (PCSI)  
  - Post-Concussion Executive Inventory (PCEI)  
  - Academic Effects (CLASS)  
  - Exertion ratings  
- PCSI:  
  - Physical: Headaches, dizziness, balance problems, sensitivity to light, blurry vision  
  - Cognitive: fogginess, problems concentrating, slowed thinking  
  - Emotional: irritability  
  - Sleep/fatigue: fatigue, drowsiness, sleeping more than usual

Acute Concussion Evaluation (ACE)  
B. Symptom Checklist

JT (cont)  
- PostConcussion Executive Inventory:  
  - Difficulties with working memory, task completion; mild emotional (dys)control  
- Physical & cognitive activity worsens symptoms  
- CLASS: Moderately concerned  
  - Academic problems  
  - Stress  
  - Classes affected
**Score Summary Table**

<table>
<thead>
<tr>
<th>Visit 1</th>
<th>Scale</th>
<th>RAPID score</th>
<th>rs</th>
<th>80%</th>
<th>90%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Working Memory</td>
<td>12</td>
<td>0-2</td>
<td>3</td>
<td>4+</td>
</tr>
<tr>
<td></td>
<td>Emotional Control</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>2+</td>
</tr>
<tr>
<td></td>
<td>Task Completion</td>
<td>0-3</td>
<td>4</td>
<td>5</td>
<td>5+</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>0-6</td>
<td>7-8</td>
<td>9</td>
<td>9+</td>
</tr>
</tbody>
</table>

**Gradual Return to School**

**Six Stages w Recommended Activity Level**

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
<th>Activity Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No return, at home</td>
<td>Day 1 - Maintain low level cognitive and physical activity. No prolonged concentration. Cognitive Readiness Challenge: As symptoms improve, try reading or math challenge task for 10-30 minutes, assess for symptom increase.</td>
</tr>
<tr>
<td>1</td>
<td>Return to School, Partial Day (1-3 hours)</td>
<td>Attend 1-3 classes, intersperse rest breaks. No tests or homework. Minimal expectations for productivity.</td>
</tr>
<tr>
<td>2</td>
<td>Full Day, Maximal Supports (required throughout day)</td>
<td>Attend most classes, with 2-3 rest breaks (20-30'), no tests. Minimal HW (&lt; 20%). Minimal-moderate expectations for productivity.</td>
</tr>
<tr>
<td>3</td>
<td>Return to Full Day, Moderate Supports (provided in response to symptoms during day)</td>
<td>Attend all classes with 1-2 rest breaks (20-30'); begin quizzes. Moderate HW (60-90'). Moderate expectations for productivity. Design schedule for make-up work.</td>
</tr>
<tr>
<td>4</td>
<td>Return to Full Day, Minimal Supports (Monitor final recovery)</td>
<td>Attend all classes with 0-1 rest breaks (20-30'); begin modified tests (breaks, extra time); HW (60-90'). Moderate-minimum expectations for productivity. Full class schedule, no rest breaks.</td>
</tr>
<tr>
<td>5</td>
<td>Full Return, No Supports Needed</td>
<td>Max. expectations for productivity. Begin to address make-up work.</td>
</tr>
</tbody>
</table>

**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

**Symptom Targeted Academic Management Plan (STAMP)**

- 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.

**Assessing & Monitoring Executive Function in Concussion**

- 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.
- Systematic Return to School 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!

Rewards of Working with Concussion

What to Do?
- Join the Concussion Mgt Team
- Help develop a Concussion Mgt Team
- Use the Pathway(s)
- Apply your good skills in evidence-based assessment, consultation & intervention

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

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References


