Trends in High School Sports Concussion: Some Good News Finally?

R. Dawn Comstock, PhD
Associate Professor, Epidemiology, CSPH
PIPER Program

March, 2014: 5th Annual Youth Sports Safety Summit

Home Safety Quiz

- Think about your home
  - Smoke alarms?
  - CO detectors?
  - First aid kit?
  - Family “rally point”?

Workplace Safety Quiz

- Think about your workplace
  - Two nearest fire escape routes?
  - First aid kit?
  - AED?
  - Tornado shelter or flood/hurricane evacuation plan?
  - Plan for armed aggressor?

Youth Sports Safety Quiz

- Youth sports risks?
  - Sports with highest rates of injury?
  - Injury patterns by sport?
  - Factors that place athletes at risk or are protective?
- Youth sports safety
  - Coach?
    - *Certification, education, experience*
  - Equipment and facilities?
    - *In good repair, appropriate for sport, adequate*
  - Medical resources?
    - *Level of clinician, level of coverage, and level of coordination*
  - Emergency plan?
    - *Who makes the call (removing an athlete from play)*
    - *Who makes the call (activating EMS)*

Sports Injury Epidemiology Research

- Proven public health methodologies can improve athlete health and safety
  - Describe rates and patterns of injury
  - Monitor trends over time
  - Compare subgroups of interest
  - Contribute to evidence-based policy discussions
  - Drive the development of interventions
  - Evaluate the effectiveness of interventions

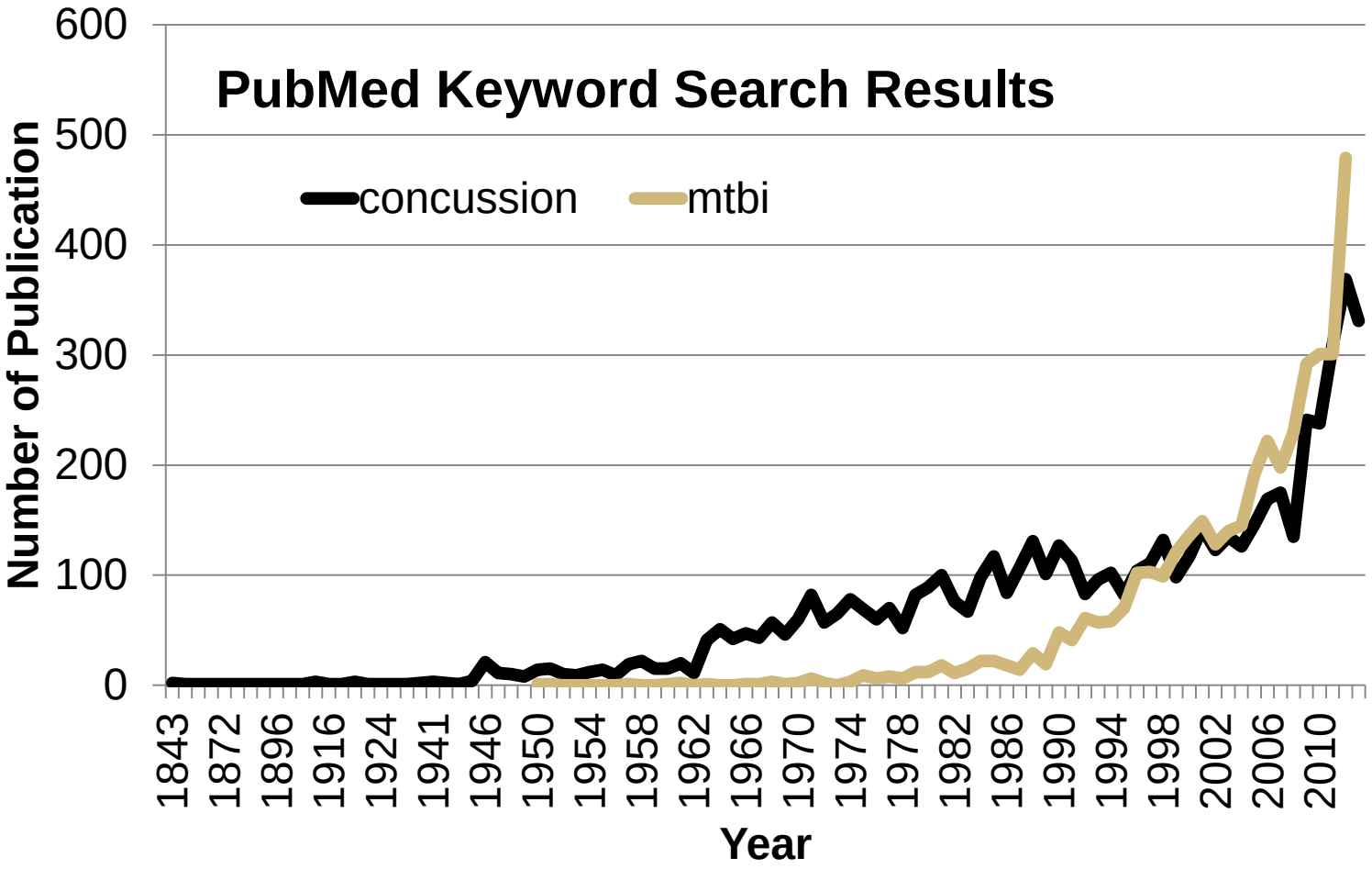
Alarming News over past 5-10 Years

- Concussion epidemic
  - Underreporting
  - Significantly increasing rates
  - Recognition of symptom prevalence and persistence
- Severe outcomes
  - Second impact syndrome
  - CTE
  - Dementia
  - Depression,
- Lack of knowledge
  - Objective, accurate, and conclusive diagnostic tools
  - Best clinical practices for managing recovery and return to play
  - Primary prevention programs
- Confusion
  - Helmets all the same vs. some helmets better than others

Time for Action!

- “There is a very definite brain injury due to single or repeated blows on the head or jaw which cause multiple concussion hemorrhages. ... The condition can no longer be ignored by the medical profession or the public.”
  - JAMA, Oct 13, 1928

Concussions: a HOT Topic



Significant Increase in Concussion Rates Over Time

- Lincoln AE, Caswell SV, Almquist JL, Dunn RE, Norris JB, Hinton RY. Trends in concussion incidence in high school sports: a prospective 11-year study. *Am J Sports Med*, 2011; 39(5):958-63.
  - Examined concussion trends in 12 high schools boys' and girls' sports from 97/98 – 07/08
  - 25 schools in Fairfax Co, Virginia
  - Concussion rate increased 4.2 fold (95% CI 3.4-5.2) over the 11 years
    - *15.5% annual increase*
  - Concussion rates increased over time in all 12 sports

Time for Some Good News?

- Has the epidemic curve peaked?
- Level of knowledge increased?
- Better data available?

History of High School RIO

- Established in 2005/06 with a 1 year, $100,000 New Investigator Award from CDC, NCIPC in 2004
  - Goal: provide a high school correlate to the NCAA ISS
  - Initial contributors included experts from NFHS, NCCSIR, CPSC NEISS, and NCAA
- Surveillance system has evolved over time
  - Original, nationally representative sample reporting 9 sports
  - Large national convenience sample reporting 11 other sports
- Goals
  - Support all those working to keep young athletes safe and healthy
  - Continue to contribute to the body of knowledge by publishing in the peer-review scientific literature and presenting at national meetings

High School RIO

- National High School Sports-Related Injury Surveillance System (High School RIO)
  - Athletic Trainers from US high schools report injuries
  - Internet-based data collection tool (RIO): 24/7 and updatable

- Definitions
  - Injury: 1) occurred as result of organized high school practice or competition, AND 2) required medical attention by a team physician, certified athletic trainer, personal physician, or emergency department/urgent care facility, AND 3) resulted in restriction of the high school athlete's participation for ≥1 days beyond the day of injury OR any concussion, fracture, dental injury, or heat event

  - Athletic exposure (AE): one athlete participating in one competition or practice

High School RIO Data

- ATs asked to log on weekly throughout each academic year to provide data

- Exposure data
  - Practice AEs
  - Competition AEs

- Injury data
  - Athlete: height, weight, year in school, position/event
  - Injury: body site, diagnosis, severity
  - Injury event: mechanism, specific activity

Sports Included in High School RIO

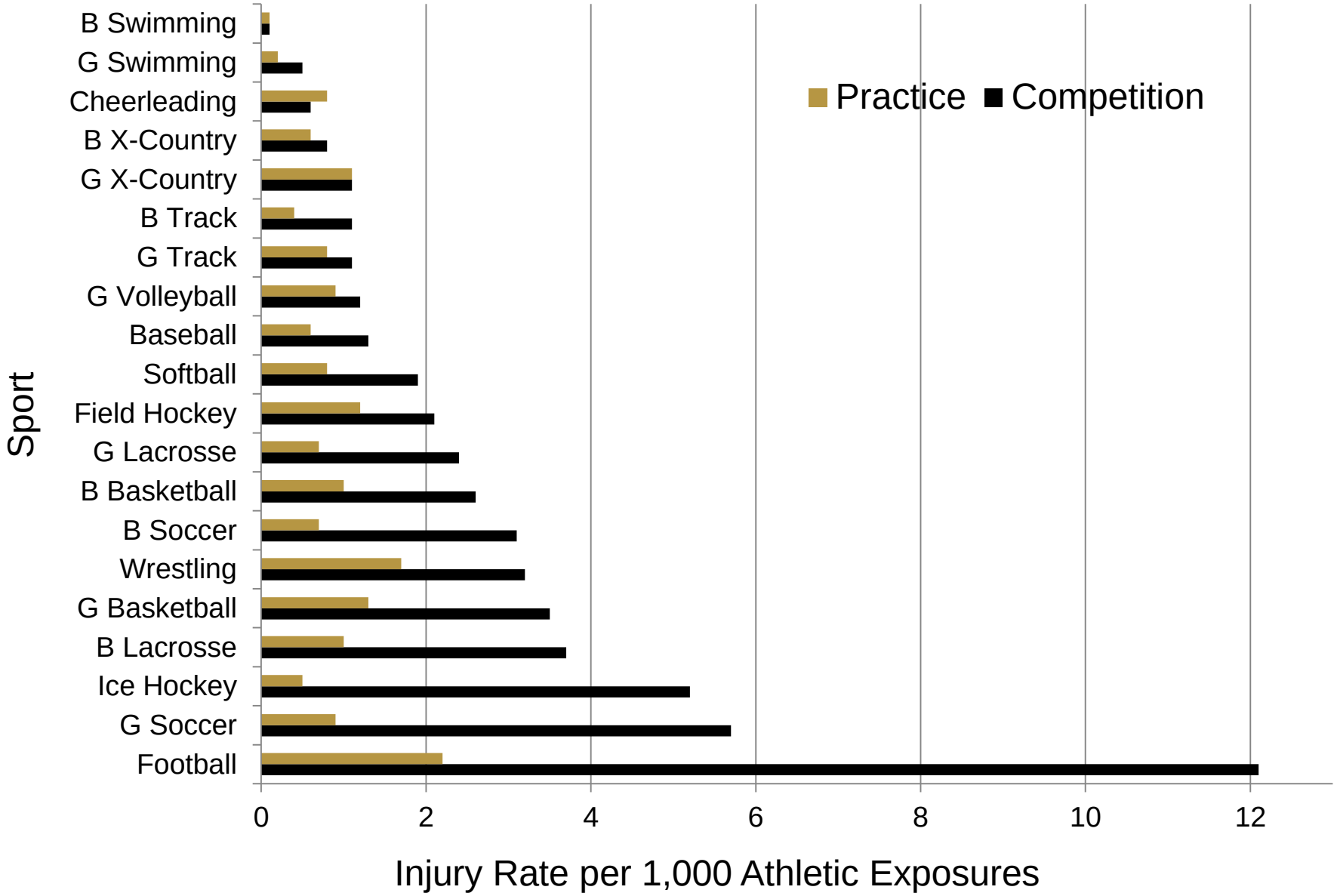
Boys' Sports	Years Studied	Girls' Sports	Years Studied
Baseball	8	Basketball	8
Basketball	8	Cross Country	1
Cross Country	1	Field Hockey	5
Football	8	Gymnastics[+]	4
Ice Hockey	5	Lacrosse	5
Lacrosse	5	Softball	8
Soccer	8	Soccer	8
Swimming	5	Swimming	5
Track	5	Track	5
Volleyball[+]	3	Volleyball	8
Wrestling	8	Cheerleading*	4

[+]Sports no longer under surveillance

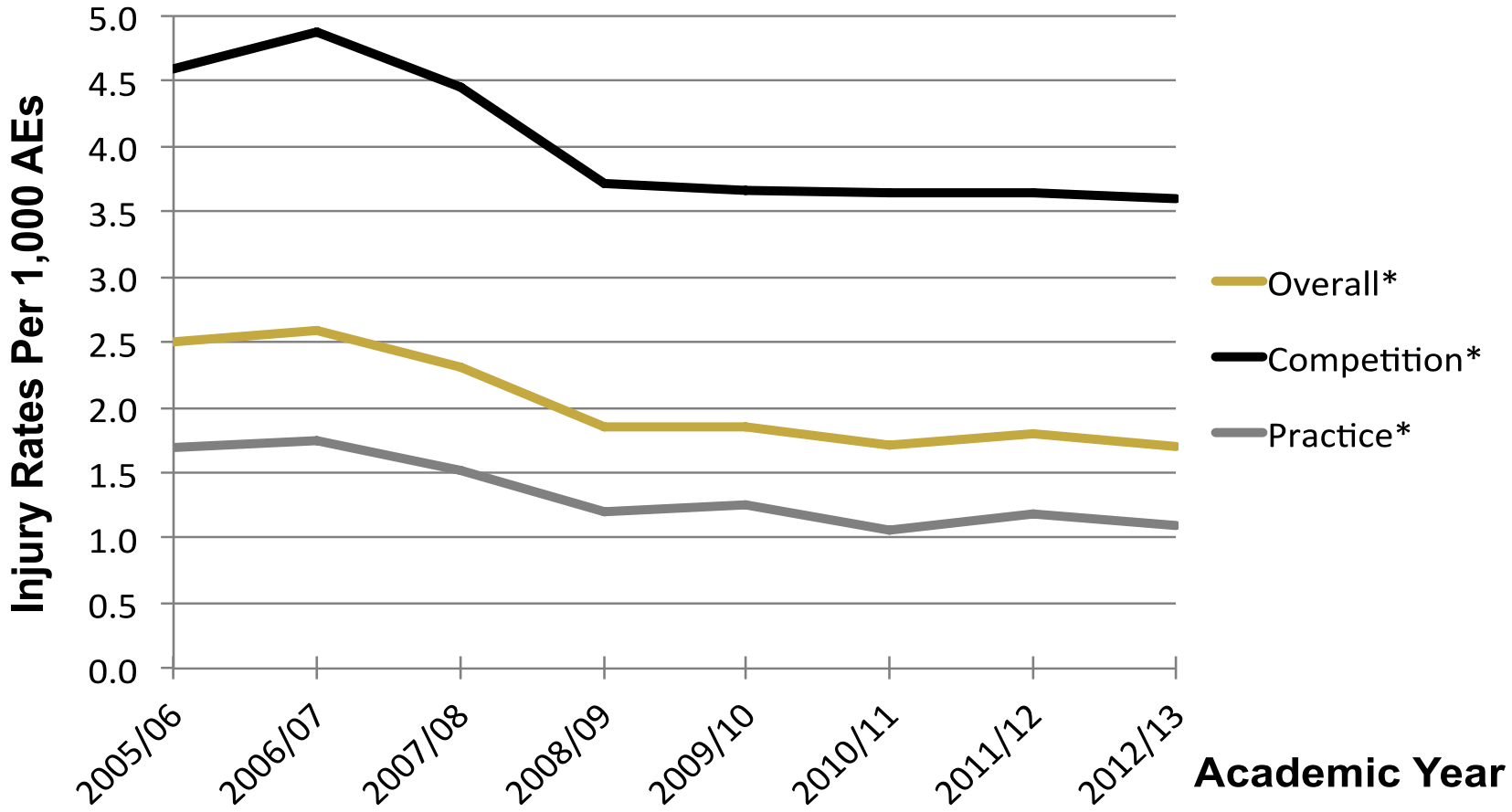
* Co-Ed sport although predominantly female participants

High School RIO Dataset

- Injury data captured 05/06 through 12/13
  - 50,449 injuries
  - 25,268,873 AE
  - 2.00 injuries per 1,000 AE
- Injury by type of exposure
  - 51.6% competition related
  - Competition rate 4.00 per 1,000 AE
  - Practice rate 1.31 per 1,000 AE
  - RR=3.07 (95% CI: 3.01, 3.12)

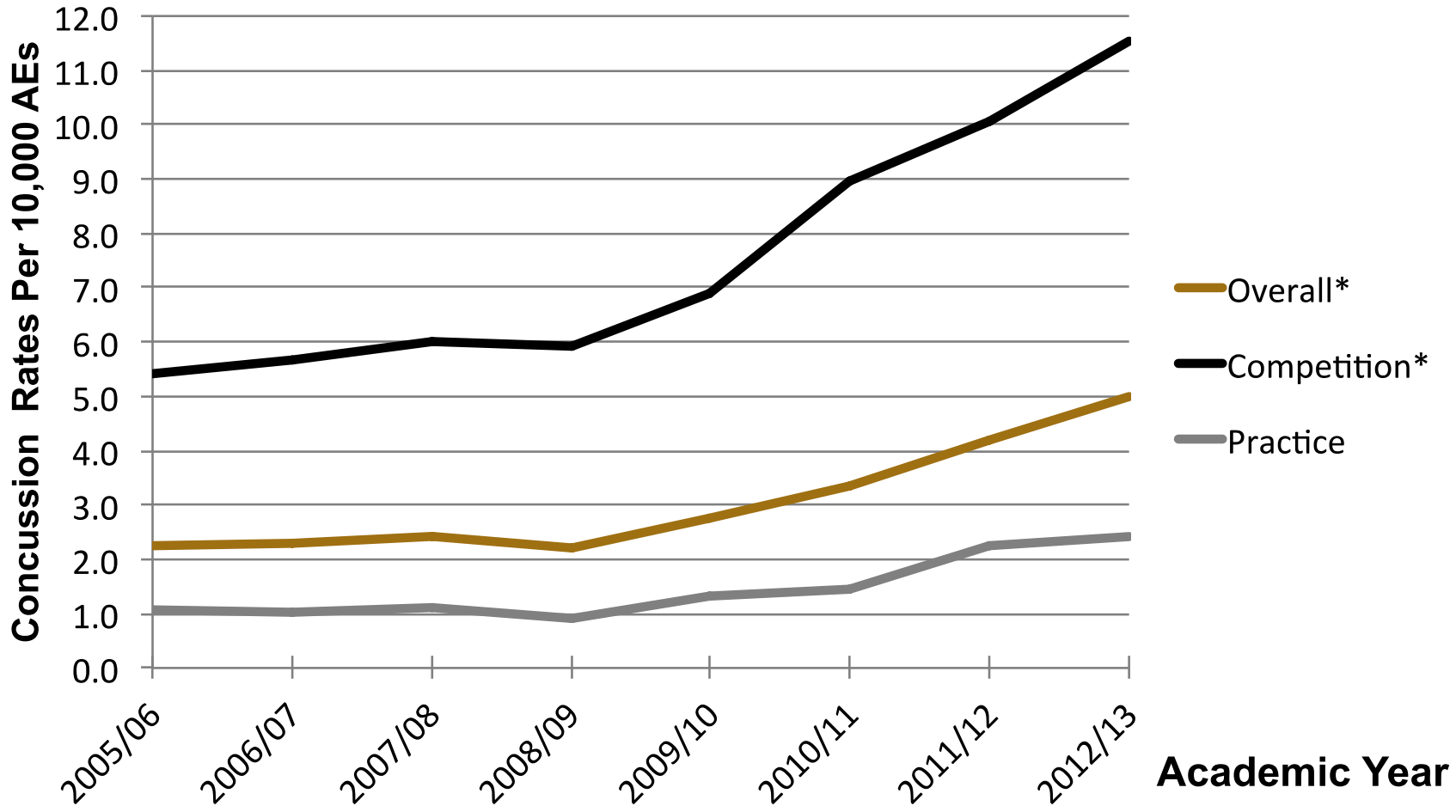

Practice
Competition
Sport
B Swimming
G Swimming
Cheerleading
B X-Country
G X-Country
B Track
G Track
G Volleyball
Baseball
Softball
Field Hockey
G Lacrosse
B Basketball
B Soccer
Wrestling
G Basketball
B Lacrosse
Ice Hockey
G Soccer
Football
0
2
4
6
8
10
12
Injury Rate per 1,000 Athletic Exposures

Injury Rates Per 1,000 AE



*significant decrease over time

Concussion Rates Per 10,000 AE



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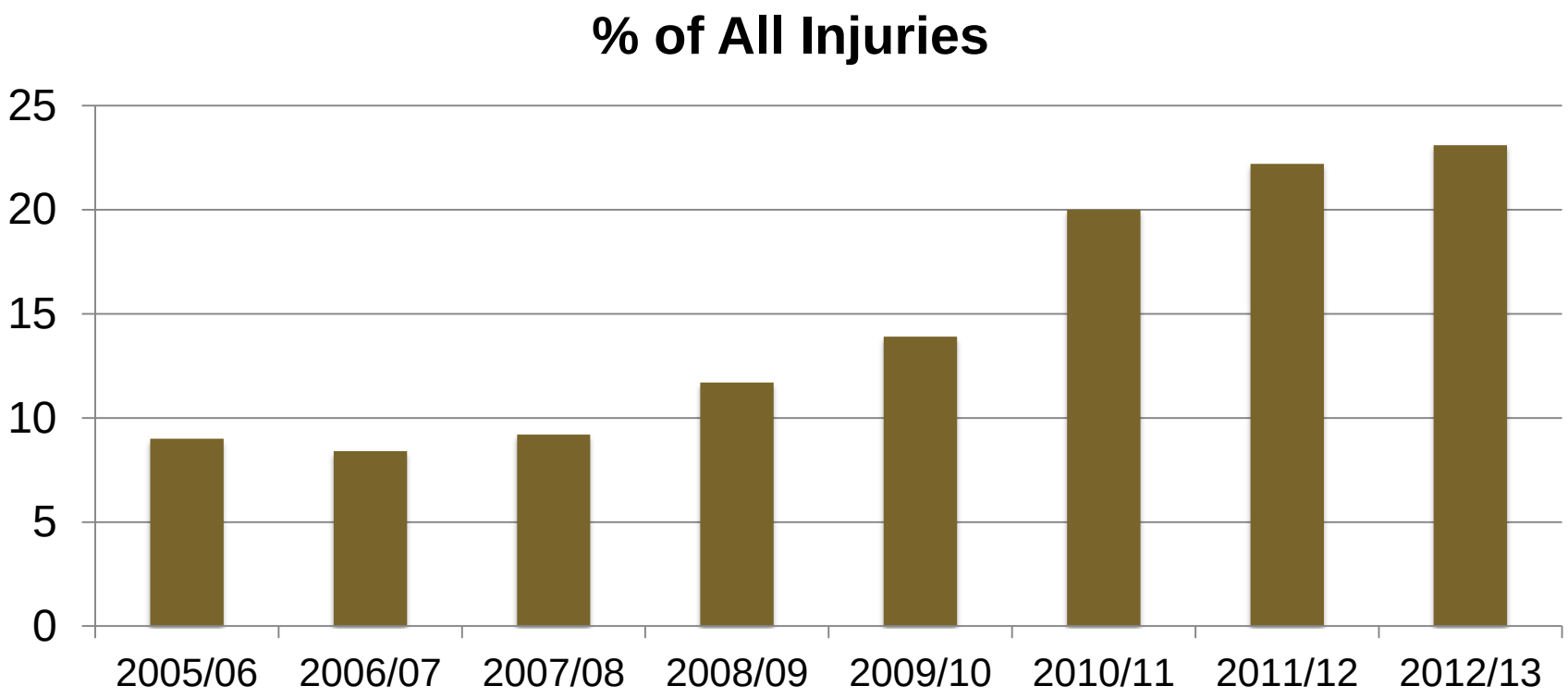
Concussion Burden



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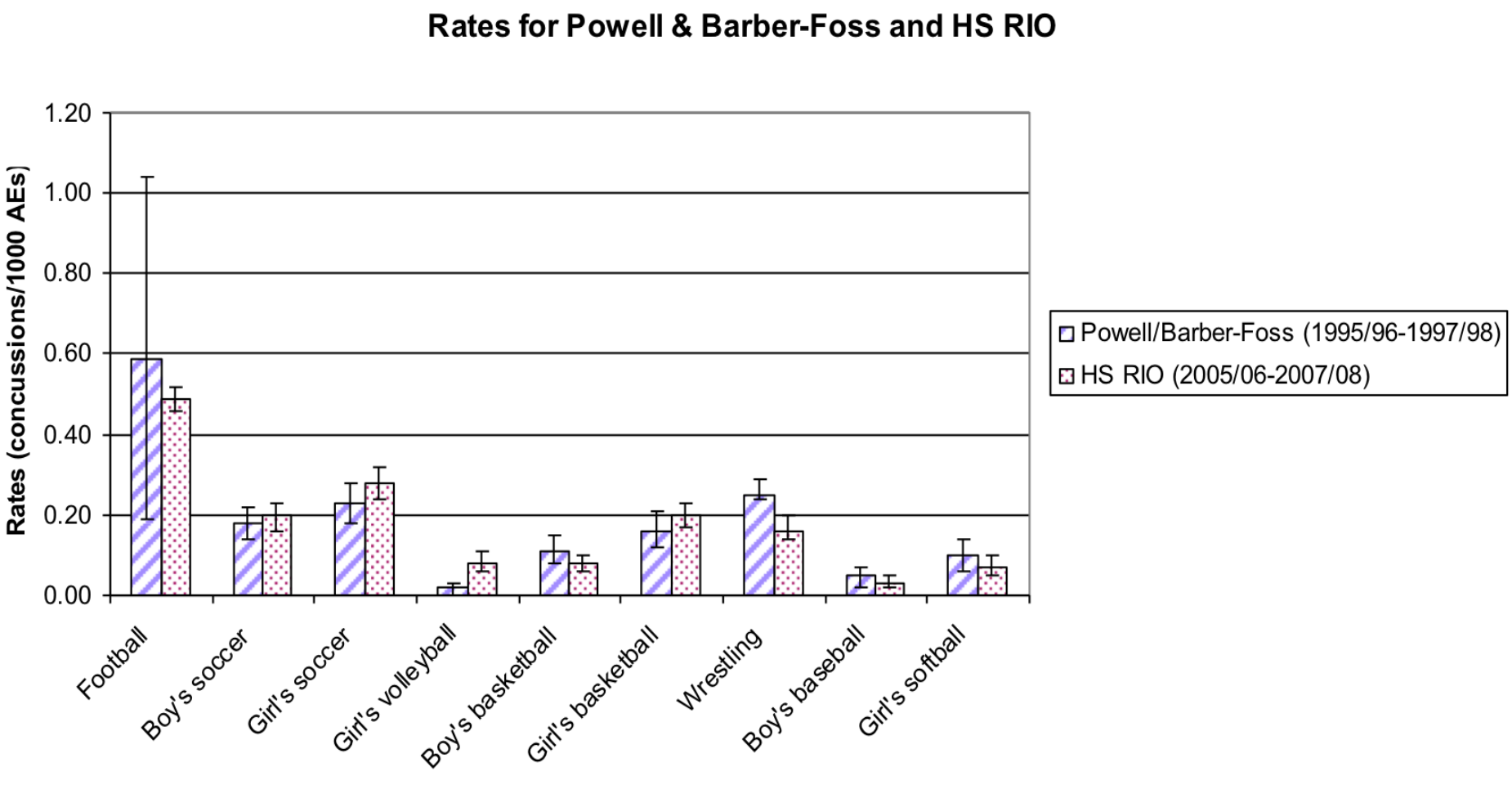
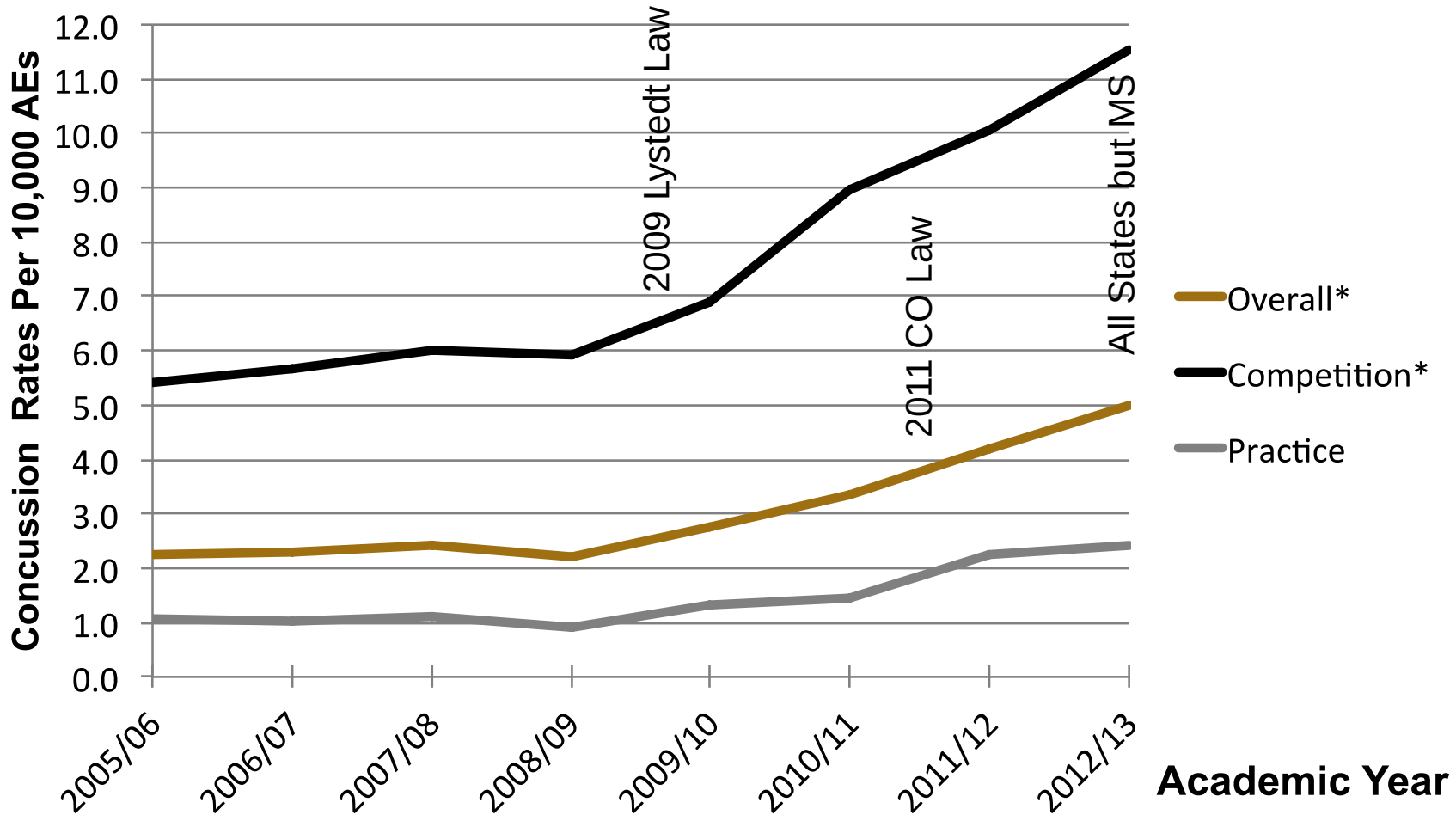
Change Over Time Actually More Recent



Effect of State Level Concussion Legislation?



*significant increase over time

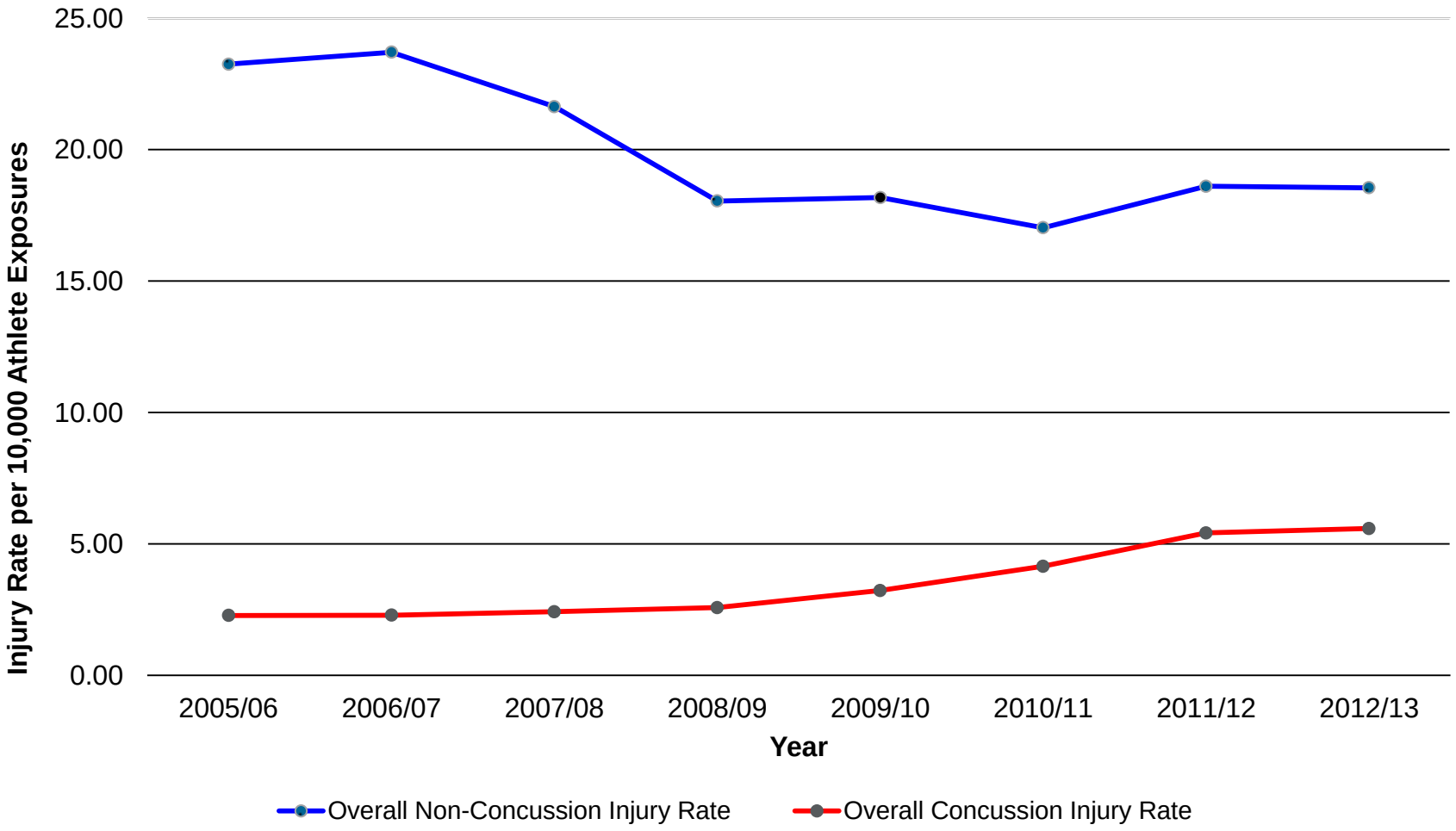
Multiple Factors Driving Change?

- Education of coaches, parents and athletes
- Changes in practice policies and tackling technique
- Clinical coverage
- Policies, rules, regulations

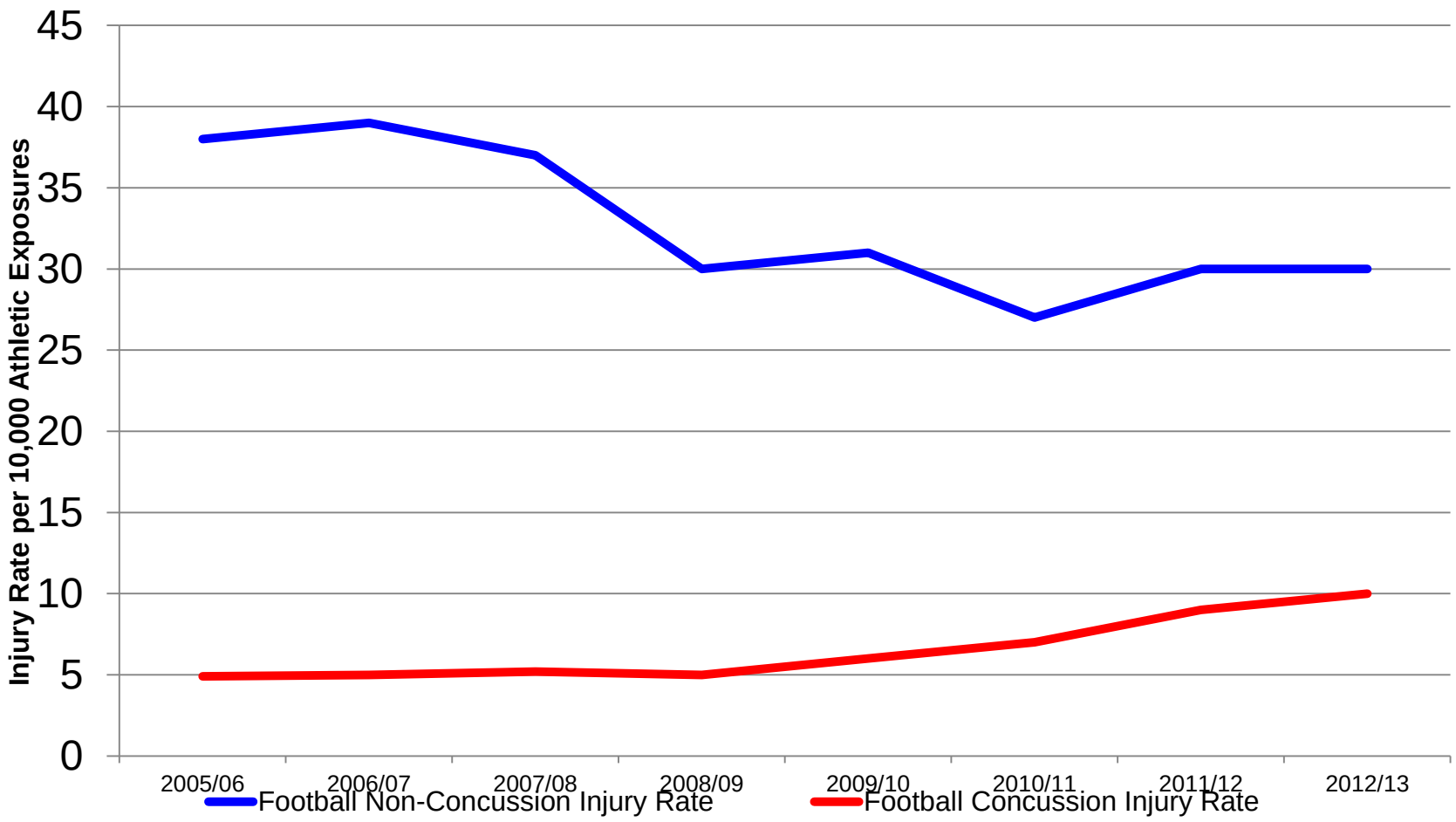
Current Concussion Research

- Cuts across all areas
  - Clinical
  - Biostatistics
  - Epidemiology
  - Community & Behavioral Health
  - Health Systems Management & Policy
  - Environmental Health

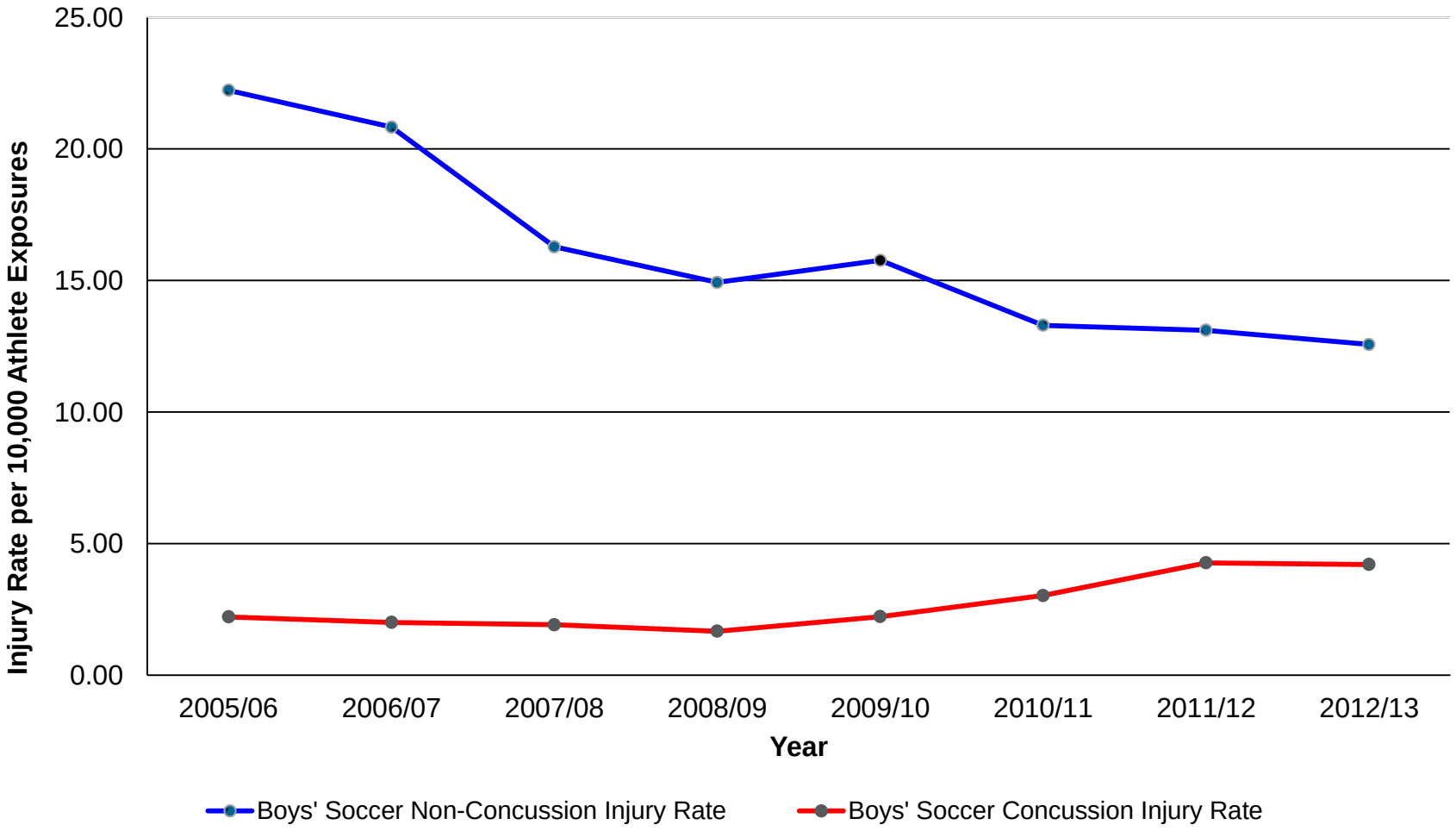
Trends Over Time: All Sports



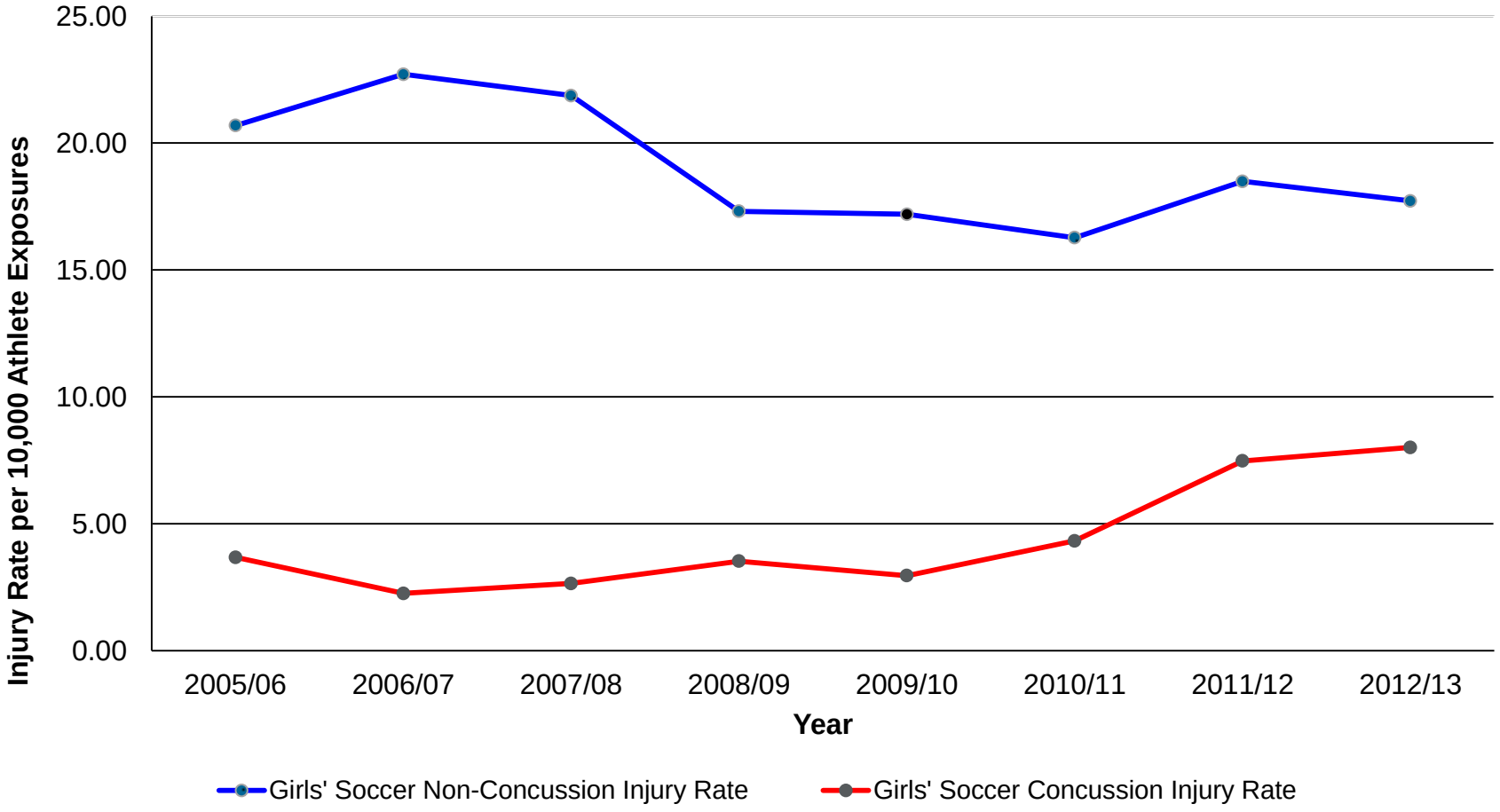
Trends Over Time: Football



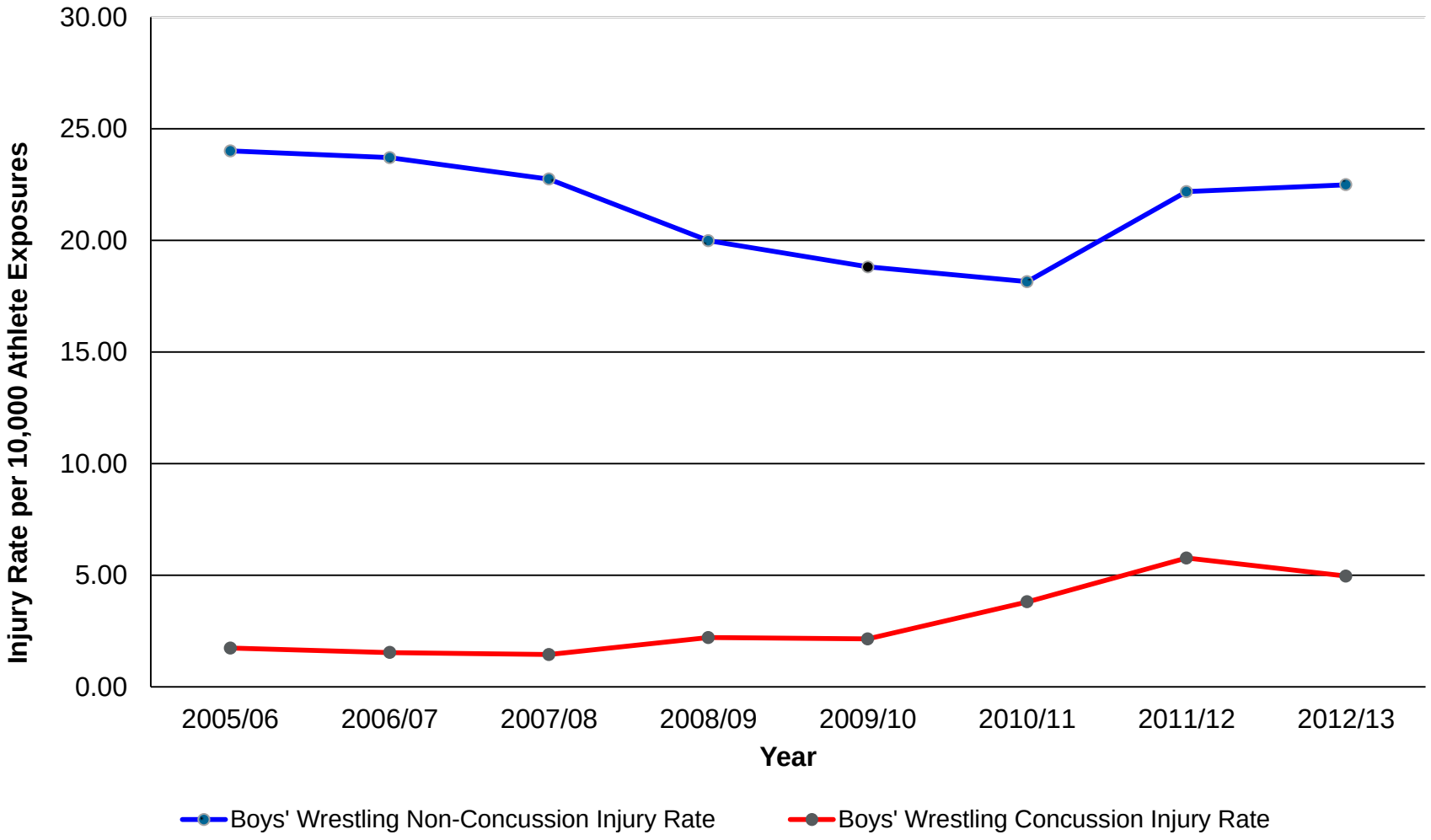
Trends Over Time: Boys' Soccer



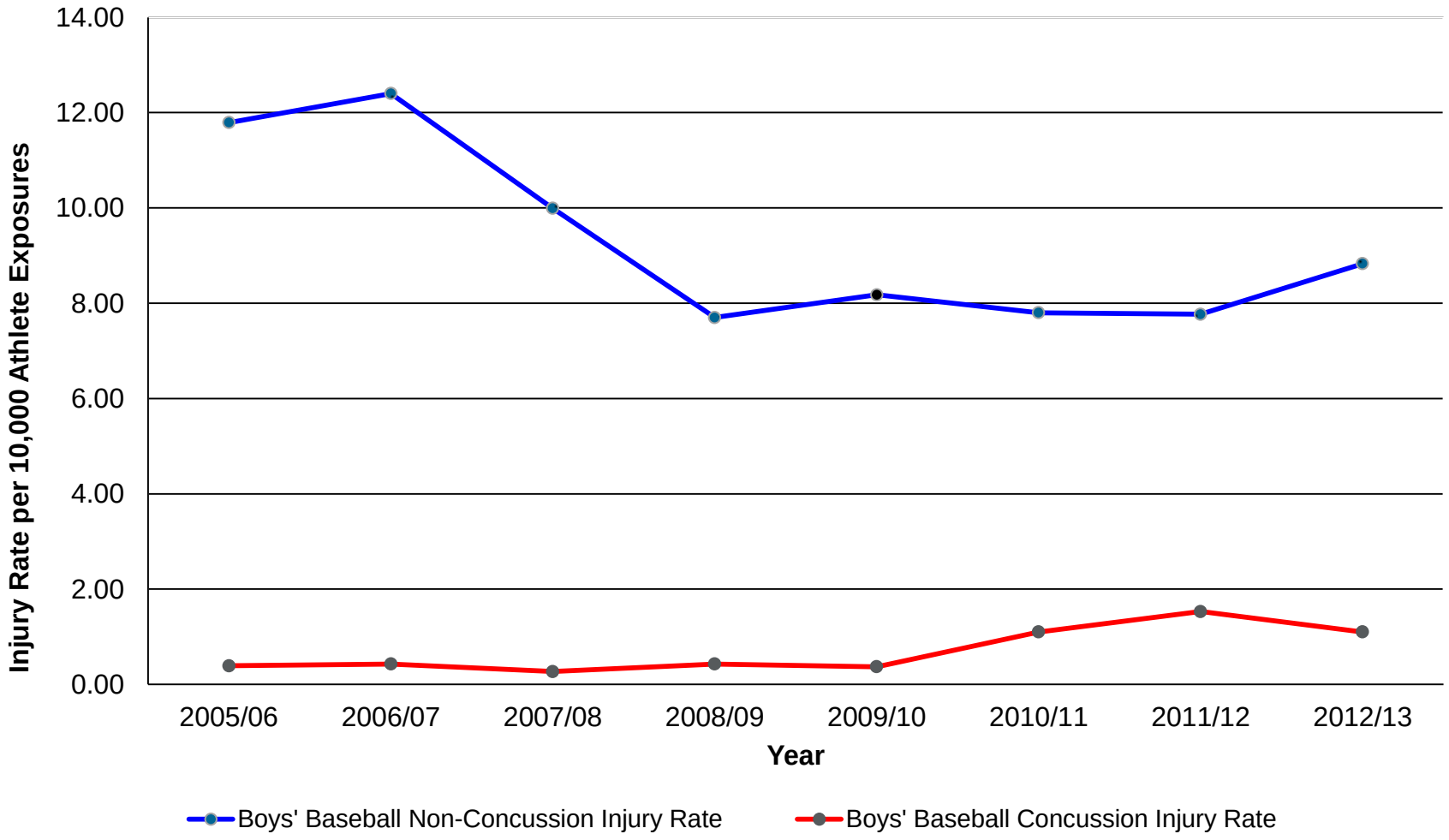
Trends Over Time: Girls' Soccer



Trends Over Time: Wrestling



Trends Over Time: Baseball



Trends Over Time: Compliance with Return to Play Guidelines (All Sports)

% of Student Athletes in Each Category of RTP by Year

	07/08	08/09	09/10	10/11	11/12	12/13
<1 day	7.9	2.6	1.5	0.8	1.8	0.6
1-2 days	6.7	6.4	3.9	2.4	1.9	0.8
3-6 days	21.4	19.5	17.9	12.9	8.9	8.3
Season ended	0.8	0.1	8.7	12.2	14.2	14.5
Athlete decides not to continue	0.4	1.4	1.2	1.4	1.9	1.9

Trends Over Time: Compliance with Return to Play Guidelines (Football)

% of Student Athletes in Each Category of RTP by Year

	07/08	08/09	09/10	10/11	11/12	12/13
<1 day	11.1	3.3	0.8	0.8	1.7	0.2
1-2 days	5.4	3.8	4.9	2.2	1.8	0.7
3-6 days	20.5	21.3	17.5	12.8	8.1	9.0
Season ended	0.0	0.0	8.8	12.6	10.9	13.5
Athlete decides not to continue	0.7	2.5	1.4	1.2	2.2	2.1

Current Sources of Pediatric Sports-Related TBI Epidemiologic Data

- 2013 IOM Report
  - "The National Collegiate Athletic Association Injury Surveillance System and High School RIO™ (Reporting Information Online) data systems are the only ongoing, comprehensive sources of sports-related injury data, including data on concussions, in youth athletes." p. 6
  - "Currently most of the reported epidemiologic data on sports-related concussions in youth come from three surveillance systems…" p. 23
    - *"National Electronic Injury Surveillance System – All Injury Program (NEISS-AIP)*
    - *NCAA Injury Surveillance System (NCAA ISS)*
    - *High School RIO™ (Reporting Information Online)"*

Other Historical Sources of Pediatric Sports-Related TBI Epidemiologic Data

- NCCSIR – UNC
  - Catastrophic only
- Inpatient hospital data
  - The most severe, biased toward young age, limited cause info
- ED data
  - Only 33% present to ED (31% outpatient clinics, 28% urgent care)
  - Large % never present for care outside AT setting
- Clinic data
  - More severe, biased re: SES, reflects variation among clinicians
  - ICD codes and costs vary by clinical setting
    - *ED, 68% head injury unspecified and $1,185 average charge*
    - *Outpatient clinics, 72% concussion and $394 average charge*
- Small surveillance efforts (Fairfax County, etc.)
  - Generalizability?

Newer Sources of Pediatric Sports-Related TBI Epidemiologic Data

- Datalys NATA NATION
  - National injury surveillance, treatment, and outcomes
- AT CORE
  - Regional injury surveillance, treatment, and outcomes
- State of Maine
- South Florida
- Southern California

- And many more coming on-line…

Gaps/Weaknesses in Current Sources of Data

- 2013 IOM Report
  - "…there is currently a lack of data to accurately estimate the incidence of sports-related concussions across a variety of sports and for youth across the pediatric age spectrum." p. 2
  - "A major limitation to existing data on sports-related concussions in youth is a lack of research on the incidence of such injuries in nonacademic settings, such as in intramural and club sports, and for athletes younger than high school age." p. 2
  - "…studies of sports-related concussions in youth do not routinely include information on the race, ethnicity, or socioeconomic status of the participants." p. 6
  - "There is currently no comprehensive system for acquiring accurate data on the incidence of sports and recreation-related concussions across all youth age groups and sports." p. 6

Gaps/Weaknesses in Current Sources of Data from a Feasibility Standpoint

- No way to link existing data sources consistently, effectively, and inexpensively
- No way to follow individual athletes
  - Across sports
  - Across systems
  - As they age
- No consistent definition of concussion

- Not everyone wants to “play together”

Where We Need to Go

- 2013 IOM Report Recommendation 1
  - "The [CDC], taking account of existing surveillance systems and relevant federal data collection efforts, should establish and oversee a national surveillance system to accurately determine the incidence of sports-related concussions, including those in youth ages 5 to 21. The data collected should include, but not be limited to, demographic information (e.g., age, sex, race and ethnicity), pre-existing conditions (e.g., [ADHD], learning disabilities), concussion history (number and dates of prior concussions), the use of protective equipment and impact monitoring devices, and the qualifications of personnel making the concussion diagnosis."

Where We Need to Go - Continued

- 2013 IOM Report Recommendation 1 continued
  - "Data on the cause, nature, and extent of the concussive injury also should be collected, including
    - *Sport or activity*
    - *Level of competition (e.g., recreational or competitive level)*
    - *Event type (e.g., practice or competition)*
    - *Impact location (e.g., head or body) and nature (e.g., contact with playing surface, another player, equipment)*
    - *Signs and symptoms consistent with a concussion"*

What the IOM Missed

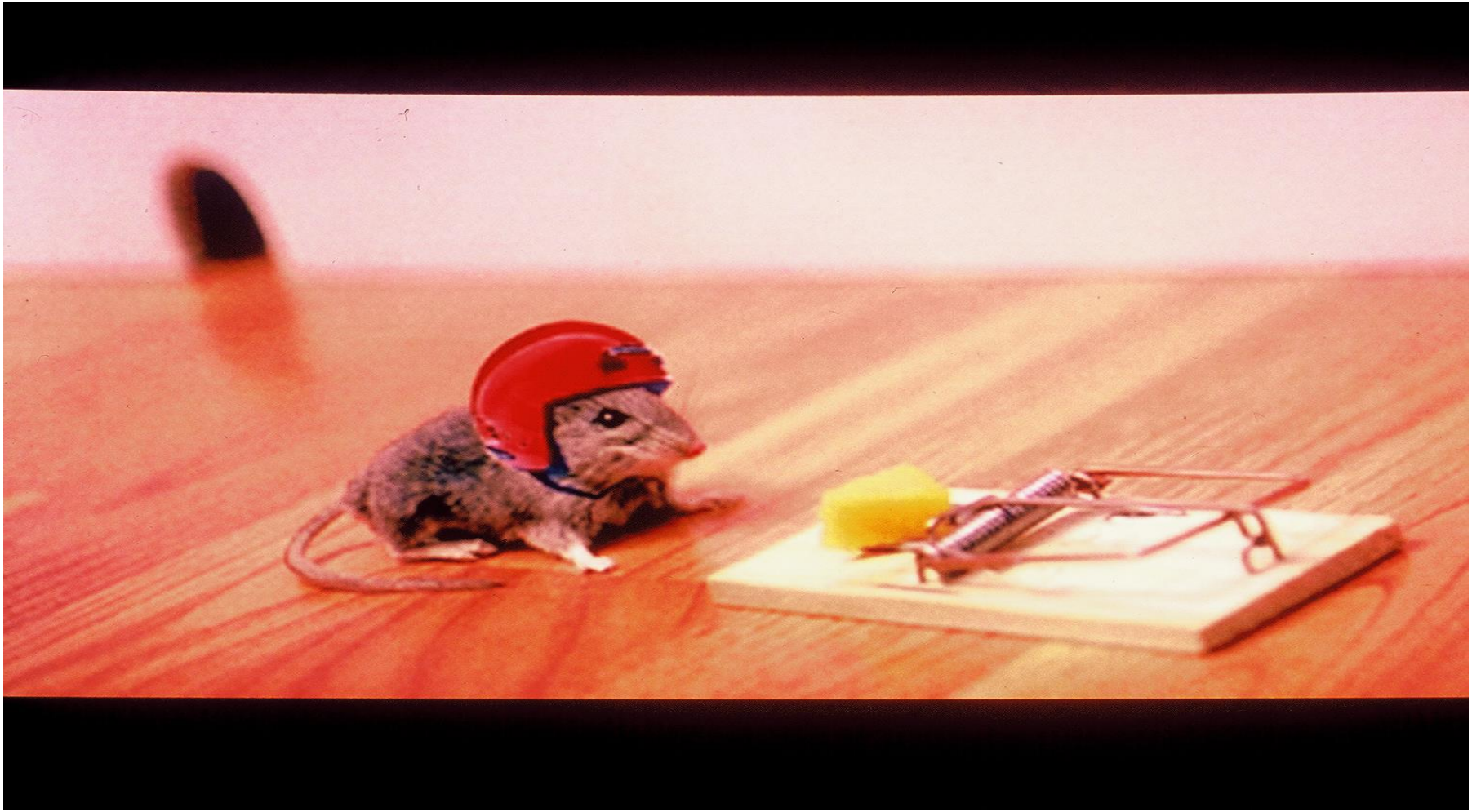
- Need to be able to follow individual athletes throughout their playing years and on over the course of their lifespan to monitor concussion history and both short and long term outcomes
  - Health – physical and emotional
  - Academic experience/career success
  - Social connections
  - Quality of life
  - Economic

Challenges We Can and Must Meet

- Lack of a definitive, objective diagnostic tool
- Lack of mandated reporting at any level
- Technical issues
  - Current lack of a universal data collection system
  - Current lack of a GUID system
  - Inability to easily link various record systems
- "Process" issues
  - HIPPA and FERPA
  - IRB approval
  - Reluctance to report data
  - Lack of qualified data reporters
  - Lack of funding

"… and it did a world of good which never became manifest"

Charles Dickens, A Tale of Two Cities



dawn.comstock@ucdenver.edu