THE SPECTRUM OF CONCUSSION PREVENTION

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DUQUESNE UNIVERSITY

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DISCLSOURES

Conflicts of Interest – None

Prior/ On-Going Funding –

OBJECTIVES

At the end of this session, you will be able to:

1. Demonstrate a foundational understanding of injury prevention and risk reduction models.
2. Recognize the important role of the athletic trainer and athletic therapist in primary, secondary, and tertiary concussion prevention practice development and implementation.
3. Construct appropriate, site-specific concussion prevention measures based upon the current research evidence available.

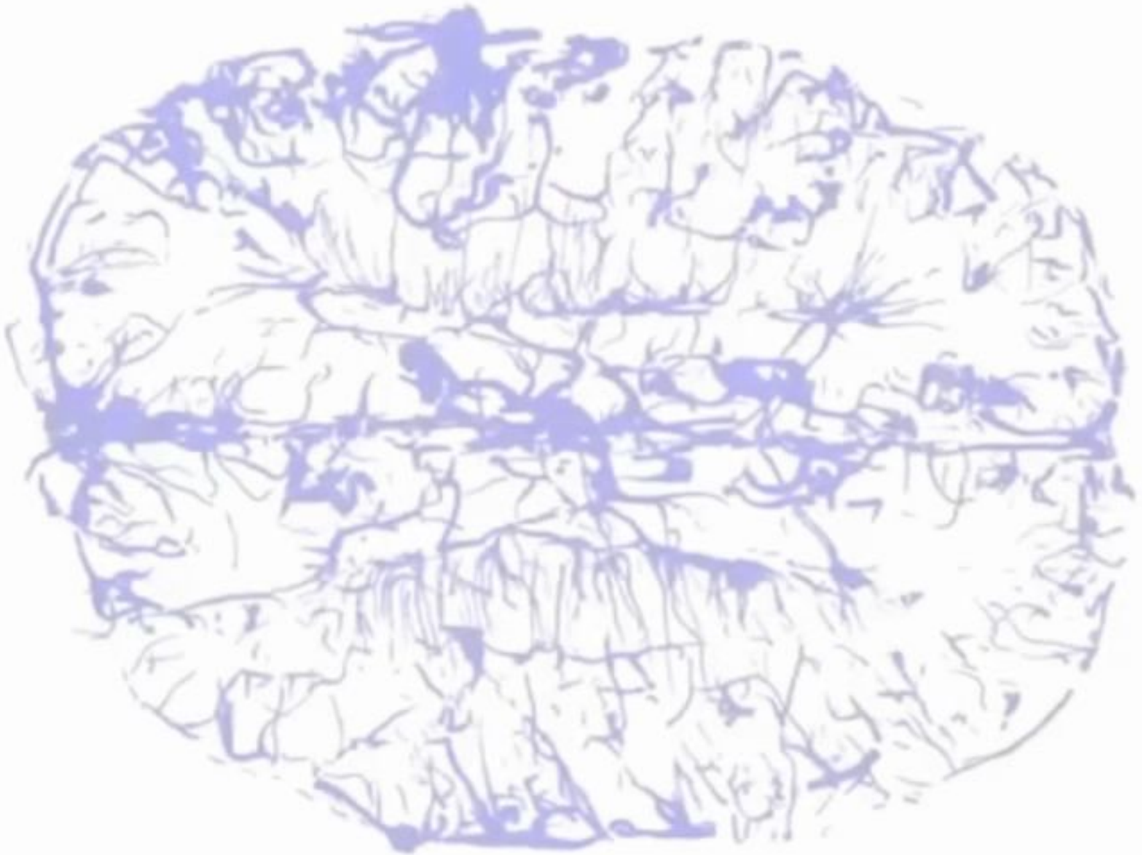
Scan here for references:

Use slide #s to navigate

Imperial College London

Microbleed Modelling

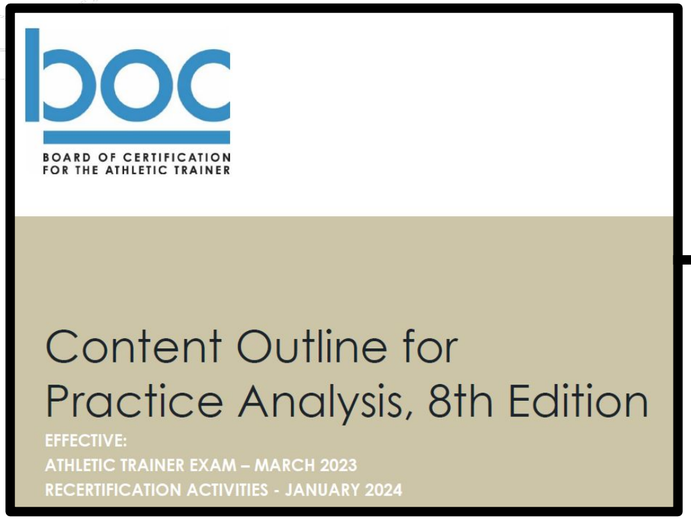
HEAD LAB



Our model showed never before seen patterns of motion of the venous system …

What comes to mind when you hear “injury prevention”?

PREVENTION & AT



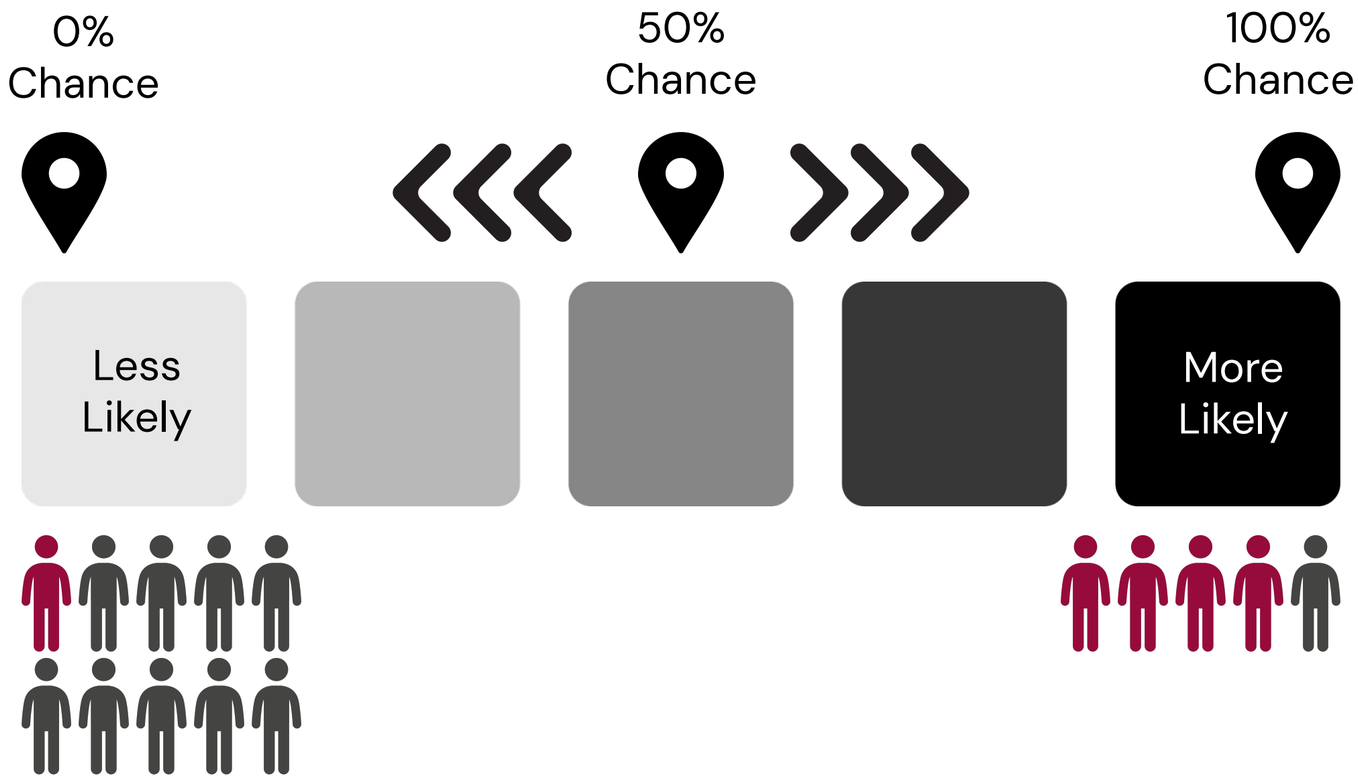
DOMAIN 1 [1]

Risk Reduction, Wellness, and Health Literacy

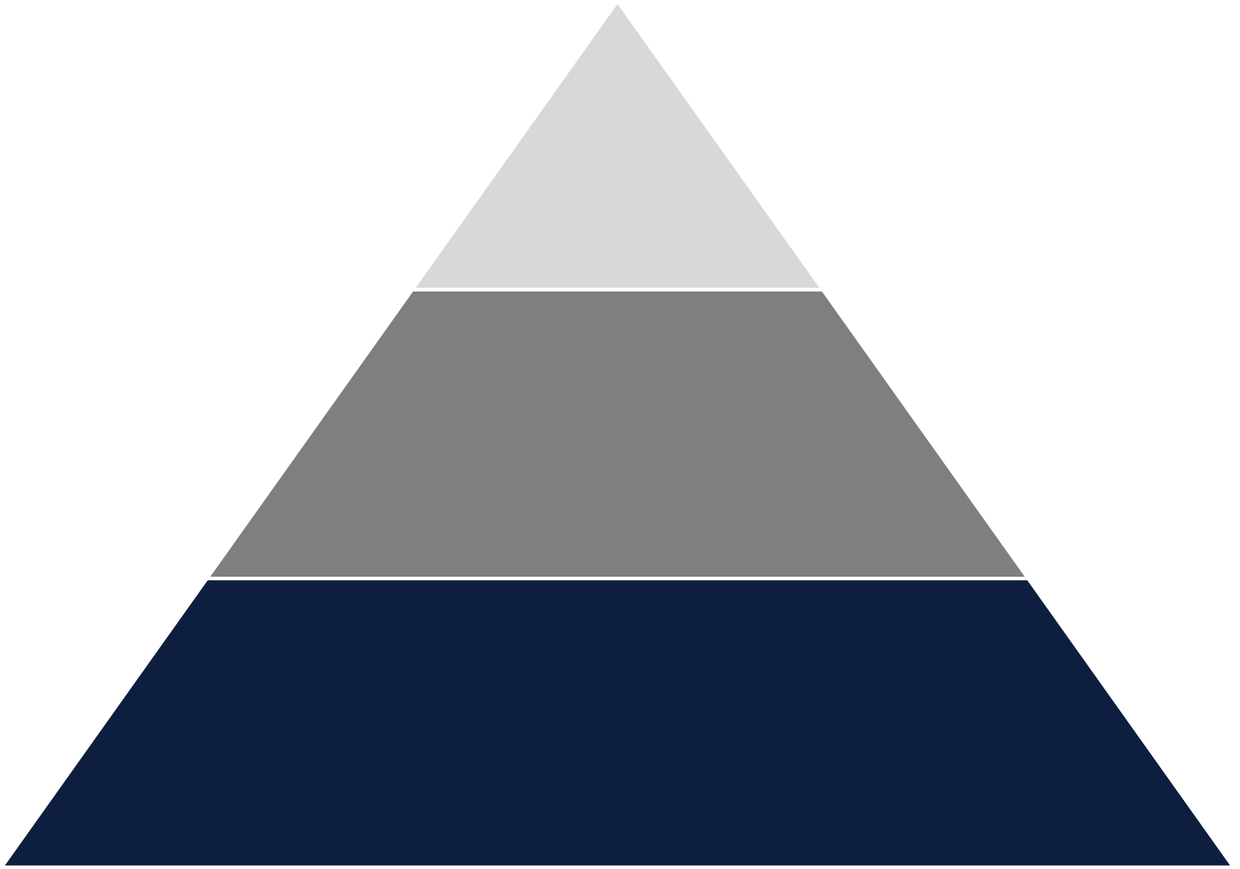
PERFORMACE DOMAIN 1 [2]

Prevention

Prevention & Risk Reduction

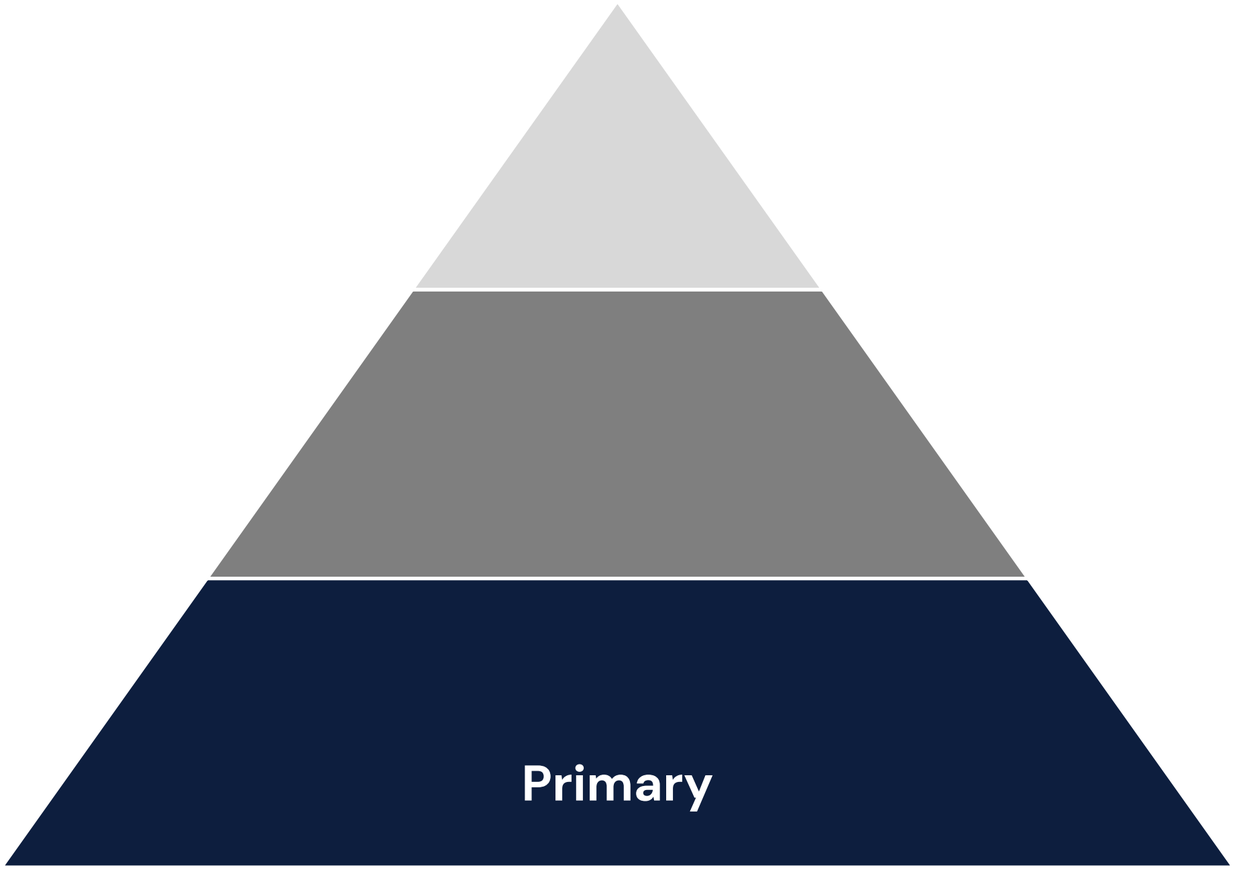


PUBLIC HEALTH LEVELS OF PREVENTION



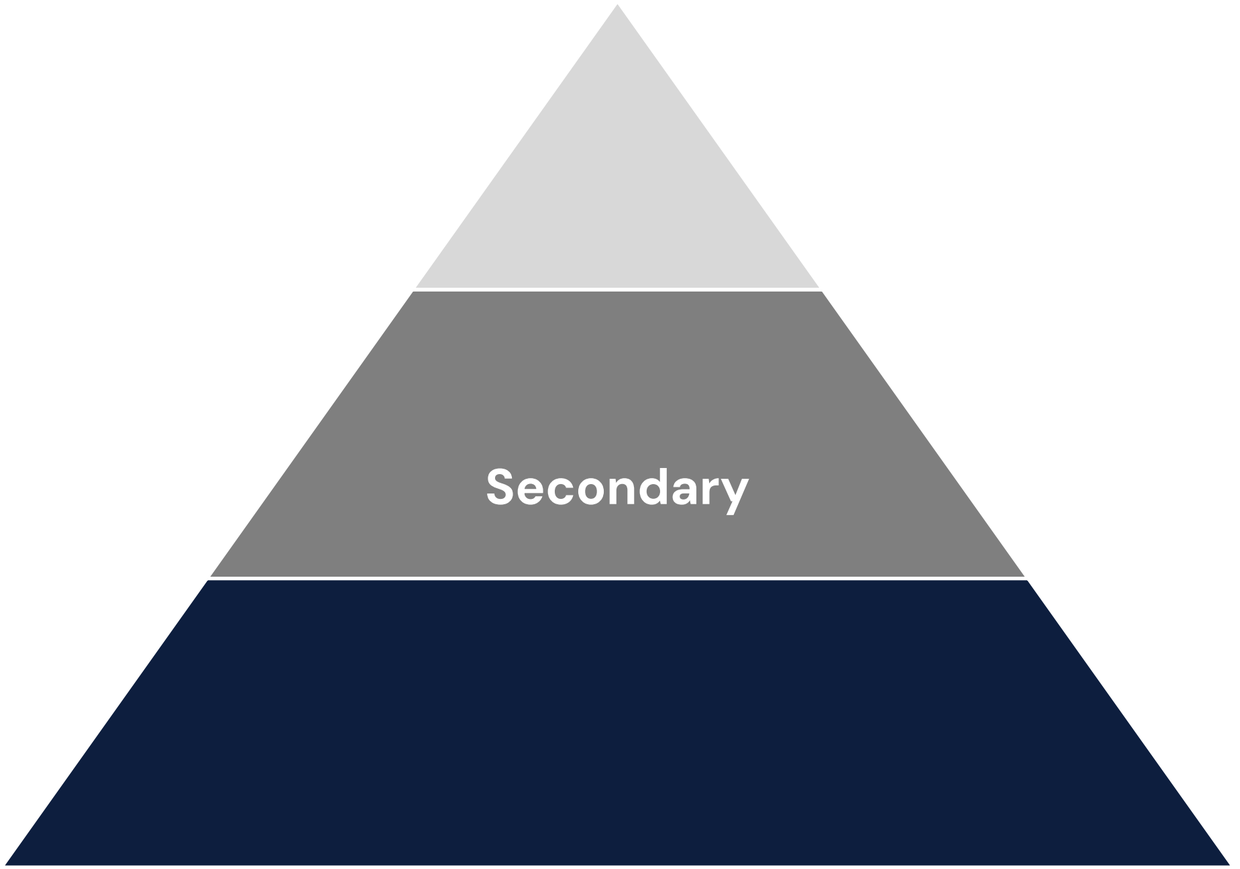
PUBLIC HEALTH LEVELS OF PREVENTION

Approaches to reduce the occurrence of an injury or illness



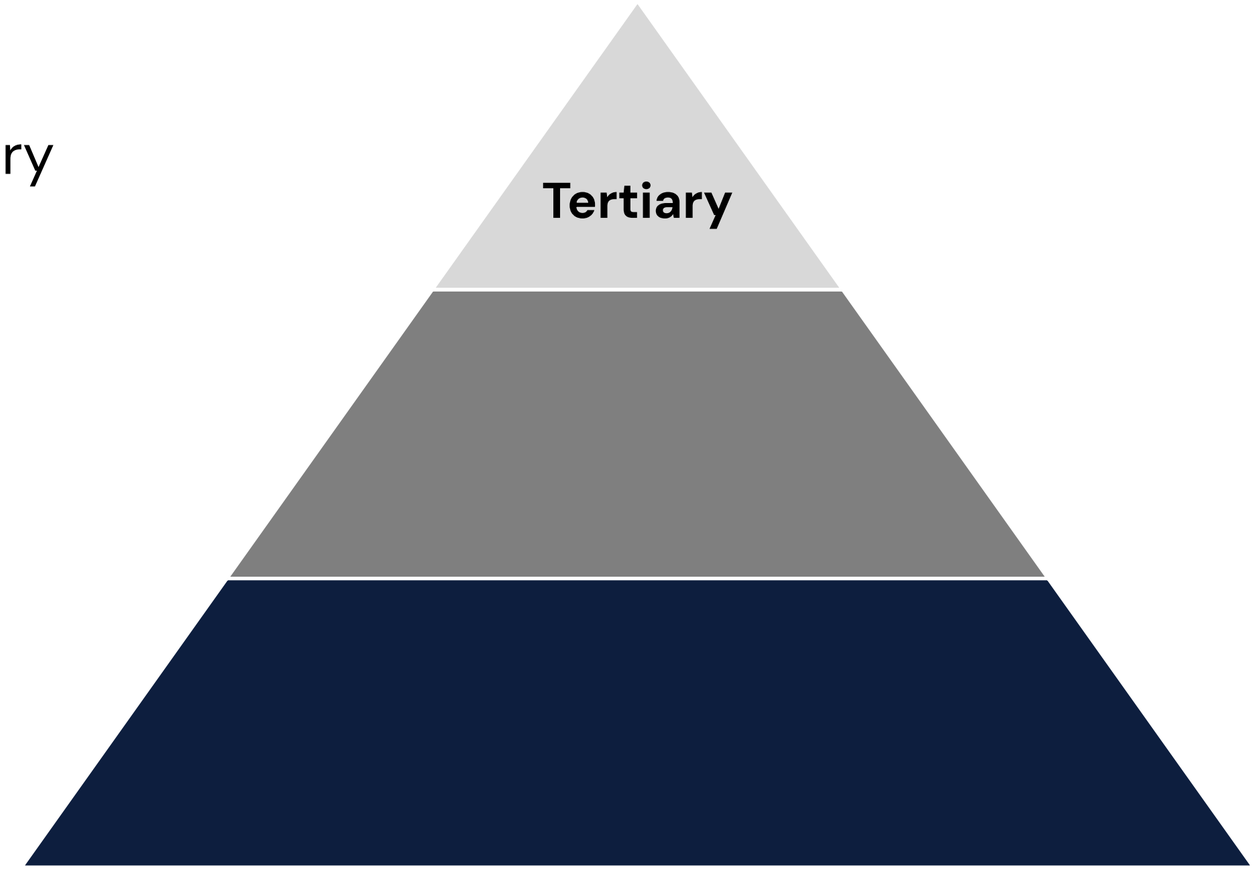
PUBLIC HEALTH LEVELS OF PREVENTION

Approaches to reduce the acute impact of an injury or illness after it occurs



PUBLIC HEALTH LEVELS OF PREVENTION

Approaches to reduce the longer-term effects of an injury or illness

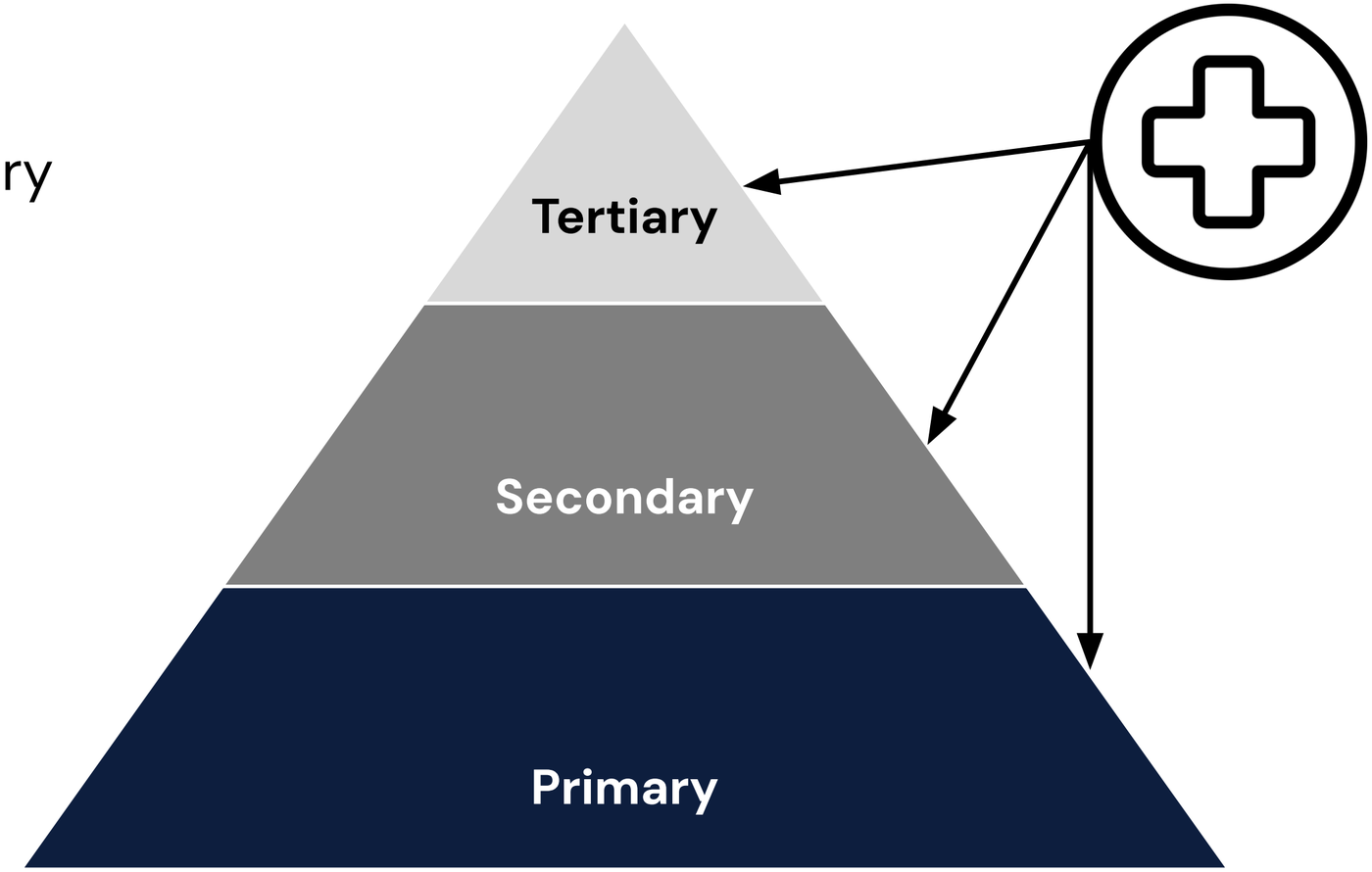


PUBLIC HEALTH LEVELS OF PREVENTION

Approaches to reduce the longer-term effects of an injury or illness

Approaches to reduce the acute impact of an injury or illness after it occurs

Approaches to reduce the occurrence of an injury or illness



How are injury prevention interventions established?

Translating Research into Injury Prevention Practice (TRIPP) Framework for Sports Injury Prevention[3]

STEP 1
Injury Surveillance

↓

STEP 2
Establish etiology and mechanisms of injury

↓

STEP 3
Develop preventative measures

↓

STEP 4
Evaluation of prevention approaches in ideal conditions

↓

STEP 5
Field study on real-world implementation

↓

STEP 6
Implementation of the prevention intervention in a real-world context and evaluation of its effectiveness (Stage 1)

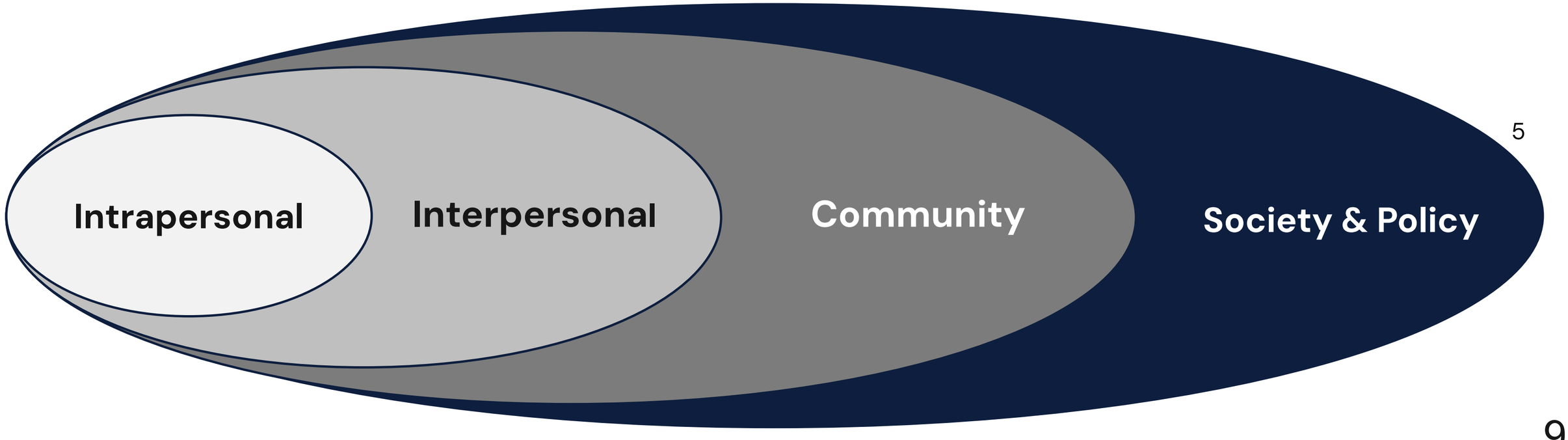
Journal of Athletic Training 2017;52(3):195–205
doi: 10.4085/1062-6050-51.12.02

www.natajournals.org

literature review

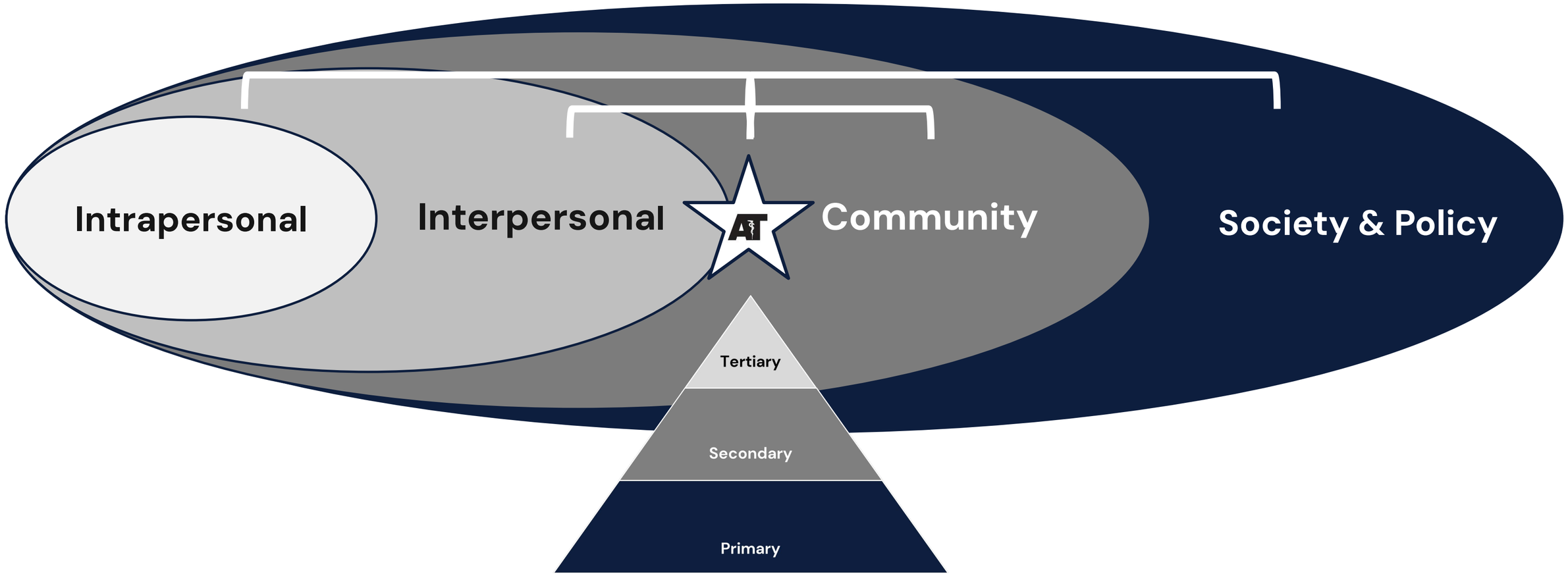
A Multifactorial Approach to Sport-Related Concussion Prevention and Education: Application of the Socioecological Framework[4]

Johna Register-Mihalik, PhD, LAT, ATC*; Christine Baugh, MPH†; Emily Kroshus, ScD, MPH‡; Zachary Y. Kerr, PhD, MPH*; Tamara C. Valovich McLeod, PhD, ATC, FNATA§



[5]

ROLE OF THE AT



ROLE OF THE AT

STUDY IN MOTION

Navigating Concussion Care in Secondary Schools: Resources and Barriers in Policies and Procedures Development and Implementation

Did you play a role in the development of your current secondary school's written concussion policies and procedures?

70.6% YES (n = 397/562)

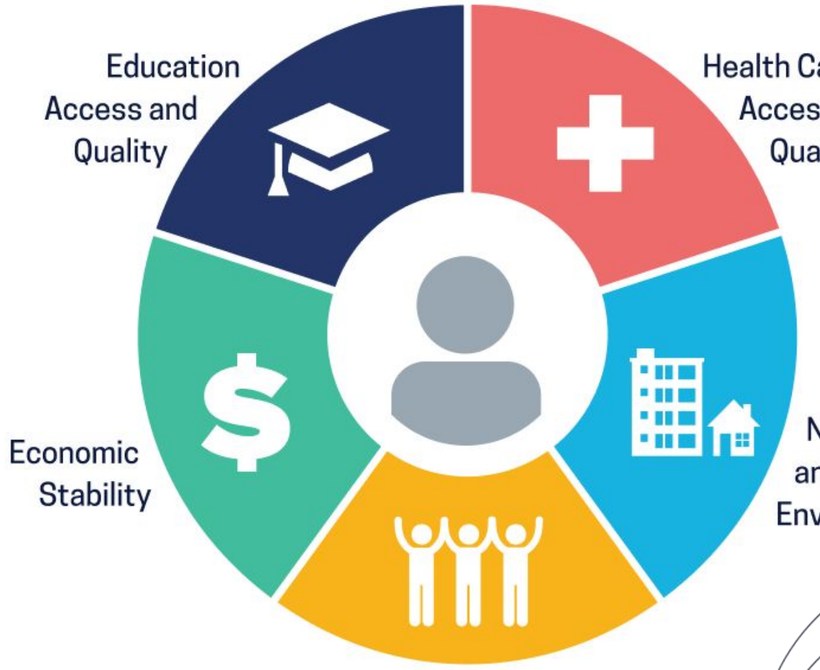
Please indicate your level of involvement in the development of your secondary school's concussion policy.

49.4% PRIMARY DEVELOPER (n = 196/397)

21.4% ASSISTED WITH DEVELOPMENT (n = 85/397)

24.4% UPDATED EXSISTING POLICY (n = 97/397)

Social Determinants of Health



Social Determinants of Health
Copyright-free

Healthy People 2030

ROLE OF THE AT

CAATE
Commission on Accreditation
of Athletic Training Education

STANDARD 93

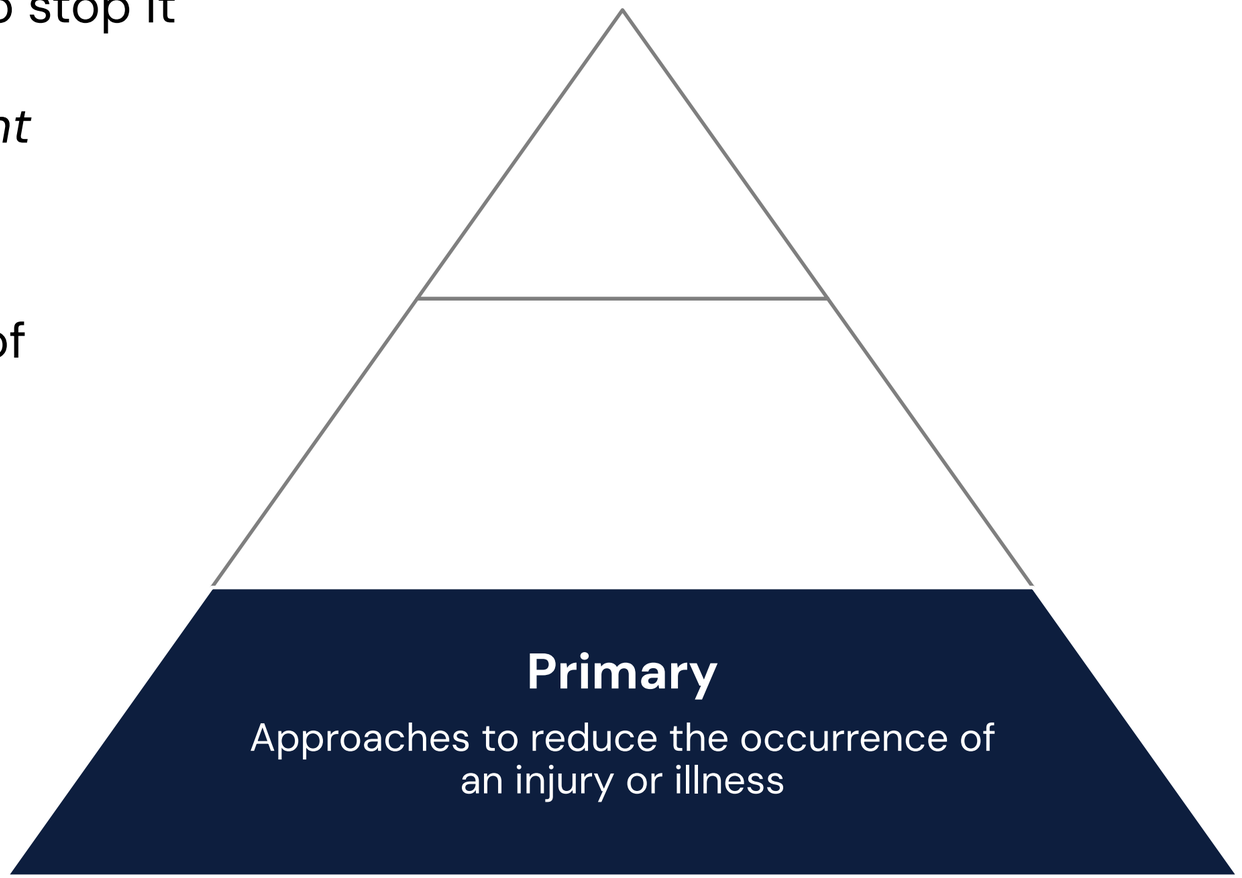
Develop and implement specific policies and procedures for individuals who have sustained concussion or other brain injuries.

PRIMARY PREVENTION OF CONCUSSION

"The best way to treat a concussion is to stop it from occurring in the first place."
– *Someone, somewhere, at some point*

Primary Prevention Goal:
Reduce the frequency and magnitude of head impacts as much as possible during training and competitions

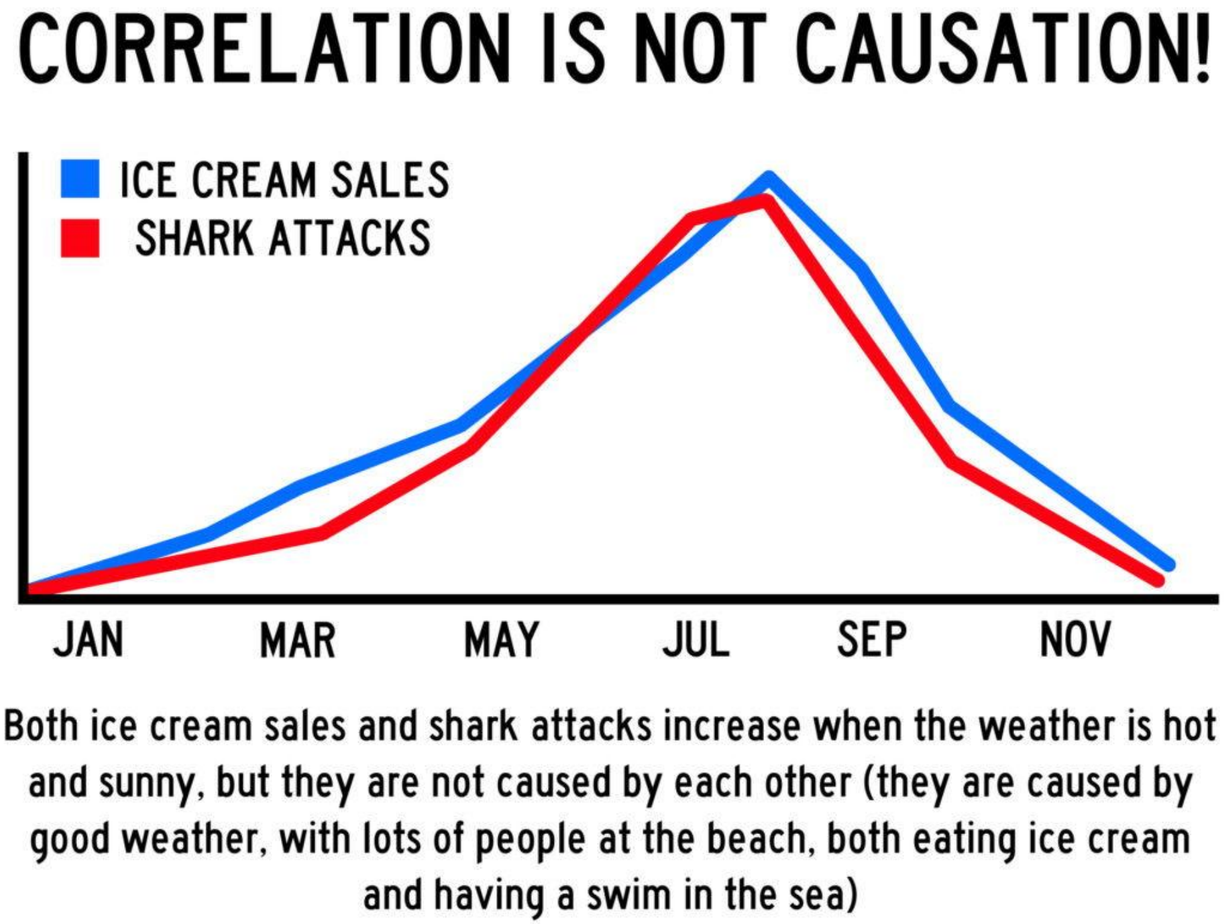
- Equipment
- Policy & Rule Changes
- Training Interventions



QUICK REMINDERS

Absence of evidence is not always evidence of absence

Association is **not** causation



PRIMARY PREVENTION OF CONCUSSION

Current state of concussion prevention strategies: a systematic review and meta-analysis of prospective, controlled studies

Daniel K Schneider,[1,2] Ravi K Grandhi,[2,3] Purnima Bansal,[4] George E Kuntz IV,[2] Kate E Webster,[5] Kelsey Logan,[1] Kim D Barber Foss,[1,6] Gregory D Myer[1,2,3,7,8,9]

2017

British Journal of Sports Medicine

Systematic review

Prevention strategies and modifiable risk factors for sport-related concussions and head impacts: a systematic review and meta-analysis

Paul H Eliason ,[1] Jean-Michel Galarneau,[1] Ash T Kolstad ,[1] M Patrick Pankow,[1] Stephen W West ,[2] Stuart Bailey,[3] Lauren Miutz,[4] Amanda Marie Black ,[1] Steven P Broglio ,[5] Gavin A Davis ,[6] Brent E Hagel ,[7] Jonathan D Smirl,[1] Keith A Stokes,[8] Michael Takagi,[6] Ross Tucker,[9] Nick Webborn ,[10] Roger Zemek ,[11] Alix Hayden,[12] Kathryn J Schneider ,[1] Carolyn A Emery [1,7]

2023

Scan here for references:

HEADGEAR

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Daniel K Schneider,[1,2] Ravi K Grandhi,[2,3] Purnima Bansal,[4] George E Kuntz IV,[2] Kate E Webster,[5] Kelsey Logan,[1] Kim D Barber Foss,[1,6] Gregory D Myer[1,2,3,7,8,9]

2017 – Systematic review and meta-analysis of 14 prospective studies concluded concussion prevention effects for **interventional protective equipment is limited** (RR=0.82, 95% CI 0.56 to 1.20).

Systematic review

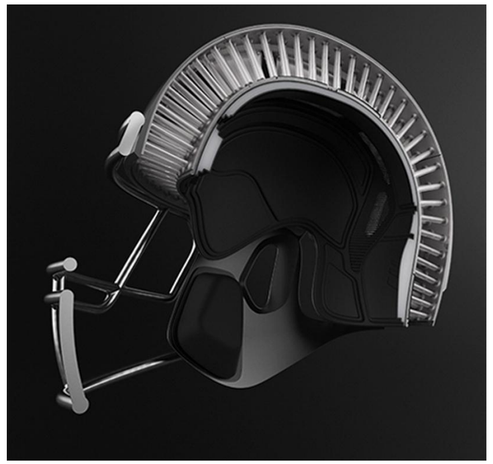
Prevention strategies and modifiable risk factors for sport-related concussions and head impacts: a systematic review and meta-analysis

Paul H Eliason ,[1] Jean-Michel Galarneau,[1] Ash T Kolstad ,[1] M Patrick Pankow,[1] Stephen W West ,[2] Stuart Bailey,[3] Lauren Miutz,[4] Amanda Marie Black ,[1] Steven P Broglio ,[5] Gavin A Davis ,[6] Brent E Hagel ,[7] Jonathan D Smirl,[1] Keith A Stokes,[8] Michael Takagi,[6] Ross Tucker,[9] Nick Webborn ,[10] Roger Zemek ,[11] Alix Hayden,[12] Kathryn J Schneider ,[1] Carolyn A Emery [1,7]

2023 – Systematic review and meta-analysis of 39 studies found that **helmets and headgear do not prevent concussion** and risk mitigation varies among sports.

HELMETS – US FOOTBALL

Mixed evidence supporting reduced concussion risk via helmet design



Some evidence associating poor fit with worse concussion symptoms

HELMETS - FOOTBALL

NFL NFLPA

2025 HELMET LABORATORY TESTING PERFORMANCE RESULTS

BETTER LABORATORY PERFORMANCE

- Riddell Axiom 3D (R61227) [1]
- VICIS ZERO2-R MATRIX ID 2025 (19007) [1, NEW]
- Schutt F7 Pro (206300) [1, NEW]
- Schutt F7 Pro WR/DB (206390) [1, NEW]
- VICIS ZERO2-R (190301)
- LIGHT Gladiator Thunder [NEW]
- Riddell SpeedFlex Precision Diamond (R41106) [1]
- Riddell SpeedFlex Precision (R41156) [1]
- LIGHT Apache Pro [NEW]
- Riddell Axiom (R61247) [1]
- Riddell SpeedFlex True (R61365) [1]

NOT RECOMMENDED

- Schutt F7 2.0 (209000)
- Schutt F7 UR1 2.0 2024 (209301) [1]
- Riddell SpeedFlex (R41195)

NEWLY PROHIBITED [2]

- Riddell Foundation
- Riddell Speed Icon
- Riddell Speed
- Riddell Revolution Speed Classic
- Schutt Air XP Pro Q11 LTD
- Xenith Epic+
- Xenith Epic

[1]Actual performance and ranking may vary since these helmets are customized for each player's head shape.

[2]These helmets join a list of previously-prohibited models and are prohibited for all players.

These models are part of a list of 10 models for which any player in a Guardian Cap-required position may choose to wear one of these helmets without a Guardian Cap NXT 1.8 in practices. Players should consult the full list of these models.

THE NFL AND NFLPA, THROUGH THEIR RESPECTIVE APPOINTED BIOMECHANICAL EXPERTS AND THE JOINT ENGINEERING AND EQUIPMENT SAFETY COMMITTEE, ANNUALLY COORDINATE EXTENSIVE LABORATORY RESEARCH TO EVALUATE WHICH HELMETS BEST REDUCE HEAD IMPACT SEVERITY. THE RESULTS OF THOSE TESTS, WHICH ARE GENERALLY SUPPORTED BY ON-FIELD PERFORMANCE, ARE SET FORTH ON THIS POSTER.

The helmet models are listed in order of their performance, with a shorter bar representing better performance. The rankings are based exclusively on the ability of the helmet to reduce head impact severity measures in laboratory testing. Performance variation related to helmet fit, retention, temperature-dependence, and long-term durability are not addressed in these rankings.

All helmets in green are recommended for use by NFL players. These Top-Performing helmets performed similarly to top-ranked helmets based on a statistical grouping analysis. Helmets with poorer laboratory performance were placed in the Not Recommended (yellow) or Prohibited (red) groups. Players using helmets from the yellow group should consider offerings in the green group. Red helmets are prohibited for all players.

Players are encouraged to discuss their helmet options with their clubs' equipment and athletic training staffs, including other model offerings such as position-specific helmets and models that may be worn without a Guardian Cap NXT 1.8 in practices.

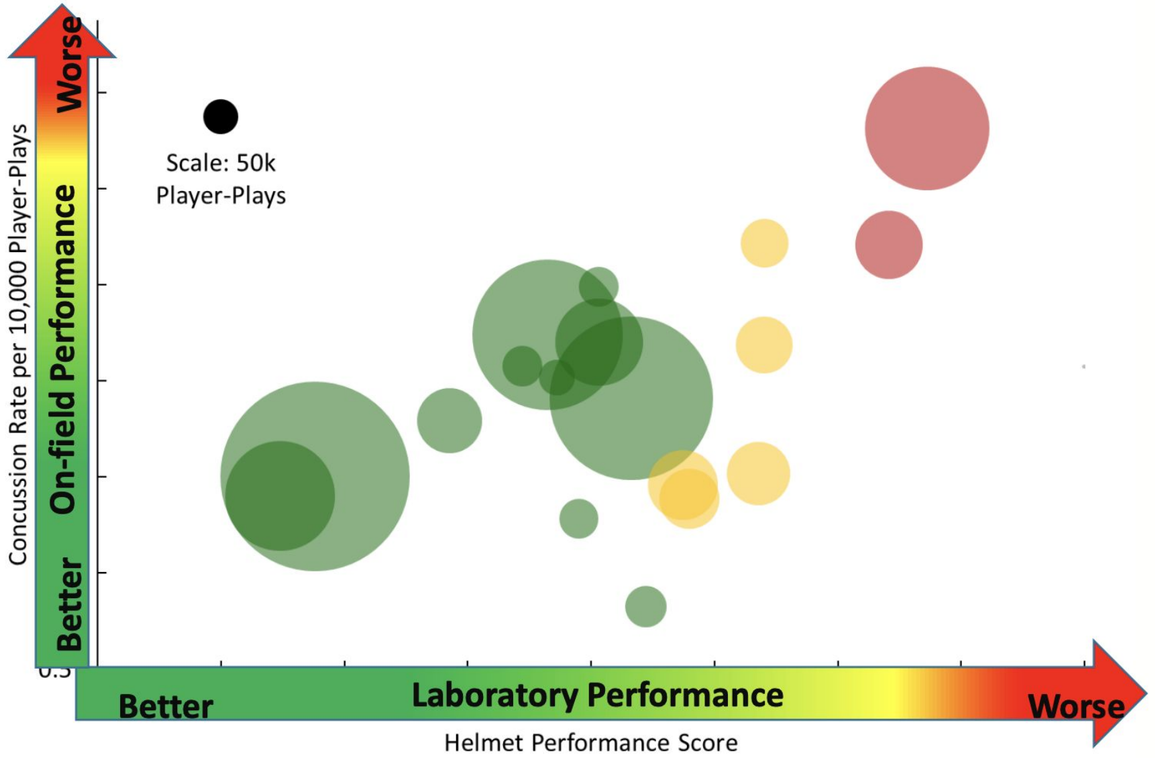
The laboratory test conditions were intended to represent potentially concussive head impacts in the NFL. The results of this study should not be extrapolated to collegiate, high school, or youth football.

POSITION-SPECIFIC HELMET TESTING

Top-performing helmets were evaluated using position-specific test methodologies for quarterbacks, and offensive and defensive linemen. Position-specific helmet rankings are available at this link.

NO HELMET SYSTEM CAN COMPLETELY PROTECT AGAINST SERIOUS BRAIN AND/OR NECK INJURIES A PLAYER MIGHT SUSTAIN WHILE PARTICIPATING IN FOOTBALL.

Helmet <u>lab</u> performance vs <u>on-field</u> performance



1 bubble = 1 helmet model
Bubble size = # of plays

HELMETS

Bicycling

Mixed evidence supporting reduced concussion risk

Snow Sports

Mixed evidence supporting reduced concussion risk

Hockey

Some evidence associating poor fit with concussion risk

HEADGEAR

“Soccer headgear did not reduce the incidence or severity of SRC in high school soccer players...” *

★ ★ ☆ ☆ ☆

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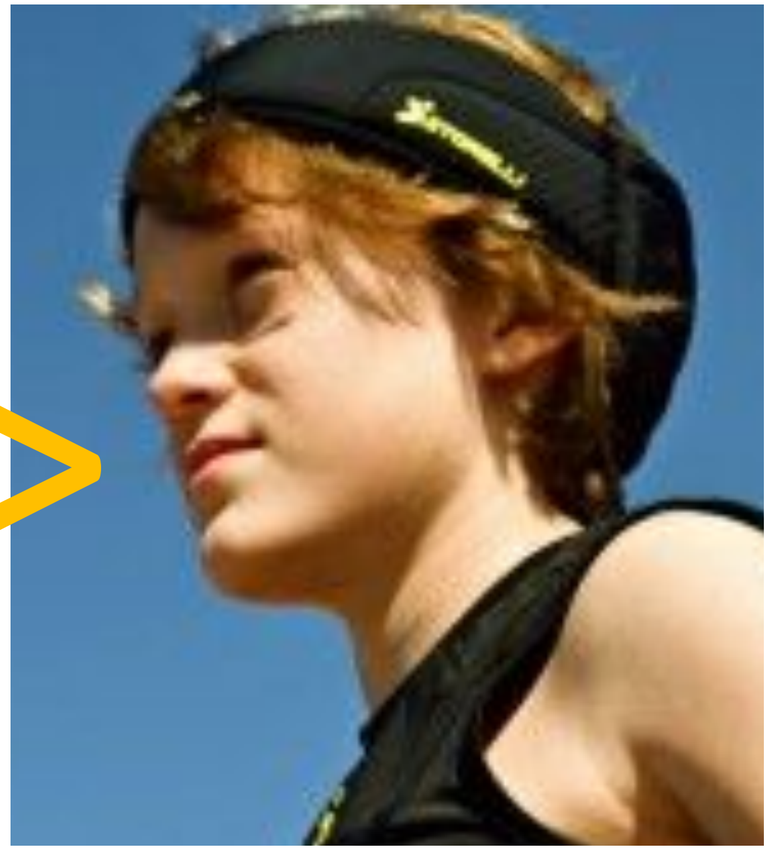

★ ★ ★ ★ ★

WOMEN'S LACROSSE HEADGEAR

Laboratory Performance Evaluation of Pristine and Used Headgear for Girls' Lacrosse

Patricia M. Kelshaw,[1] Trenton E. Gould,[2] Mark Jesunathadas,[2] Nelson Cortes,[1] Amanda Caswell,[1] Elizabeth D. Edwards,[2] and Shane V. Caswell[1]
[1]George Mason University; [2]The University of Southern Mississippi

Original Research

The Effects of Headgear in High School Girls' Lacrosse

Shane V. Caswell,*† PhD, LAT, ATC, Patricia M. Kelshaw,†‡ PhD, LAT, ATC, Andrew E. Lincoln,§‖ ScD, Daniel C. Herman,¶ MD, PhD, CAQSM, Lisa H. Hepburn,§ PhD, Heather K. Vincent,# PhD, Reginald E. Dunn, MS,§, and Nelson Cortes,† PhD

Brief Report

Pilot study to explore girls' lacrosse players' attitudes toward headgear

Patricia M. Kelshaw, Dana R. Eyerly, Daniel C. Herman, Heather K. Vincent, Lisa Hepburn, Andrew E. Lincoln & Shane V. Caswell ...show less

Received 04 Mar 2022, Accepted 14 Mar 2022, Published online: 11 Apr 2022

Research Article

Headgear safety attitudes: a national survey of collegiate women's lacrosse stakeholders

Patricia M. Kelshaw, Meredith E Kneavel, Thomas G. Bowman & Cat Rainone

Received 17 May 2022, Accepted 11 Aug 2022, Published online: 22 Aug 2022

Major Article

Headgear safety attitudes among women's lacrosse stakeholders: Qualitative results

Patricia M. Kelshaw, PhD, LAT, ATC, Thomas G. Bowman, PhD, ATC, Meredith E. Kneavel, PhD & Cat Rainone, MPH

Received 10 Nov 2021, Accepted 25 Sep 2022, Published online: 13 Oct 2022

Association of headgear mandate and concussion injury rates in girls' high school lacrosse

Daniel C Herman, [1] Shane V Caswell, [2,3] Patricia M Kelshaw,[3,4] Heather K Vincent,[5] Andrew E Lincoln[3,6]

NOCSAE®

AMSSM AMERICAN MEDICAL SOCIETY FOR SPORTS MEDICINE

USA LACROSSE

University of New Hampshire

UCDAVIS UNIVERSITY OF CALIFORNIA

GEORGE MASON UNIVERSITY

WOMEN'S LACROSSE HEADGEAR

Frequency of Head Impacts

Magnitude of Head Impacts

Rate of Concussion

From a National Study:

"Concussion rates among players wearing headgear were 59% lower than those not wearing headgear"

-Herman et al, BJSM, 2022

HURLING & CAMOGIE

- Helmets with faceguards are mandatory in camogie & hurling
- Helmets are required to meet the National Standards Authority of Ireland's (NSAI) IS:355 standard
- Reduced head/face traumatic injuries but does not prevent concussion

MOUTHGUARDS

Systematic review

Prevention strategies and modifiable risk factors for sport-related concussions and head impacts: a systematic review and meta-analysis

Paul H Eliason ,[1] Jean-Michel Galarneau,[1] Ash T Kolstad ,[1] M Patrick Pankow,[1] Stephen W West ,[2] Stuart Bailey,[3] Lauren Miutz,[4] Amanda Marie Black ,[1] Steven P Broglio ,[5] Gavin A Davis ,[6] Brent E Hagel ,[7] Jonathan D Smirl,[1] Keith A Stokes,[8] Michael Takagi,[6] Ross Tucker,[9] Nick Webborn ,[10] Roger Zemek ,[11] Alix Hayden,[12] Kathryn J Schneider ,[1] Carolyn A Emery [1,7]

8

Mouthguards do not prevent concussion

Mouthguards were associated with a 28% lower rate of concussion in ice hockey

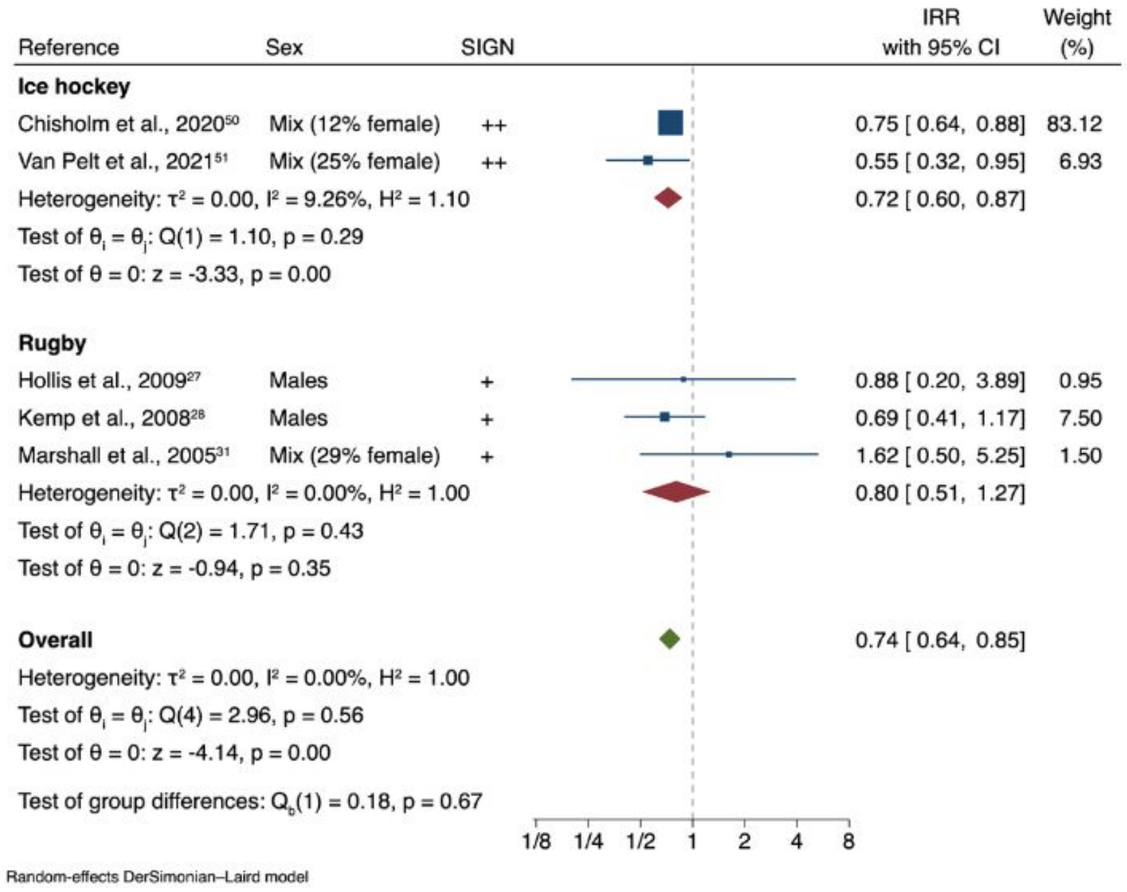

Figure 3 Forest plot based on meta-analysis evaluating mouthguard use

JUGULAR VEIN COMPRESSION DEVICES

Systematic review

Prevention strategies and modifiable risk factors for sport-related concussions and head impacts: a systematic review and meta-analysis

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- JVC Devices were **not associated** with reducing head impact frequencies, magnitudes, nor concussions
- Some studies suggest that there is an association with slight changes in brain imaging, the implications are not clear at this time

$199

JUGULAR VEIN COMPRESSION DEVICES

Current Evidence for the Use of Jugular Vein Compression Collars in Sport: A Systematic Review

Blake E. Delgadillo, BS;[1] Frederic Montz, BS;[2] Byron Ward, Jr., BS;[3] Andrew B. Herson, DO;[1,4] and James P. Toldi, DO[5]

Potential effect of the collar in ameliorating the changes against repetitive head impacts

Table 3.
Certainty of evidence for JVCC versus control using the Cochrane GRADE Method (39).

Certainty of Evidence for JVCC versus Control

People: High school athletics, study participants, and SWAT personal
Settings†: Longitudinal sports season and breacher training
Intervention†: JVCC
Comparison†: Control

Outcomes	Description of Outcome	Number of studies	Certainty of the evidence (GRADE)†	Comments
White matter alterations	The changes in white matter reported using measures of MD, AD, RD, and FA	7	⊕⊕◯◯ Low	The majority of study populations were adolescents, which is difficult to control for head impacts outside of the sports season
Head impact exposure	The exposures to the head impact between intervals	9	⊕⊕⊕◯ Moderate	Adolescents were the primary study population with overall insignificant difference between interventions
Blast exposure	The exposure to blasts experienced by both intervals	3	⊕⊕⊕◯ Moderate	Limited by small sample size and insignificant benefit/harm between interventions
Neurocognitive scores	Neurocognitive exam scores from participants	2	⊕⊕◯◯ Low	Limited by multiple per-protocol studies, lack of compliance by participants, small sample size, and population confined to adolescents
fMRI N-back working memory tasks	N-Back exam scores	3	⊕⊕◯◯ Low	Limited by small sample size, and one study did not have all participants complete the N-Back Working Memory Task
Concussion incidence rate	Diagnosed concussion between interventions	1	⊕◯◯◯ Very low	Incidence did not significantly change between JVCC/control groups Limited by lack of compliance among participants, multiple per-protocol studies, small sample size, and population confined to adolescents

†GRADE Working Group grades of evidence.
High = This research provides a very good indication of the likely effect. The likelihood that the effect will be substantially different‡ is low.
Moderate = This research provides a good indication of the likely effect. The likelihood that the effect will be substantially different‡ is moderate.
Low = This research provides some indication of the likely effect. However, the likelihood that it will be substantially different‡ is high.
Very low = This research does not provide a reliable indication of the likely effect. The likelihood that the effect will be substantially different‡ is very high.
‡Substantially different = a large enough difference that it might affect a decision.

EXTERNAL ADD-ON DEVICES

Journal of Athletic Training 2017;52(9):802–808
doi: 10.4085/1062-6050-52.6.01

www.natajournals.org

original research

The Ability of an Aftermarket Helmet Add-On Device to Reduce Impact-Force Accelerations During Drop Tests

Katherine M. Breedlove, PhD, ATC*†; Evan Breedlove, PhD†; Eric Nauman, PhD†; Thomas G. Bowman, PhD, ATC‡; Monica R. Lininger, PhD, ATC, LAT§

*University of Delaware, Newark; †Purdue University, West Lafayette, IN; ‡Lynchburg College, VA; §Northern Arizona University, Flagstaff

"The Guardian **Cap failed to significantly improve** the helmets' ability to mitigate impact forces at most locations"

Preliminary Examination of Guardian Cap Head Impact Data Using Instrumented Mouthguards

Kristen G Quigley,[1] Dustin Hopfe, MS, LAT, ATC,[1] Madison R Taylor,[1] Philip Pavilionis, MS, ATC,[1] Vincentia Owusu-Amankonah,[1] Arthur Islas, MD,[2] and Nicholas G Murray, PhD[1,*]

"These data suggest no difference in head kinematics data when [Guardian Caps] are worn…**[Guardian Caps] are not effective in reducing the magnitude of head impacts** experienced by NCAA Division I American football players"

Original research

The association between Guardian Cap use during practices and sport-related concussion risk in high school American football players

Erin Hammer , Sam Mosiman , Mikel R Joachim , Ethan Taylor , Adam Cordum , M Alison Brooks , Timothy McGuine

Correspondence to Dr Erin Hammer; ehammer@uwhealth.org

"[Guardian Cap] use during practice in high school American football players **was not associated with a decreased risk of sustaining SRC**…"

$70–130

Research Articles

Media Reports

Journal of Athletic Training 2017;52(9):802–808
doi: 10.4085/1062-6050-52.6.01

www.natajournals.org

original research

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"These data suggest no difference in head kinematics data when [Guardian Caps] are worn…**[Guardian Caps] are not effective in reducing the magnitude of head impacts** experienced by NCAA Division I American football players"

Guardian Cap tracker: Patriots' Jabrill

COLTS

5 Colts, including Jonathan Taylor, wear 'Guardian Caps' to protect against concussions

Indianapolis Star

Cyril football team makes Guard… mandatory for practi… concussion…

Guardian Caps make football safer. Will you … them in regular-season NFL games?

CNN Health Life, But Better Fitness Food Sleep Mindfulness Relationships Watch

The NFL embraced soft-shell helmet … protect players from …

BUSINESS > SPORTSMONEY

Wearing A Guardian Cap Could Have Prevented Tua Tagovailoa's Concussion, Research Suggests

By Vincent Frank, Contributor. I cover the San Francisco 49ers and broader N... Follow Author

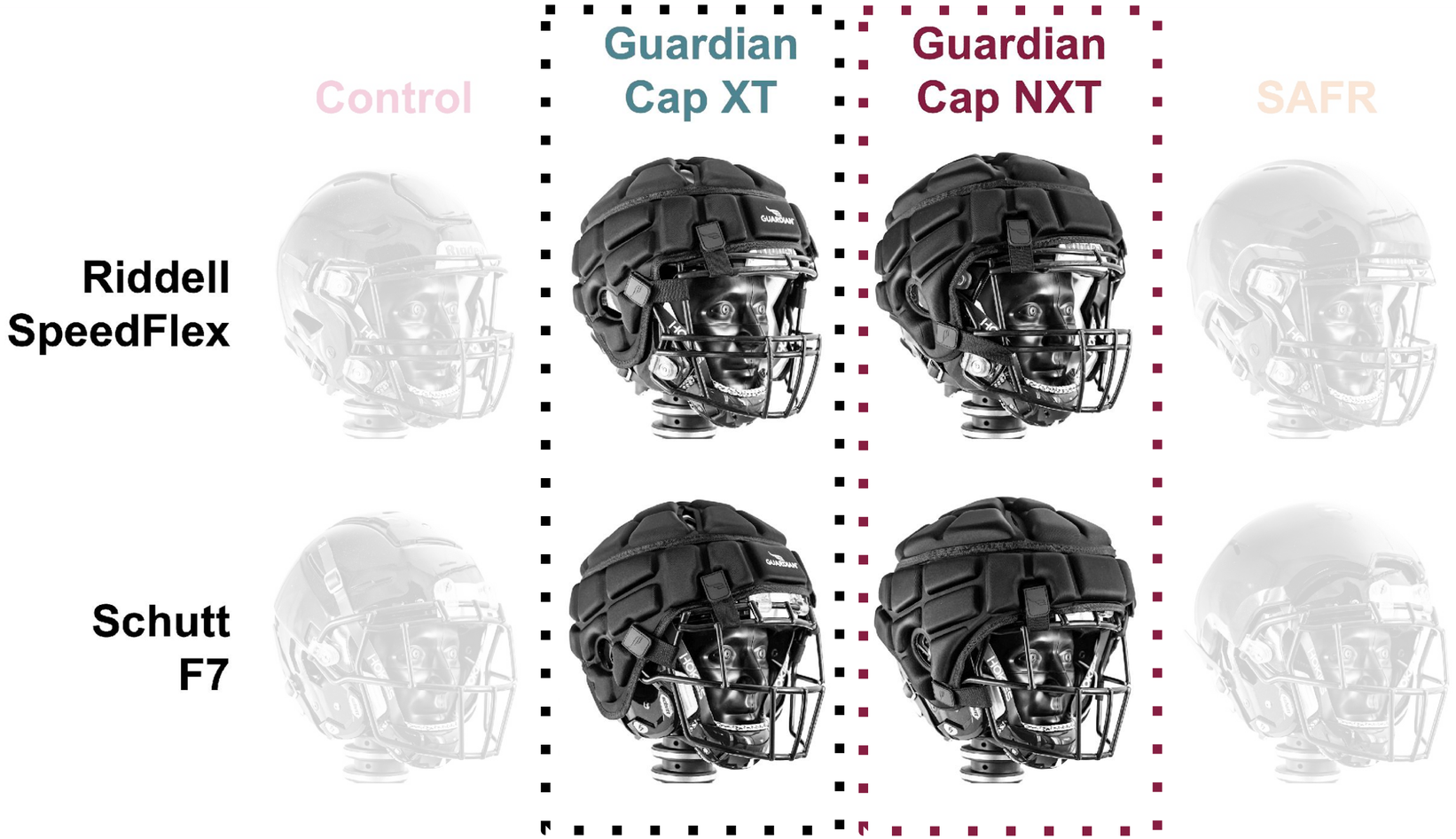
Sep 19, 2024, 04:31pm EDT

NOT ALL DEVICES ARE EQUAL

	Control	Guardian Cap XT	Guardian Cap NXT	SAFR
Riddell SpeedFlex				
Schutt F7				

Scan here
for references:

NOT ALL DEVICES ARE EQUAL



Worn at NCAA Level

Worn at NFL Level

CONTEXT MATTERS

NFL Level

Guardian Cap NXT

+ Neuromuscular Training + No/minimal contact practices + Access to Trained & Licensed HCP

Promote Safety in NFL

HEADGEAR & ADD-ON DEVICES

Journal of Athletic Training 2022;57(2):113–124
doi: 10.4085/1062-6050-0062.21

www.natajournals.org

National Athletic Trainers' Association Position Statement: Reducing Intentional Head-First Contact Behavior in American Football Players

**Erik E. Swartz, PhD, ATC*;
Johna K. Register-Mihalik, PhD, LAT, ATC†;
Steven P. Broglio, PhD, ATC‡;
Jason P. Mihalik, PhD, ATC†;
Jay L. Myers, PhD*;
Kevin M. Guskiewicz, PhD, ATC†;
Julian Bailes, MD§; Merril Hoge, BA||**

*Department of Physical Therapy and Kinesiology, University of Massachusetts, Lowell; †Matthew Gfeller Center, Department of Exercise and Sport Science, University of North Carolina, Chapel Hill; ‡Michigan Concussion Center, University of Michigan, Ann Arbor; §NorthShore University HealthSystem, Evanston, IL; ||Find A Way, Fort Thomas, KY

Recommendation 11:

"Recognize that helmet and after-market companies that produce helmet add-on products may overstate injury-prevention benefits, leading to risk-taking behavior."

RISK COMPENSATION RESEARCH

Soccer

- May engage in riskier aerials to head ball
- No research supports riskier behavior
- Research on risk taking behavior is limited

Skiing & Snowboarding

- Use increasing
- Females and younger athletes
- No evidence of risk compensation

Cycling

- Most research suggests helmet use is associated with safer behavior

Rugby

- May engage in riskier tackles
- Findings inconsistent

Ice Hockey

- Full face protection may increase risk taking behavior
- Willing to stand in front of puck
- Concern for field of vision

Equestrian

- No or very limited risk compensation

BEYOND DEVICES – RULE CHANGES!

Reducing Concussion Risk

Disallowing bodychecking in child and adolescent hockey

58 %

Limiting contact practice

64 %

Banning heading in youth

TBD

Neuromuscular training warmup programs

32-60 %

Rules limiting collisions between base runners and catchers at home plate

69 %

TRAINING INTERVENTIONS

Heads Up Football Training Decreases Concussion Rates in High School Football Players

Ellen Shanley, PT, PhD, OCS,*† Charles Thigpen, PhD, PT, ATC,*† Michael Kissenberth, MD,†‡ Robert Gil Gilliland, ATC,‡ John Thorpe, ATC,‡ Darryl Nance, CMAA, CIC,§ Johna K. Register-Mihalik, PhD, ATC,¶ and John Tokish, MD†‡

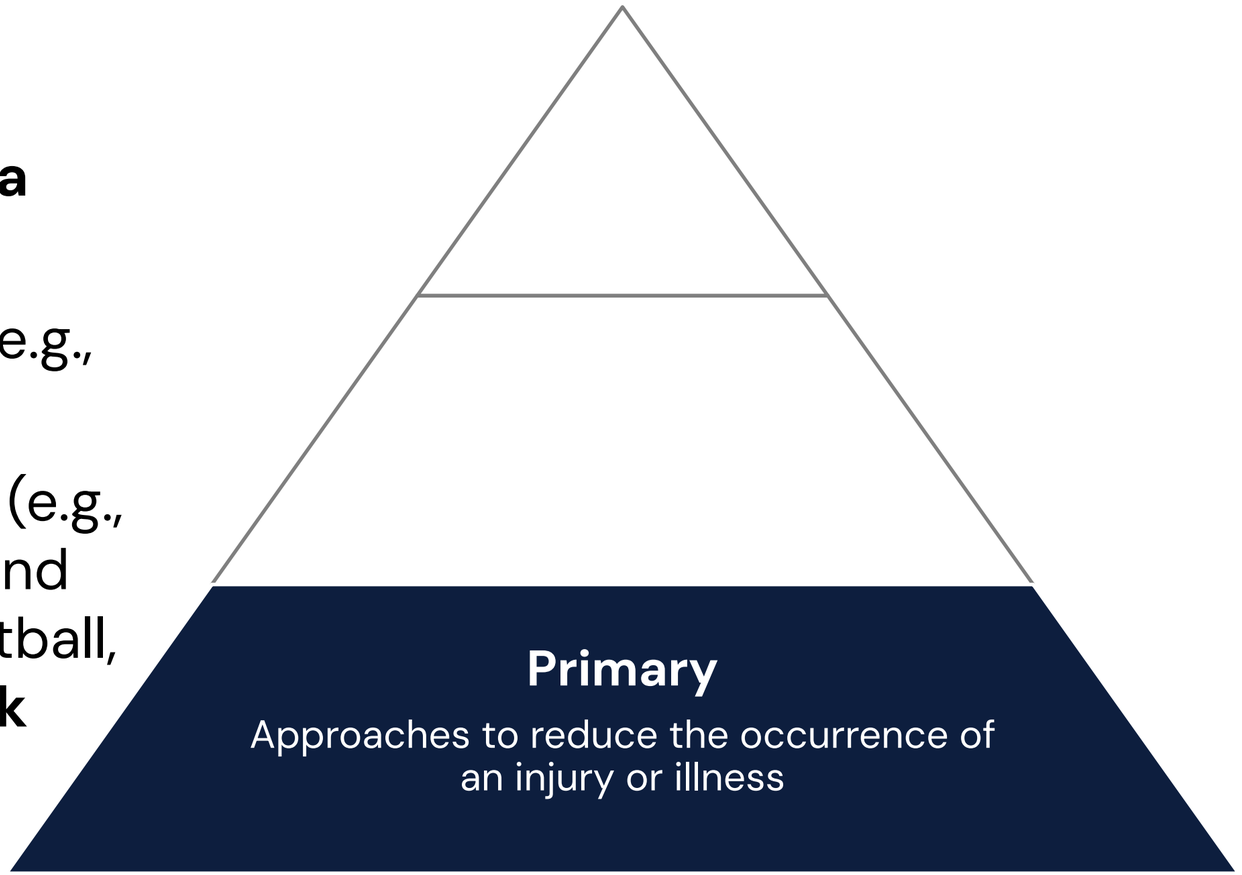
14 HU Intervention Schools (n = 1818)	10 Control Schools (n = 696)
4.1 concussions per 100 players	6.0 concussions per 100 players

CLINICAL IMPLICATIONS: The Heads Up Football training program reduced concussion rates by 33% across 1 season. This supports the Heads Up Football training program as an effective intervention for decreasing concussion rates in high school football.

PRIMARY PREVENTION OF CONCUSSION

In Summary

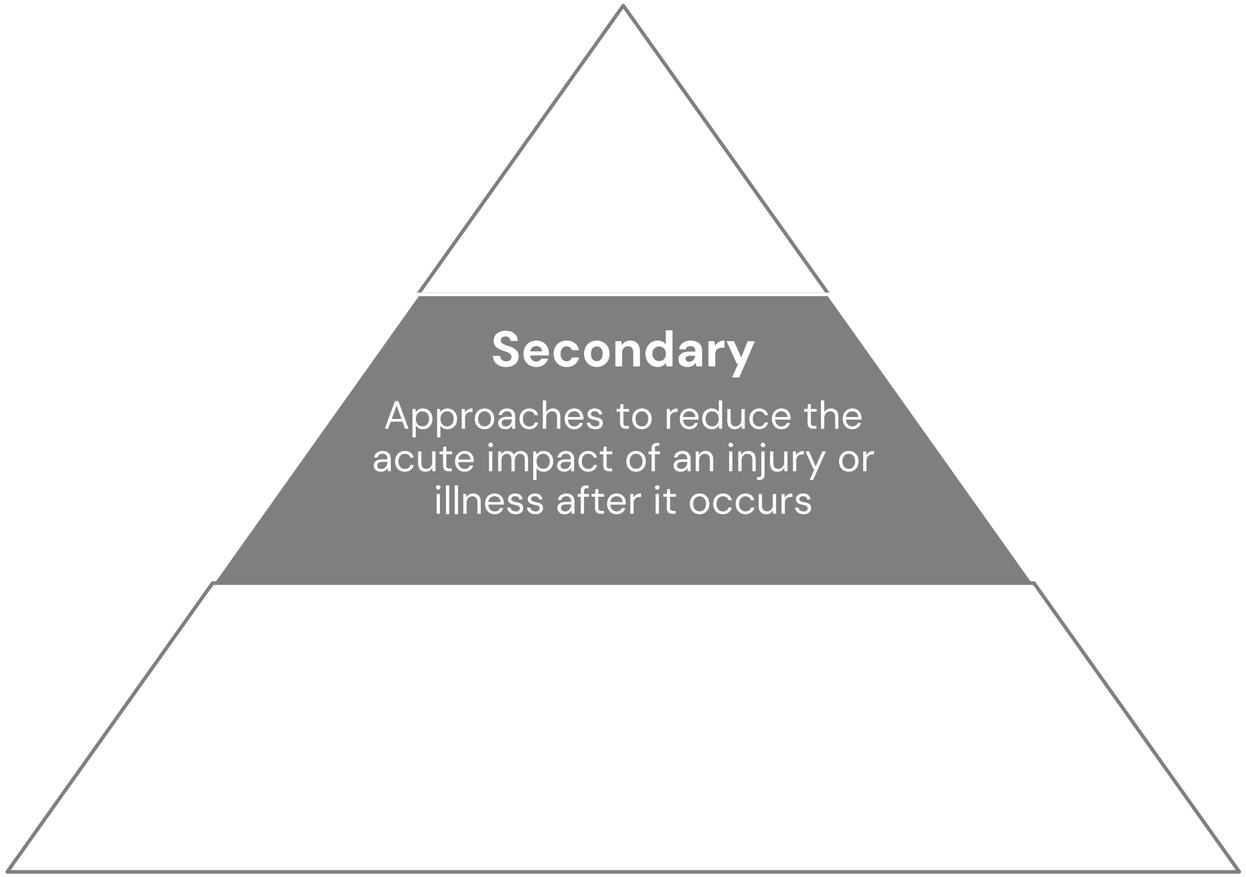
- **No external device can prevent a concussion**
- Some sport-specific equipment (e.g., headgear in women's lacrosse)
- Training protocols & rule changes (e.g., neuromuscular training in rugby, and reducing contact practices in football, etc.) **may reduce concussion risk**



SECONDARY PREVENTION OF CONCUSSION

Secondary Prevention Goal:
Identify, remove from participation, evaluate, and initiate care as quickly as possible following concussion occurrence

- Laws & Policies
- Education Interventions

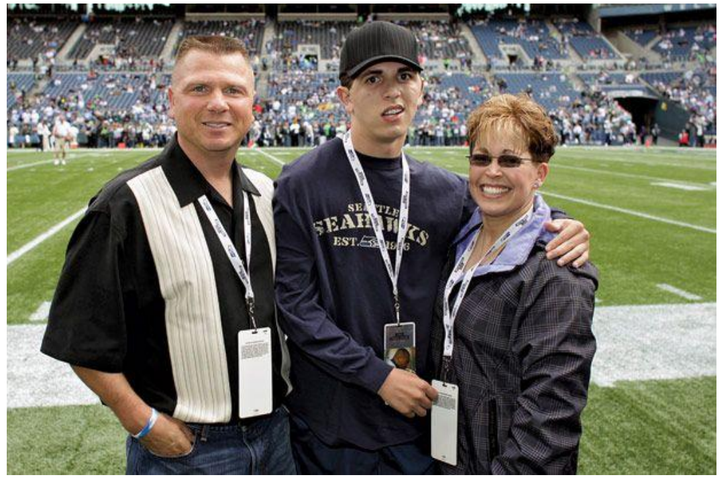


Scan here for references:

CONCUSSION STATE LAWS

PRIMARY TENETS:

1. Education for sport stakeholders (e.g., parents, athletes, coaches)
2. Immediate removal from play if a concussion is suspected
3. Medical clearance required for return-to-play



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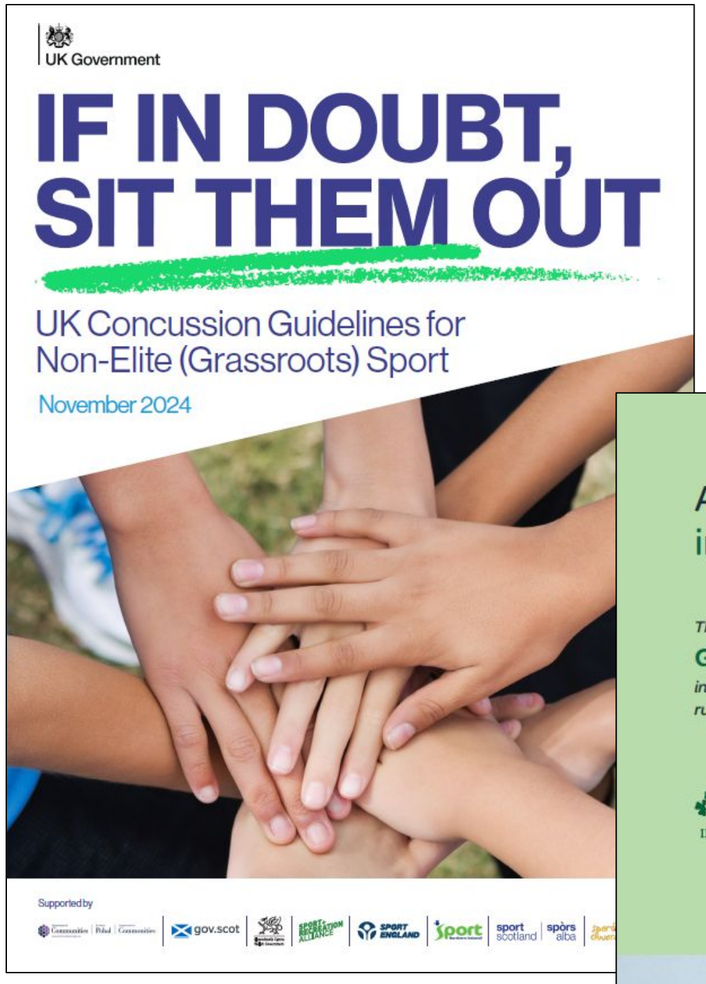
TRAUMATIC BRAIN INJURY IN YOUTH SPORTS
Fact Sheet

Summary Matrix of State Laws Addressing Concussions in Youth Sports

According to the CDC, an estimated 248,418 children aged 19 or younger were treated in U.S. emergency departments for sports and recreation related injuries that included a diagnosis of concussion or traumatic brain injury. Science is increasingly beginning to realize the severe impacts of brain injuries especially to children and teenagers even if they are not immediately felt or noticed. Public health law is working to reduce the risks of head injuries to young and professional athletes through federal, local and state laws.

This table contains information on state concussion laws, including which states require return-to-play protocols for student athletes, which type of provider can issue a return-to-play clearance, and whether or not the law applies to recreational sports.

Laws as of December 31, 2018


UK Government
IF IN DOUBT, SIT THEM OUT
UK Concussion Guidelines for Non-Elite (Grassroots) Sport
November 2024
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gov.scot
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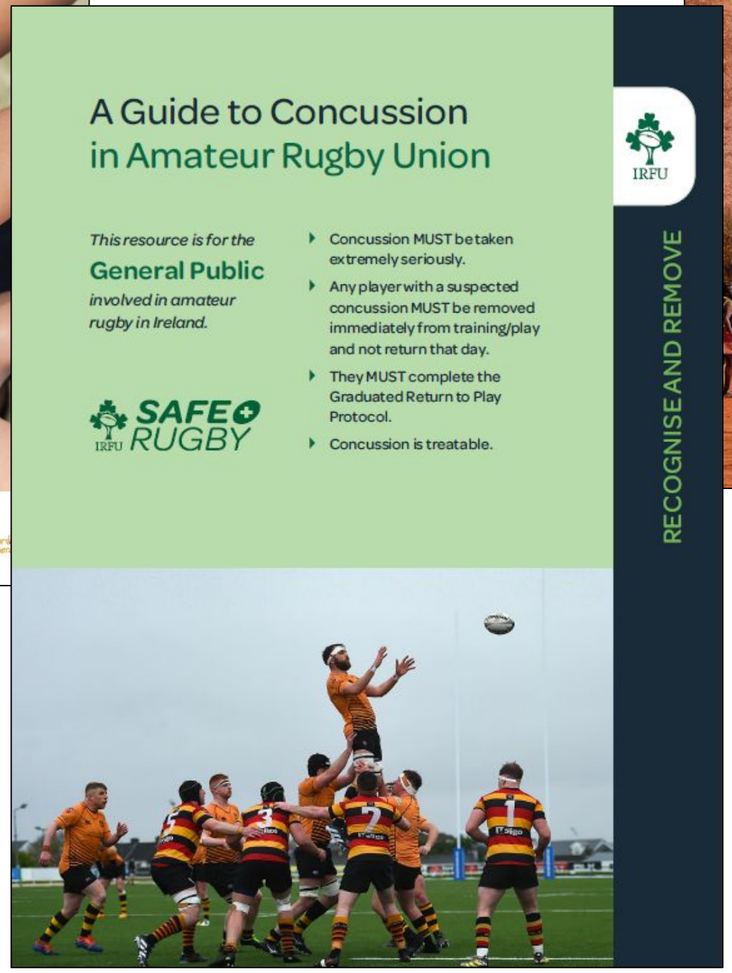
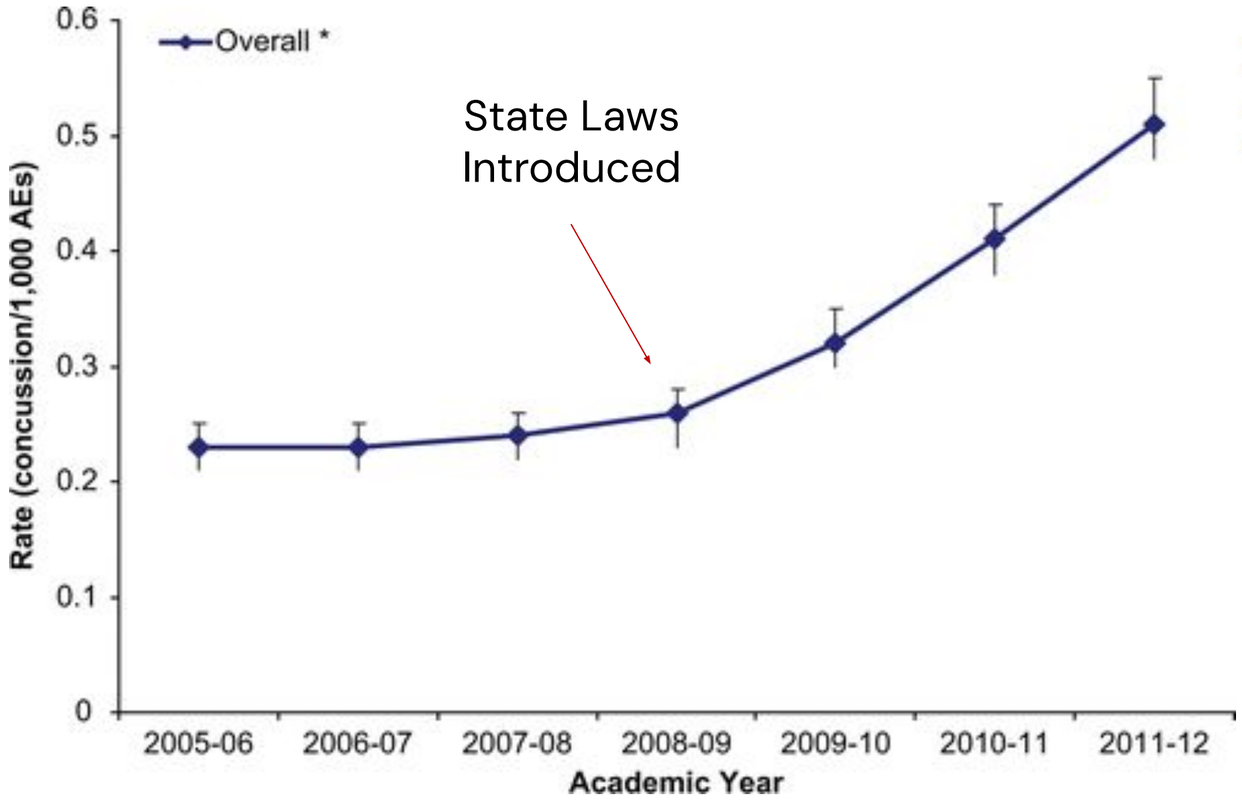

A Guide to Concussion in Amateur Rugby Union
This resource is for the
General Public
involved in amateur rugby in Ireland.
IRFU SAFE RUGBY
Concussion MUST be taken extremely seriously.
Any player with a suspected concussion MUST be removed immediately from training/play and not return that day.
They MUST complete the Graduated Return to Play Protocol.
Concussion is treatable.
IRFU
RECOGNISE AND REMOVE


Strategic Plan for Sport-Related Concussion in Australian Football
2022-2026
AFL


FIFA
CONCUSSION
SUSPECT AND PROTECT
FIFA CONCUSSION CAMPAIGN TOOLKIT
FIFA MEMBER ASSOCIATIONS

CONCUSSION STATE LAWS



National High School Athlete Concussion Rates From 2005-2006 to 2011-2012

Joseph A. Rosenthal,*† MD, Randi E. Foraker,‡ PhD,
Christy L. Collins,§ MA, and R. Dawn Comstock,‖ PhD
Investigation performed at the Center for Injury Research and Policy, Research Institute, Nationwide Children's Hospital, Columbus, Ohio, USA

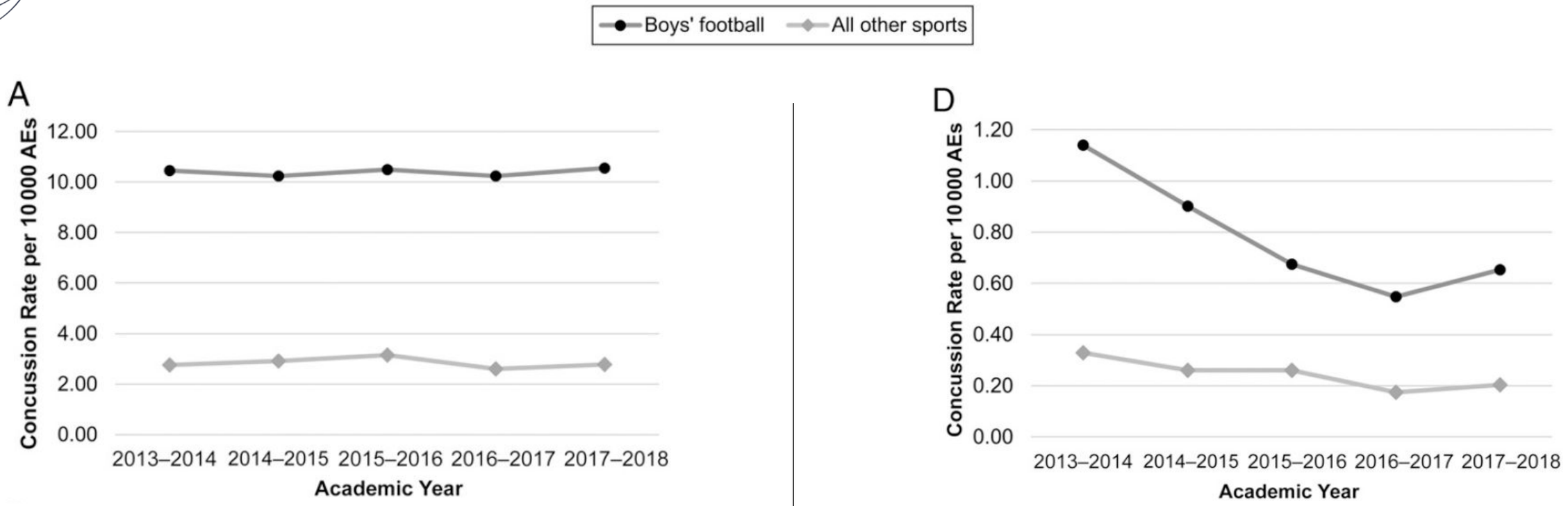
Concussion State Laws

=

↑ Awareness
↑ Identification
↑ Diagnosis

Concussion Incidence and Trends in 20 High School Sports

Zachary Y. Kerr, PhD, MPH,[b,c] Avinash Chandran, PhD, MS,[b,c] Aliza K. Nedimyer, MA, ATC,[a,c] Alan Arakkal, BS,[d] Lauren A. Pierpoint, PhD, MS,[e] Scott L. Zuckerman, MD, MPH[f]

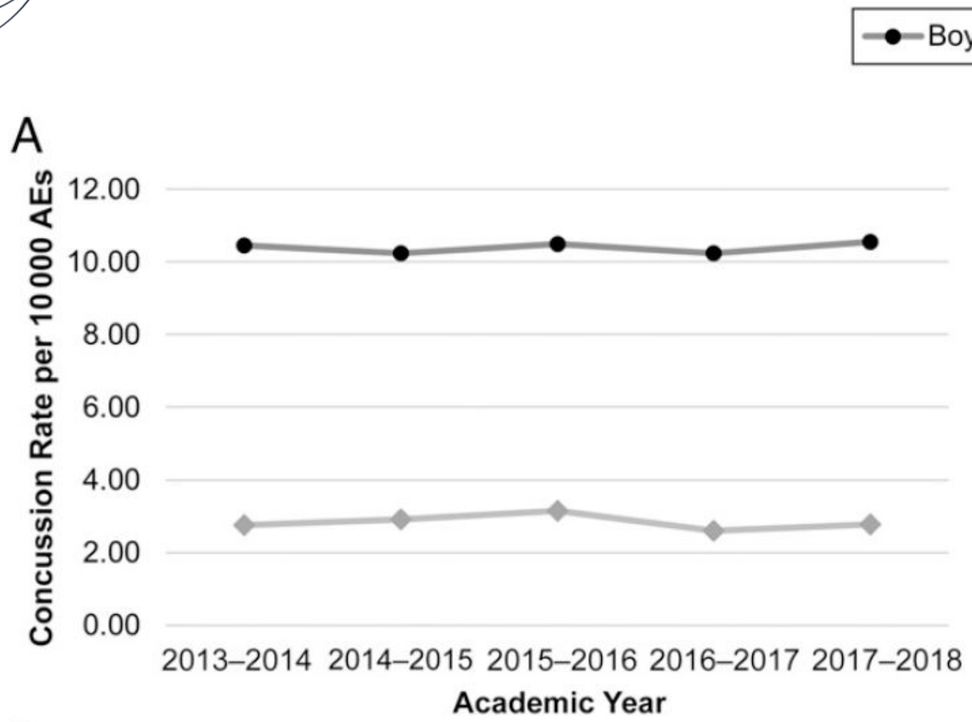


Concussion rates in the current study were generally higher than previous estimates from similar studies of different time periods.

Recurrent concussions across all sports decreased over the study period.

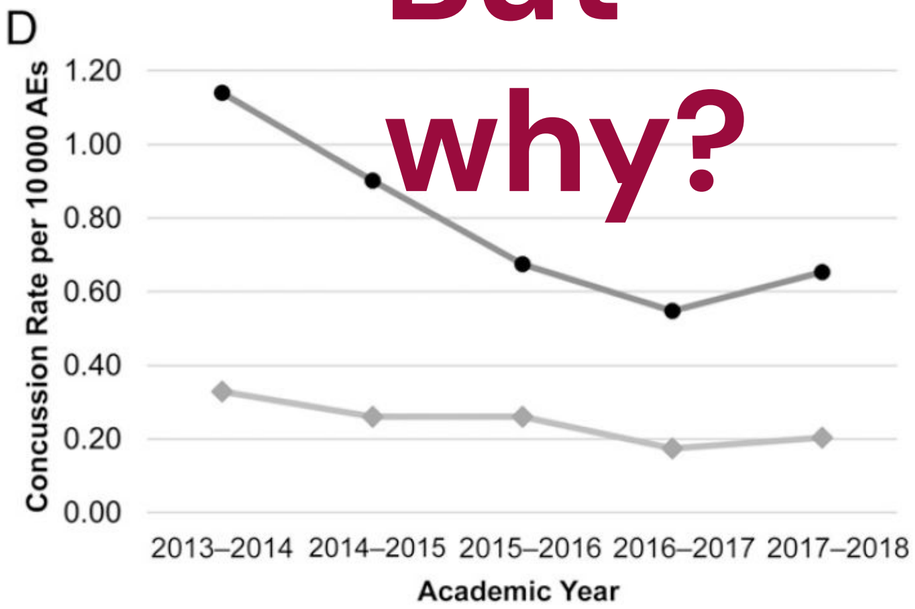
Concussion Incidence and Trends in 20 High School Sports

Zachary Y. Kerr, PhD, MPH,[b,c] Avinash Chandran, PhD, MS,[b,c] Aliza K. Nedimyer, MA, ATC,[a,c] Alan Arakkal, BS,[d] Lauren A. Pierpoint, PhD, MS,[e] Scott L. Zuckerman, MD, MPH[f]



Concussion rates in the current study were generally higher than previous estimates from similar studies of different time periods.

But why?



Recurrent concussions across all sports decreased over the study period.

ATHETIC TRAINER ACCESS

Consensus statement

Consensus statement on concussion in sport: the 6th International Conference on Concussion in Sport–Amsterdam, October 2022

Jon S Patricios ,[1] Kathryn J Schneider ,[2] Jiri Dvorak ,[3] Osman Hassan Ahmed ,[4,5] Cheri Blauwet ,[6,7] Robert C Cantu,[8,9] Gavin A Davis ,[10,11] Ruben J Echemendia ,[12,13] Michael Makdissi,[14,15] Michael McNamee,[16,17] Steven Broglio ,[18] Carolyn A Emery ,[2] Nina Feddermann-Demont,[19,20] Gordon Ward Fuller ,[21] Christopher C Giza,[22,23] Kevin M Guskiewicz,[24] Brian Hainline ,[25] Grant L Iverson ,[26,27] Jeffrey S Kutcher,[28] John J Leddy ,[29] David Maddocks,[30] Geoff Manley ,[31] Michael McCrea ,[32] Laura K Purcell,[33] Margot Putukian ,[34] Haruhiko Sato ,[35] Markku P Tuominen,[36] Michael Turner ,[37,38] Keith Owen Yeates ,[39] Stanley A Herring,[40,41] Willem Meeuwisse[42]

For numbered affiliations see end of article.

Correspondence to
Dr Kathryn J Schneider, Sport Injury Prevention Research Centre, Faculty of Kinesiology, University of Calgary, Calgary, AB T2N 1N4, Canada; kjschneider@ucalgary.ca

JSP and KJS are joint first authors.

Accepted 2 June 2023

ABSTRACT

For over two decades, the Concussion in Sport Group has held meetings and developed five international statements on concussion in sport. This 6th statement summarises the processes and outcomes of the 6th International Conference on Concussion in Sport held in Amsterdam on 27–30 October 2022 and should be read in conjunction with the (1) methodology paper that outlines the consensus process in detail and (2) 10 systematic reviews that informed the conference outcomes. Over 3½ years, author groups conducted systematic reviews of predetermined priority topics relevant to concussion in sport. The format of the conference, expert panel meetings and workshops to revise or develop new clinical assessment tools, as described in the methodology paper, evolved from previous consensus meetings with several new components. Apart from this consensus statement, the conference process yielded revised tools including the Concussion Recognition Tool-6 (CRT6) and Sport Concussion Assessment Tool-6 (SCAT6, Child SCAT6), as well as a new tool, the Sport Concussion Office Assessment Tool-6 (SCOAT6, Child SCOAT6). This consensus process also integrated new features including a focus on the para athlete, the athlete's perspective, concussion-specific medical ethics and matters related to both athlete retirement and the potential long-term effects of SRC, including neurodegenerative disease. This statement summarises evidence-informed principles of concussion prevention, assessment and management, and emphasises those areas requiring more research.

Check for updates

INTRODUCTION

This Amsterdam 2022 International Consensus Statement on Concussion in Sport (Statement) builds on previous Concussion in Sport Group (CISG) statements with the goal of updating current for sport-related concussion informed consensus

methodology. The purpose of this Statement is to provide a summary of the evidence and practice recommendations based on science and expert panel consensus recommendations at the time of the conference. Additional outputs of the consensus process include freely available evidence-informed tools to assist in the detection and assessment of SRC, including the Concussion Recognition Tool-6 (CRT6), Sport Concussion Assessment Tool-6 (SCAT6), Child SCAT6, Sport Concussion Office Assessment Tool-6 (SCOAT6) and Child SCOAT6. Apart from this Statement, in the interest of knowledge translation, the tools are free to distribute in their original formats.

This Statement is developed for the healthcare professional (HCP) involved in the care of athletes at risk of SRC or who have sustained a suspected SRC at any level of sport (ie, recreational to professional). The authors recognise that differences in geography, healthcare structure and culture are important considerations when implementing the principles presented. Thus, this Statement provides recommendations that can be adapted for different sport, clinical and cultural environments and is not meant to be used as a prescriptive guideline. We also recognise that the science of concussion continues to evolve, and the Amsterdam Statement reflects the state of the evidence at the time of the Consensus Conference and will need to be updated as new scientific information emerges. Also included are recommendations for future research where notable gaps in the literature have been identified. Although this Statement provides recommendations and is a summary of the consensus process, it should be read in combination with the 10 systematic reviews and methodology papers that informed the consensus process and outcomes.

MEDICOLEGAL CONSIDERATIONS

This Statement is not intended as a clinical practice directive or legal standard of care and should not

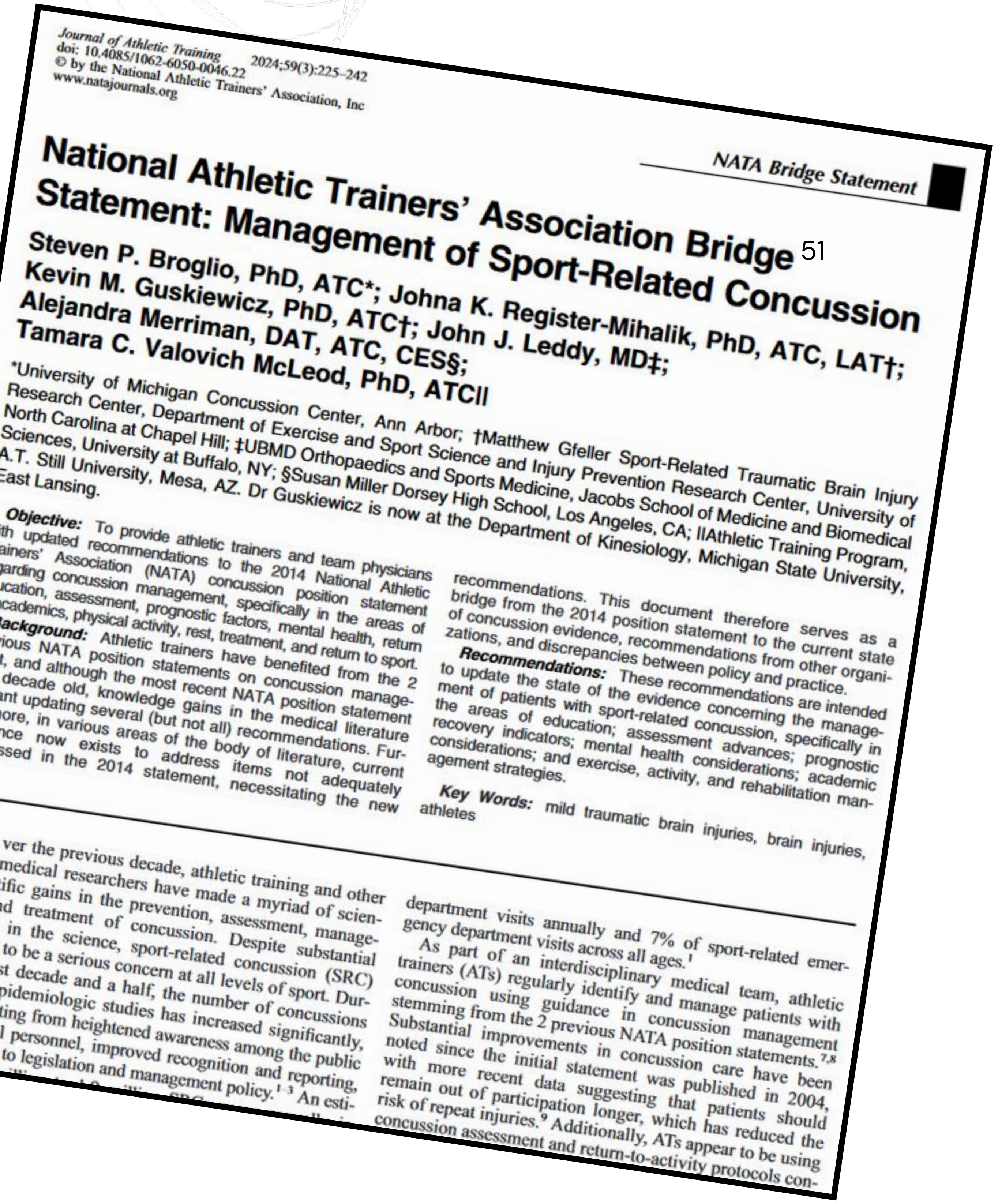
bjsports-2023-106898

Concussion management

Optimal concussion management strategies including implementing laws and protocols (eg, mandatory removal from play following actual or suspected concussion; requirements to receive clearance to return-to-play from an HCP; and education of coaches, parents and athletes regarding concussion signs and symptoms) are associated with a reduction in recurrent concussion rates.[12]

REDUCE: PREVENTION OF CONCUSSION (Pg. 699)

CONCUSSION EDUCATION


Journal of Athletic Training 2024;59(3):225–242
doi: 10.4085/1062-6050-0046.22
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www.natajournals.org

NATA Bridge Statement

National Athletic Trainers' Association Bridge Statement: Management of Sport-Related Concussion 51

Steven P. Broglio, PhD, ATC*; Johna K. Register-Mihalik, PhD, ATC, LAT†; Kevin M. Guskiewicz, PhD, ATC†; John J. Leddy, MD‡; Alejandra Merriman, DAT, ATC, CES§; Tamara C. Valovich McLeod, PhD, ATC||

*University of Michigan Concussion Center, Ann Arbor; †Matthew Gfeller Sport-Related Traumatic Brain Injury Research Center, Department of Exercise and Sport Science and Injury Prevention Research Center, University of North Carolina at Chapel Hill; ‡UBMD Orthopaedics and Sports Medicine, Jacobs School of Medicine and Biomedical Sciences, University at Buffalo, NY; §Susan Miller Dorsey High School, Los Angeles, CA; ||Athletic Training Program, A.T. Still University, Mesa, AZ. Dr Guskiewicz is now at the Department of Kinesiology, Michigan State University, East Lansing.

Objective: To provide athletic trainers and team physicians with updated recommendations to the 2014 National Athletic Trainers' Association (NATA) concussion position statement regarding concussion management, specifically in the areas of education, assessment, prognostic factors, mental health, return to academics, physical activity, rest, treatment, and return to sport.

Background: Athletic trainers have benefited from the 2 previous NATA position statements on concussion management, and although the most recent NATA position statement is a decade old, knowledge gains in the medical literature warrant updating several (but not all) recommendations. Furthermore, in various areas of the body of literature, current evidence now exists to address items not adequately addressed in the 2014 statement, necessitating the new recommendations. This document therefore serves as a bridge from the 2014 position statement to the current state of concussion evidence, recommendations from other organizations, and discrepancies between policy and practice.

Recommendations: These recommendations are intended to update the state of the evidence concerning the management of patients with sport-related concussion, specifically in the areas of education; assessment advances; prognostic recovery indicators; mental health considerations; academic considerations; and exercise, activity, and rehabilitation management strategies.

Key Words: mild traumatic brain injuries, brain injuries, athletes

Over the previous decade, athletic training and other medical researchers have made a myriad of scientific gains in the prevention, assessment, management, and treatment of concussion. Despite substantial gains in the science, sport-related concussion (SRC) continues to be a serious concern at all levels of sport. During the past decade and a half, the number of concussions in epidemiologic studies has increased significantly, resulting from heightened awareness among the public and personnel, improved recognition and reporting, to legislation and management policy.[1–3] An esti-

department visits annually and 7% of sport-related emergency department visits across all ages.[1]

As part of an interdisciplinary medical team, athletic trainers (ATs) regularly identify and manage patients with concussion using guidance in concussion management stemming from the 2 previous NATA position statements.[7,8] Substantial improvements in concussion care have been noted since the initial statement was published in 2004, with more recent data suggesting that patients should remain out of participation longer, which has reduced the risk of repeat injuries.[9] Additionally, ATs appear to be using concussion assessment and return-to-activity protocols con-

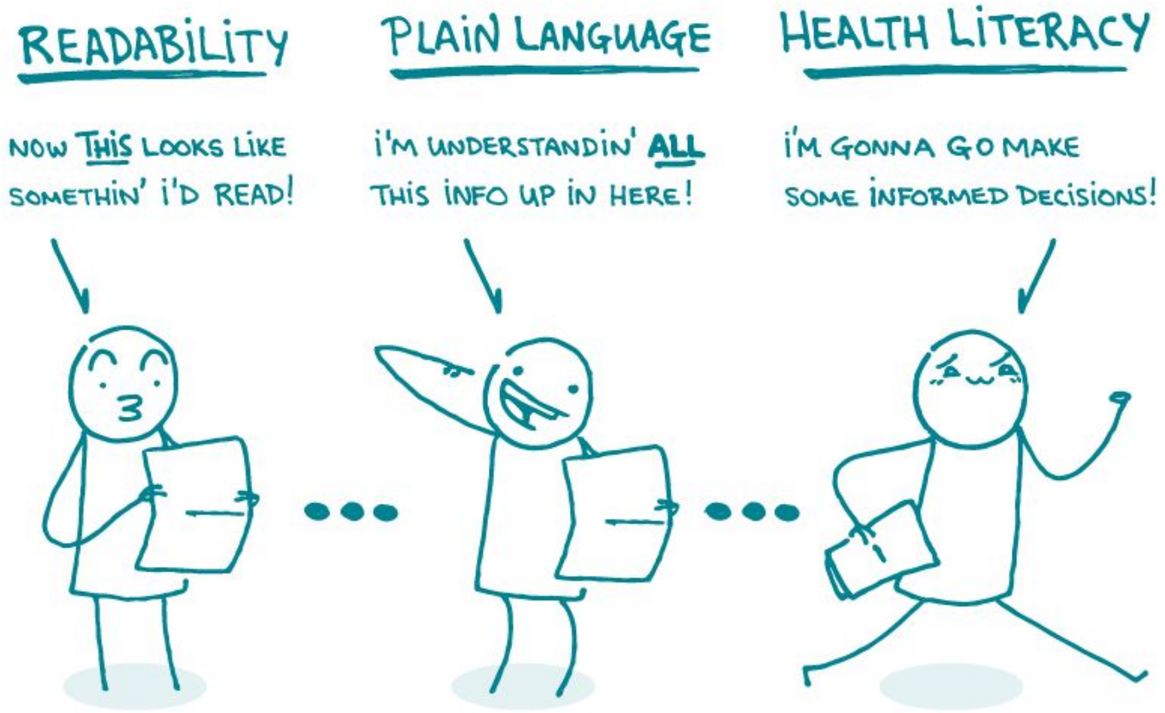
Table 1. Recommendations for Education and Prevention

2014 Statement	2024 Bridge Statement
1. The AT should use, and educate others in using, the proper terminology of concussion and mild traumatic brain injury as opposed to such colloquial terms as "ding" and "bell ringer." SOR: B	NA
~~2. The AT should work with the appropriate administrators to ensure that parents and coaches are educated on the following aspects of concussion: prevention, mechanism, recognition and referral, appropriate return to participation, physical and cognitive restrictions for concussed athletes, and ramifications of improper concussion management.[10–12] SOR: B~~	Update to 2014 Recommendation 2: The AT should collaborate with administrators to ensure all relevant stakeholders, including but not limited to athletes, parents and coaches, school administrators, student resources personnel, and organizational management teams, are educated on the following aspects of concussion: prevention, mechanism, recognition and referral, appropriate return to participation, physical and cognitive restrictions for patients with concussion, including driving postconcussion when relevant, and the ramifications of improper concussion management.[8,20,32–37] SOR: B
3. The AT should be aware of and document potential modifying factors that could delay the return to play, and patients should be educated on the implications of these conditions as they affect recovery. SOR: C	NA
4. The AT should work to educate coaches, athletes, and parents about the limitations of protective equipment for concussion prevention. SOR: C	NA
5. As part of educational efforts, ATs, athletes, coaches, and parents should read all warning labels associated with protective equipment. SOR: C	NA
	New: All ATs and other licensed medical professionals should collaborate with administrators to ensure all relevant stakeholders are specifically educated on the qualifications licensed medical professionals, including ATs and physicians, possess concerning concussion prevention and management. In accordance with laws, practice acts, and the relevant organizational guidelines, these medical professionals should have unchallengeable medical authority in decision-making concerning patients with concussion.[38,39] SOR: C

Abbreviations: AT, athletic trainer; NA, not applicable; SOR, strength of recommendation.[31]

Scan here for references:

HEALTHY LITERACY



The degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions.

What are the potential negative byproducts of athletes having low health literacy related to concussion?

What are the potential negative byproducts of athletes having low health literacy related to concussion?

LACK OF QUICK
INJURY IDENTIFICATION
&
DELAYED CARE INITIATION

Journal of Athletic Training 2021;56(1):77–84
doi: 10.4085/1062-6050-0575.19

www.natajournals.org

Collegiate Athletes' Concussion Awareness, Understanding, and -Reporting Behaviors in Different Countries With Varying Concussion Publicity

Erica Beidler, PhD, LAT, ATC*; Jessica Wallace, PhD, LAT, ATC†; Alia A. Alghwiri, PT, MSc, PhD‡; Siobhan O'Connor, MSc, PhD, CAT§

Previous Concussion Education: 75.8%
Average Knowledge Score: 32.1 ± 3.5
Diagnosed Concussion History: 29.6%

Previous Concussion Education: 26.4%
Average Knowledge Score: 35.1 ± 5.6
Diagnosed Concussion History: 2.3%

Previous Concussion Education: 90.6%
Average Knowledge Score: 40.9 ± 4.5
Diagnosed Concussion History: 31.8%

Journal of Athletic Training 2024;59(8):793–800
doi: 10.4085/1062-6050-0382.23

www.natajournals.org

History, Knowledge, and Education of Sport-Related Concussion Among College Athletes in Japan

Chihiro Tashima, MS*; Mana Otomo, PhD†; Yuri Hosokawa, PhD, ATC‡

*Graduate School of Sport Sciences, Waseda University, Saitama, Japan; †Toin University of Yokohama, Kanagawa, Japan; ‡Faculty of Sport Sciences, Waseda University, Saitama, Japan

Previous Concussion Education: 45.2%
Average Knowledge Score: 33.4 ± 6.1
Diagnosed Concussion History: 19.1%

BRAIN INJURY
https://doi.org/10.1080/02699052.2024.2309265

Taylor & Francis
Taylor & Francis Group

Lost in translation: the association of international status and native language on concussion in collegiate athletes in the United States

Patricia M. Kelshaw[a], E. Beidler[b], M. Decker[c], T. G. Bowman[d], M. R. Pappadis[e], R. Robles[f], S. R. Walton[f], N. Didehbani[g], D. X. Cifu[f], and J. E. Resch[h]

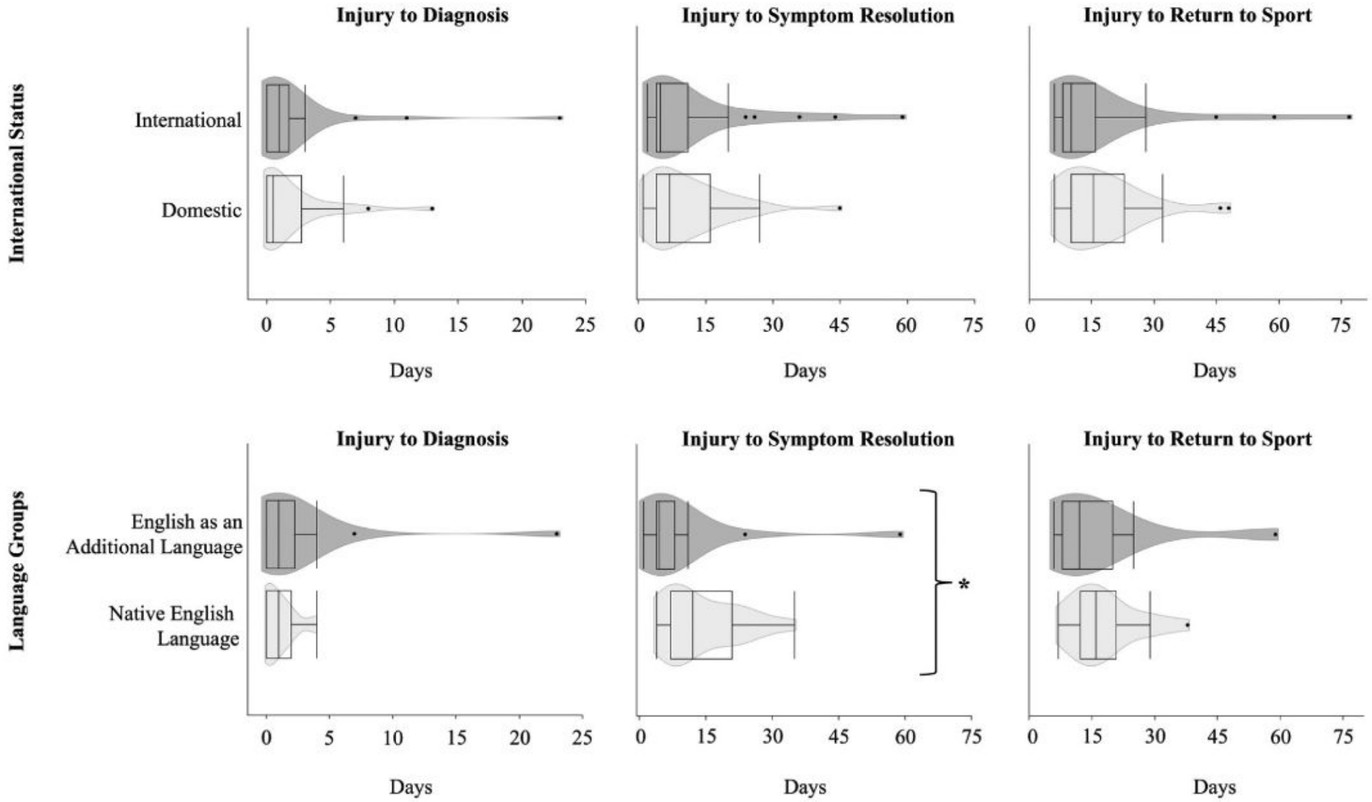


Figure 1. International status and language group comparisons on clinical milestones of diagnosis and recovery following concussion. Notation (*) indicates statistical significance between the respective groups at $p < 0.05$.

POST-INJURY CONSIDERATIONS

English as an Additional Language (EAL) speakers experienced symptom resolution approximately 7.5 days sooner (Md = 4.50) than Native English language speakers (Md = 12.00).

CONCUSSION EDUCATION

International Journal of Athletic Therapy and Training, (Ahead of Print)
https://doi.org/10.1123/ijatt.2024-0082

First Published Online: June 18, 2025

Human Kinetics
CRITICALLY APPRAISED TOPIC

Effectiveness of Concussion-Education Strategies Implemented With High School Athletes: A Critically Appraised Topic

Taia MacEachern, MSc,[1,2] Adam Knowlden, PhD, MCHES®,[1] and Jessica Wallace, PhD, MPH, LAT, ATC[1,2]
[1]Department of Health Science, University of Alabama, Tuscaloosa, AL, USA; [2]MATCHED Lab, University of Alabama, Tuscaloosa, AL, USA

CLINICAL BOTTOM LINE: Concussion education is effective at increasing concussion knowledge and concussion-reporting intention; however, it remains inconclusive if education is enough to change reporting behavior.

CONCUSSION EDUCATION

Recommendation #1: Design interventions based on assessments utilizing a multilevel theory such as the Integrated Behavioral Model (IBM) for clear organization.

Recommendation #2: Include a measure of concussion prevalence pre and post intervention to determine education efficacy.

Recommendation #3: Design interactive interventions to further enhance concussion knowledge within the intended population.

Recommendation #4: Include educational material tailored to the specific population in which it is being disseminated.

IMMEDIATE REMOVAL FROM PLAY

Sports Medicine (2021) 51:1491–1508
https://doi.org/10.1007/s40279-021-01444-7

SYSTEMATIC REVIEW

The Influence of Timing of Reporting and Clinic Presentation on Concussion Recovery Outcomes: A Systematic Review and Meta-Analysis

Mitchell Barnhart[1] · R. Curtis Bay[2] · Tamara C. Valovich McLeod[1,2,3]

Patients who continued play or delayed reporting their concussion had significantly longer recovery times and higher symptom scores compared to those who immediately reported or were removed from play.

Those who immediately reported recovered in **5.4 days** (95% CI: 10.14, – 0.75) fewer than delayed reporters.

Table 3 Post-concussion symptom severity scores [Mean(Standard Deviation)]

Study	Immediate removal	Delayed removal
Asken et al. [10] Visit 1	26.3 (19.3)	31.5 (20.9)
Asken et al. [10] Visit 2	19.3 (20.2)	25.6 (22.7)
Elbin et al. [12]Visit 1	15.1 (15.3)	33.0 (24.1)
Elbin et al. [12] Visit 2	3.9 (8.0)	16.2 (16.1)
Howell et al. [14]	24.4 (25.0)	27.3 (24.8)
Zynda et al. [20] Visit 1	47.8 (NR)	44.5 (NR)
Zynda et al. [20] Visit 2	19.6 (NR)	21.4 (NR)

IMMEDIATE REMOVAL FROM PLAY

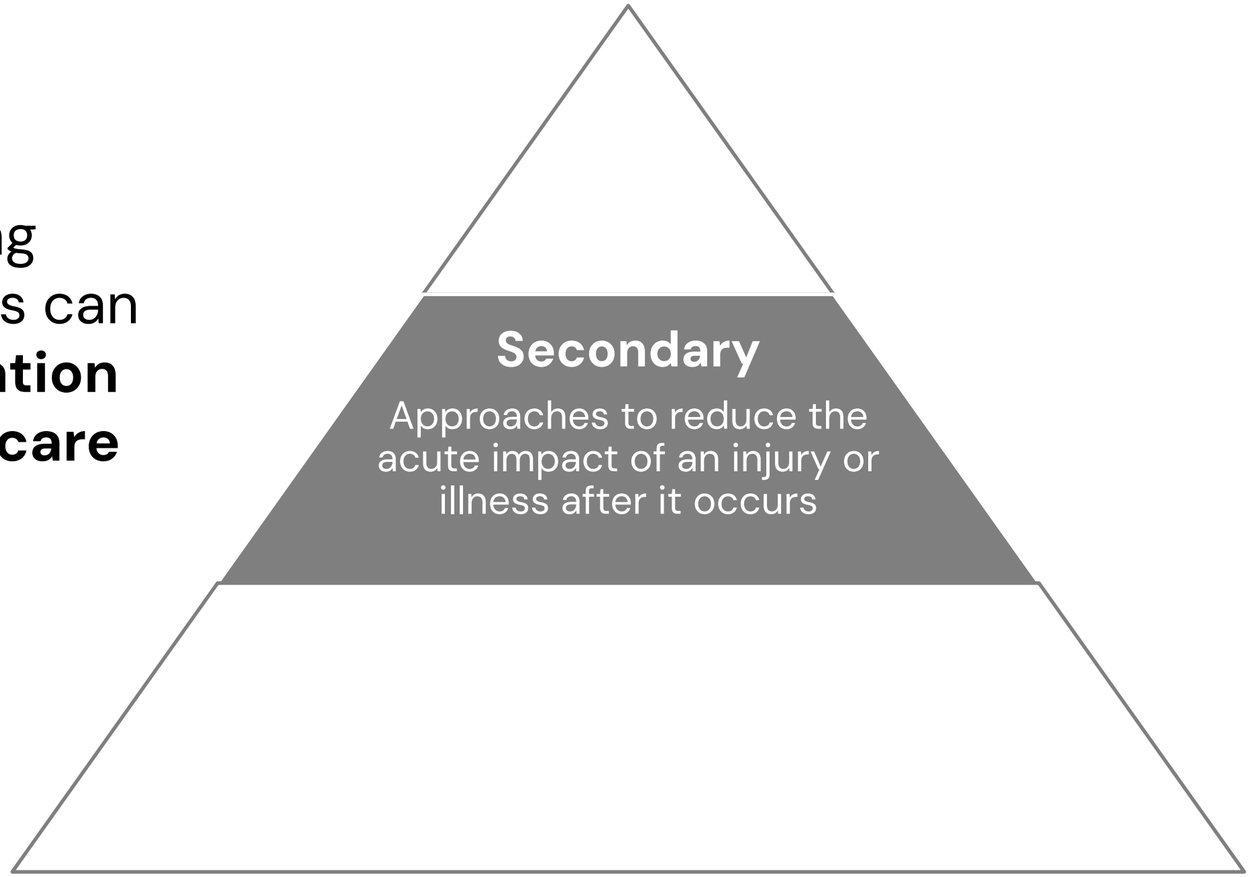
QUICKER RECOVERY TIME, LESS TIME MISSED FROM SPORT, AND LESS LIKELY TO HAVE PROTRACTED RECOVERY!

Scan here
for references:

SECONDARY PREVENTION OF CONCUSSION

In Summary

- Concussion health literacy among athletes and healthcare providers can **lead to quicker injury identification and reduce delays in initiating care**

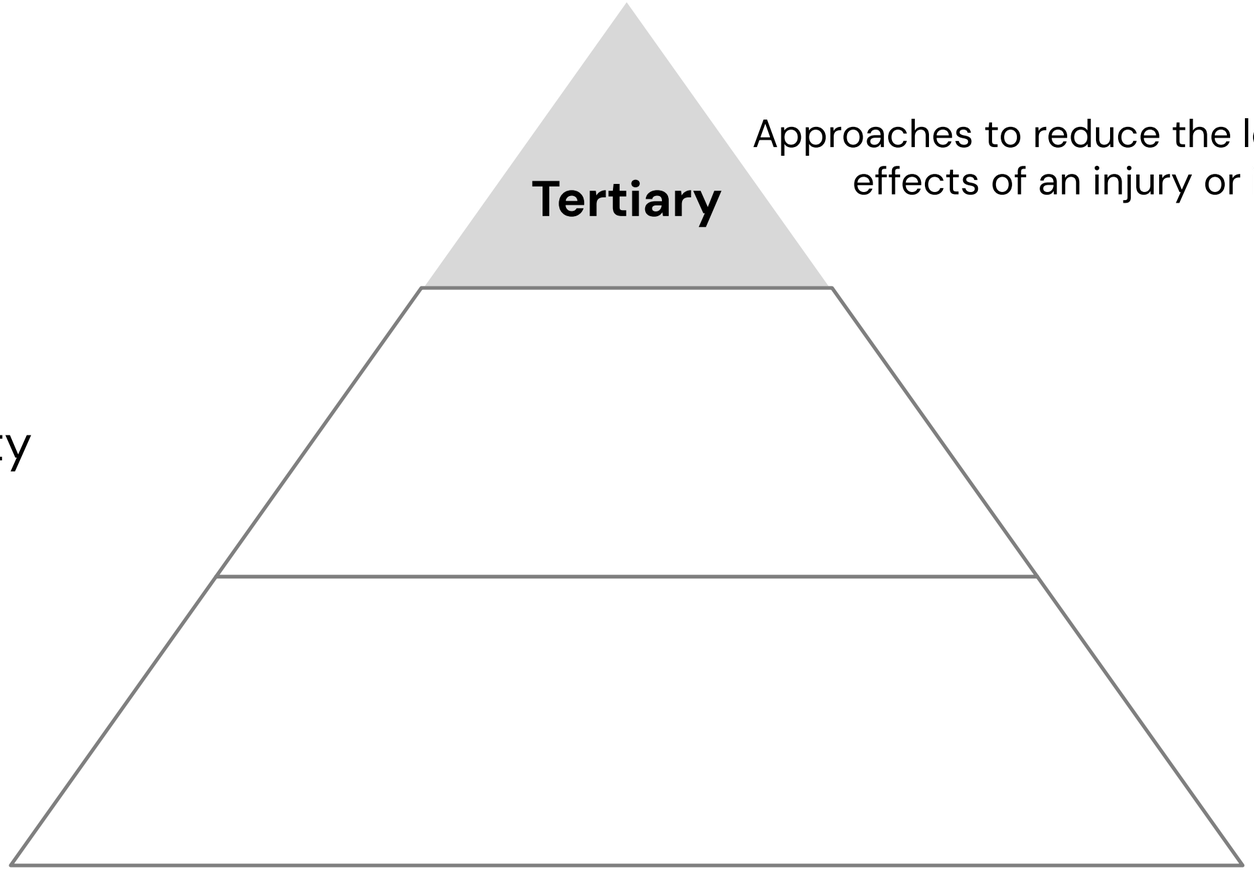


Scan here for references:

PUBLIC HEALTH LEVELS OF PREVENTION

Tertiary Prevention Goal:
Implement approaches that minimize the potential for persistent symptoms after concussion (PSaC) and long-term issues to preserve health-related quality of life

- Early Symptom-Limited Activity
- Treatment Prescription

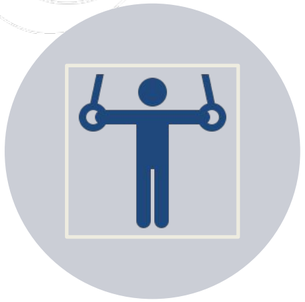


Approaches to reduce the longer-term effects of an injury or illness

Scan here
for references:


The Original Concussion Recovery Strategy

EARLY ACTIVITY



Promotes active recovery, increased physical and social engagement, normalizing routines

Early cognitive and physical activity may reduce symptoms and recovery time

While symptoms may be provoked initially with exercise, they are transient and do not worsen outcomes

Early activity and graded exercise interventions can decrease odds of and reverse persisting symptoms

Table 2 Return-to-sport (RTS) strategy—each step typically takes a minimum of 24 hours

Step	Exercise strategy	Activity at each step	Goal
1	Symptom-limited activity	Daily activities that do not exacerbate symptoms (eg, walking).	Gradual reintroduction of work/school
2	Aerobic exercise **2A—Light** (up to approximately 55% maxHR) **then** **2B—Moderate** (up to approximately 70% maxHR)	Stationary cycling or walking at slow to medium pace. May start light resistance training that does not result in more than mild and brief exacerbation* of concussion symptoms.	Increase heart rate
3	Individual sport-specific exercise Note: If sport-specific training involves any risk of inadvertent head impact, medical clearance should occur prior to Step 3	Sport-specific training away from the team environment (eg, running, change of direction and/or individual training drills away from the team environment). No activities at risk of head impact.	Add movement, change of direction
Steps 4–6 should begin after the resolution of any symptoms, abnormalities in cognitive function and any other clinical findings related to the current concussion, including with and after physical exertion.			
4	Non-contact training drills	Exercise to high intensity including more challenging training drills (eg, passing drills, multiplayer training) can integrate into a team environment.	Resume usual intensity of exercise, coordination and increased thinking
5	Full contact practice	Participate in normal training activities.	Restore confidence and assess functional skills by coaching staff
6	Return to sport	Normal game play.	

*Mild and brief exacerbation of symptoms (ie, an increase of no more than 2 points on a 0–10 point scale for less than an hour when compared with the baseline value reported prior to physical activity). Athletes may begin Step 1 (ie, symptom-limited activity) within 24 hours of injury, with progression through each subsequent step typically taking a minimum of 24 hours. If more than mild exacerbation of symptoms (ie, more than 2 points on a 0–10 scale) occurs during Steps 1–3, the athlete should stop and attempt to exercise the next day. Athletes experiencing concussion-related symptoms during Steps 4–6 should return to Step 3 to establish full resolution of symptoms with exertion before engaging in at-risk activities. Written determination of readiness to RTS should be provided by an HCP before unrestricted RTS as directed by local laws and/or sporting regulations.

HCP, healthcare professional; maxHR, predicted maximal heart rate according to age (ie, 220-age).

BUFFALO CONCUSSION TREADMILL TEST

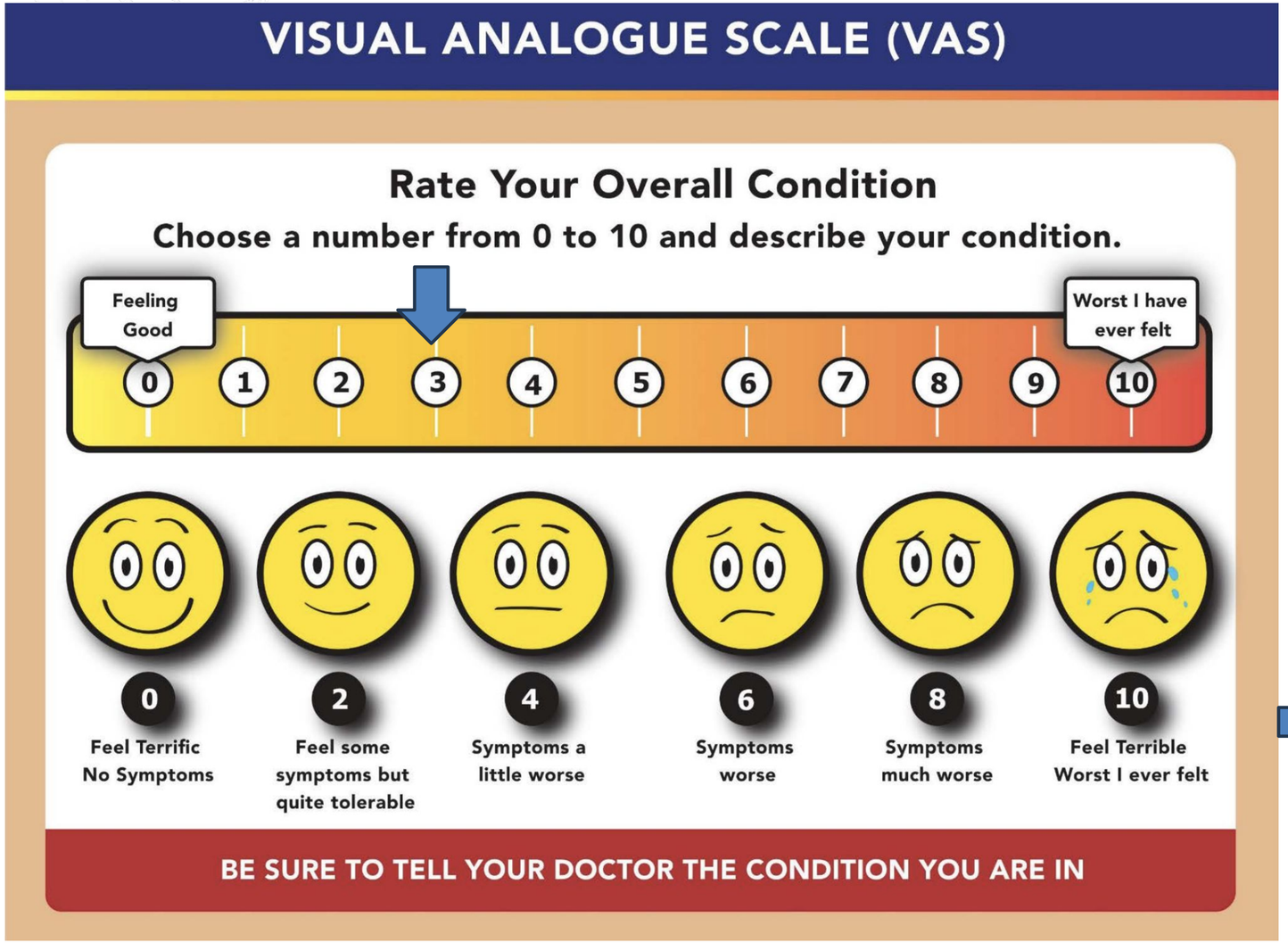
The purpose of the BCTT is to establish sub-symptom heart rate max to use for exercise prescription

Equipment: Symptom visual analog scale (VAS), heart rate monitor, RPE scale, treadmill

Procedure: To be completed following 24-48 hours of complete rest:

- Pre-test symptom VAS assessment
- Start with speed between 3.3-3.6 mph at 0% incline
- Increase incline by 1% every minute while maintaining speed (Assess RPE and ask whether there are any symptom VAS changes)
- Test is terminated when RPE ≥17 or ≥3 point increase in symptom VAS score
- Sub-symptom HR max = HR at BCTT termination

BUFFALO CONCUSSION TREADMILL TEST



Borg Rating of Perceived Exertion		
Green	6	Zero Exertion
	7	Extremely light
	8	Minimal effort
Yellow	9	Very light exertion (comfortable)
	10	Just start to hear breathing
	11	Conversation is easy
	12	Light exertion
Orange	13	Somewhat hard
	14	Breathing hard but not struggling
	15	Can converse but not full sentences
	16	Hard work
Red	17	Very hard - getting uncomfortable
	18	Can no longer converse
	19	Extremely hard - body is screaming
	20	Maximal exertion

BUFFALO CONCUSSION TREADMILL TEST

- The prescribed target heart rate is **90%** of the sub-symptom HR max established by the BCTT
  - Stationary bike, treadmill, elliptical, light jog in a safe environment

- Instruct patients to stop the exercise session if their symptom VAS score increase by ≥3 from their pre-exercise symptoms or after 20 minutes

- The patient will have successfully completed Stage 2 of the Return-to-Sport Strategy when they are able to complete 20-minutes of consecutive aerobic exercise at or below the prescribed target heart rate without symptom exacerbation

- Establish a new target heart rate using the BCTT every 7 days for as long as the patient remains symptomatic

DUQUESNE
ATHLETICS

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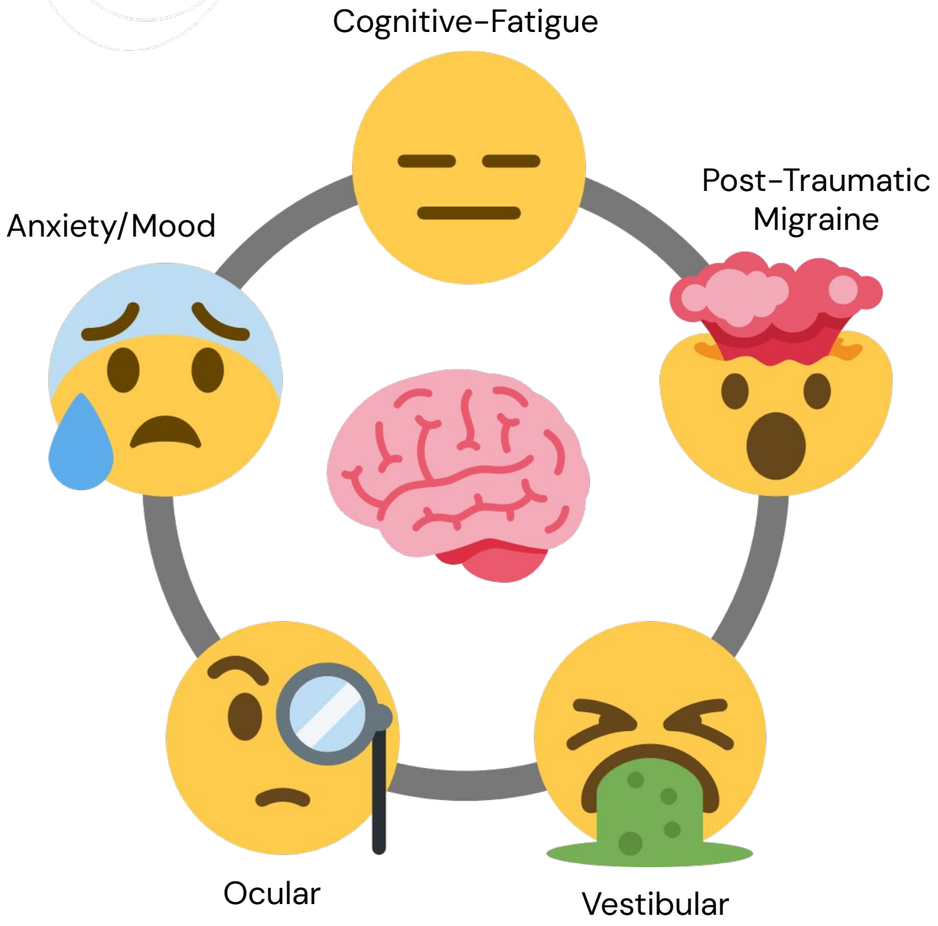
TARGETED TREATMENT



Concussions are heterogenous and multi-faceted…therefore, treatments may consider a clinical profile-based approach

UPMC
LIFE CHANGING MEDICINE

Scan here for references:

CONCUSSION CLINICAL PROFILES

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Concussion Clinical Profiles Screening (CP Screen) Tool: Preliminary Evidence to Inform a Multidisciplinary Approach

CONCLUSION: The CP Screen demonstrated strong reliability, concurrent validity with commonly used concussion assessment (ie, PCSS, VOMS, and ImPACT), and predictive validity for identifying concussion. The CP Screen extends current symptom inventories by evaluating more specific symptoms that may reflect clinical profiles and inform better clinical care.

TABLE 6. Comparison of CP Screen Factor and Modifier Scores between Concussed (n = 121) and Controls (n = 127)

CP Screen factor/modifier	Concussed		Controls		F	Partial eta squared
	M (SD)	95% CI	M (SD)	95% CI		
Anxiety/mood	2.93 (2.92)	2.41-3.45	1.02 (1.56)	1.02-1.29	39.06*	.15
Cognitive	2.98 (2.14)	2.60-3.36	.85 (1.19)	.64-1.06	88.59*	.28
Migraine	4.42 (3.29)	3.83-5.01	.38 (.92)	.22-.54	181.56*	.45
Ocular	4.71 (3.38)	4.11-5.31	.55 (1.16)	.35-.75	164.42*	.42
Vestibular	3.55 (2.97)	3.02-4.08	.38 (.92)	.22-.54	126.68*	.36
Sleep	1.92 (2.32)	1.51-2.33	.89 (1.45)	.64-1.14	16.77*	.07
Neck	.98 (1.55)	.70-1.26	.23 (.57)	.13-.33	24.58*	.10

*$P < .001$.

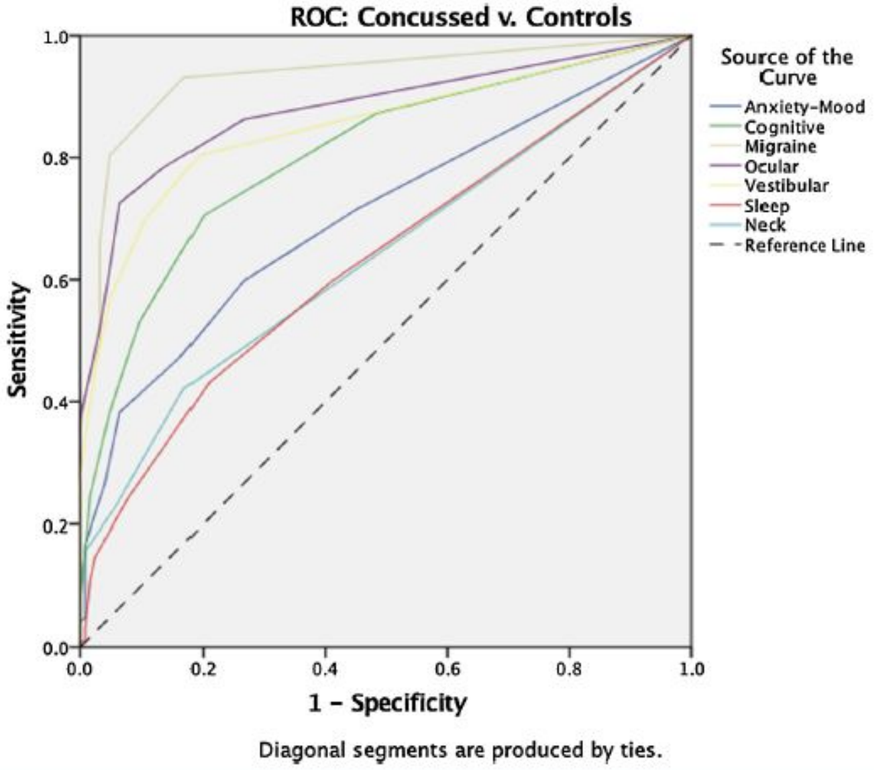

FIGURE 2. *ROC for CP Screen factor and modifier scores for concussed compared to controls.*

Targeting Treatment

	Vestibular	Ocular	Cognitive-Fatigue	Posttraumatic Migraine	Anxiety/Mood
Common symptoms	• Slow, wavy dizziness with movement or change of positions • Dizziness, nausea, mental fogginess, and anxiety in busy environments • Balance problems • Motion sensitivity • Vertigo when lying down, looking up, or rolling over	• Blurry vision, diplopia, eye strain, difficulty focusing • Difficulty reading (*e.g.*, skipping lines, reading comprehension problems) • Headache and fatigue triggered specifically by visual activity	• Feeling ''in a fog'' • Difficulty concentrating • Memory problems • Feeling slowed down • Fatigue or low energy • Symptoms worsen throughout the day, especially headache	• Intermittent, moderate to intense headache • Headache often present upon wakening • Headache with nausea and/or phono/photosensitivity • Visual aura including flashing or shimmering lights, zigzagging lines, or stars • Pulsating quality • Motion sickness and sleep problems common	• Anxiety/depression, worry, difficulty turning off thoughts, rumination, excessive preoccupation or focus on symptoms • Sadness, limited social interaction or loss of interest • Panic attacks
Clinical examination/ evaluation findings	• Abnormal vestibular screening (*e.g.*, symptom provocation with vestibular ocular reflex testing)	• Abnormal near point convergence measurements • Tracking, saccadic deficits • Neurocognitive deficits typical, especially reaction time	• Neurocognitive deficits across domains	• Neurocognitive deficits across domains are common	• Elevated scores above cut-off on mood/anxiety questionnaires
Risk factors	• Personal history of motion sickness/sensitivity • Personal history of vestibular disorder • Comorbid migraine • Comorbid anxiety disorder	• Not established • Personal/family history of eye muscle surgery, strabismus, amblyopia, or other ocular diagnosis	• Not established • Personal history of ADHD, learning disability	• Personal/family history of migraine • Personal history of motion sickness • Comorbid anxiety disorder or sleep problems • Female gender	• Personal and/or family history of psychiatric issues • Psychiatric/mood medications taken in past • Comorbid migraine and sleep problems • Presence of significant life stressor
Targeted treatment strategies	• Vestibular rehabilitation • Dynamic Exertion Therapy • Exposure/recovery approach in day to day activity	• Vision therapy • Exposure/recovery approach when engaging in visually demanding tasks	• Brief academic/work accommodations • Behavioral regulation • Medication with stimulant properties	• Referral to headache specialist • Behavioral regulation	• Psychotherapy approaches, including cognitive behavioral therapy, behavioral activation, and exposure therapy • Psychotropic medication

MODIFIERS

CONCUSSION REHABILITATION

The ACTIVE REHAB Study

THE UNIVERSITY of NORTH CAROLINA at CHAPEL HILL

WISCONSIN
UNIVERSITY OF WISCONSIN-MADISON

A multi-sport, multi-age, and multi-country study

PRIMARY OBJECTIVE: Evaluate the efficacy and feasibility of an acute multidimensional rehabilitation program on short and intermediate outcomes following concussion

- 28 sites
- 3 countries
- High school, college, and professional levels
- Sports with varying levels of contact

Scan here for references:

CONCUSSION REHABILITATION

The ACTIVE REHAB Study

THE UNIVERSITY of NORTH CAROLINA at CHAPEL HILL

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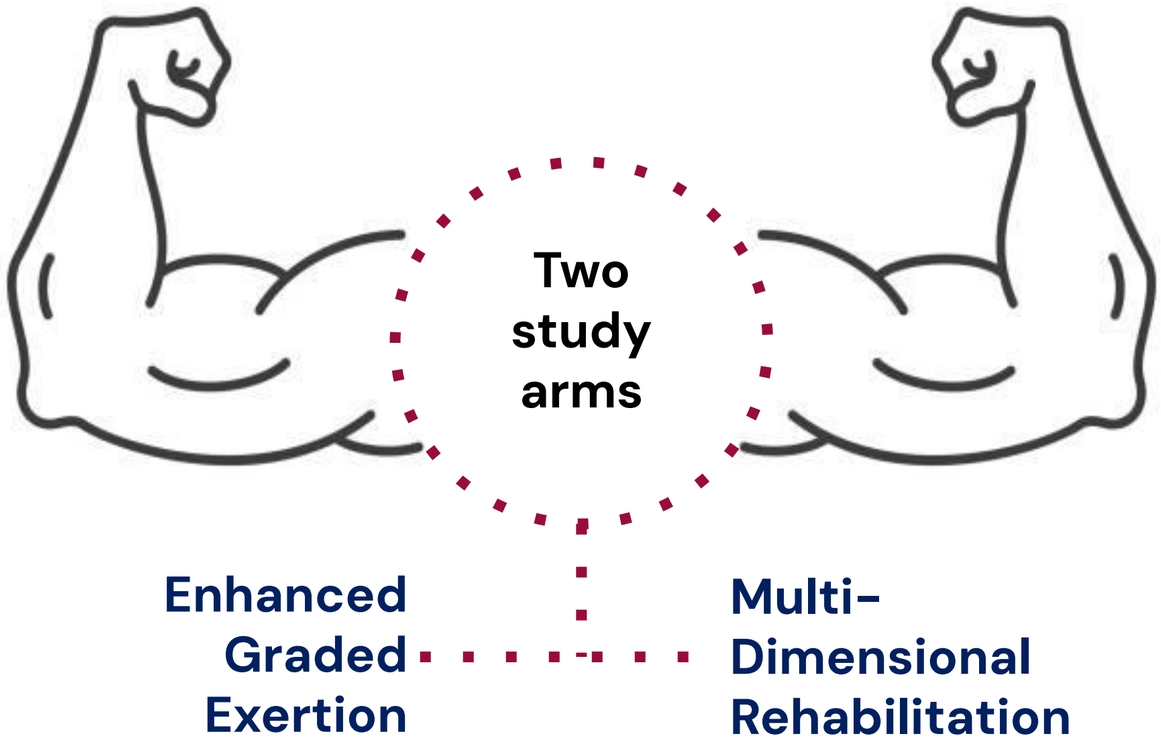

CONCUSSION REHABILITATION

Multidimensional Rehabilitation (MDR)

Phase 1: Symptom Control – Comfort (Minimum of 2 sessions)

Phase 2: Impairment Reduction – Comfort + 1–2 basic impairment activities

Phase 3: Activity Integration – Comfort if needed + Add new impairment activity

Phase 4: Recovery Acceleration – Comfort if needed + Add new and progress the complexity of impairment activities (divided attention tasks)

Phase 5: Sport Specific Applications – Comfort if needed + Add and progress the complexity of impairment activities (divided attention & sport specific tasks)

CONCUSSION REHABILITATION

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www.natajournals.org

Concussion

Symptom Exacerbation and Adverse Events During a Randomized Trial of Early-Stage Rehabilitation After Sport-Related Concussion: Safety Outcomes From the Active Rehab Study

Johna K. Register-Mihalik, PhD, ATC*†;

CLINICAL IMPLICATIONS: The multidimensional rehabilitation and enhanced graded exertion and the current return-to-sport strategy, when clinically monitored, resulted in few significant symptom exacerbations and few overall safety concerns.

Table 4. Frequency of Global Symptom Exacerbation, Significant Symptom Exacerbation, and Sustained Symptom Exacerbation[a]

	Sessions With Intrasession Symptom Exacerbation	Sessions With Significant Intrasession Symptom Exacerbation	Sustained Significant Symptom Exacerbation (AE)
MDR + EGE (n = 819 sessions)	136 (16.7%)	8 (1.0%)	1 (0.1%)
Professional football (n = 182)	23 (12.6%)	2 (1.1%)	1 (0.0%)
Professional rugby (n = 150)	32 (21.3%)	5 (3.3%)	0 (0.0%)
College or university (n = 317)	57 (18.0%)	1 (0.3%)	0 (0.0%)
Interscholastic (n = 170)	24 (14.1%)	0 (0.0%)	0 (0.0%)
EGE only (n = 618 sessions)	97 (15.7%)	1 (0.2%)	0 (0.0%)
Professional football (n = 133)	22 (16.5%)	0 (0.0%)	0 (0.0%)
Professional rugby (n = 48)	2 (4.2%)	0 (0.0%)	0 (0.0%)
College or university (n = 352)	67 (19.0%)	1 (0.3%)	0 (0.0%)
Interscholastic (n = 85)	6 (7.0%)	0 (0.0%)	0 (0.0%)

Abbreviations: AE, adverse event; EGE, enhanced graded exertion; MDR, multidimensional rehabilitation.
[a] See Table 1 for definitions.

THE UNIVERSITY of NORTH CAROLINA at CHAPEL HILL

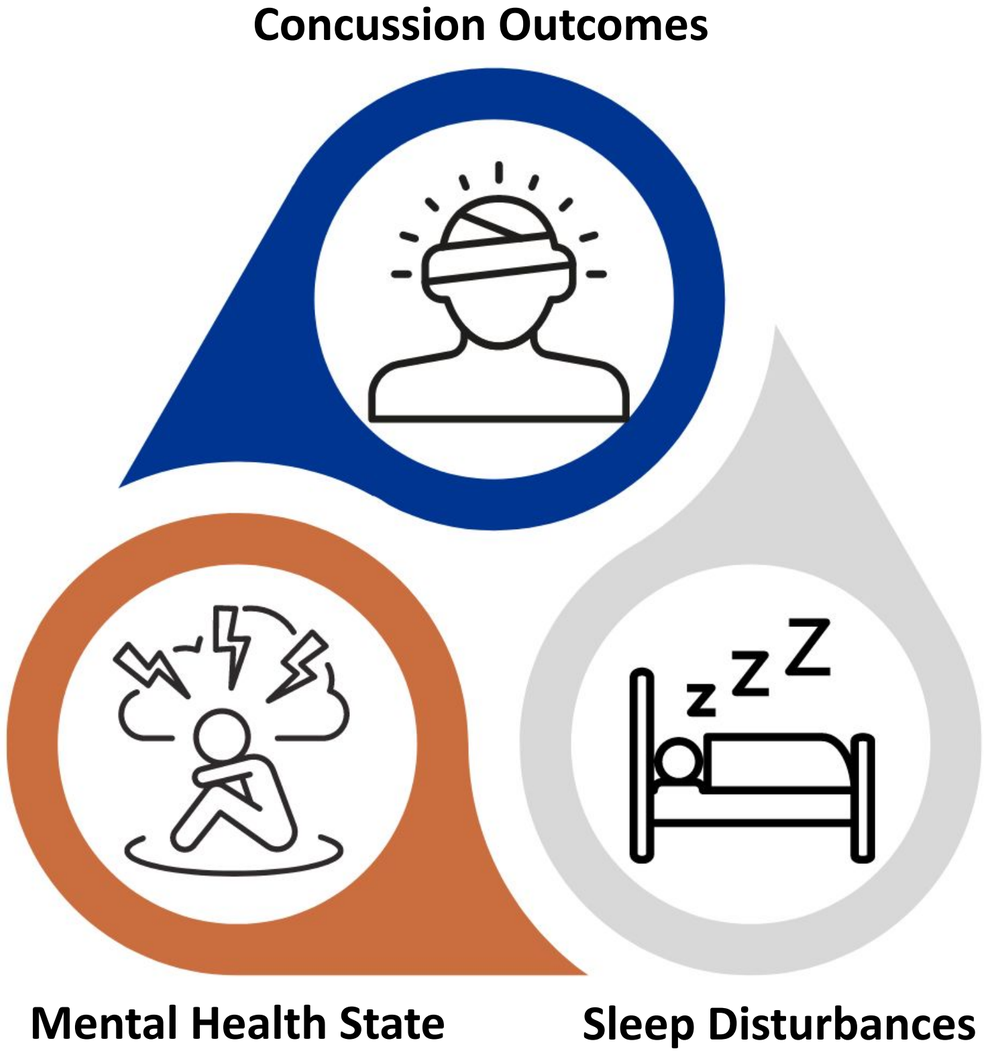
FUTURE OF SRC MANAGEMENT?

20-40% of athletes report affective symptoms following concussion that significantly delay recovery

The probability of **developing depression or anxiety** is significantly amplified for those who have sustained a brain injury of any severity

Sleep disturbances are reported in 30-80% of individuals following a concussion

Sleep disturbances subsequent to concussion, may be linked to **longer recovery and poorer post-concussion outcomes & contribute to symptoms of anxiety and depression**




93
No Zone

Continuum of Concussion Care	Wearables Used	Applications	Findings
Risk	- Inertial sensors (helmet, mouthguard IMUs)	- Monitor head impact frequency and magnitude - Inform safer practice and rule changes	- Impact counts are not reliable predictors of concussion - High variability across athletes and sessions
Acute Post-Concussion	- Physiological sensors (Oura, WHOOP, ActiGraph) - Eye-tracking wearables - EEG headbands	- Detect early physiological and neurobehavioral changes - Identify subtle dysfunction in acute stages	- HRV decreases and sleep disturbances are common acutely - Eye-tracking reveals oculomotor issues - EEG shows abnormal brain activity
Recovery	- Oura Ring - ActiGraph - EEG headbands	- Track longitudinal recovery - Support return-to-play decisions based on physiological normalization	- Wearables may offer ecologically valid data over time, more research needed - Potential to support RTP readiness - Limited integration with standard care

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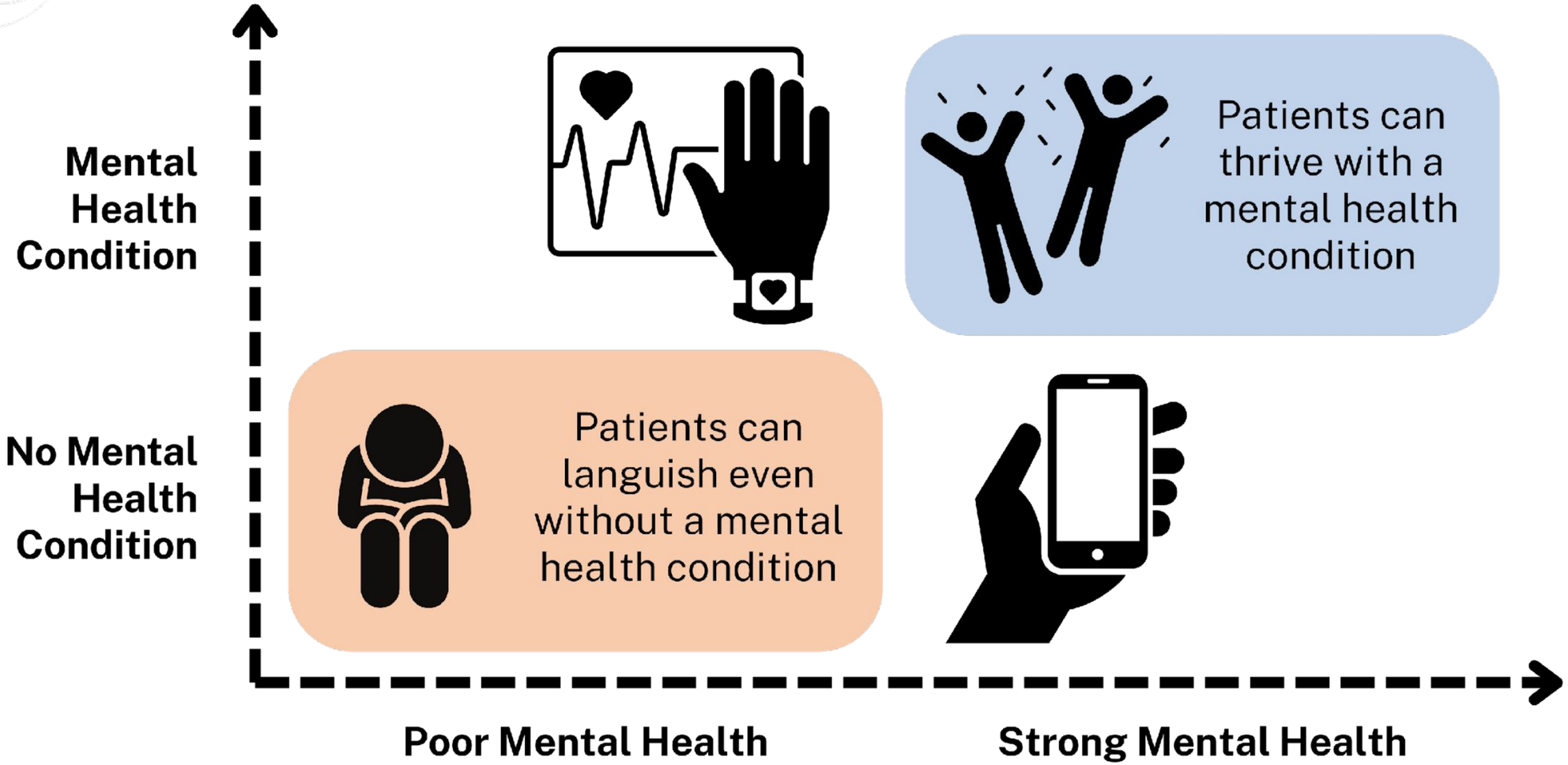
for references:

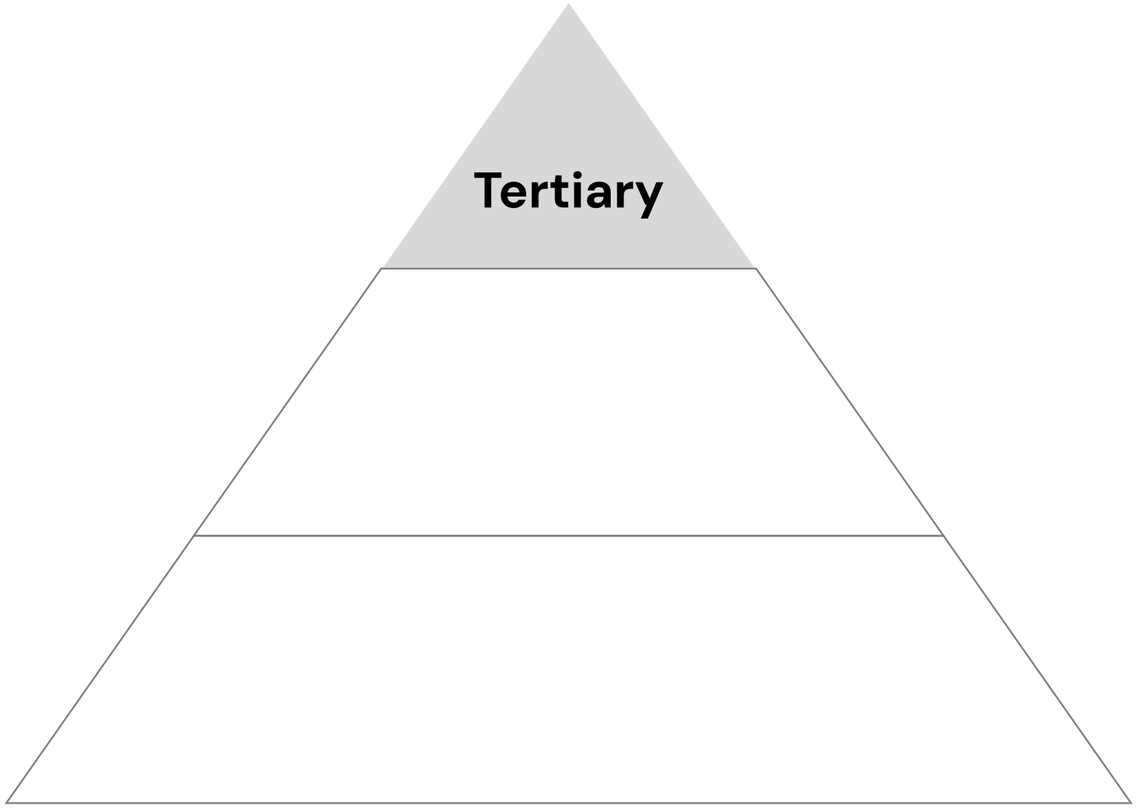
MONITORING CLINICAL STATE



PUBLIC HEALTH LEVELS OF PREVENTION

In Summary

- **Early symptom-limited activity and multidimensional rehabilitation exercises** targeting specific symptoms can promote active recovery
- This can increase physical and social engagement, normalize routines for athletes, and **support clinical recovery**



Scan here to access Duquesne University's exercise prescription ready-to-use protocol for athletes with concussion to adapt to your own clinical practice!

SOME PARTING THOUGHTS

- Some sport-specific equipment and training protocols may better reduce the risk of concussion.
- State laws have been effective at increasing the rate of concussion diagnosis in sport.
- The selection of awareness and education strategies must be in a language and mode of delivery that is digestible by the target audience with information that matters to them.
- Early sub-symptom exercise is now a best practice recommendation and the prescription of additional treatments for specific injury subtypes is the future of concussion care.

Scan here
for references:

THANK YOU!

REFERENCES

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