The Importance of Return-to-Academic Plans and Active Rehabilitation for Mental Health in Concussion Management

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Plan for the talk

- Concussion Management
  - What happens when an athlete is injured?
  - Rest – Is it important?
  - Active Rehabilitation – what are ways to improve recovery?
  - Return to Learn – importance for student-athletes
  - Role of Social Support
- Long-term implications on mental health
- Questions??

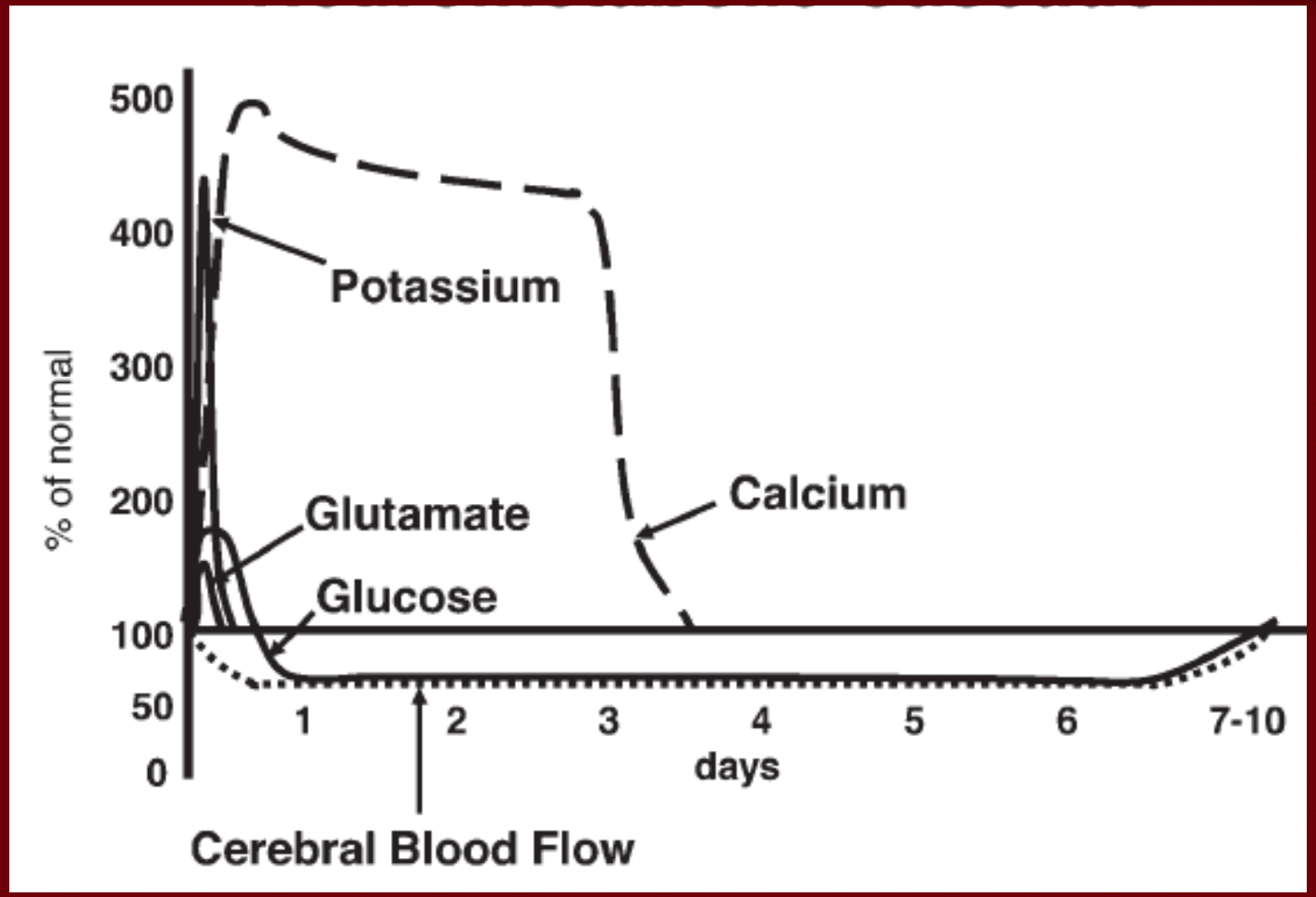
Case Study – When concussion management goes bad??

What may have been responsible for this result?

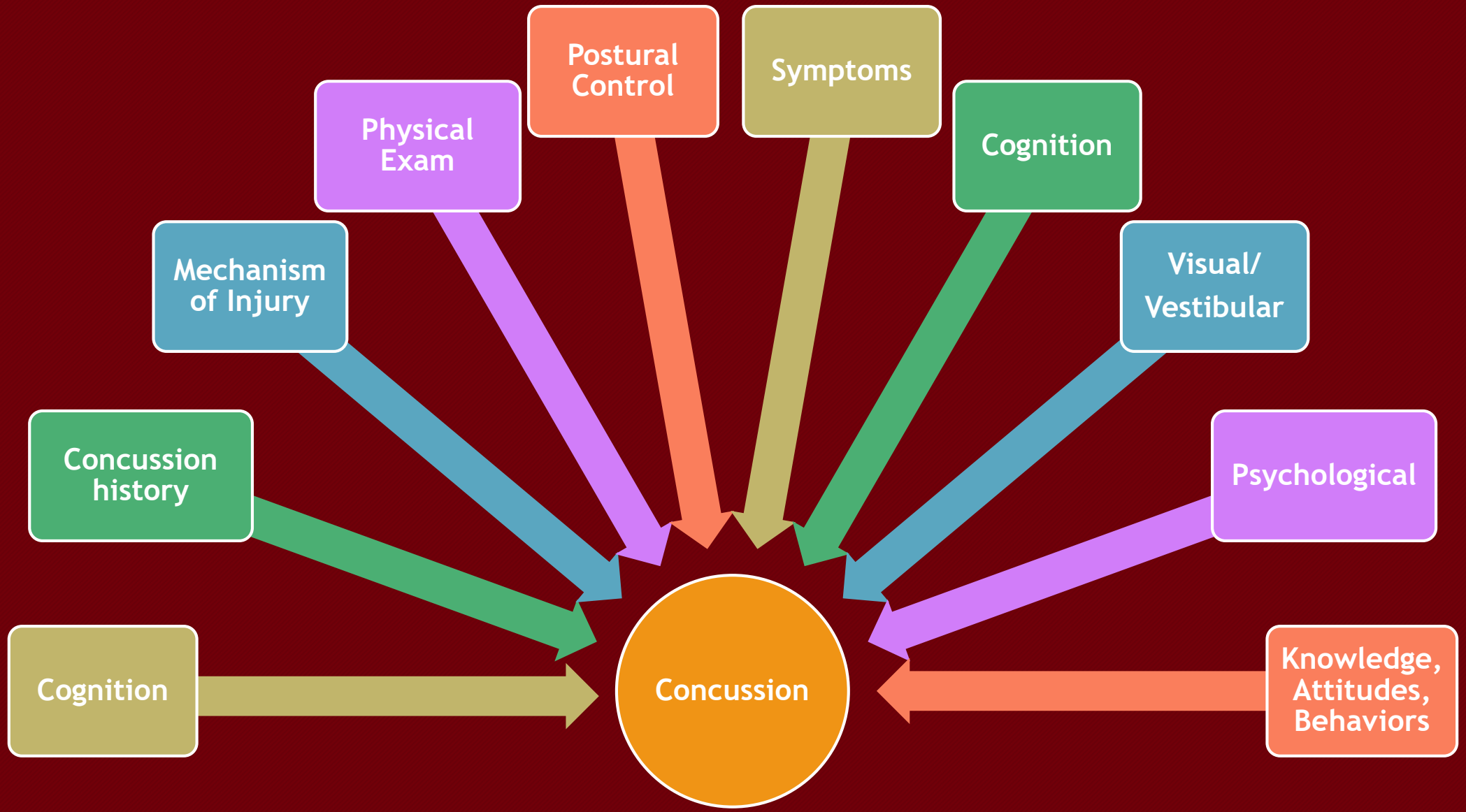
Father said combination of factors:

1. Personality – intelligent, hardworking, unable to say no, limited ability to express emotions; pride, self-worth and identity tied to success; unwilling to seek and accept help
2. Overtraining + additional stresses – training hard for world championships; attending school Stanford (complex mathematics and computer programming); previous injury (bone fracture and concussion)
3. Concussion – may have been more severe, mental deterioration, headaches, apathy
4. Additional hypoxic brain and cardiac damage from first suicide attempt

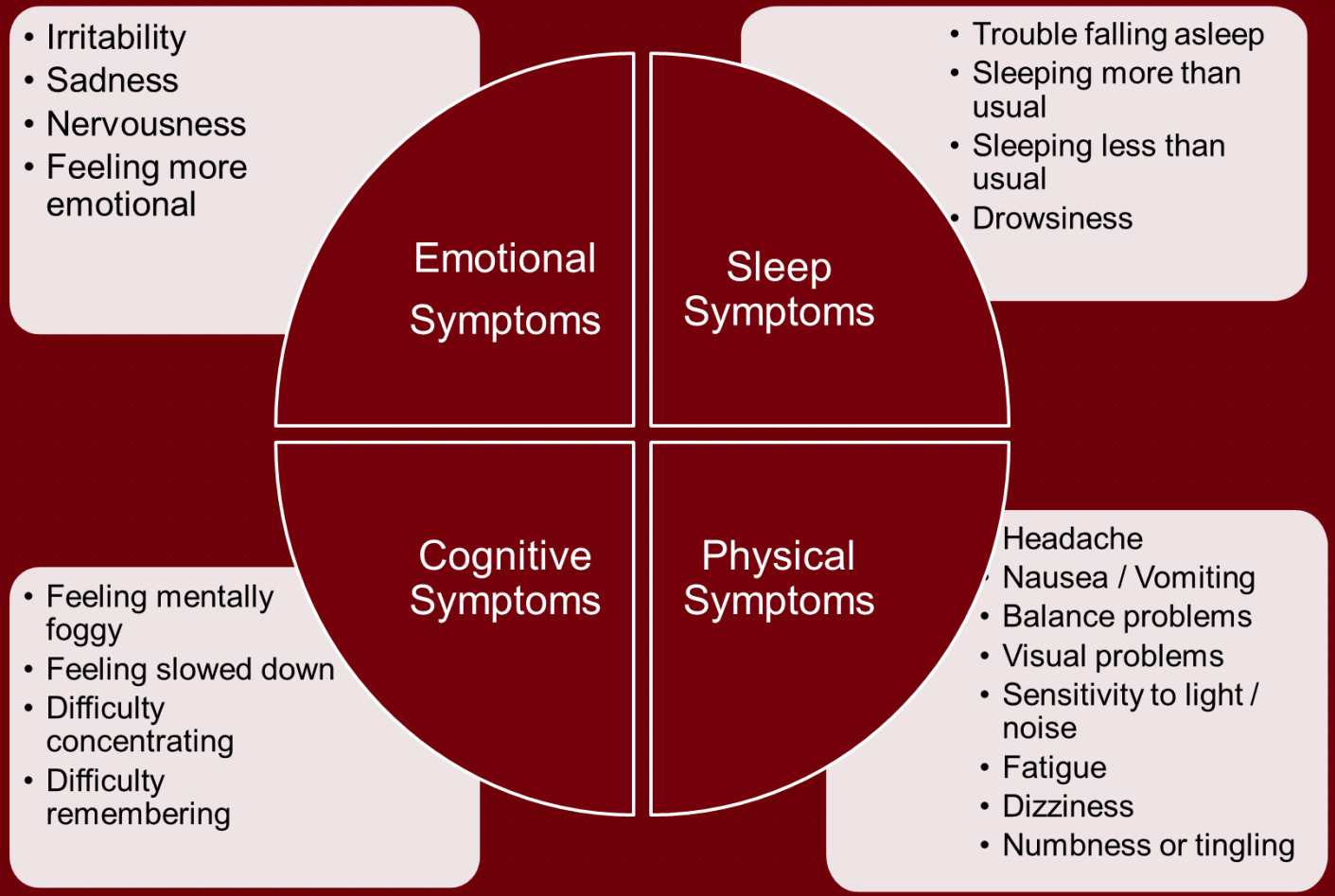
Neurometabolic Cascade (Giza and Hvoda, 2013)



Concussion: A Multifaceted Condition

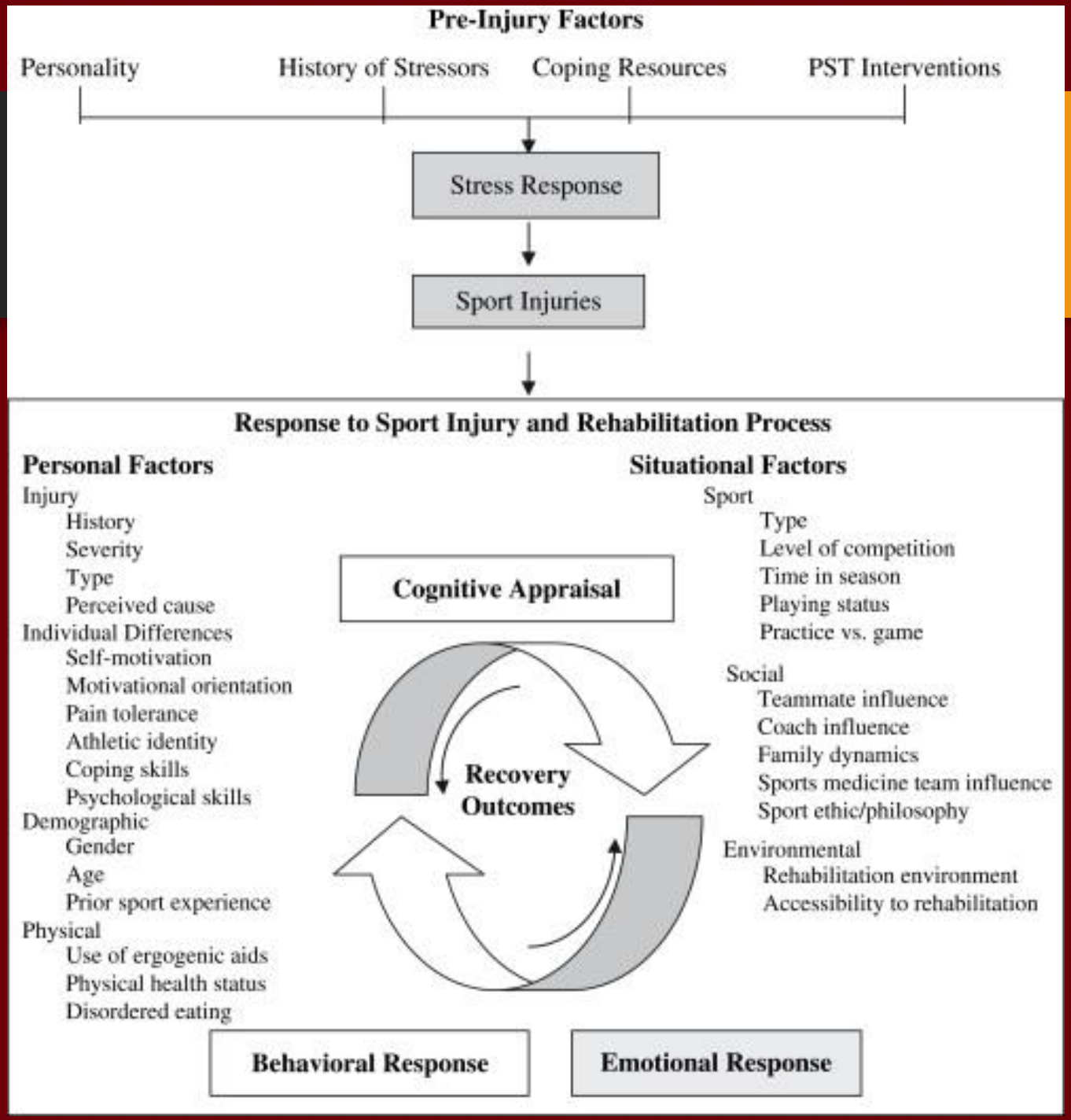


Common Concussion Symptoms and Behaviors

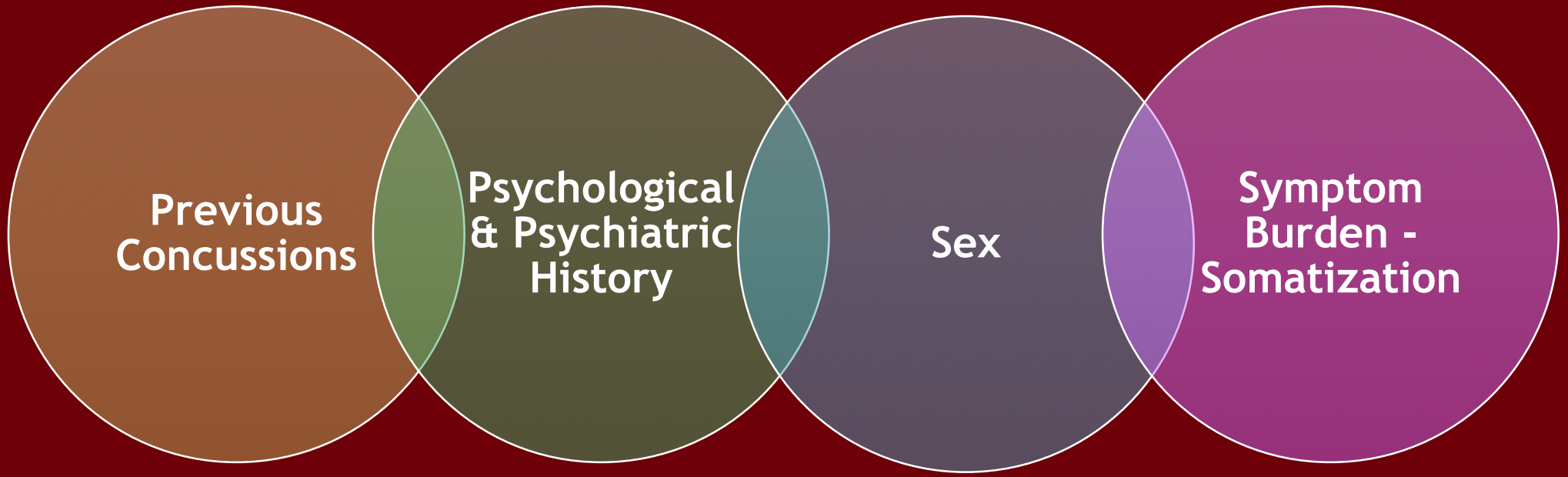


Wiese-Bjornstal's Model

- Integrated Model of Response to Sport Injury was first introduced in 1998
- This expanded Andersen and Williams (1988) stress and injury model

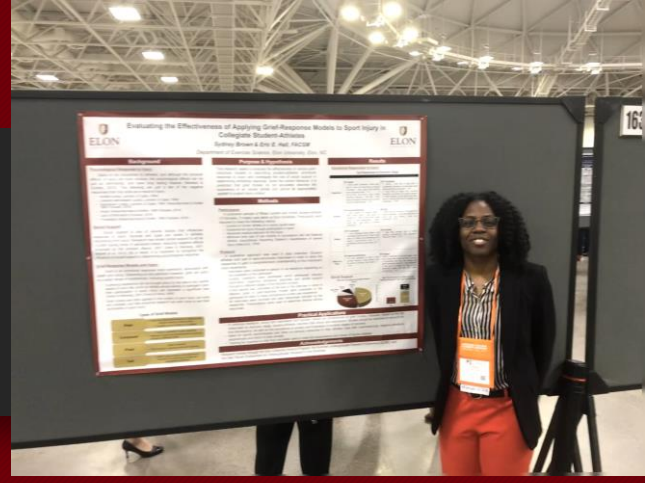


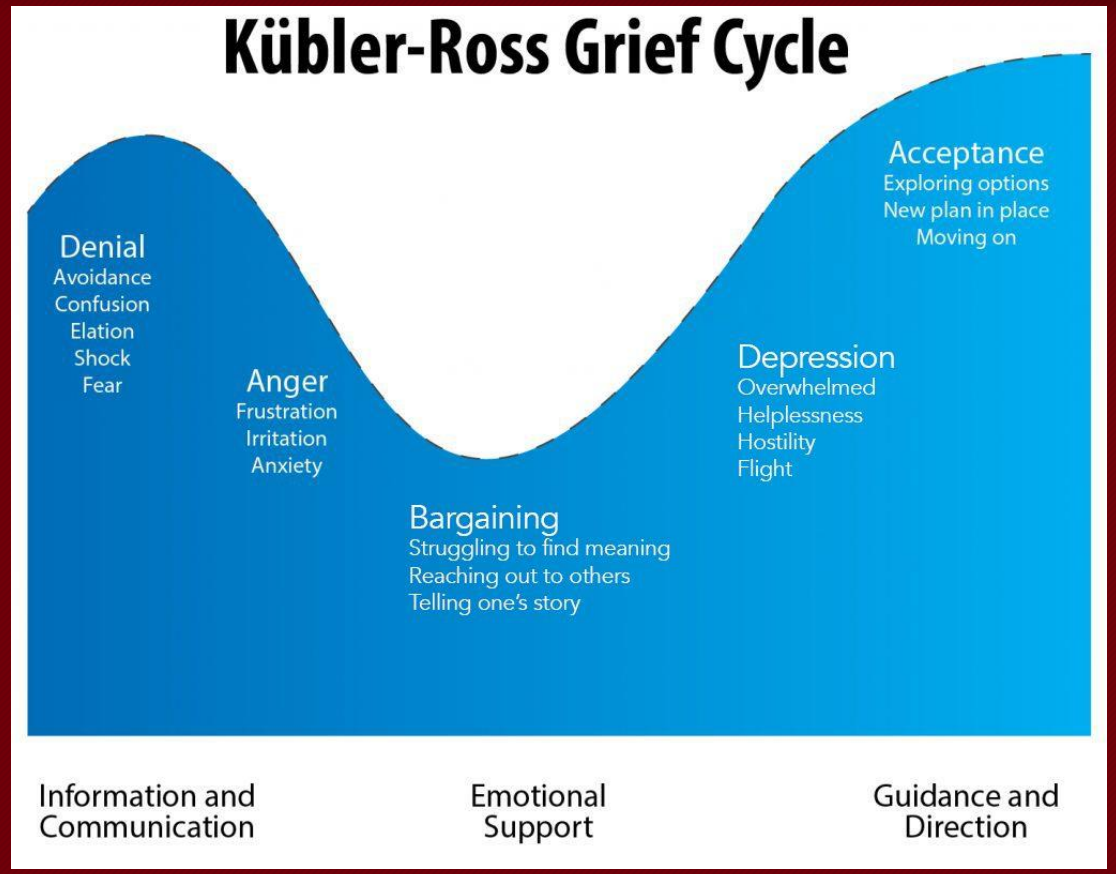
Response to Injury



This suggests that every concussion is different and treatment might need to be tailored to the individual

Emotional Response to Injury





Brown & Hall (2018)

- 15 collegiate student-athletes

- Diagnosis
  - Upset and Frustrated
- Surgery
  - Nervous
- Rehabilitation
  - Frustration
- Return to Play
  - Happiness
  - Frustration

Identity is Important – Strong identity may predispose to depression

Moreau, Langdon and Buckley (2014)

Lived experience of in-season concussion amongst Division I SAs

Five Major Themes:

1. Symptoms and emotional response
   - Headaches, irritability, anxiety
2. Experiences of concussion testing
   - (difficulty – anxiety provoking)
3. Fear of failing to meet teammate expectations
4. Support from friends/teammates and family
5. Effect on school
   - Did not have academic accommodations

Lets talk about … Concussion Management

What can we do?

- Rest
- Active Rehab
- Return-to-Learn

Use of Rest in Concussion Management

Complete physical and cognitive rest were cornerstones of concussion management and are a common intervention

(Zurich 2012; McCrory 2013)

Rationale:

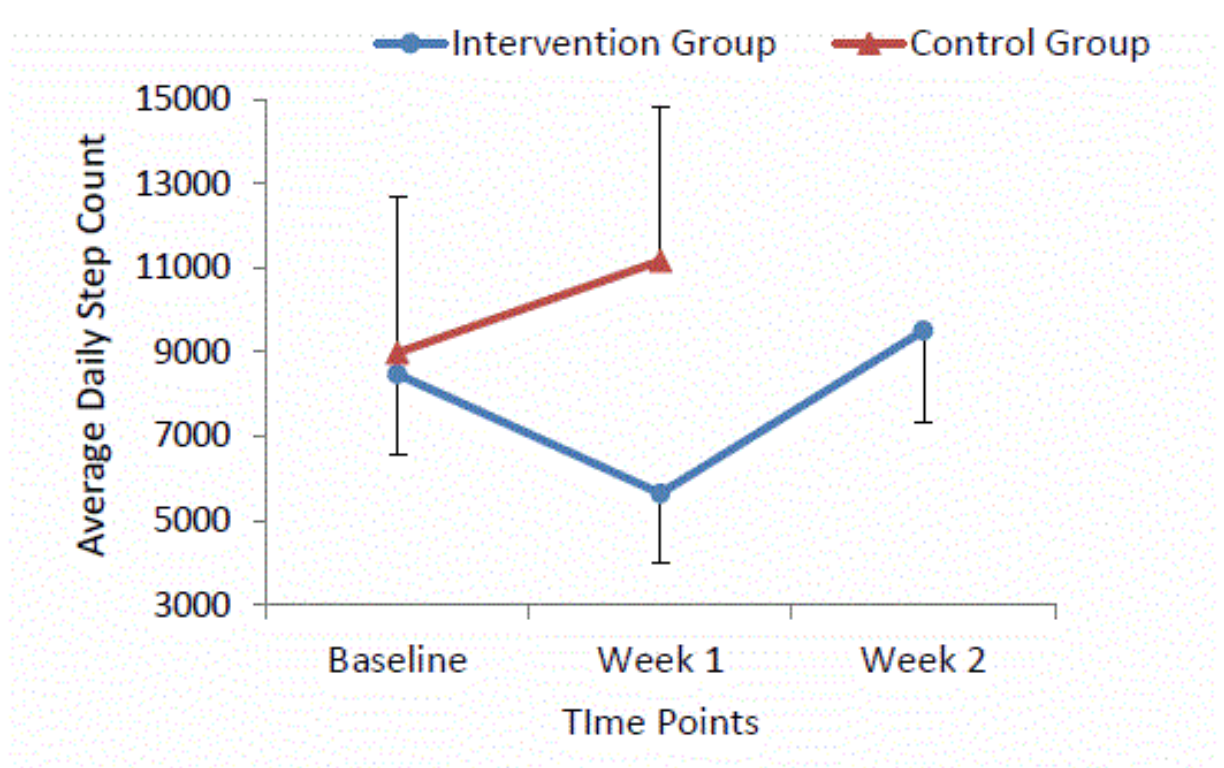
- Rest may ease discomfort by mitigating symptoms
- Promote recovery by minimizing energy demands of brain after a concussion
- Prevent a second head injury

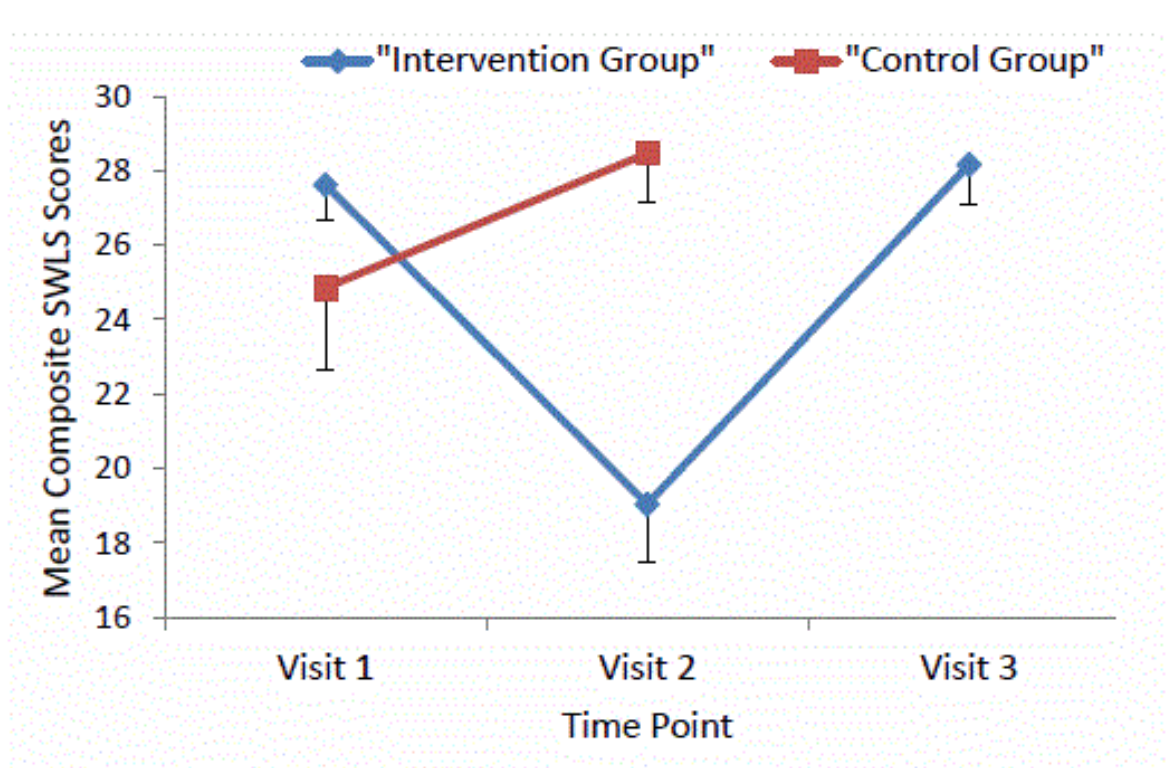
Detriments of prescribed “rest”

Edwards and Loprinzi (2016; 2017)

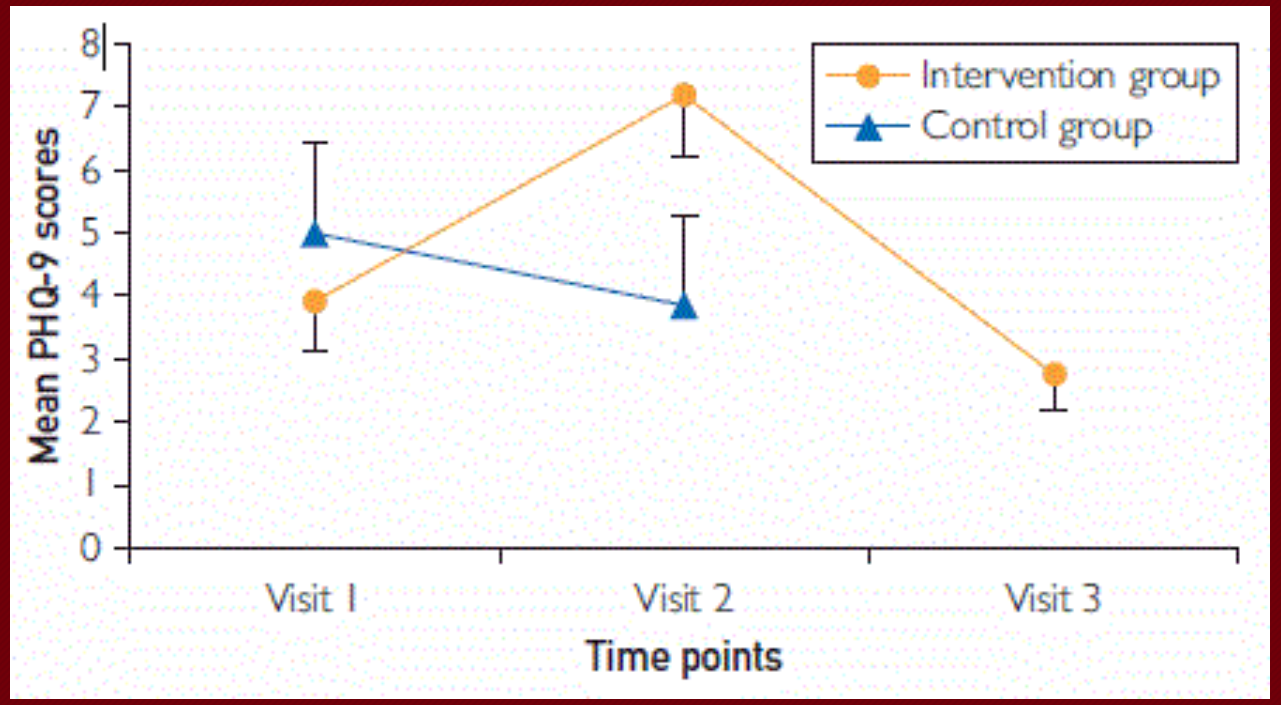
- 39 participants who were confirmed to be active based on self-report and accelerometer data
- Randomly assigned to one of two groups:
  - Sedentary behavior intervention group (n = 26)
    - Asked to eliminate all exercise and minimize steps to 5000 or less per day for 1 week
  - Control group (n = 13)
    - Asked to resume normal physical activities for 1 week

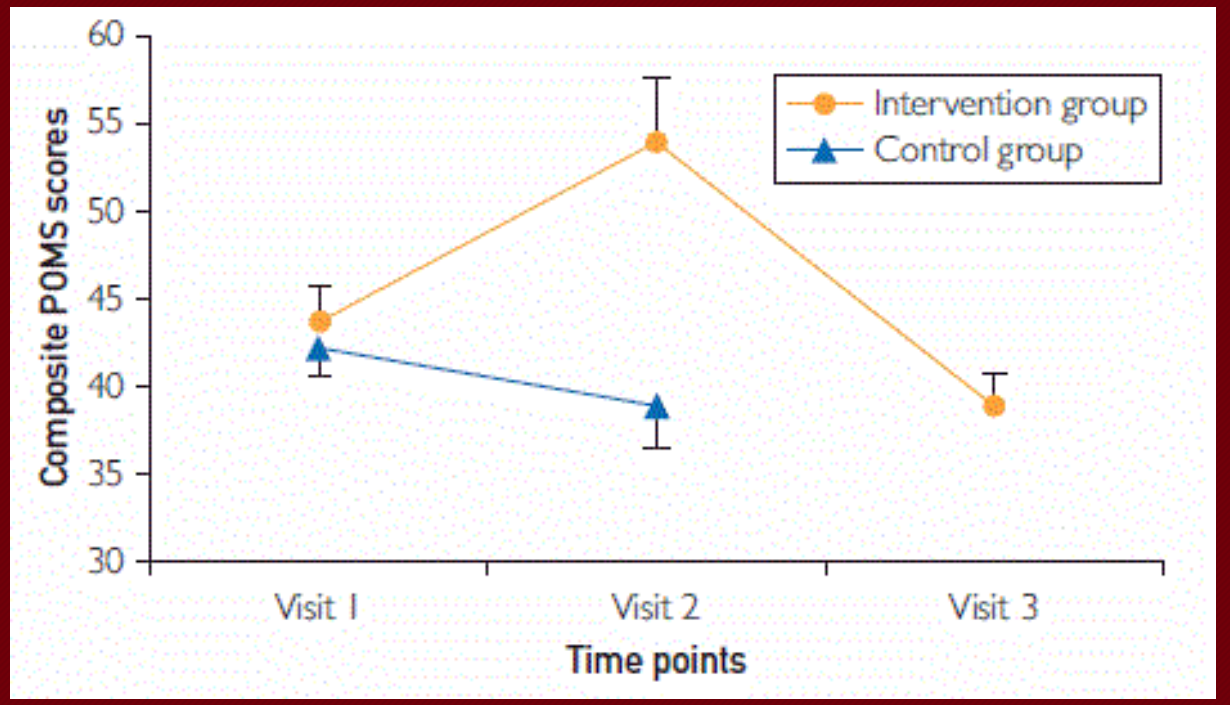
Edwards and Loprinzi (2016; 2017)





Edwards and Loprinzi (2016; 2017)

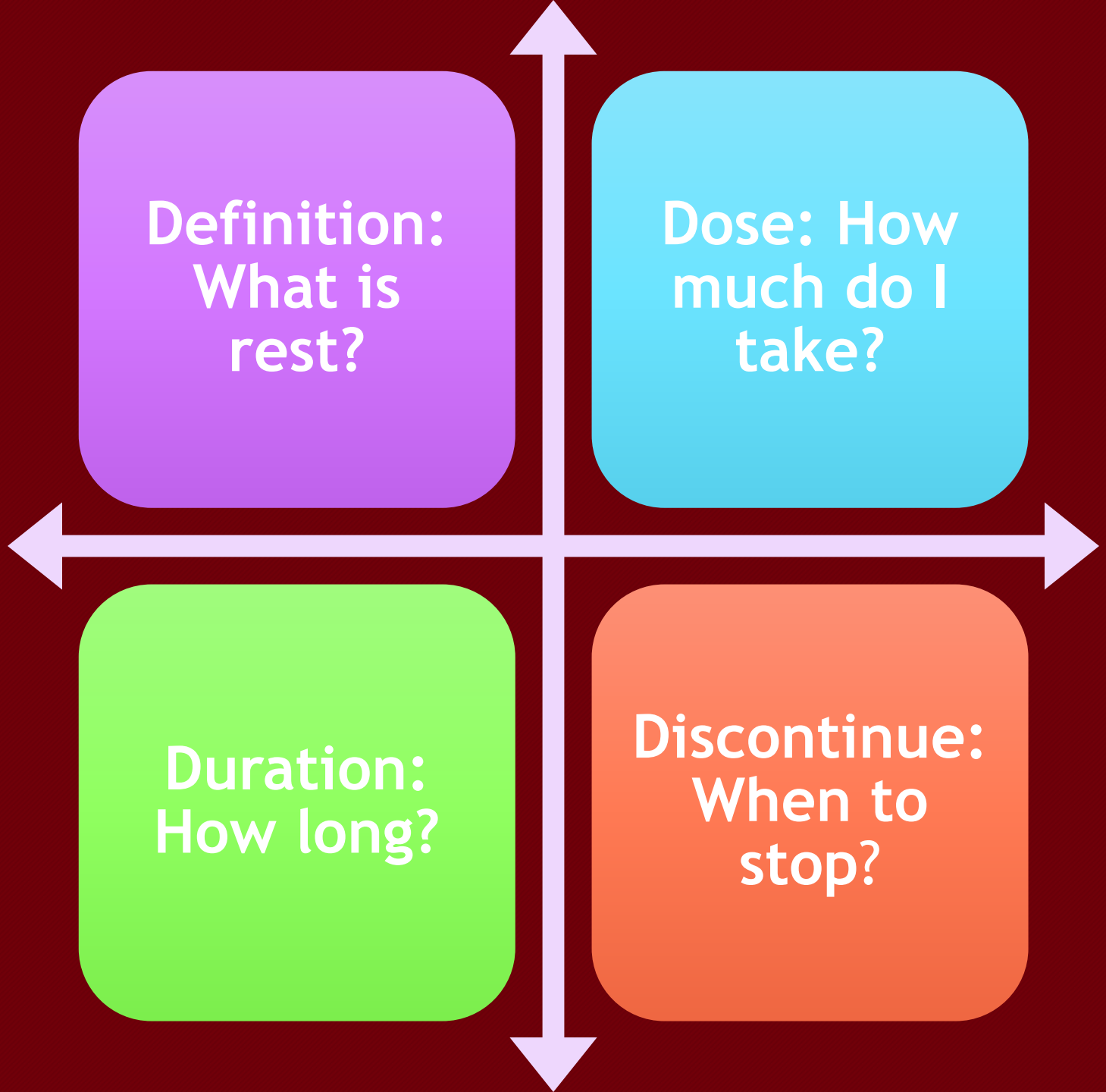




Use of Rest in Concussion Management

"There is currently insufficient evidence that prescribing complete rest achieves these objectives. ***After a brief period of rest during*** *the acute phase (24-48 hours) after injury, patients can be encouraged to* ***become gradually and progressively more active*** *while staying* ***below their cognitive and physical symptom-exacerbation thresholds*** *(i.e., activity level should not bring on or worsen their symptoms). It is reasonable for athletes to avoid vigorous exertion while they are recovering.* ***The exact amount and duration of rest is not yet well defined in the literature and requires further study****."*

(McCrory et al., 2017; Schneider et al., 2017)


Definition: What is rest?
Dose: How much do I take?
Duration: How long?
Discontinue: When to stop?

Potential Activities for Post-concussion Interventions

Active management category	Proposed Management Considerations
Symptom management	Guided activity based on symptoms Manual therapy for head/neck pain
Cognitive activity	Short digit spans or Word memory tasks Cognitive rehabilitation program
Motor/balance activity	General, progressive balance training
Exercise/controlled exertion	Buffalo Concussion Treadmill Test Graduated return progression
Divided attention activity	Balance activities with cognitive tasks Gait tasks with cognitive tasks
Visual activity	Convergence/Divergence Accommodation
Vestibular activity	Dix-Hallpike Gaze stabilization
Pharmacological/Supplements	Omega-3 fatty acids Melatonin

Adapted from Register-Mihalik & Vander Vegt (2017)
In Hall & Ketcham, *Concussions in Athletics: Assessment, Management and Emerging Issues*

Gold Standard

Current Return to Sport Strategy

- Symptom Limited Activity
- Light Aerobic Activity
- Sport Specific Exercise
- Non-Contact Training
- Full Contact Training
- Return to Sport / Full Contact Return to Play

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position statement

National Athletic Trainers' Association Position Statement: Management of Sport Concussion

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Objective: To provide athletic trainers, physicians, and other health care professionals with best-practice guidelines for

Recommendations: The recommendations for concussion management provided here are based on the most current

Consensus statement

PDF

Consensus statement on concussion in sport—the 5th international conference on concussion in sport held in Berlin, October 2016 FREE

Paul McCrory[1], Willem Meeuwisse[2], Jiří Dvorak[3, 4], Mark Aubry[5], Julian Bailes[6], Steven Broglio[7], Robert C Cantu[8], David Cassidy[9], Ruben J Echemendia[10, 11], Rudy J Castellani[12], Gavin A Davis[13, 14], Richard Ellenbogen[15], Carolyn Emery[16], Lars Engebretsen[17], Nina Feddermann-Demont[18, 19], Christopher C Giza[20, 21], Kevin M Guskiewicz[22], Stanley Herring[23], Grant L Iverson[24], Karen M Johnston[25], James Kissick[26], Jeffrey Kutcher[27], John J Leddy[28], David Maddocks[29], Michael Makdissi[30, 31], Geoff Manley[32], Michael McCrea[33], William P Meehan[34, 35], Sinji Nagahiro[36], Jon Patricios[37, 38], Margot Putukian[39], Kathryn J Schneider[40], Allen Sills[41, 42], Charles H Tator[43, 44], Michael Turner[45], Pieter E Vos[46]

Specific Aims – Active Rehab Project

Specific Aim 1

Compare the effects of a **multidimensional rehabilitation protocol versus enhanced graded exertion** on clinical recovery, return to play, and patient outcomes after SRC.

Specific Aim 2

Demonstrate the **safety and feasibility of active intervention protocols** when introduced **during the sub-acute recovery period** after SRC, as part of an multidimensional rehabilitation protocol.

*Enhanced graded exertion will encompass the Berlin RTP guidelines, including guided activity in Stage 1 and more sport specific concepts throughout the return to play process, consistent with common current day practice.

IN SUMMARY

(see study overview document in packet)

- **We are comparing two treatments for sports-related concussion**
- **We don't know which one is better**
- **They are both safe, based on current clinical and scientific knowledge**

Frontier for the Graduated RTP: Can we use rehabilitation in concussion management?

Contents lists available at ScienceDirect

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journal homepage: www.elsevier.com/locate/jsams

Original research

Outcomes, utility, and feasibility of single task and dual task intervention programs: Preliminary implications for post-concussion rehabilitation

Joseph M. Ingriselli[a], Johna K. Register-Mihalik[a,b,*], Julianne D. Schmidt[c], Jason P. Mihalik[a,d], Benjamin M. Goerger[e], Kevin M. Guskiewicz[a,d]

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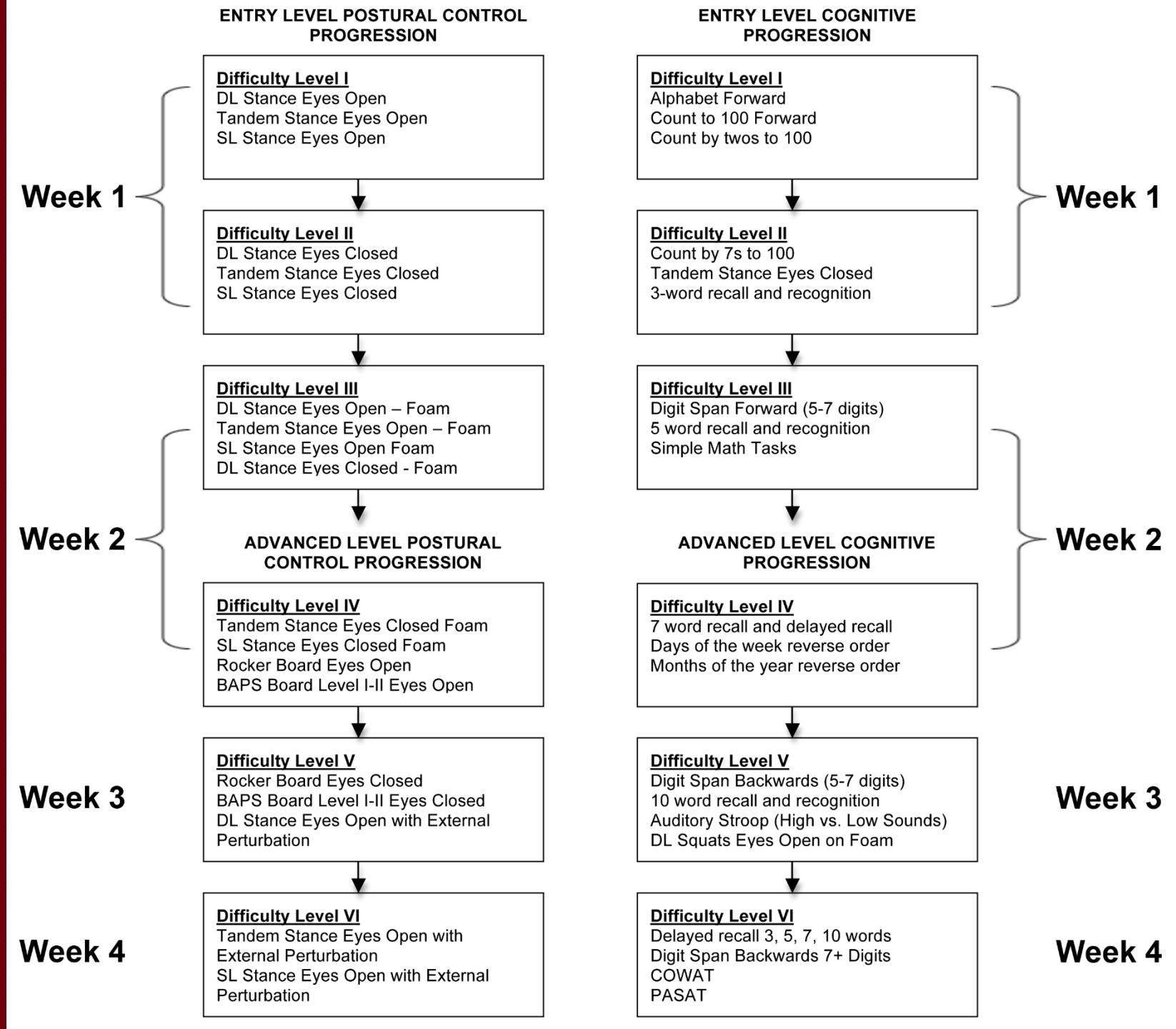
- Motor and cognitive tasks
- Low-level to more intense progressions
- Fun, engaging, move to sport-specific

Pilot work

- Improvements in balance and coordination after 4 weeks


ENTRY LEVEL POSTURAL CONTROL PROGRESSION
ENTRY LEVEL COGNITIVE PROGRESSION
Week 1
Difficulty Level I
DL Stance Eyes Open
Tandem Stance Eyes Open
SL Stance Eyes Open
Difficulty Level I
Alphabet Forward
Count to 100 Forward
Count by twos to 100
Week 1
Difficulty Level II
DL Stance Eyes Closed
Tandem Stance Eyes Closed
SL Stance Eyes Closed
Difficulty Level II
Count by 7s to 100
Tandem Stance Eyes Closed
3-word recall and recognition
Week 2
Difficulty Level III
DL Stance Eyes Open – Foam
Tandem Stance Eyes Open – Foam
SL Stance Eyes Open Foam
DL Stance Eyes Closed - Foam
Difficulty Level III
Digit Span Forward (5-7 digits)
5 word recall and recognition
Simple Math Tasks
Week 2
ADVANCED LEVEL POSTURAL CONTROL PROGRESSION
ADVANCED LEVEL COGNITIVE PROGRESSION
Difficulty Level IV
Tandem Stance Eyes Closed Foam
SL Stance Eyes Closed Foam
Rocker Board Eyes Open
BAPS Board Level I-II Eyes Open
Difficulty Level IV
7 word recall and delayed recall
Days of the week reverse order
Months of the year reverse order
Week 3
Difficulty Level V
Rocker Board Eyes Closed
BAPS Board Level I-II Eyes Closed
DL Stance Eyes Open with External Perturbation
Difficulty Level V
Digit Span Backwards (5-7 digits)
10 word recall and recognition
Auditory Stroop (High vs. Low Sounds)
DL Squats Eyes Open on Foam
Week 3
Week 4
Difficulty Level VI
Tandem Stance Eyes Open with External Perturbation
SL Stance Eyes Open with External Perturbation
Difficulty Level VI
Delayed recall 3, 5, 7, 10 words
Digit Span Backwards 7+ Digits
COWAT
PASAT
Week 4

Dual-Task Weekly Exercise Examples

- Week 1
  - Tande, Stance EC while Counting by 7s to 100
- Week 2
  - SL Stance EC on Foam with Digit Span Forward
  - Wii Fit Running with Digit Span Forward
- Week 3
  - BAPS Board with Ball toss and 10-Word Recall
- Week 4
  - Rocker Board EO with Ball Toss and PASAT (2”)

Use of Exercise in Concussion

Exercise is known to have numerous benefits

- Improve cardiovascular function (BP, HRV)
- Improve cognitive function
- Improve mood, anxiety and affect
- Improve sleep quality

- **These are many of the symptoms influenced by concussion, so exercise might help in concussion recovery**

Early PA and Concussion Symptoms

Grool et al. (2016)

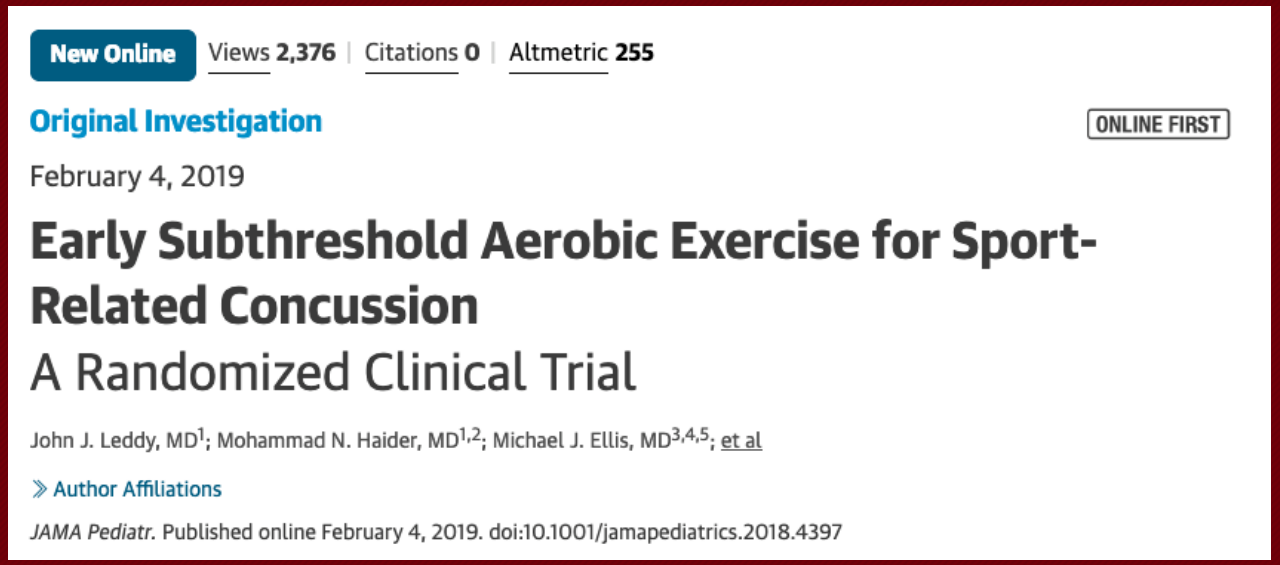
- Prospective, multicenter cohort study in Canada
- 3063 children and adolescents (5-18 years)
- Assessed physical activity and post concussion symptoms at 7 days and 28 days post injury
- Almost 70% participated in some level of early physical activity
- Those who had early participation in PA had lower risk of persistent post concussive symptoms
  - **24.6% vs. 43.5%**

Physical Exercise After a Concussion

Lal et al. (2018)

- Conducted a systematic review and meta-analysis
- **Exercise group significantly different than control on:**
  - Post-Concussion Symptom Score
  - Percentage of patients with symptoms
  - Days off work
  - Improved reaction time
- No differences BESS or other neurocognitive components

Most Recent Acute / Sub-Acute Evidence



New Online | Views 2,376 | Citations 0 | Altmetric 255

Original Investigation ONLINE FIRST

February 4, 2019

Early Subthreshold Aerobic Exercise for Sport-Related Concussion

A Randomized Clinical Trial

John J. Leddy, MD[1]; Mohammad N. Haider, MD[1,2]; Michael J. Ellis, MD[3,4,5]; et al

» Author Affiliations

JAMA Pediatr. Published online February 4, 2019. doi:10.1001/jamapediatrics.2018.4397

- 103 concussed participations (~46% female)
- Randomly signed aerobic exercise vs. stretching treatment
  - Supervised aerobic exercise ~20 min sessions daily at a **prescribed** heart rate on a treadmill or bike
  - No Ix administered prior to 48 hours post-injury
- Mean time to visit 4.8/4.9 days from injury
- Aerobic exercise recovered in median 13 (IQR 10-18.5 days)
- Stretching recovered in median 17 (IQR 13-23 days)

Exercise Intensity

How can we determine suitable exercise intensity?

- Stress testing via graded exercise has been used for long time by exercise physiologists
- Most commonly it is used to evaluate cardiac function and used in cardiac rehabilitation
- Can be used to determine how well body handles increased demands of physical activity
- Key is to make sure the person is aware of important symptoms to limit test or exercise bout

Buffalo Concussion Treadmill Test

- Modification of the Balke Protocol
  - Starting speed is 3.6 mph at 0% incline
    - Can be altered to account for height or activity level
  - 0% grade for 2 minutes
  - Increase 1% grade every minute after
  - Assess HR, BP (if possible), RPE and Symptoms every 2 minutes

Buffalo Concussion Treadmill Test

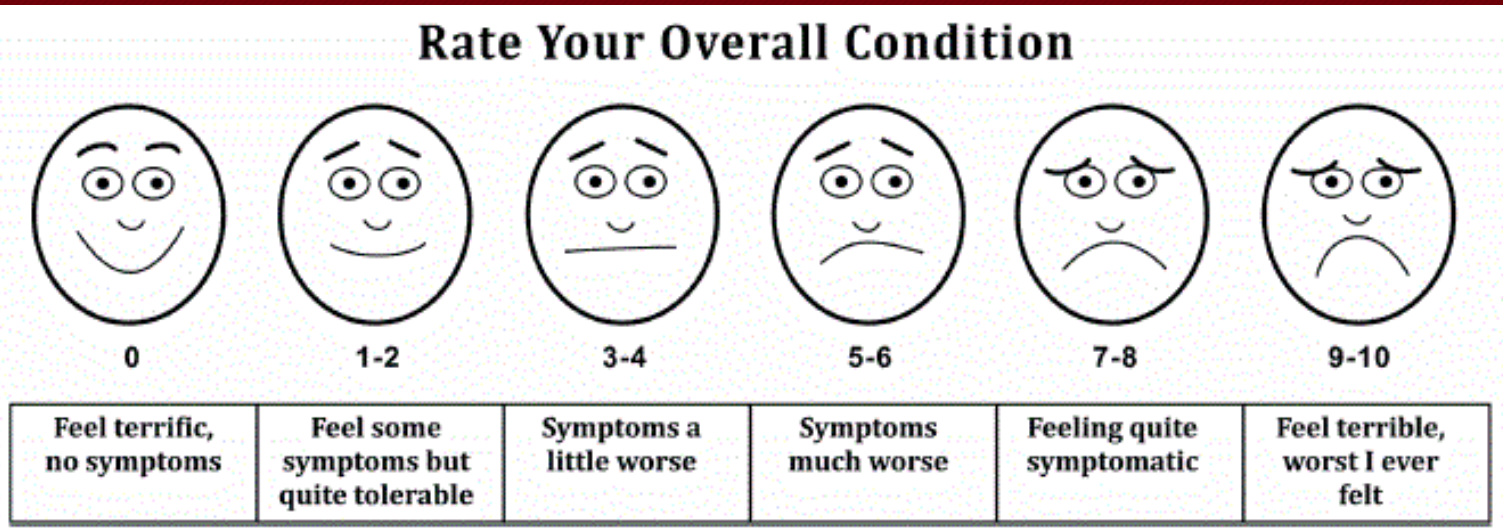


Figure 1: Visual Analog Scale for assessment of overall symptom level before and during the Buffalo Concussion Treadmill Test.

Terminate test if ≥ 3 change in symptoms from rest or exhaustion (19 or 20 on RPE scale)
If report ≥ 7 symptoms at rest before test, do not do the test

Return to Learn Policy - Elon

- When a concussion happens on campus, the person who diagnoses sends a note to academic advising to send out notice about missed classes
- Academic advising sends an e-mail to faculty members that student has had a concussion
  - Attaches FAQ we created about concussions
- Academic advisor for athletics will provide a bit more support throughout
- If concussion recovery is prolonged (>2 weeks) disability support services will often be brought in

Return to Academics (Hall et al., 2015)

Stage	Activity	Objective
No activity	Complete cognitive rest	Recovery
Gradual reintroduction of cognitive activity	Slowly add cognitive activities for short periods of time and gradually increase time	Gradual increase cognitive activity at sub-symptom threshold levels; increase length of time that can be tolerated
Gradual reintegration into academics	Begin introduction of class attendance; slowly build up attendance to full days	Increase cognitive load at sub-symptom threshold; Decrease accommodations needed
Resumption of full cognitive workload	Catch up with essential work; No restrictions	Full return to academics; commence Return-to-Play protocol

Accommodations by symptoms

TABLE 3. Potential Academic Implications Based on Signs and Symptoms of a Concussion

Signs/Symptoms	Potential academic Implications	Accommodations
Headache	Difficulty concentrating Often triggered by florescent lighting, loud noises, prolonged focusing	Focus for short periods in quiet and naturally lit environments
Dizzy; lightheaded	Vestibular difficulties, difficult standing or changing levels (sit-to-stand)	Allow transition time for engaged activities; allow student to put head down if symptoms worsen
Visual symptoms (light sensitivity, blurred or double vision)	Difficult concentrating on visual information (PowerPoint, videos, reading, computer, etc.)	Give materials presented in class to student so they can work on it in spurts; provide a note-taker
Noise sensitivity	Loud activities in class (ie, group activities)	Allow to move to quieter location with group or do in a smaller group
Concentration and memory problems	Difficult to gather and retain new information, recall previously learned material, take tests, focusing in class	Provide new material in different formats for student to learn in small spurts outside of class (notes, lecture materials); provide test and assignment accommodations (delayed, more time)
Sleep disturbances	Difficulty falling asleep, difficulty waking up	Allow student to attend a later section if it is the same material

Adapted from Halstead et al.[8] Adaptations are themselves works protected by copyright. So in order to publish this adaptation, authorization must be obtained both from the owner of the copyright in the original work and from the owner of copyright in the translation or adaptation.

Key personnel in return-to-academics

Professional	Roles
Student-Athlete	Report symptoms of concussion at all stages of injury and recovery Follow cognitive/physical rest requirements Communicate with advisors and instructors and come up with a realistic return-to-academics plan
Team Physician	Responsible for health care of student-athlete Design and implement appropriate baseline concussion testing program Determine if student-athlete has a concussion and development of a treatment plan for student-athlete Make ultimate determination about return-to-play and return-to academics
Sports Medicine Staff/ Athletic Trainer	Perform preseason baseline assessments on student-athletes Assessment of possible concussions during practice and competitions Monitor symptoms and performance on assessments to determine recovery progress Lead graduated return-to-play protocol

Key personnel in return-to-academics

Professional	Roles
Neuropsychologist**	Perform neuropsychological assessments following concussions Make recommendations about treatment and return-to-academics
Academic support/ Disability services	Inform faculty about class absences when it is discovered a student-athlete has suffered a concussion Keep faculty informed about progress of student Educate faculty about implications of concussion on student Help student-athlete
Coach	Be supportive and understand the concussion management protocol Assist in the implementation of treatment recommendations to the student-athlete

Key personnel in return-to-academics

Professional	Roles
Athletic Director	Be supportive and understand the concussion management protocol Encourage education of athletics department about concussions and their consequences
Provost, chancellor, CEO	Be supportive and understand the concussion management protocol Encourage education of faculty and staff at institution about concussions and their consequences

Importance of Social Support

Social Support - Injury

- Brown and Hall (2018)
  - Family (parents) are primary source, especially during recovery
    - Teammates
    - Significant others
  - 75% wished received more support
    - Primarily from coaches
    - Teammates
  - Most support happened during diagnosis and during surgery

Social Support - Concussion

Heaton, Hall, Ahmed, Rees and Ketcham (2018)

- Interviewed Varsity (n= 6) and Club Athletes (n = 7) and Dancers (n = 3)
- Most participants reported a negative change in behavior from others
- Most people preferred emotional support
  - Unless first concussion then preferred emotional support
- Preferred face-to-face support
- Found athletic trainer to provide most support
  - Friends and family next
- Varsity athletes wanted more support from coaches and teammates
  - Club athletes wanted more support from faculty

Long-term Effects on Quality of Life

Iadevaia et al (2015)

- Interviews with adolescents (12-16 years) and parents one year post concussion
- 4 major themes
  - Significant effect of symptoms
  - Feelings of frustration
  - Influence on school attendance and activities
  - Nature of interpersonal and team relationships

Table 3. Hierarchy of Topics That Participants Referenced

Topic	Characteristics
Significant effect of symptoms	Nausea
	Headaches
	Dizziness
	Sensitivity to light
	Sensitivity to sound
	Decreased reaction time
	Balance deficits
	Blurry vision: seeing stars
	Symptoms still bother me
	Trouble sleeping
	Forgetfulness
	Hard to concentrate
	Confusion
Feelings of frustration	Anger or frustration
	Was emotional or upset
	Irritability
	Anxiety
	Nervousness
Influence on school attendance and activities	Academic accommodations
	Left school early due to symptoms
	Decrease in grades
	Wanted to be in school
Nature of interpersonal and team relationships	Seemed "not right"
	Change: interpersonal relationship
	Teammate support

JAMA Psychiatry | Original Investigation

Risk of Posttraumatic Stress Disorder and Major Depression in Civilian Patients After Mild Traumatic Brain Injury

A TRACK-TBI Study

Murray B. Stein, MD, MPH; Sonia Jain, PhD; Joseph T. Giacino, PhD; Harvey Levin, PhD; Sureyya Dikmen, PhD; Lindsay D. Nelson, PhD; Mary J. Vassar, RN, MS; David O. Okonkwo, MD, PhD; Ramon Diaz-Arrastia, MD, PhD; Claudia S. Robertson, MD; Pratik Mukherjee, MD, PhD; Michael McCrea, PhD; Christine L. Mac Donald, PhD; John K. Yue, MD; Esther Yuh, MD, PhD; Xiaoying Sun, MS; Laura Campbell-Sills, PhD; Nancy Temkin, PhD; Geoffrey T. Manley, MD, PhD; and the TRACK-TBI Investigators

Table 2. Mental Health Outcomes at Follow-up Visits[a,b]

	3 mo		6 mo		12 mo	
Variable	mTBI[c]	Orthopedic Trauma	mTBI[c]	Orthopedic Trauma	mTBI[c]	Orthopedic Trauma
PCL-5 Total[d]						
No.	842	165	809	148	750	NA
Mean (SE)	17.6 (0.6)	12.2 (1.0)	17.4 (0.6)	13.7 (1.3)	17.0 (0.7)	NA
Probable PTSD (SE), %	18.7 (1.4)	7.6 (2.1)	19.2 (1.4)	9.8 (2.8)	17.2 (1.5)	NA
PHQ-9 Total[e]						
No.	867	167	823	150	759	NA
Mean (SE)	5.4 (0.2)	4.2 (0.4)	5.1 (0.2)	4.0 (0.4)	4.7 (0.2)	NA
Probable MDD (SE), %	8.8 (1.0)	3.0 (1.3)	9.0 (1.0)	5.5 (2.4)	6.6 (0.9)	NA

Abbreviations: MDD, major depressive disorder; mTBI, mild traumatic brain injury; NA, not applicable; PCL-5, PTSD Checklist for *DSM-5*; PHQ-9, Patient Health Questionnaire–9; PTSD, posttraumatic stress disorder.

[a] All comparisons of mTBI vs orthopedic trauma comparison patient are statistically significant with *P* values ranging from <.001 to .023, except for comparison of probable MDD at 6 months (*P* = .26).

[b] Values shown are raw numbers (sample sizes) and propensity weights–adjusted summaries.

[c] Glasgow Coma Scale scores of 13 to 15.

[d] PCL-5 total score was calculated as the sum of 20 individual items. Range was 0 to 80, and higher score indicates worse symptoms. Total score was prorated if less than 25% of the individual items were missing. Probable PTSD diagnosis was defined as PCL-5 total score 33 or higher.

[e] PHQ-9 total score was calculated as the sum of 9 individual items. Range was 0-27, and higher score indicates worse symptoms. Probable MDD (moderately severe to severe depression) was defined as PHQ-9 total score 15 or higher. Data for this report are available for the orthopedic trauma comparison patients only through 6 months.

Conclusions

- Prescription of prolonged rest may not be appropriate (and potentially detrimental) in those who have had a concussion
- Active rehabilitation interventions should be explored to speed recovery and possibly reduce potential PCS
  - Novel approaches to test based on symptoms (cognitive and balance)
  - Explore more options for subthreshold exertion
  - Maybe also vestibular and vision symptoms
- Return-to-learn protocols could also alleviate some stress
- All of these concussion management principles could play significant role on mental health of the student-athlete

Thank You!

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