Helpful interventions for mental problems after concussion

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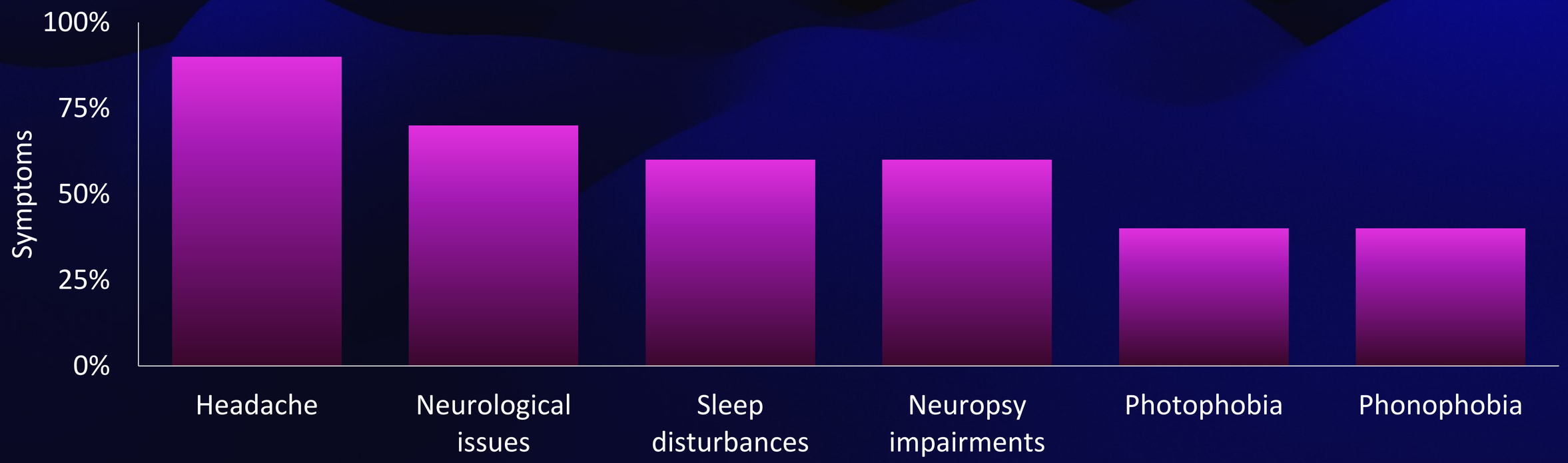
Concussion

Definition

- Subset of mild traumatic brain Injury (mTBI) that leads to a temporary impairment of brain function
- Often lack outward physical findings



Diagnosis

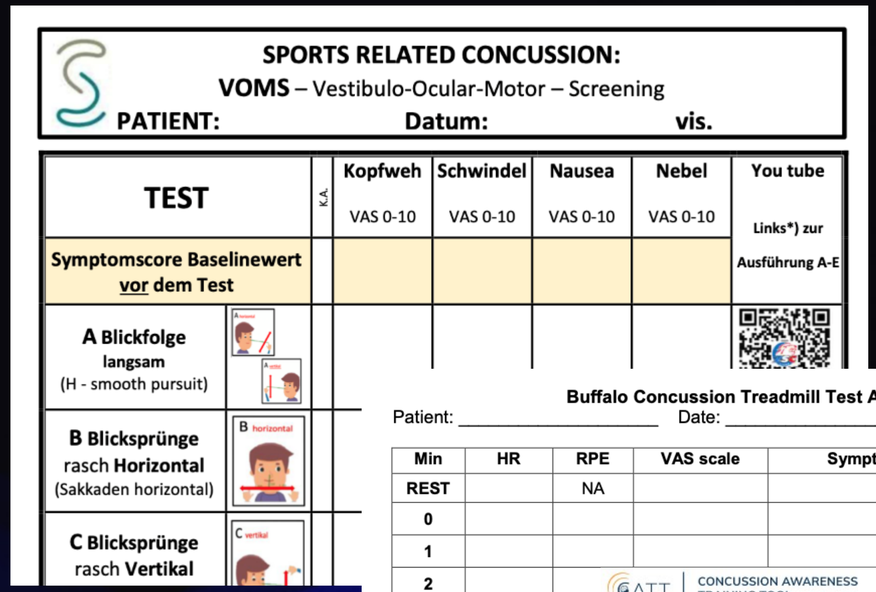
ICD-11: NA07.0 Intracranial Injury - Concussion

- NA07.00 Incomplete loss of consciousness with amnesia
- NA07.01 Incomplete loss of consciousness without amnesia
- NA07.02 loss of consciousness, short duration of less than 30 minutes
- NA07.03 … NA07.0Y Other specified concussion
- GCS > 13 (Glasgow Coma Scale)

https://medictests.com/units/glasgow-coma-score

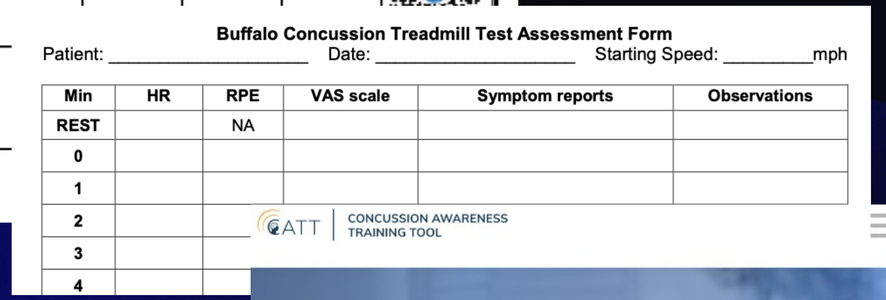
Tests

- Post-concussion Symptom Scale
- Standardized Assessment of Concussion
- SCAT6/ Child SCAT6
- Sport Concussion Office Assessment Tool 6 (SCOAT6)/ Child SCOAT6
- Buffalo Concussion Treadmill Test
- Vestibular/ Ocular Motor Screening (VOMS)
- Neuropsychological Tests (memory, executive functions, concentration, perception, attention)



SPORTS RELATED CONCUSSION:
VOMS – Vestibulo-Ocular-Motor – Screening
PATIENT: **Datum:** **vis.**

TEST	K.A.	Kopfweh VAS 0-10	Schwindel VAS 0-10	Nausea VAS 0-10	Nebel VAS 0-10	You tube Links*) zur Ausführung A-E
Symptomscore Baselinewert vor dem Test						
A Blickfolge langsam (H - smooth pursuit)						
B Blicksprünge rasch **Horizontal** (Sakkaden horizontal)						
C Blicksprünge rasch **Vertikal**						



Buffalo Concussion Treadmill Test Assessment Form

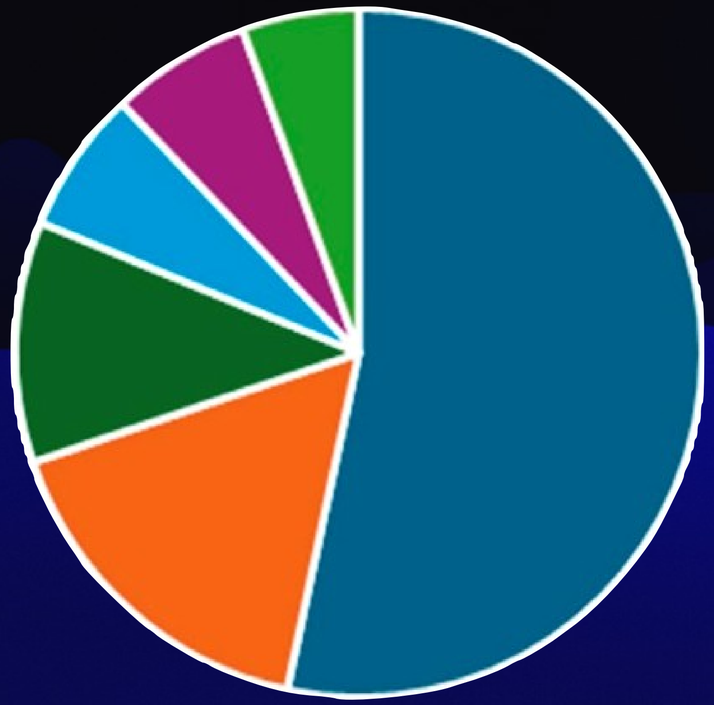
Patient: _____ Date: _____ Starting Speed: _____mph

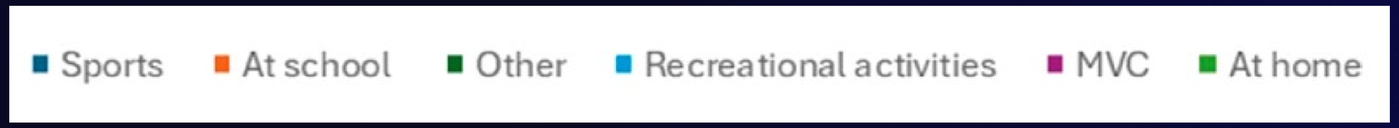
Min	HR	RPE	VAS scale	Symptom reports	Observations
REST		NA			
0					
1					
2					
3					
4					

CATT | CONCUSSION AWARENESS TRAINING TOOL

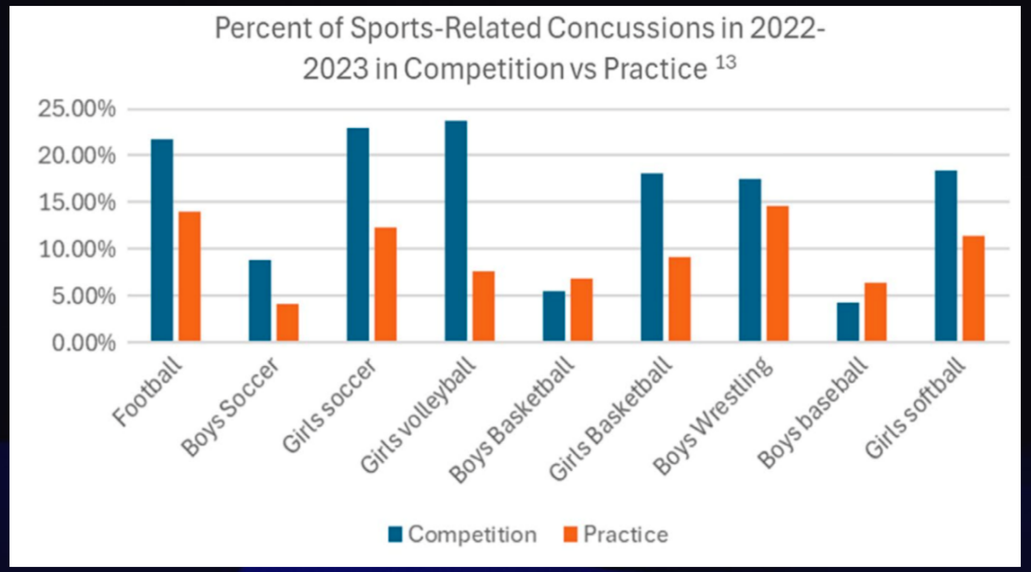
Incidence

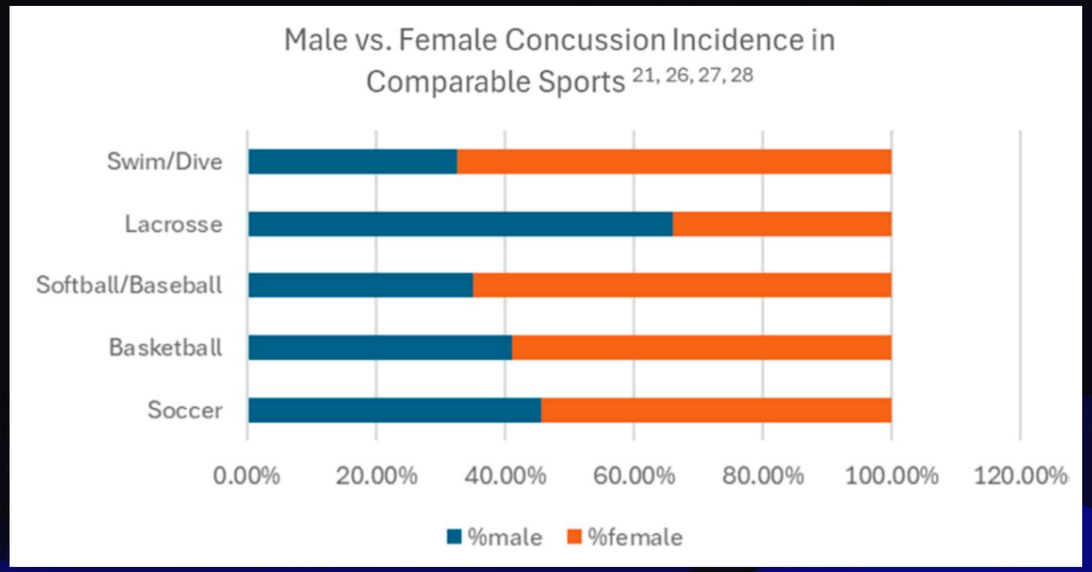
- Incidence: WHO estimates
  600 per 100’000 people each year (Patel, 2025)
- CH: 25’000 each year, 300 per 100’000 (SUVA 2020)
- Highest rates: ages 0-4, 15-24 and > 65
  (both, female and male) (Patel, 2025)
- 14.8% sports-related (US)
  highest rates in contact sports (Patel, 2025)
- CH: Icehockey 17.9%, Soccer/ Handball 6.2%, Basketball 8.8 % (VBG-Sportreport 2016)

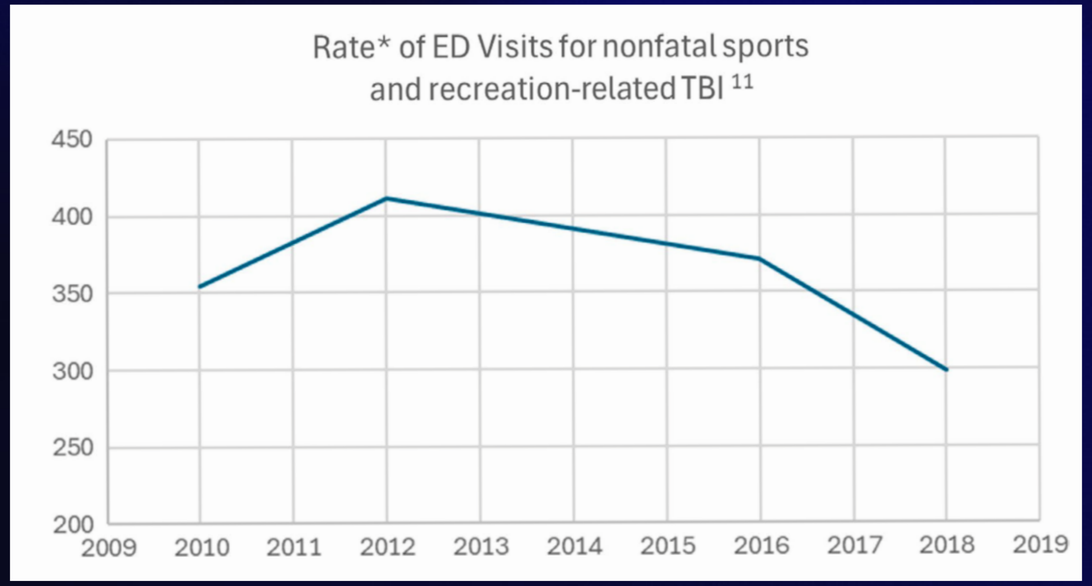




Concussion Management for Primary Care, Springer 2025







Concussion Management for Primary Care, Springer 2025

Risk Factors

- Age < 18
- Femaie gender
- Multiple symptoms
- History of mental health disorders
- Past history of concussion
- Severe on-field signs and symptoms
- Past history of migraines
- Post-traumatic headaches
- Delayed reporting or "playing through it"
- History of substance abuse
- Suboptimal heart rate threshold on BCTT
- Completed fewer post-injury assessment time points
- Prolonged rest (>5 days)
- History of leaming dbability or attention deficit disorder
- Cervical spine dystunction
- Vestibular or oculomotor

Guidelines

https://www.neuropt.org/practice-resources/anpt-clinical-practice-guidelines/concussion-cpg

https://www.ninds.nih.gov/news-events/events/ninds-tbi-classification-and-nomenclature-workshop

https://concussionsontario.org/

https://register.awmf.org/assets/guidelines/008-001k_S2e_Schaedelhirntrauma_SHT_Erwachsene_2016-06-abgelaufen.pdf

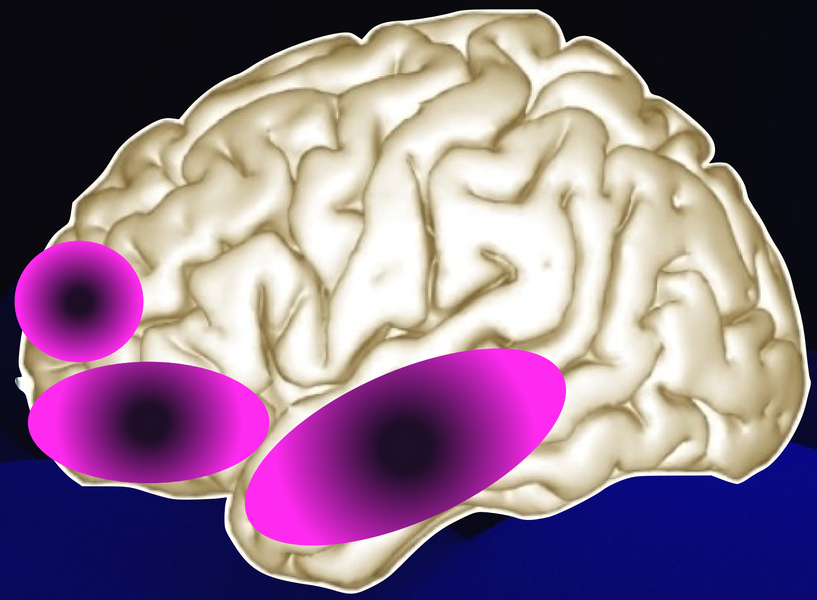
https://www.suva.ch/de-ch/unfall/fuer-leistungserbringer/suva-medical/publikationen/2020/september/aerztliche-akutversorgung-der-leichten-traumatischen-hirnverletzung#state=[anchor-D053D785-BA06-48B1-80A4-F638B0D1A505]

Davis GA, et al., (2024). Pediatric sport-related concussion: recommendations from the Amsterdam consensus statement 2023. *Pediatrics 153*, 1.

Patricios JS, Schneider KJ, Dvorak J, Ahmed OH, Blauwet C, Cantu RC, Davis GA, Echemendia RJ, Makdissi M, McNamee M, Broglio S., (2022). Consensus statement on concussion in sport: the 6th International Conference on Concussion in Sport–Amsterdam. *Br J Sports Med., 57*(11), 695–711. https://bjsm.bmj.com/content/57/11/695.long

Concussion & Mental Problems

Neurological Damages



- Microscopic axonal damages
- Multifocal damages, mostly in orbitofrontal Cortex, frontopolar and temporal Cortex
- Cellular and metabolic changes that lead to alterations in neurotransmitter release (and ion concentrations)

Neurologie Hoch2, Elsevier 2024; Kognitive Neurowissenschaften, Hogrefe 2021; Bertò et al. 2024; Kenzie et al. 2017

Ocular Symptoms

- Blurred vision
- Double vision
- Difficulty reading

Common symptoms of double vision include the visual appearance of objects overlapping each other or appearing adjacent to one another.

Concussion Management for Primary Care, Springer 2025

Vestibular Symptoms

- Balance alterations
- Lightheadedness
- Dizziness

Neuropsychological Symptoms

- Decreasing mental clarity (mental fogginess, confusion)
- Difficulty concentrating
- Memory impairment
- Deficits in attention, working memory, executive functions and perception
- Fatigue
- Post-traumatic amnesia

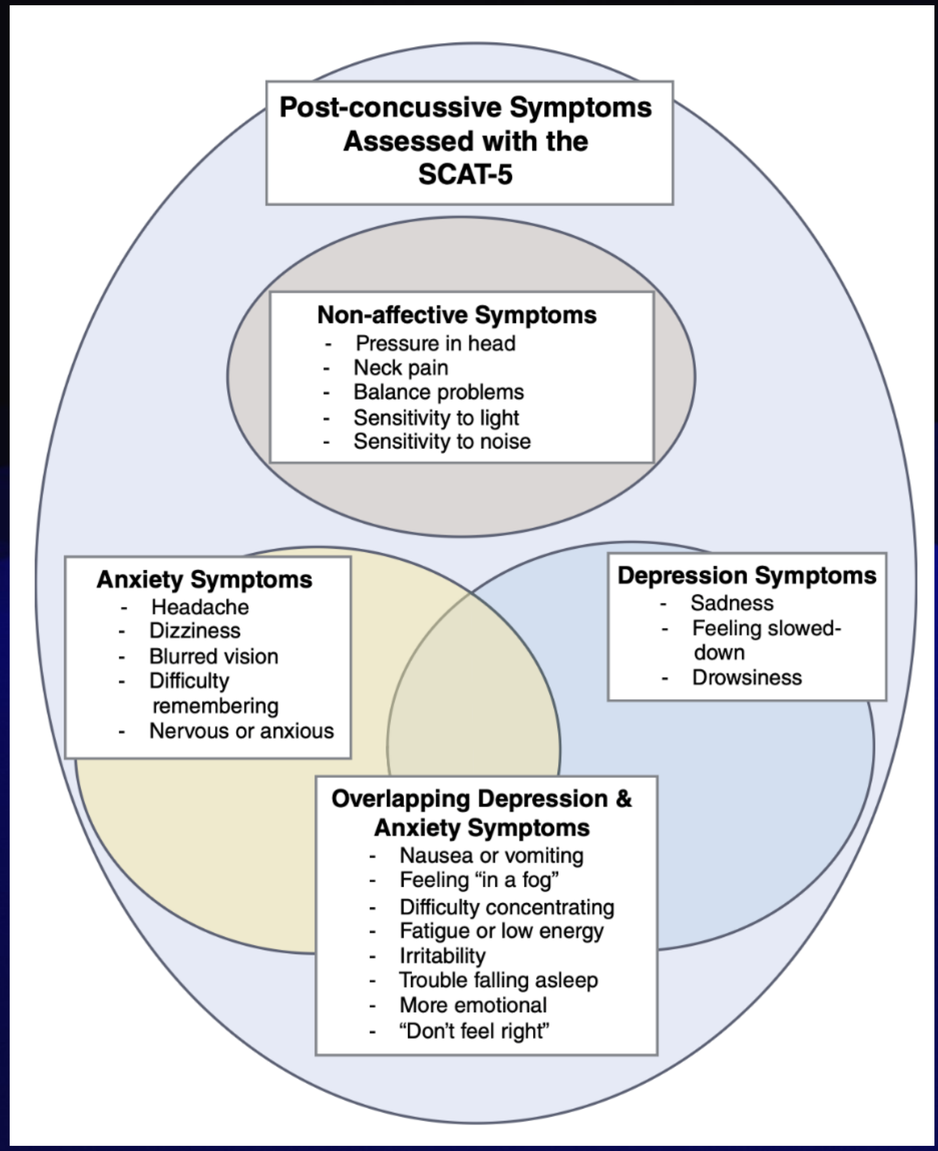
Allie et al., 2023; Czerniak et al. 2025; Concussion Management for Primary Care, Springer 2025

Emotional Symptoms

→ Individuals with abnormal sleep patterns are more susceptible to depression

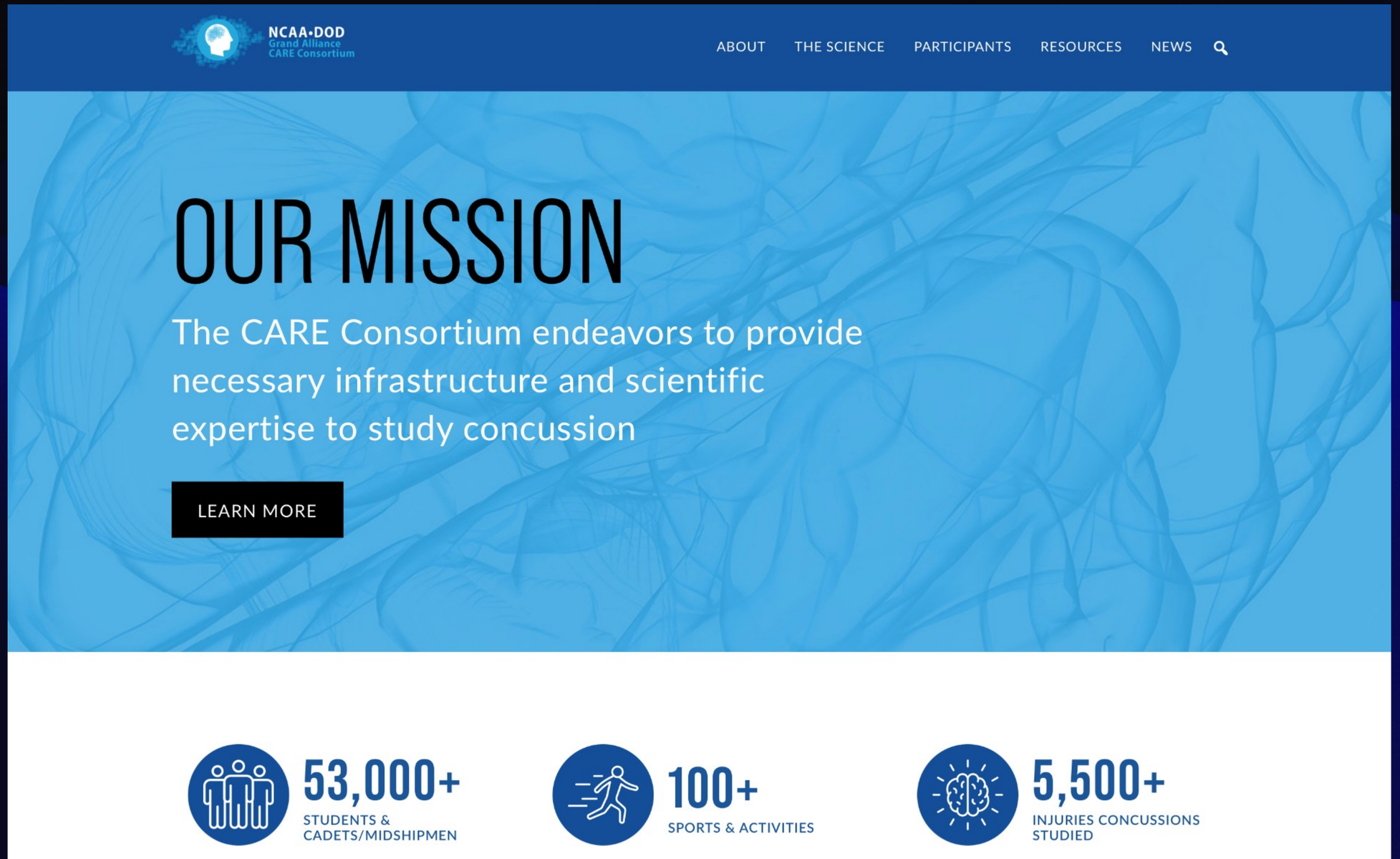
→ Patients that suffer from fatigue after sustaining a concussion are likely to have emotional symptoms

- **Depression**; Mood lability; Frustration
- **Anxiety**
- Disinhibition; Irritability
- Restlessness



Allie et al., 2023; Anderson et al. 2024; Gouttebarge and Kerkhoffs, 2020; Hutchison 2018; Liebel et al. 2023; Scott 2025; Concussion Management for Primary Care, Springer 2025

Study Care Consortium



https://careconsortium.net/

Helpful Interventions

Clinical Case

A 16-year-old and his mother present to clinic for evaluation of a possible concussion. The patient plays soccer and suffered a head-to-head collision with a teammate the night prior. He did not have any immediate symptoms but began experiencing headache, photophobia, and dizziness after practice. He slept poorly overnight and is very fatigued today. He attended school today but struggled throughout the day with worsening symptoms; the mother wants to know when he can return to school. The patient would like to know if he can play in his game tomorrow night.

What would you recommend?

Early exercising

initial management of sports-related concussion

- Early light intensity physical activity improves symptoms at a faster rate & decreases the risk for post-concussion symptoms
- Avoid risk of contact, collision, or fall
- Clinic-based exercise programs may lead to faster recovery and Return-to-play/ Return-tp-learn

- But NO competitions within the next 7 days!

→ standardized approach:
https://bjsm.bmj.com/content/57/11/695

Sleep

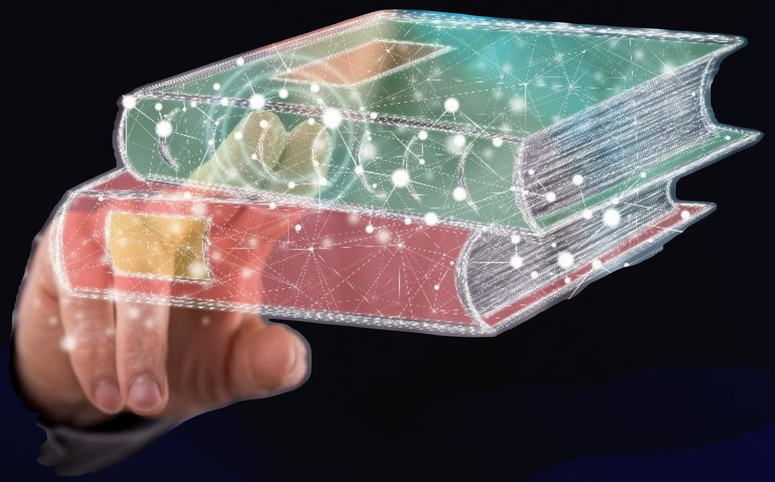
→ Adequate sleep > optimal cognitive recovery
→ Address sleep disturbances > increase sleep quality

- Excess screen time > interferes negatively with sleep quality
- Acute recovery period > brief naps (20 min or less) are appropriate
- Melatonin prescription was not associated with faster symptom recovery
- Cognitive-behavioral therapy for insomnia (CBT-I) > reduce sleep disturbances
- Less sleep disturbances > decrease neuropsychiatric effects

Donau and Resch 2024; DuPrey et al. 2022;

Cognitive training

Return-to-learn/ Return-to-sport



→ a successful return-to-learn is necessary prior to completing the return-to-sport program

- Avoid Computer-based training
- Support, when need more time to complete cognitive challenges
- Playing games in order to train neuropsychological issues (see link below)
- Neurofeedback as effective intervention to improve neurobehavioral symptoms
- improvements in symptoms of psychological distress appear necessary to drive related improvement in neurocognitive functioning and vice versa

https://www.kispisg.ch/downloads/kompetenzen/neuropsychologie/foerderung-und-erhaltung-von-hirnfunktionen-mit-gesellschaftsspielen.pdf

Allie et al. 2023; CISG consensus statement (2022); Liebel et al. 2023

Table 10.2 Return-to-learn table [3]

Stage	Home activity	School activity	Physical activity	Goal of step
Relative brain rest	Sleep as much as needed (at least 8 h) Allow short naps (<1 h) during day Start transition toward regular sleep/wake cycle Avoid bright light if bothersome Stay well hydrated and eat healthy snacks q3–4 h Limit screen time; use large font	No school No homework May begin easy tasks at home (drawing, baking, cooking) Soft music/audio books Limit screen time as symptoms tolerate during first 48 h (i.e., 10–15 min intervals)	Walking short distances to get around (RTP stage 1) No strenuous exercise or contact sports No driving	Gradual return to typical activities
Rest stage should be limited to 24–48 h post-injury only				
Return to school (partial day)	Strict sleep-wake cycle with goal 8 h of sleep at night Avoid napping during day Stay well hydrated and eat healthy snacks q3–4 h Limit screen time and social activities outside of school as symptoms tolerate	Start with a few hours/half days Sit in front of class Take a break in nurse's office or quiet room q2 hrs only PRN Avoid loud areas (music, band, choir, shop class, locker room, cafeteria loud hallway, and gym) Sunglasses/brimmed hat/ear plugs PRN Preprinted (large font -18) class notes Complete necessary assignments only Limit homework No tests or quizzes Tutoring or note taker as needed Stop work if symptoms increase	No high-intensity physical activity or contact sports (RTP stage 2A) No driving	Increase tolerance to cognitive work

(continued)

Table 10.5 Example of return-to-play table [3, 4]

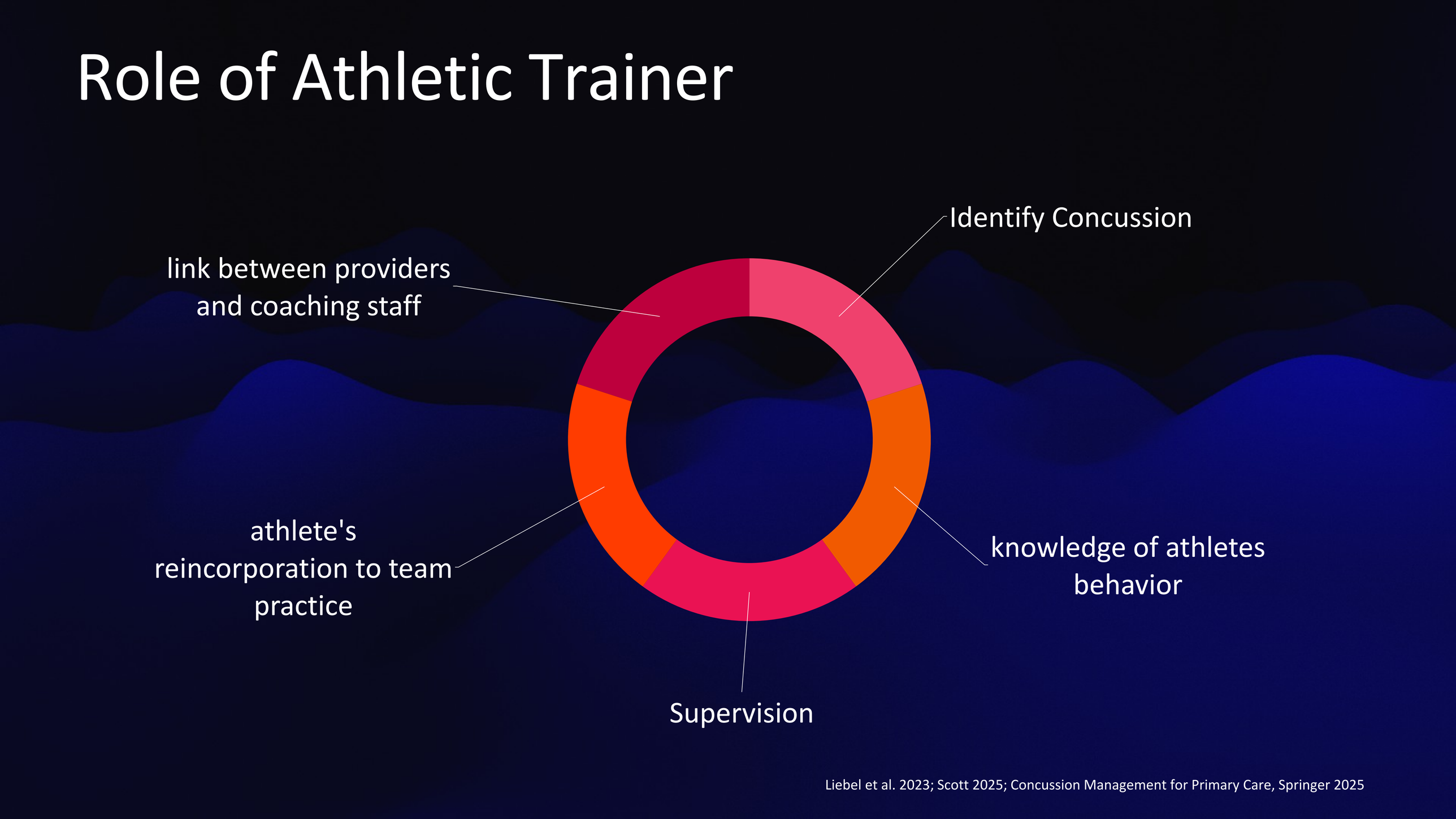
Stage	Aim	Activity	Goal of step
1	Symptom-limited activity	Daily activities that do not worsen symptoms including walking and brief cognitive loads starting 24–48 h after injury. Limit screen time in first 48 h. Maximize sleep	Gradual reintroduction of work and or school activities
2	Light aerobic exercise (2A)	Started after 24–48 h post SRC. Walking or stationary cycling at slow-to-medium pace; no resistance training	Keep HR below 55% of max predicted HR
	Moderate aerobic exercise (2B)	Walking, swimming, or stationary cycling at increased pace; light resistance training with bodyweight squats and pushups (one set of ten reps each)	Increase heart rate to 70% of maxHR
Return-to-learn protocol must be completed prior to advancing to stage 3			
3	Sports-specific exercise	Running and sports-specific drills away from team environment and activities without risk of head impact	Add movement and change of direction that challenges sensory motor systems
Medical determination of readiness to return to at-risk activities here			
4	Noncontact training drills	Harder drills (i.e., passing drills and return-to-team drills); may begin progressive resistance training and high-intensity exercise	Exercise, coordination, and increased thinking during sport
5	Full-contact practice	Participate in full/normal training activities	Restore confidence and allow coaching staff to assess functional skills
6	Return to sport	Normal unrestricted game play	Full clearance/participation

Emotions & Mood

- Building a low-stimulus environment (dimmed lights, headphones against noises)
- Providing possibilities of emotional regulation
- Offering access to Psychotherap, Sportspsychology
- Neurofeedback as intervention to reduce depressive symptoms
- improvements in symptoms of psychological distress appear necessary to drive related improvement in neurocognitive functioning and vice versa

Allie et al., 2023; Anderson et al. 2024; Gouttebarge and Kerkhoffs, 2020; Hutchison 2018; Liebel et al. 2023; Rice et al. 2017; Scott 2025; Sheldrake et al 2022

Role of Athletic Trainer



Liebel et al. 2023; Scott 2025; Concussion Management for Primary Care, Springer 2025

https://www.menti.com/alee8wozmjod

Repetitive Head Impacts in Contact Sports - CTE

RHI - repetitive head impacts

Across a long time period

- Mark bearing damages
- Vascular ruptures
- Microbleeds
- Necrosis, amyloid & p-tau deposits, increased Neurofibrils

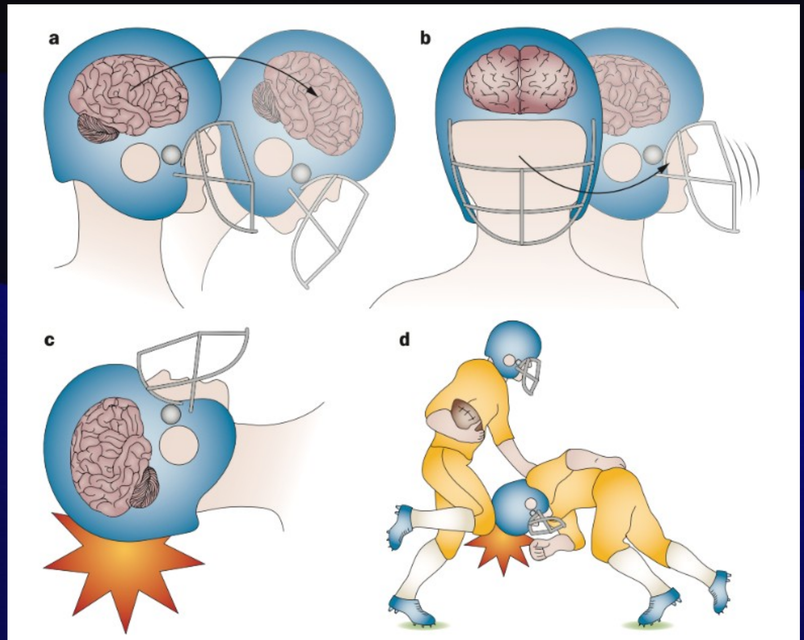


Figure 1 | Mechanisms of brain acceleration–deceleration secondary to biomechanical forces transmitted to the brain. **a** | Linear (translational) acceleration. **b** | Rotational (angular) acceleration. **c** | Impact deceleration. **d** | Impact deceleration secondary to the head striking an opposing player's body. Permission obtained from Innovative CEUs, LLC ©.

Jordan 2013

CTE

Chronic traumatic encephalopathy

- First case diagnosed in vivo 20 years ago (American Football player) (Omalu et al. 2005)
- Repetitive head impacts —> Tauopathy
- High risks mainly in contact sports (Rugby, American Football, Icehockey, Soccer (headwalls), Horseriding, Boxing)
- Biomarker: TDP-43, P-tau, Amyloid deposits —> same as with Alzheimer disease
- Fast neurodegeneration —> increases risk massively of early cognitive impairments/ early dementia

Asken et al. 2025; McKee et al. 2013, 2015; Lin et al. 2018; Ling et al. 2015 Zetterberg et al. 2018

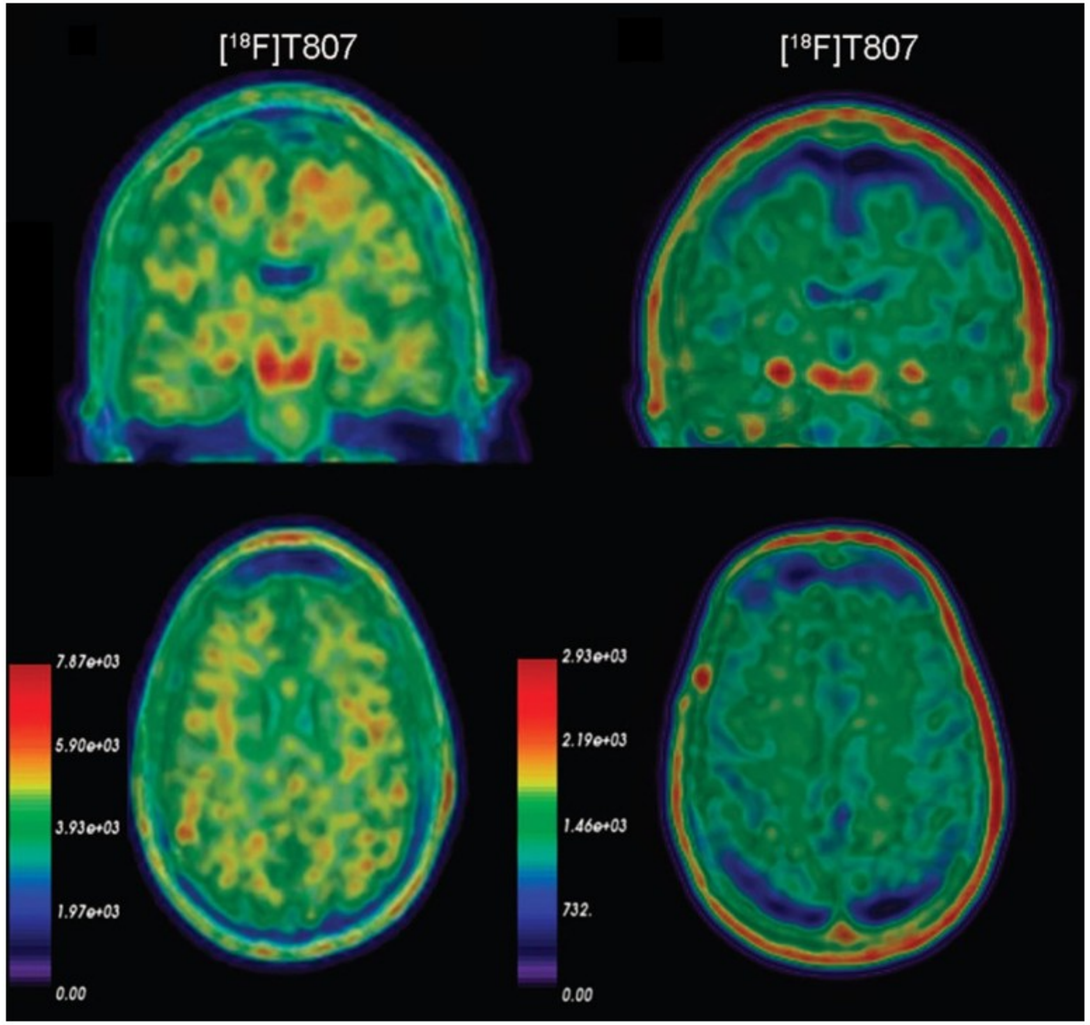


Fig. 29.1. Flortaucipir positron emission tomography scan from a 38-year-old retired National Football League player (left) and a healthy, age-matched control (right). (Reproduced from Dickstein DL, Pullman MY, Fernandez C, et al. (2016) Cerebral [(18) F] T807/AV1451 retention pattern in clinically probable CTE resembles pathognomonic distribution of CTE tauopathy. Transl Psychiatry 6: e900.)

Lin et al. 2018

Consequences

- Dementia
- Neurodegenerative damages
- Neurological/ cognitive impairments

Table 2 Causes of death in former NFL athletes with CTE (without other pathological diagnoses)

	n	Age	Cause of death
Stage I CTE	3	37.7 ± 16.8 years	1 cardiac, 1 suicide, 1 malignancy
Stage II CTE	9	48.1 ± 20.0 years	3 cardiac, 3 suicide, 1 alcohol-related, 1 drug use, 1 malignancy
Stage III CTE	9	59.9 ± 11.5 years	2 cardiac, 3 suicide, 2 overdose, 1 accidental gunshot wound, 1 malignancy
Stage IV CTE	8	81.5 ± 7.3 years	2 cardiac, 2 respiratory, 3 FTT, 1 malignancy,
Overall	27	63.9 ± 17.4 years	

CTE chronic traumatic encephalopathy, *FTT* failure to thrive secondary to dementia, *NFL* National Football League

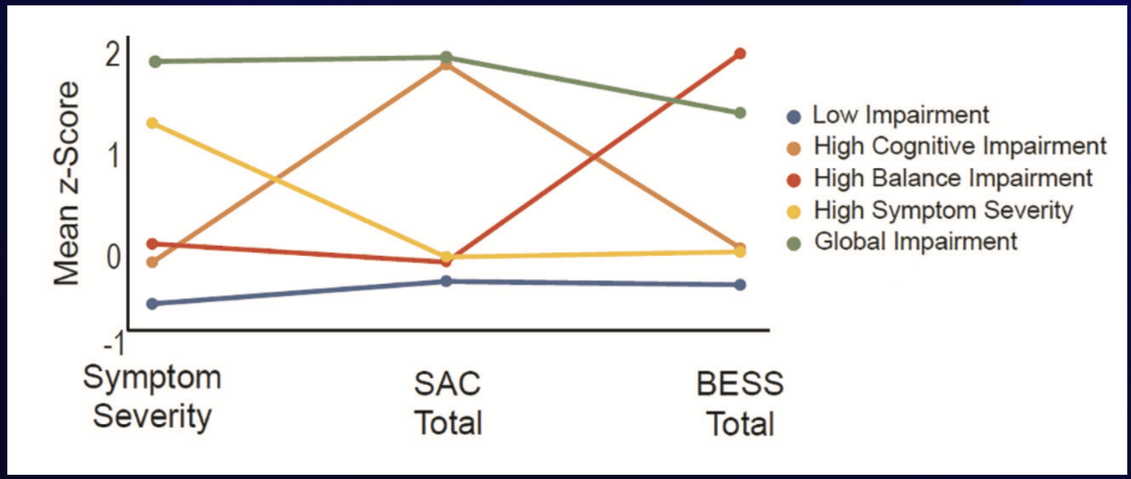
McKee et al. 2013

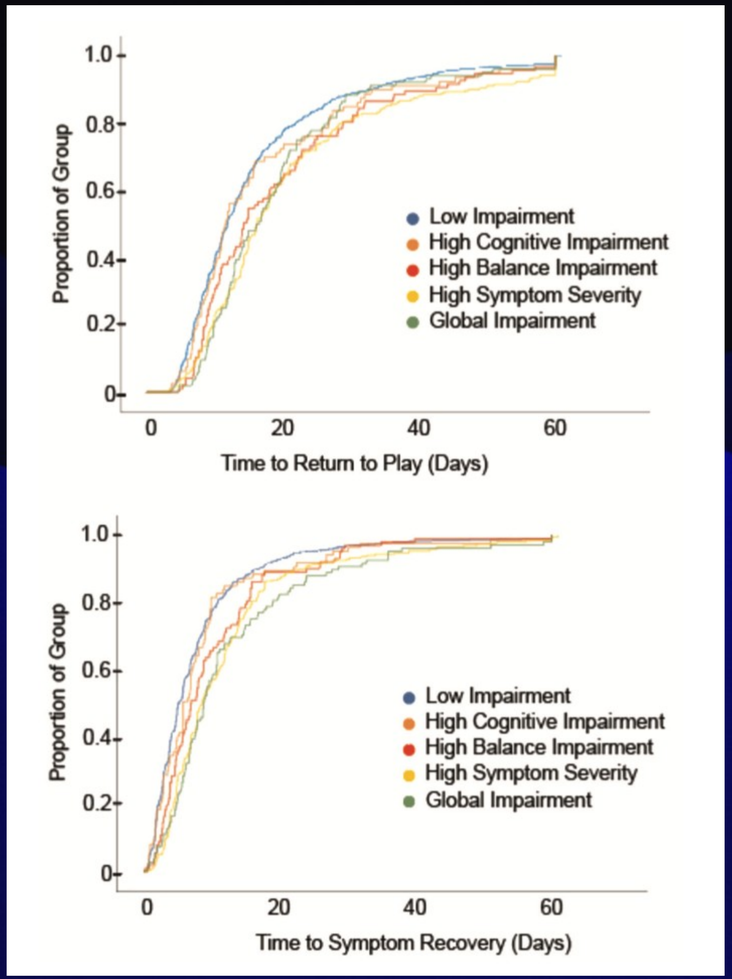
Sports-related concussions

Latent profiles of SRC

Data from the NCAA-DoD CARE Consortium (2014–2020)

- Five profiles differed in demographic and baseline characteristics
- Profiles predicted symptom burden, cognitive and balance performance, and psychological distress at 12–72h
- Low impairment profile had the fastest recovery
- High symptom severity and global impairment profiles had the slowest recovery





Simons et al. (2024): Latent Profiles of Acute Symptoms, Cognitive Performance, and Balance in Sport-Related Concussions

Predictors of Symptom Burden, Cognitive Status, and Psychological Distress

Data from the NCAA-DoD CARE Consortium.

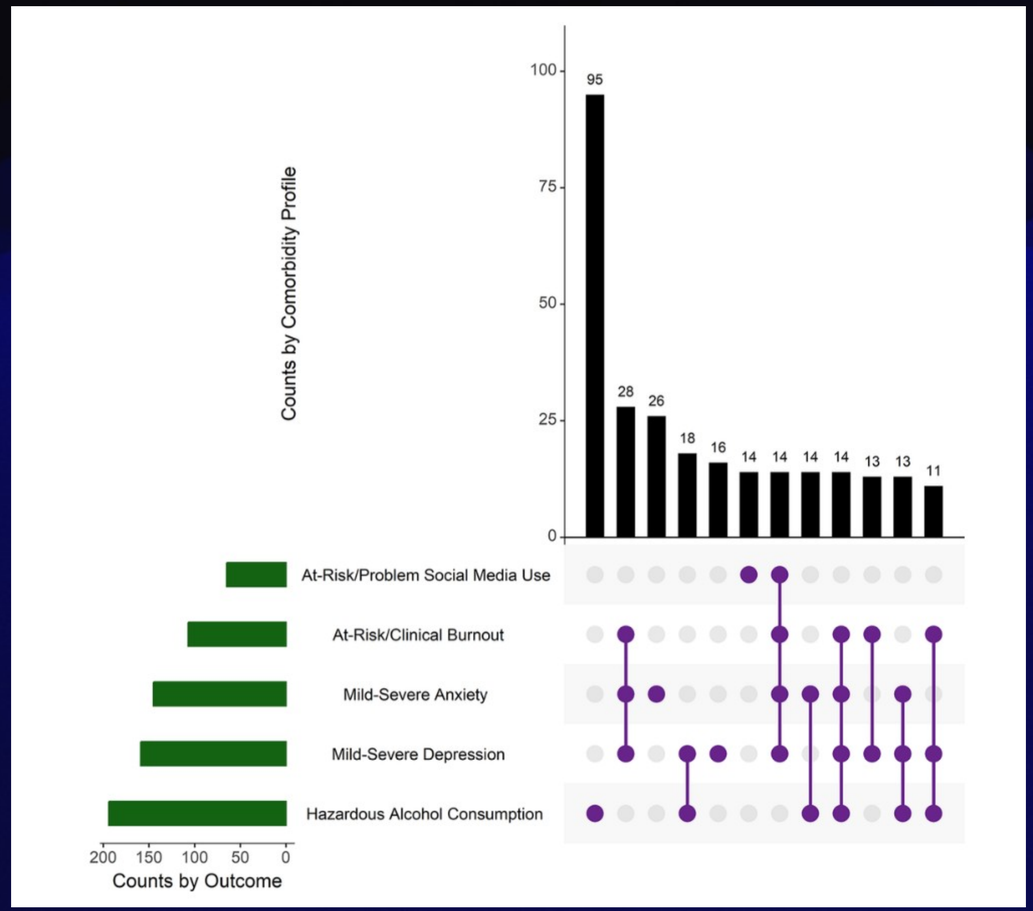
- The most important predictor for changes in all domains (symptoms, cognition, psychological distress) is the **initial baseline evaluation score**
- The number and severity of diagnosed concussions during college had little to no impact on predicting long-term changes in these domains
- Athletes with poorer baseline scores tended to show greater improvement over time

Predictors:
- Demographics
- baseline scores
- concussion history
- sport exposure
- time in CARE
- return-to-play data

Czerniak et al. (2025): Prediction of Symptom Burden, Cognitive Status, and Risk of Psychological Distress in NCAA Athletes with Sport-Related Concussion(s): Findings from the NCAA-DoD CARE Consortium

Self-reporting: Mental health symptom burden

- Hazardous alcohol use was notably high, especially among women
- Most mental health symptoms were less common in male players
- female players had higher burnout rates
- 3+ concussions had higher odds of depression and burnout
- The number of concussions was positively associated with depression, anxiety, burnout, and problematic social media use
- Most mental health symptoms were mild

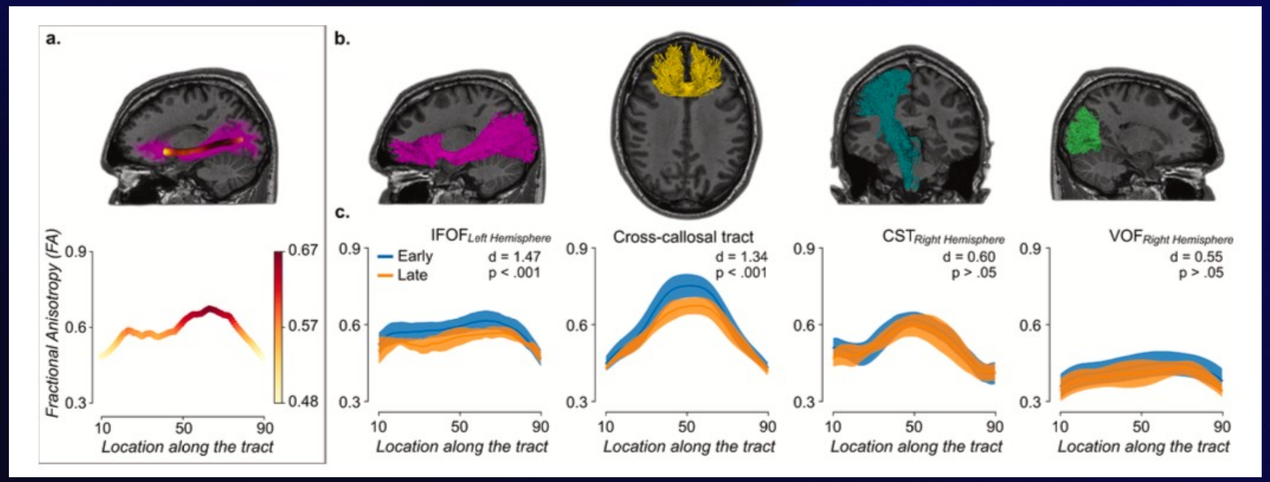


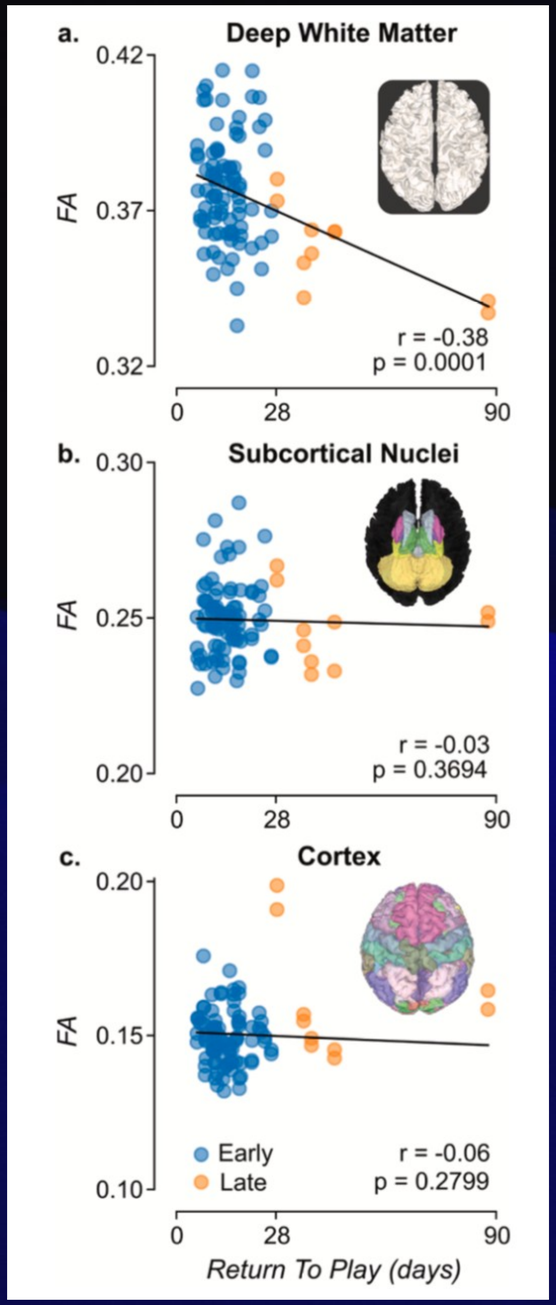
Neurological Components

Diffusion tensor analysis (DTI)

Data from the NCAA/DoD CARE Consortium (Advanced Research Core).

- Microstructural properties of white matter tracts can predict which athletes will experience persisting post-concussion symptoms
- This neuroimaging-based model outperforms previous models based on clinical variables alone.
  - Strongest correlation in the **mid-posterior corpus callosum** and left inferior fronto-occipital fasciculus (**IFOF**).

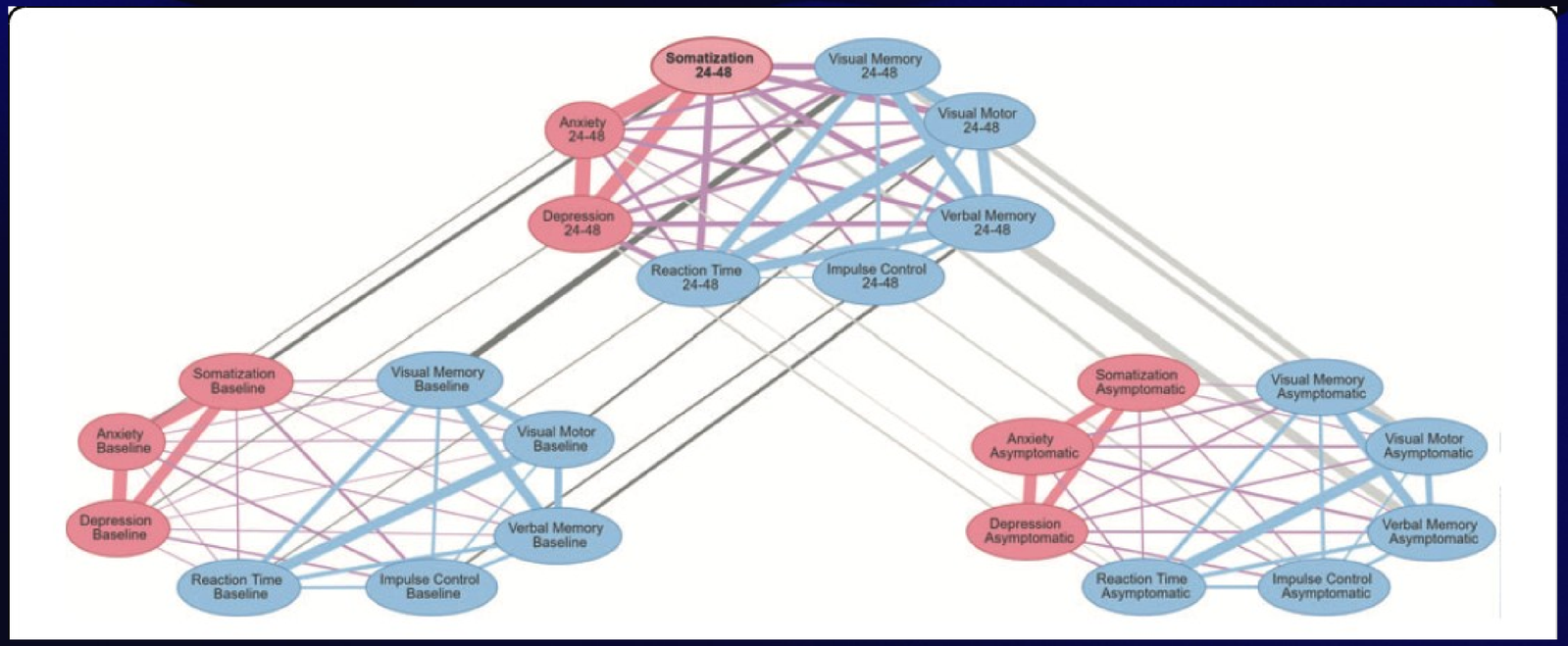




Bertò G et al. (2024): Diffusion tensor analysis of white matter tracts is prognostic of persisting post-concussion symptoms in collegiate athletes

Network Analysis

- Neurocognitive functioning and psychological symptoms after sport-related concussion are highly interconnected, especially 24–48 hours post-injury
- Improvements in psychological distress appear necessary to drive improvements in neurocognitive functioning, and vice versa
- Clinical interventions should address both psychological and neurocognitive symptoms during acute care to optimize recovery



Liebel et al. (2023): Temporal Network Analysis of Neurocognitive Functioning and Psychological Symptoms in Collegiate Athletes After Concussion

Concussion as multi-scale Framework

- **Cellular:** Ionic flux, metabolic dysfunction, neuroinflammation, axonal injury, glial function, glymphatic system
- **Network:** Structural and functional brain connectivity, network reorganization, neuroplasticity, neural reserve
- **Experiential:** Symptoms (cognitive, emotional, physical), self-awareness, coping, adaptation, personal characteristics
- **Social:** Social support, relationships, environment, societal norms, and pressures

➞ Interactions across scales produce emergent properties (e.g., consciousness, symptom expression)

➞ Feedback loops (e.g., sleep disturbance ↔ mood, social support ↔ recovery) are crucial

Kenzie et al. (2017): Concussion As a Multi-Scale Complex System: An Interdisciplinary Synthesis of Current Knowledge

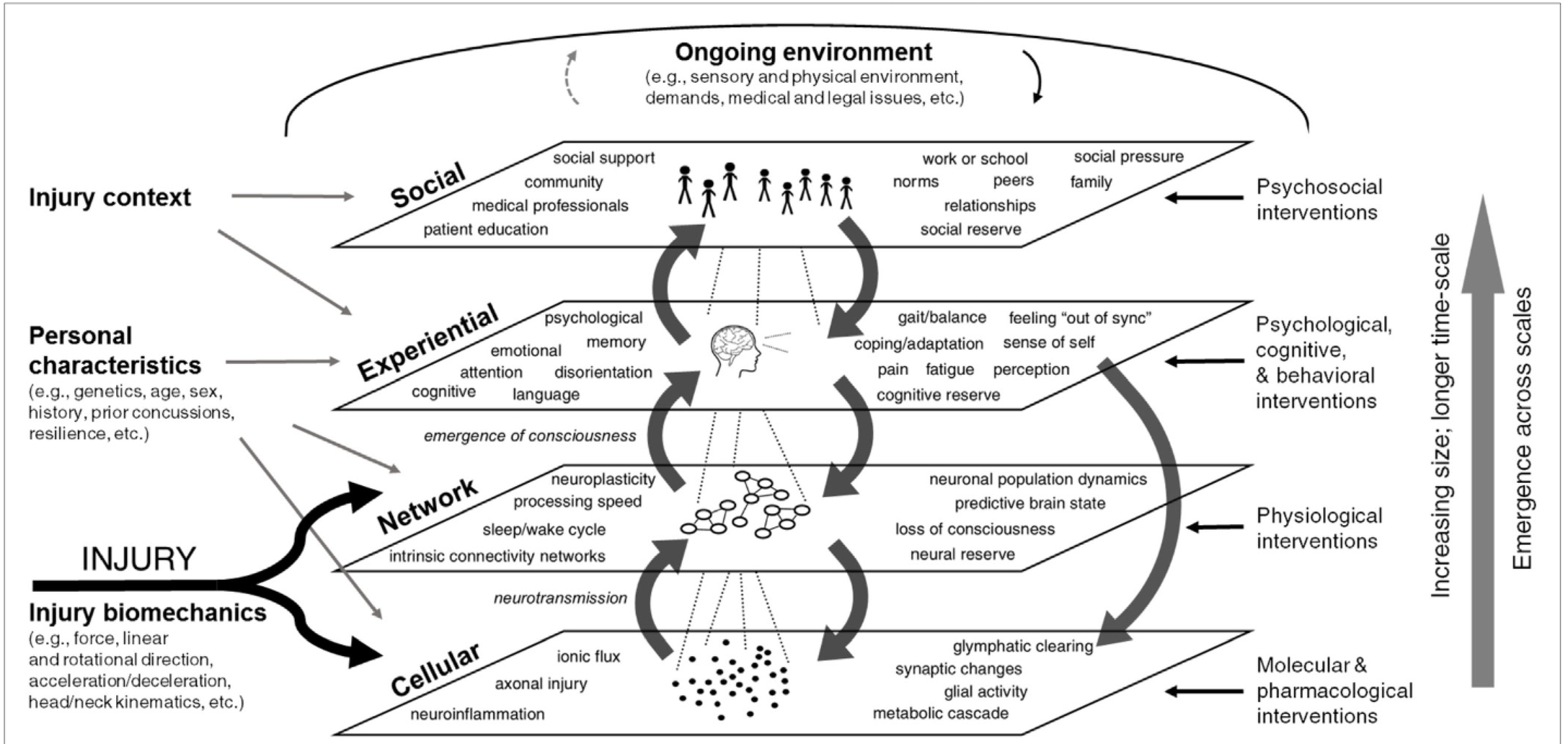


FIGURE 1 | Multi-scale framework for concussion. Factors influencing concussion pathophysiology and recovery are shown across four nested emergent scales: cellular, network, experiential, and social. Endogenous factors—those that affect and are affected by other factors in the system—are included inside the scale boxes. Exogenous system drivers that act upon the system are shown at the perimeter. On the left are exogenous factors present at the time of injury (e.g., injury phenomena and biomechanics, personal characteristics, and injury context), while interventions on the right and top margins impact the system dynamically during the recovery process. Aspects of the ongoing environment influence factors at all scales. Feedback exists within and also between scales. Medium gray arrows indicate cross-scale interactions. Factors show emergence, increasing size, and longer time-scale moving up from the cellular to social levels. A team of systems scientists produced this diagram based on literature review, interviews with researchers and clinicians, and iterative review by subject matter experts.

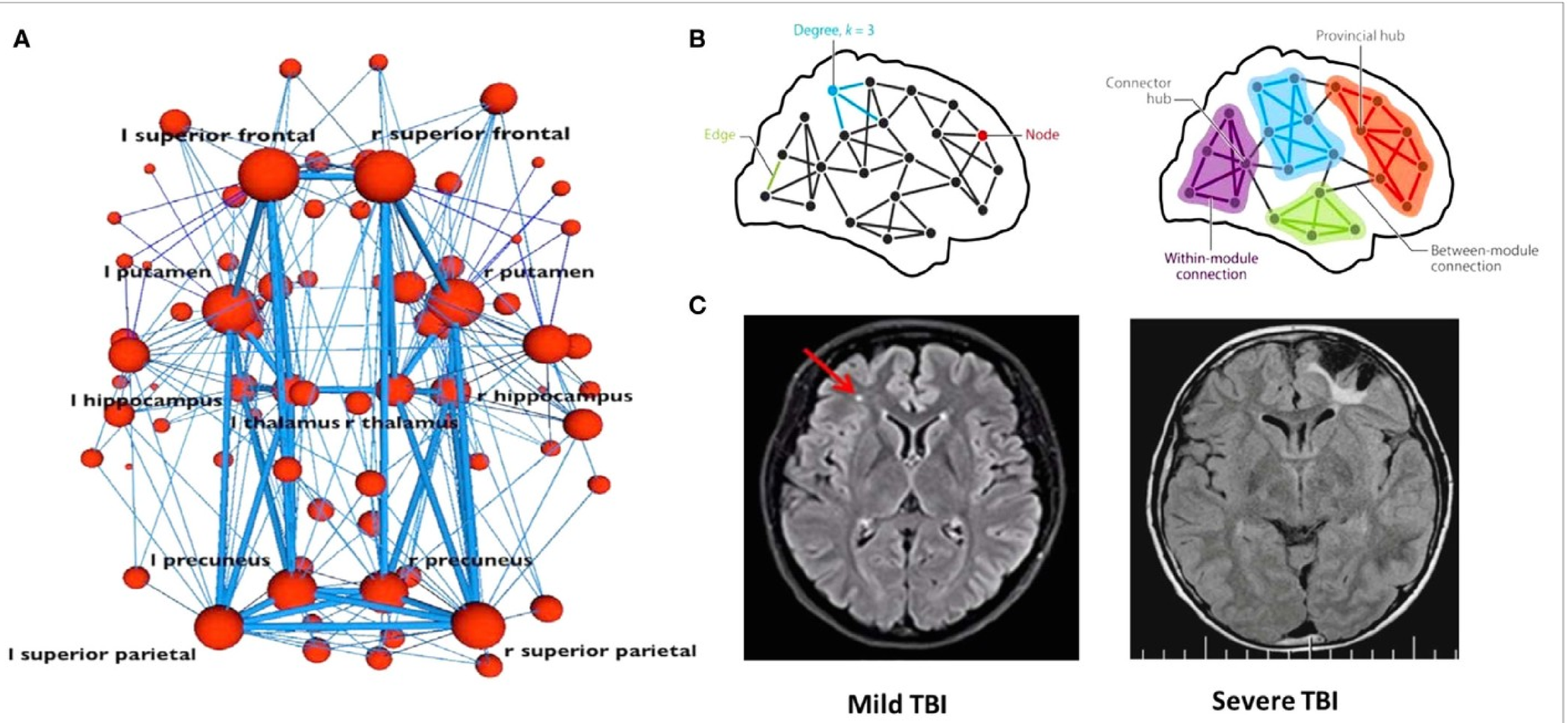


FIGURE 2 | Concussion at the network scale. When investigating how information passes through a network **(A,B)**, a node may represent neuronal activations, or network properties of gray or white matter in a given location. Connections between nodes may represent structural white matter tracts (i.e., groups of axons), temporal synchronization, or other functional relationships. Major hubs [shown in panel **(B)**] refer to regions that play a central role in connectivity and information processing. For any given structural or functional connectivity network, major hubs may be contrasted with less important hubs and peripheral nodes and edges. Comparison of magnetic resonance imaging scans from mild and severe TBI patients is shown in panel **(C)**. The smaller the site of injury, the less likely the damage is to significantly interrupt information processing within a given network. In the concussed patient, if the injury impacts a peripheral small node, there might only be a minimal disruption in function, especially if the functional connectivity needed for recovery is restored via rerouting. In the severe TBI case, such workarounds will not be possible as the damage is too extensive. A network approach illustrates the possibility that severity or prognosis may be based on extent of network damage. Panels **(A,B)** were borrowed from Ref. (138), and panel **(C)** was borrowed from Ref. (124). Used with permission.

Available Concussion Tests online

https://www.schulthess-klinik.ch/sites/default/files/2025-06/Concussion.%20VOMS%20und%20CISG.ed%20KWS.pdf

https://cattonline.com/scat

https://cdn-links.lww.com/permalink/jsm/a/jsm_2020_01_28_haider_19-313_sdc1.pdf

Games:
https://www.kispisg.ch/downloads/kompetenzen/neuropsychologie/foerderung-und-erhaltung-von-hirnfunktionen-mit-gesellschaftsspielen.pdf

Guidelines

https://www.neuropt.org/practice-resources/anpt-clinical-practice-guidelines/concussion-cpg

https://www.ninds.nih.gov/news-events/events/ninds-tbi-classification-and-nomenclature-workshop

https://concussionsontario.org/

https://register.awmf.org/assets/guidelines/008-001k_S2e_Schaedelhirntrauma_SHT_Erwachsene_2016-06-abgelaufen.pdf

https://www.suva.ch/de-ch/unfall/fuer-leistungserbringer/suva-medical/publikationen/2020/september/aerztliche-akutversorgung-der-leichten-traumatischen-hirnverletzung#state=[anchor-D053D785-BA06-48B1-80A4-F638B0D1A505]

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