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SCHOOL OF MEDICINE AND PUBLIC HEALTH

The Impact of Sport Specialization on Lower Extremity Injury Rates in High School Athletes

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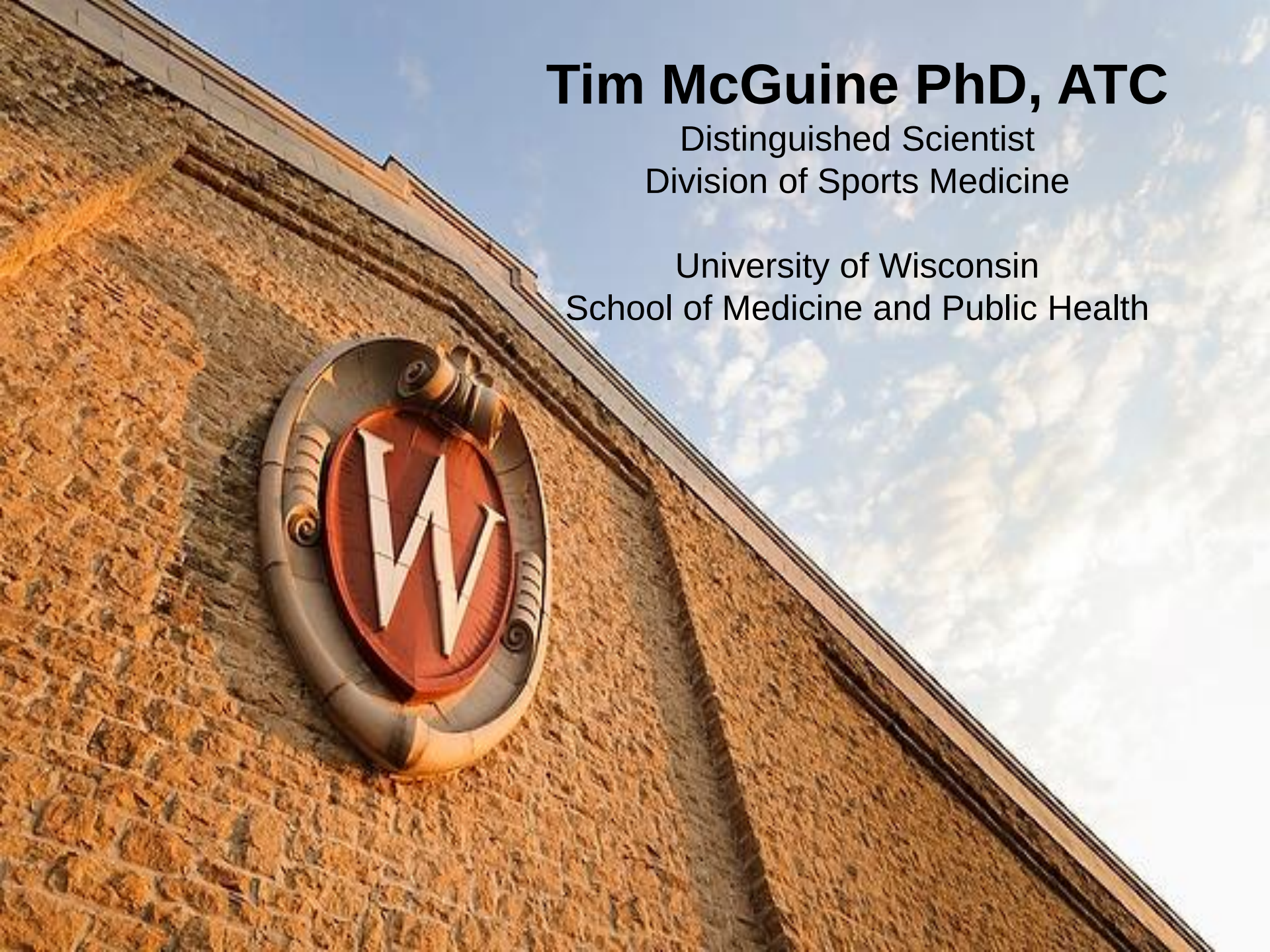

Tim McGuine PhD, ATC

Distinguished Scientist
Division of Sports Medicine

University of Wisconsin
School of Medicine and Public Health

COI – Disclosures

Neither I, nor any family member(s), have any relevant financial relationships to be discussed, directly or indirectly, referred to or illustrated within the presentation.

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Mueller Sports Medicine Inc. Prairie du Sac, WI. 2009, 2010, 2014
Don-Joy Inc. Vista, CA. 2012

Previous Research support

Don-Joy Inc. Vista, CA. 2010

Current Research Support

NATIONAL FEDERATION
STATE HIGH SCHOOL
ASSOCIATIONS

NATA
RESEARCH &
EDUCATION
FOUNDATION
25th ANNIVERSARY

NOCSAE
National Operating Committee on Standards for Athletic Equipment

WISCONSIN
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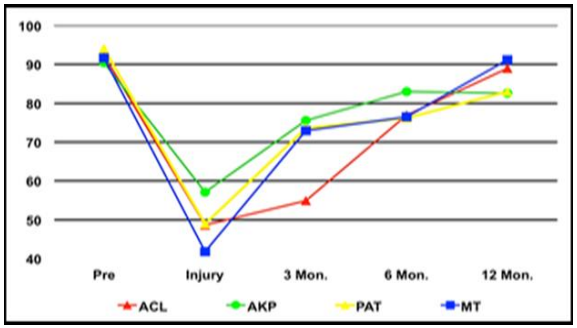
Affiliations

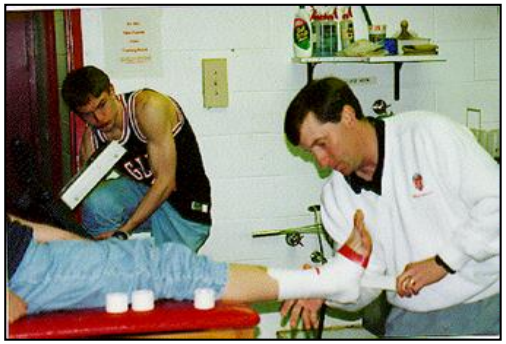
WIAA – Medical Advisory Committee

NATA – REF - Research Review Panel

NFHS – Sports Medicine Advisory Committee

Background and Perspectives



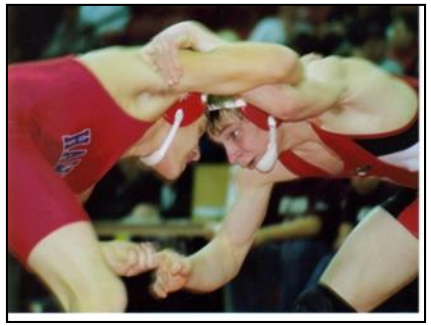


Admitting “my bias”

Family Experience with High School Athletics

36 Varsity Sport Seasons,
Hundreds of athletic competition

9 years of: Baseball, Basketball, X Country, Football, Gymnastics, Lacrosse, Swimming, Track, Wrestling



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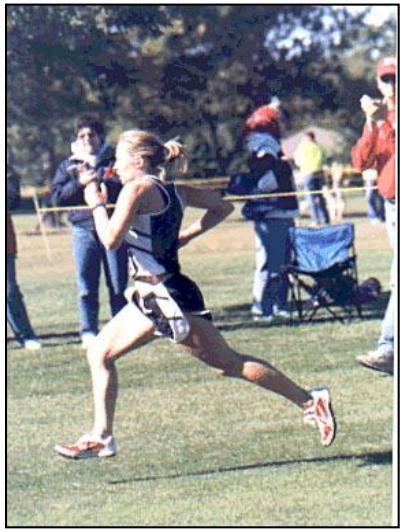
Benefits of High School Athletics



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Sport Specialization……Background

Anecdotes from the "*Front Lines*"

"Our team's post season has been negatively impacted each the last 2 years by club sport injuries…"

"I competed in 84 soccer games my senior year...."

"We can't get enough girls to play basketball at our school because of club volleyball…."

"Club sports always make my job more difficult…"

"If my son doesn't play baseball in the fall, they won't let him play in the spring…."

My daughter just wants to make her varsity team…."

Sport Specialization Concerns

SPORTS

The Age of Single-Sport Athletes Endures Despite Detractors' Suspicions

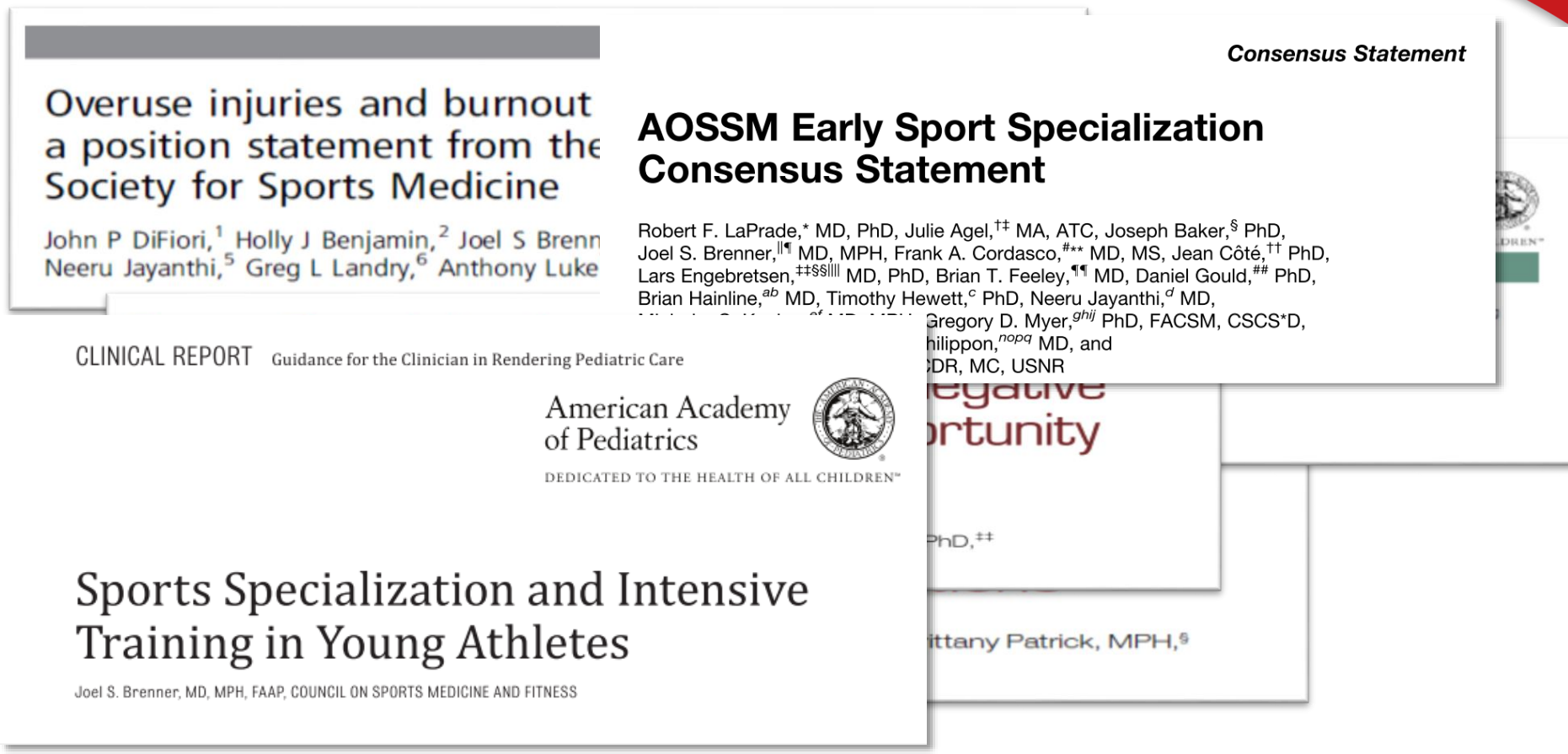
By THE ASSOCIATED PRESS APRIL 30, 2016

Harrison Heffley, an Arkansas athlete, is one of a shrinking number of high school students who play multiple sports. Kurt Voigt/Associated Press

Specialization "is not about getting a college scholarship anymore," he said, adding: "It's about just getting playing time at their high school with their peers now. That's the way we've made it, and it's a real shame."

-Tim McGuine

New York Times: April 30, 2016



Overuse injuries and burnout
a position statement from the
Society for Sports Medicine

John P DiFiori,[1] Holly J Benjamin,[2] Joel S Brenn
Neeru Jayanthi,[5] Greg L Landry,[6] Anthony Luke

Consensus Statement

AOSSM Early Sport Specialization Consensus Statement

Robert F. LaPrade,* MD, PhD, Julie Agel,[†‡] MA, ATC, Joseph Baker,[§] PhD, Joel S. Brenner,[‖¶] MD, MPH, Frank A. Cordasco,[#**] MD, MS, Jean Côté,[††] PhD, Lars Engebretsen,[‡‡§§‖‖‖] MD, PhD, Brian T. Feeley,[¶¶] MD, Daniel Gould,[##] PhD, Brian Hainline,[ab] MD, Timothy Hewett,[c] PhD, Neeru Jayanthi,[d] MD, Gregory D. Myer,[ghij] PhD, FACSM, CSCS*D, hilippon,[nopq] MD, and DR, MC, USNR

CLINICAL REPORT Guidance for the Clinician in Rendering Pediatric Care

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

Sports Specialization and Intensive Training in Young Athletes

Joel S. Brenner, MD, MPH, FAAP, COUNCIL ON SPORTS MEDICINE AND FITNESS

egative
ortunity

PhD,[‡‡]

ittany Patrick, MPH,[§]

Position Statements

Consensus statement

International Olympic Committee consensus statement on youth athletic development

Michael F Bergeron,[1,2] Margo Mountjoy,[3,4] Neil Armstrong,[5] Michael Chia,[6]

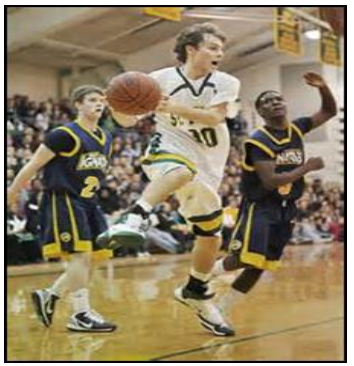
"Encourage children to participate in a variety of different unstructured (ie, deliberate play) and structured age-appropriate sport-related activities and settings, to develop a wide range of athletic, social skills and attributes……."

AOSSM Early Sport Specialization Consensus Statement

Robert F. LaPrade,* MD, PhD, Julie Agel,†‡ MA, ATC, Joseph Baker,§ PhD,

"Early sport specialization has not been shown to be beneficial for high-caliber athletic performance at the national team / Olympic / professional levels, and in fact may be detrimental."

"Specialized athletes are subject to overuse injury and burnout from concentrated activity."



AMSSM Position Statement

[Primary Care]

Sport Specialization, Part I: Does Early Sports Specialization Increase Negative Outcomes and Reduce the Opportunity for Success in Young Athletes?

Gregory D. Myer, PhD,*†‡§‖ Neeru Jayanthi, MD,¶# John P. Difiori, MD,**

"Increased degree of specialization is positively correlated with increased serious overuse injury risk."

"Youth should be encouraged to participate in a variety of sports during their growing years to influence the development of diverse motor skills…."

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Recent Evidence

Jayanthi NR and Labella C. Sport specialized training and risk of injury - *Am J Sports Med* 2015

Hall. Sports Specialization and Anterior Knee Pain in Females - *J Sport Rehab* 2015

Sport Specialization - Defined

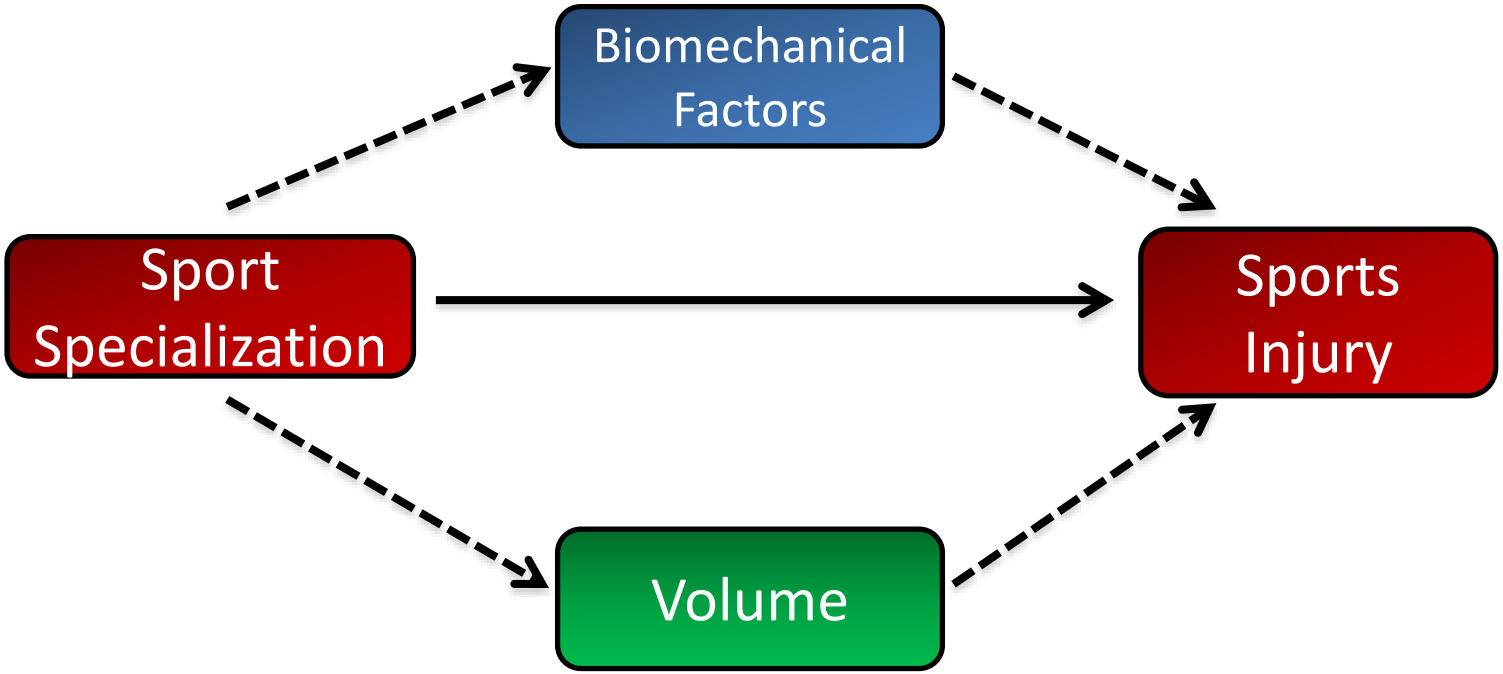
"year-round intensive training in a single sport at the exclusion of other sports".

Sport Specialization

≠

Single Sport Participation

Theoretical Model For Specialization and Injury



Research

The effects of specialization and sex on anterior Y-Balance performance in high school athletes - *In review*

High School Sport Specialization Patterns of Current Division I Athletes - *Sports Health* 2016

Prevalence of Sport Specialization in High School Athletics - *Am J Sports Med* 2016

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Specialization Scale (Jayanthi)

Do you train more than 75 percent of the time in your primary sport?	YES NO
Do you train to improve skill and miss time with friends as a result?	YES NO
Have you quit another sport to focus on one sport?	YES NO
Do you consider your primary sport more important than your other sports?	YES NO
Do you regularly travel out of state for your primary sport?	YES NO
Do you train more than eight months a year in your primary sport?	YES NO

Score: 0 – 3 = Not Specialized (NoSPEC), 4 - 6 = Specialized (YesSPEC)

Have you quit another sport to focus on one sport?	YES NO
Do you consider your primary sport more important than your other sports?	YES NO
Do you train more than eight months a year in your primary sport?	YES NO

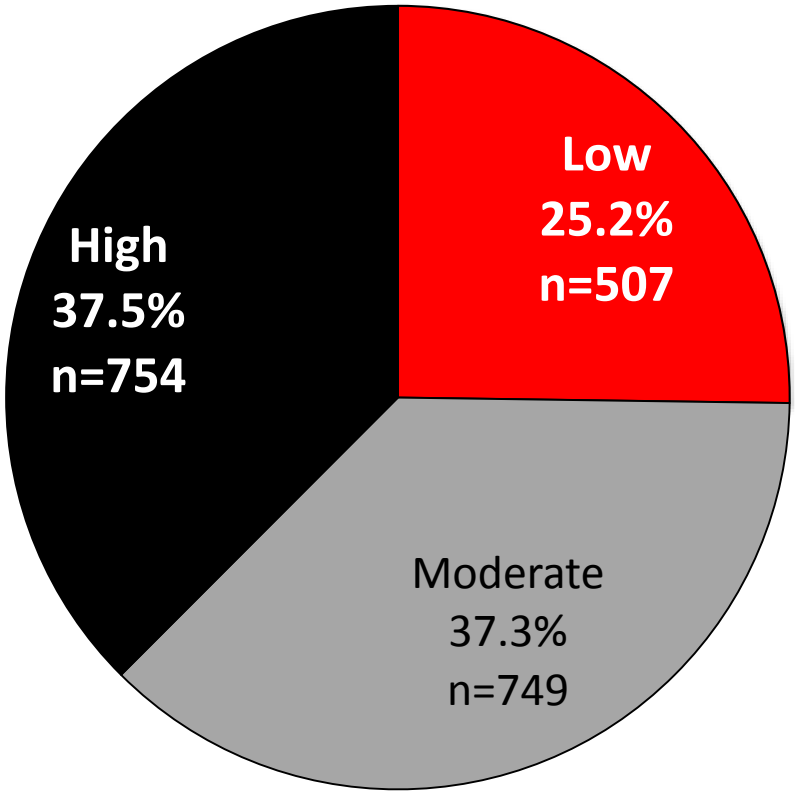
Score: 0,1 = Low Specialization (LOW)
2 = Moderate Specialization (MOD)
3 = High Specialization (HIGH)

Jayanthi, *AJSM* 2015

The Association of Sport Specialization and Training Volume With Injury History in Youth Athletes

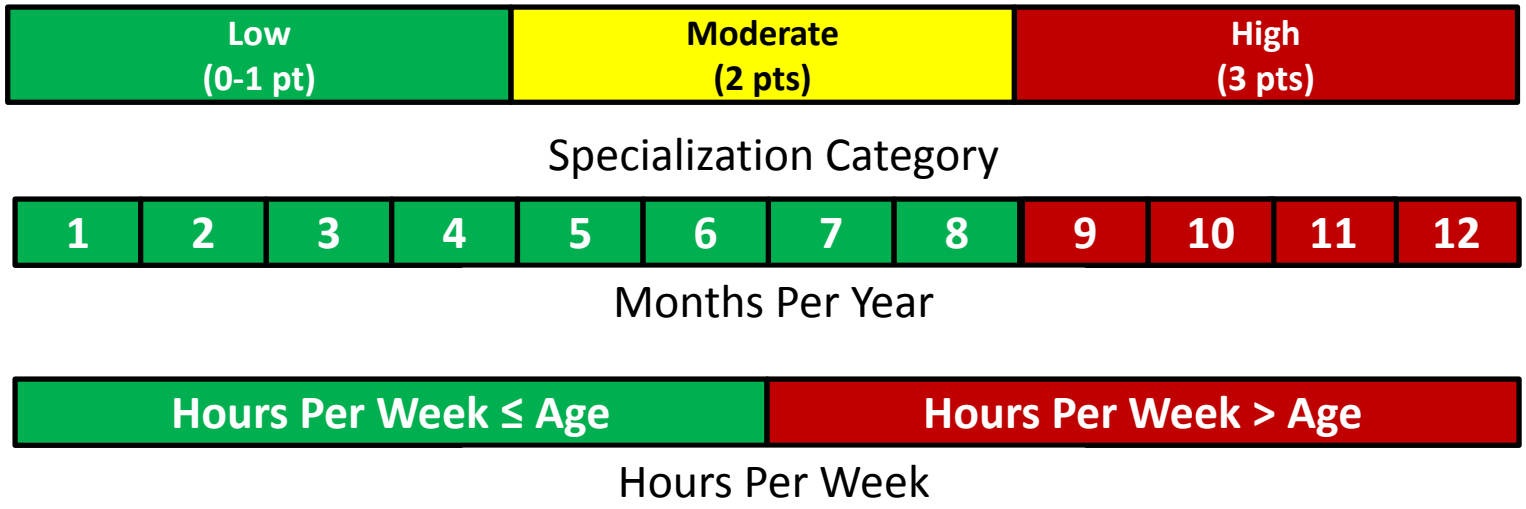
- 2011 youth athletes
- 12-18 years of age
- 49% (n=989) female and 51% (n=1022) male
- Mean age 13.7 ± 1.6 years
- Anonymous survey at local youth sport tournaments
  - Sport specialization scale
  - Sport participation volume
  - Injury history in the previous year

Prevalence of Specialization



Similar to high school data, where 36.4% (n=110) of participants were highly specialized.

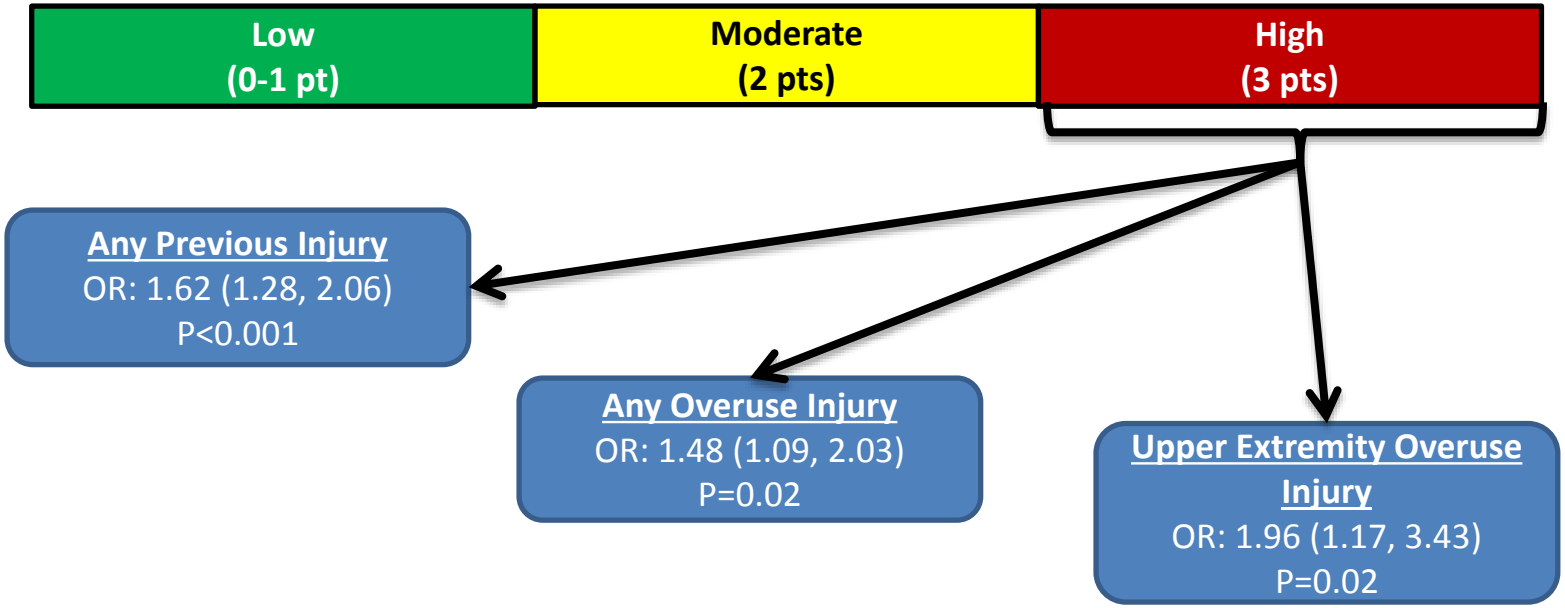
Statistical Analysis



- Logistic regression to calculate odds ratios between specialization/volume and injury history (past 12 months)

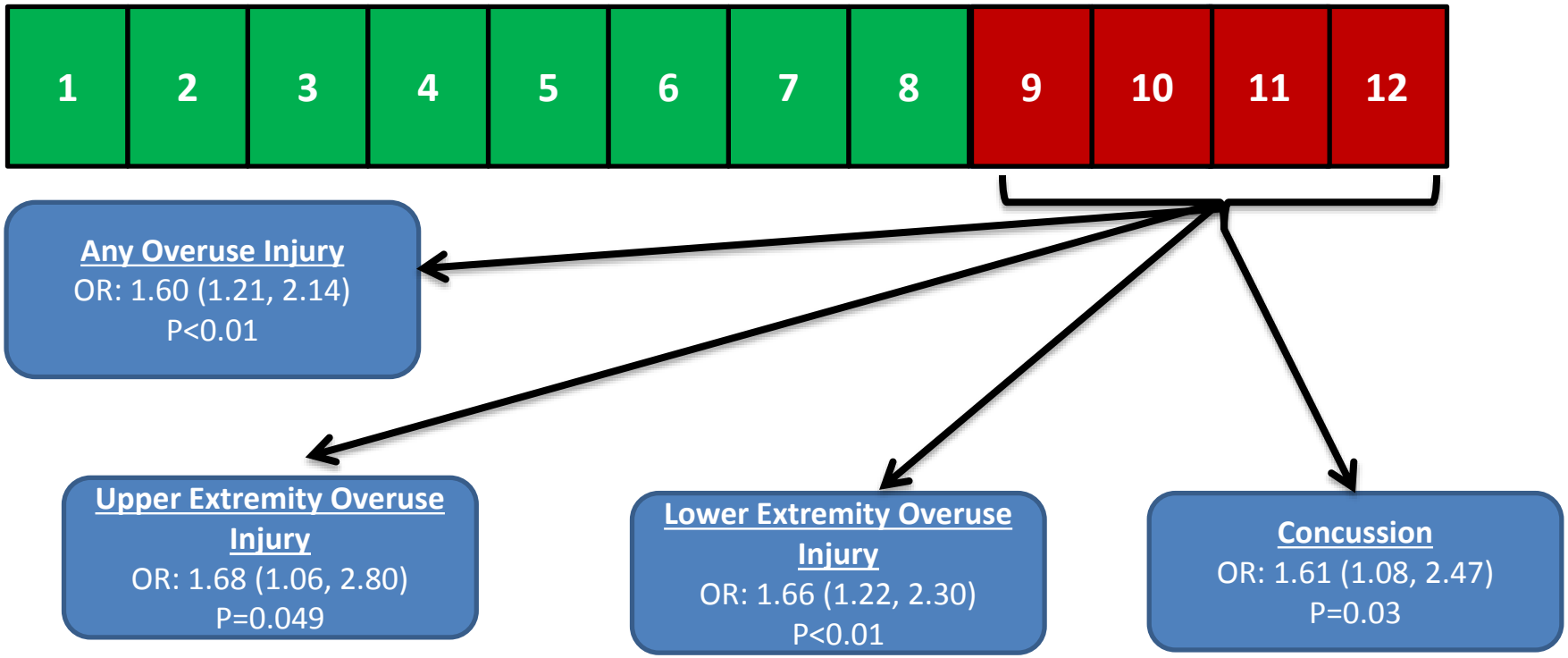
  All analyses adjusted for age and gender

Specialization and Injury



Post et al, *AJSM, In Press*

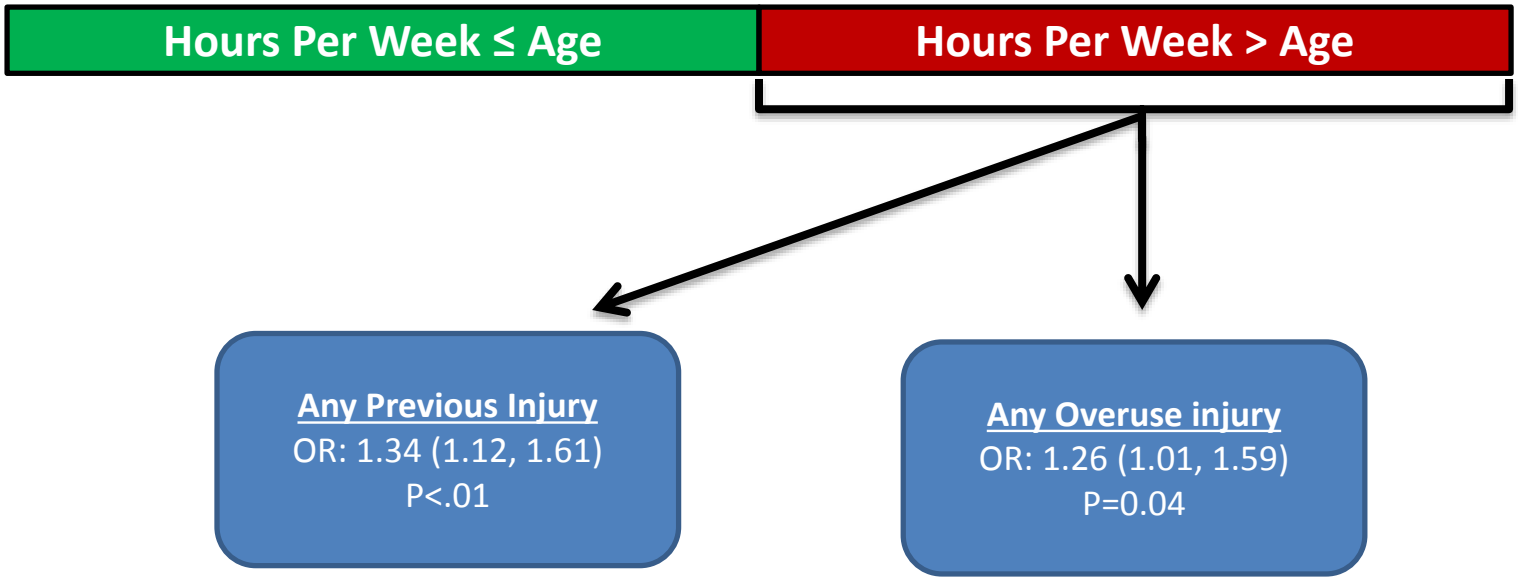
Months Per Year and Injury



*All analyses adjusted for age and gender

Post et al, *AJSM, In Press*

Hours per Week and Injury



Post et al, *AJSM, In Press*

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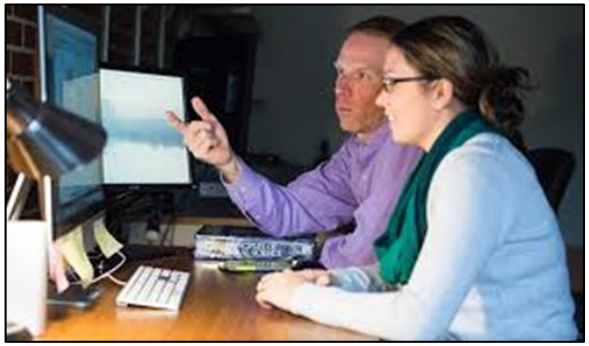
Summary

- **Prevalence of specialization depends on multiple factors**
  - Female
  - Peaks around age 15
  - Large school
- **High levels of specialization increase:**
  - Chances of burnout (Jayanthi 2013)
  - High sport volume training
  - Movement asymmetry
  - Overuse injury risk

Previous Research

Limitations:
- Small studies
- Convenience samples
- Retrospective designs
- Descriptive findings
- Limited injury focus
- Simple analyses



Alternatives:
- Prospective design
- Population samples
- Direct data collection
- Broad injury focus
- Rigorous data analyses

Solution….. a New study

Prospective

Diverse school sample

Enroll actual athletes from multiple sports

Collect baseline data and record all exposures

Licensed medical providers (AT's) collect data on specific injuries (lower extremity).

Analyses include: Multivariate analyses with Cox Proportional Hazard Modeling

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Funding


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MEDICAL
SOCIETY FOR
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METHODS

Data collection: 2015/16 academic year

Sites: 29 WI high schools ATs in with WISIRN

Subjects: (male and female, interscholastic athletes in grades 9-12).

Baseline Data: Previous time loss LEI

Club and interscholastic sports

Primary Sport

Competition volume

Specialization Scale (Jayanthi)

Daily Athletic Exposures (AE): All practices and games.

Injury Data: AT's record onset, injury type, days lost etc.

Analyses: %, days lost due to injury (Med [IQR 25^{th},75^{th}], Odds Ratios (OR, [95%CI]) Chi Square, Fishers exact tests, Cox hazards models.

Specialization Scale (Jayanthi)

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RESULTS

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Results

1,544 Subjects

(Female = 50%, Age =16.0 ± 1.1)

2,843 Athletic Seasons

167,349 Athletic Exposures

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School Size and Setting

School size (Enrollment)	Rural	Suburban	Urban	Total
SMALL (< 500)	8	1	1	10
MEDIUM (501- 1000)	5	4	1	10
LARGE (> 1,000)	1	7	1	9
Total	**14**	**12**	**3**	**29**

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Subject Demographics

Variables	(%)	Variables	(%)
Sex		**Previous LEI***	
Female	50.5	No	68.3
Male	49.5	Yes	31.7
Grade		**Primary sport league**	
9	27.1	No	50.3
10	27.1	Yes	49.2
11	24.7		
12	20.1	**Primary sport competitions**	
Primary Sport		Low (< 30)	52.8
Base / Softball	8.5	Moderate (30 - 60)	30.0
Basketball	21.4	High (> 60)	17.2
Football	17.0		
Soccer	20.2		
Tennis	4.3		
Track / XC	4.0		
Volleyball	15.9		
Wrestling	2.3		
Other[1]	11.3		

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Quick Hits!

20% of high school athletes participated in a **single sport**

Females were more likely to specialize

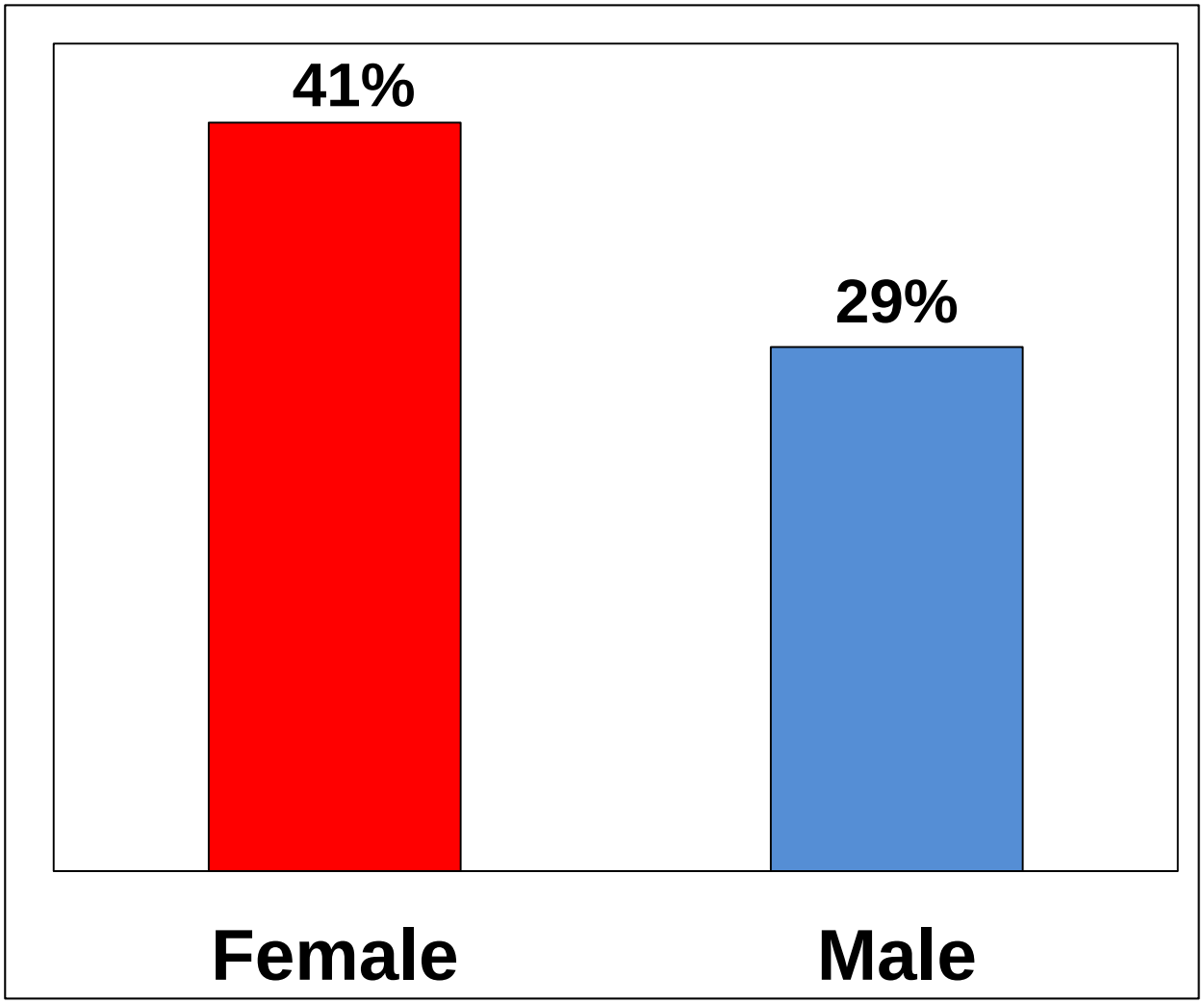
Soccer: highest level of specialization

50% played in a **league outside of school**

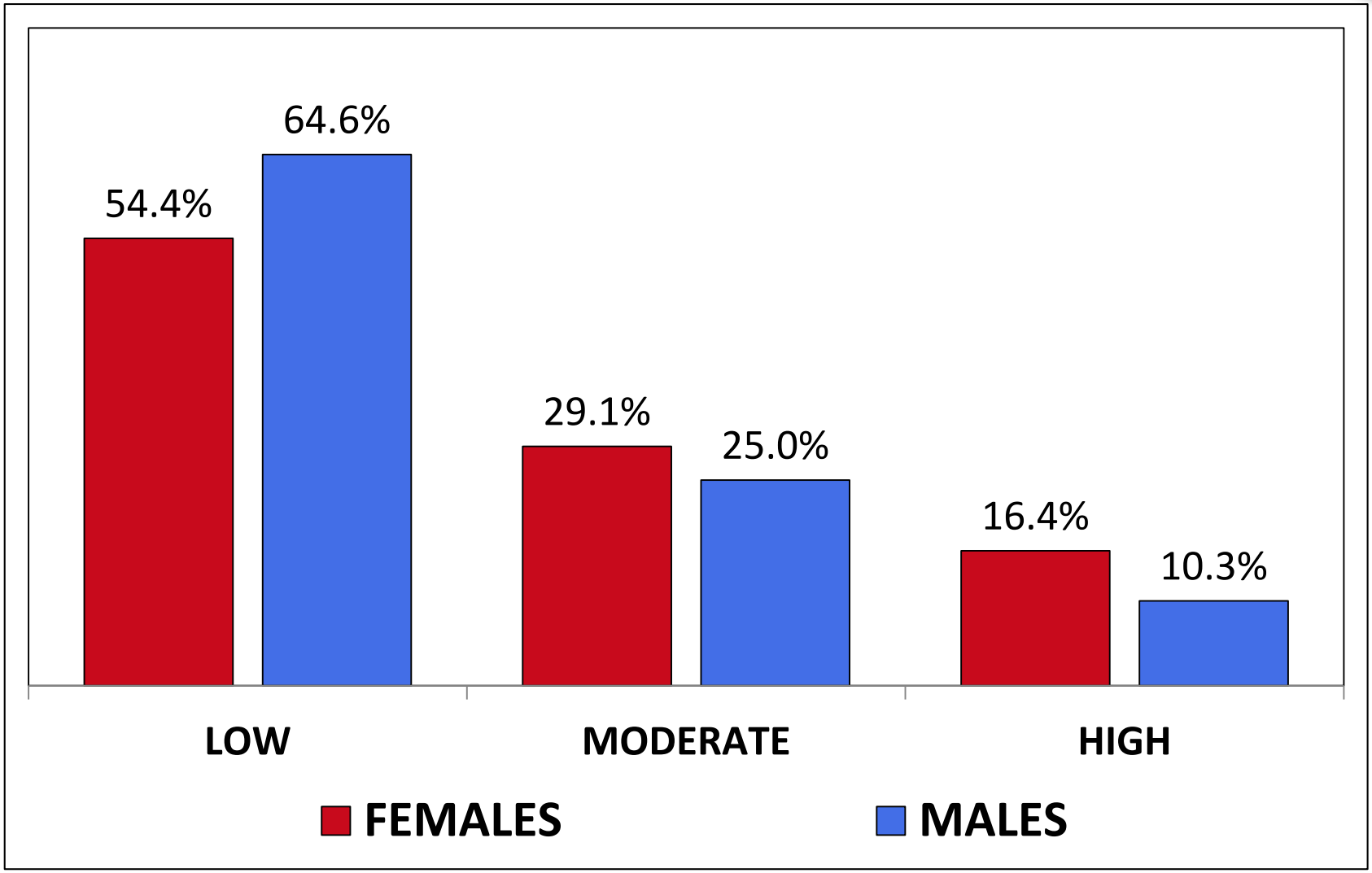
15% competed in a club sport and high school sport **simultaneously**

17% took part in **60 or more primary** sport competitions (school and club) per year

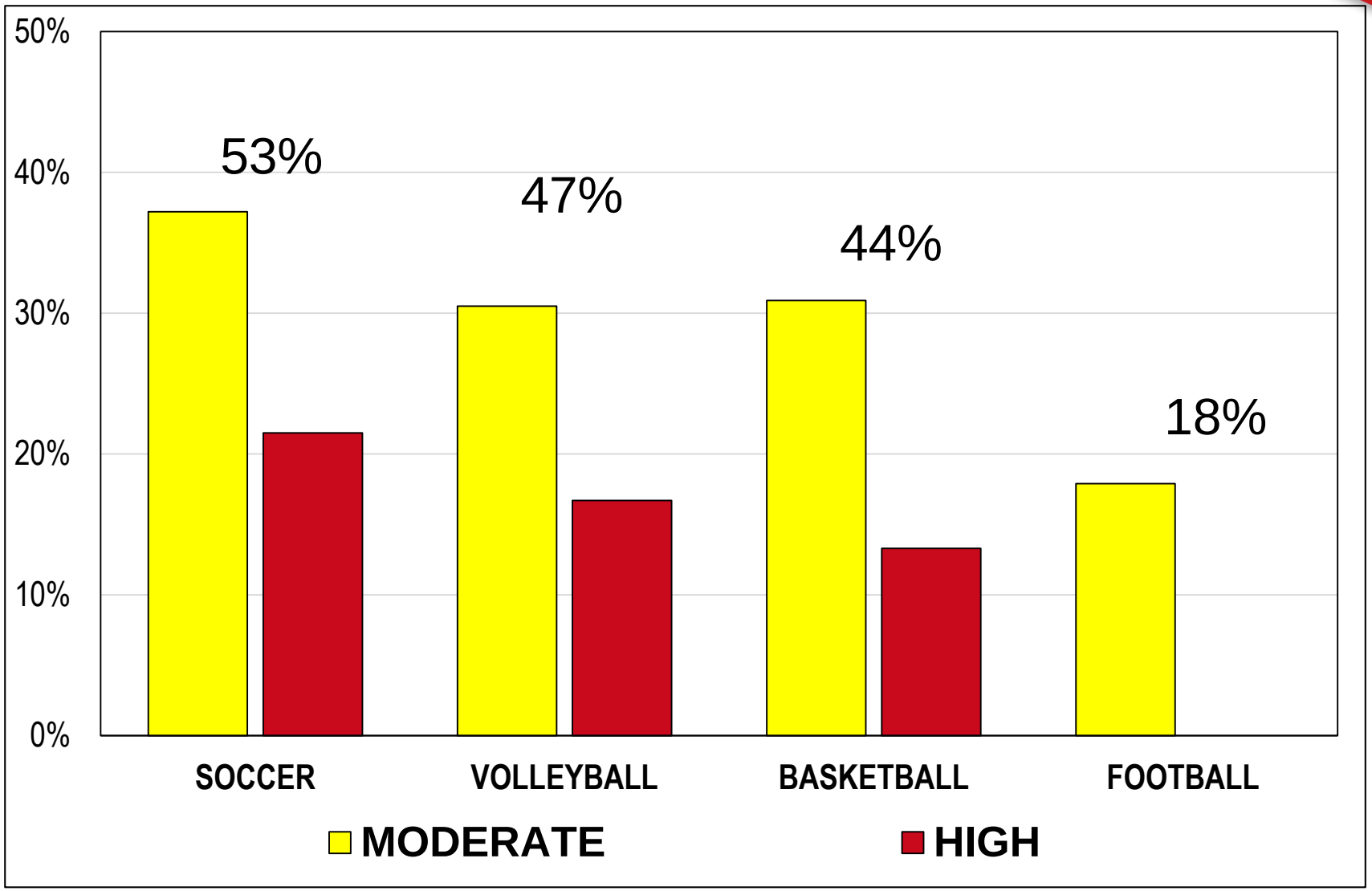
% YesSPEC



Distribution of Specialization



Distribution of Specialization



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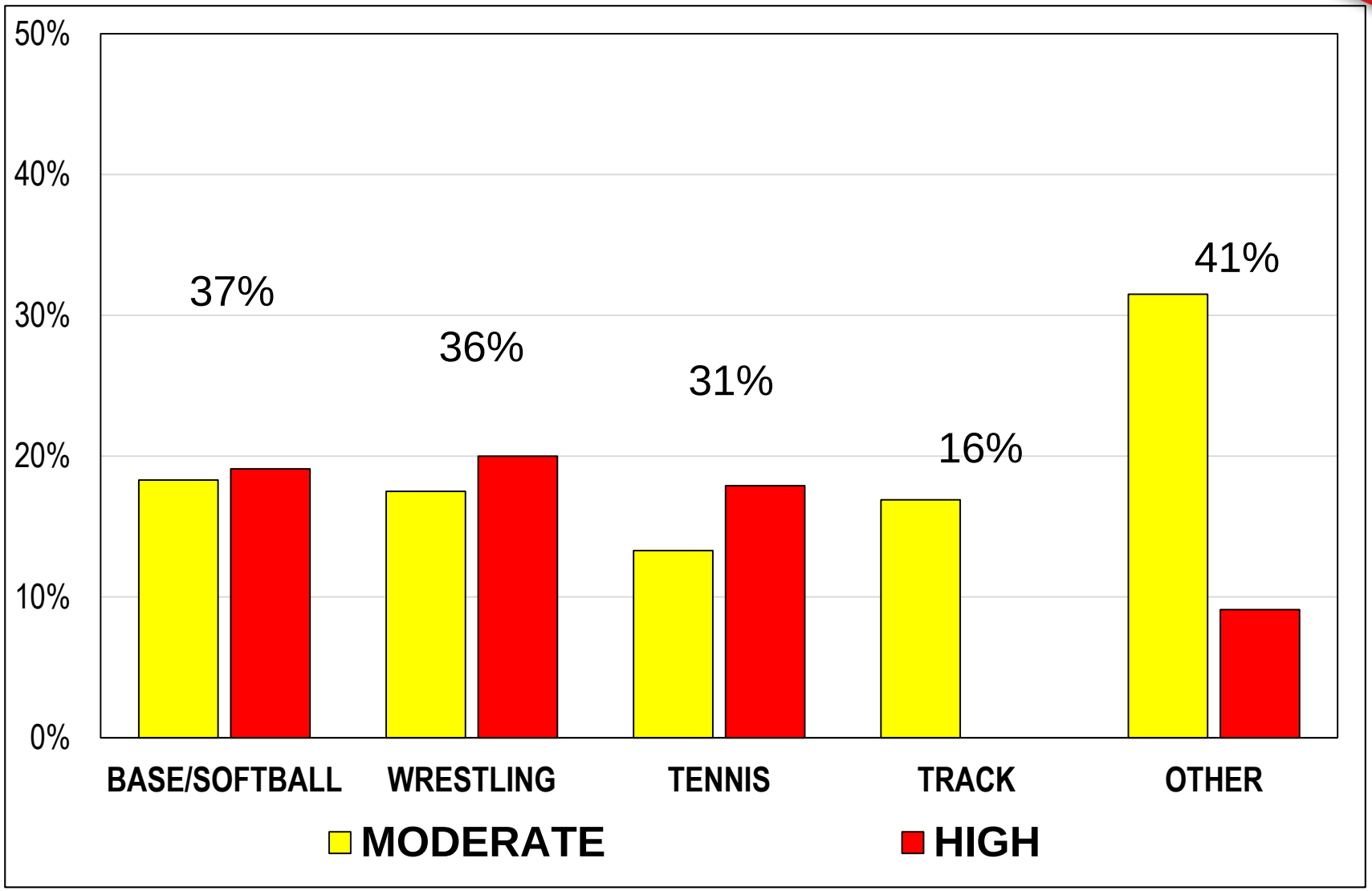
Distribution of Specialization



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Previous LEI – Retrospective Data

Increased previous injuries:

60 primary sport competitions

+ Club sport team,

Highly specialized

"Females more likely to participate in high competition volume, club teams, and be highly specialized, potentially placing them at greater risk for injury."

The Association of Competition Volume, Club Sports, and Sport Specialization with Sex and Lower Extremity Injury History in High School Athletes. Eric Post et. al. *SportsHealth* 2017

New Injuries

A Prospective Study on the Impact of Sport Specialization on Lower Extremity Injury Rates in High School Athletes *Am J Sports Med* - In press

AOSSM

Characteristics of New LEI

Body Area[1]	%
Foot	8.0
Ankle	34.4
Lower Leg	12.0
Knee	25.0
Upper Leg	12.7
Hip / Pelvis	8.0

Injury Onset	%
Acute	66.3
Gradual	23.1
Recurrent	7.9

Injury Type	%
Ligament Sprain	40.9
Muscle / Tendon Strain	25.4
Tendonitis / Tenosynovitis	19.6
Fracture - Stress	3.6
Fracture - Acute	2.9
Meniscus Tear	1.8
Other	5.8

Surgery	%
Yes	8.3
No	91.7

N = 235 Subjects

N = 276 Injuries

Actions Taken for New LEI

Medical provider	%
School AT	67.6
Primary Care Provider	24.1
ER / ED	8.2
Other	1.1

Diagnostics	
X-RAY	30.9
MRI	15.4
CT	1.2

Surgery	
YES	8.3

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Injury rates for each sport

Primary Sport	n	Injured (%)	Cox Hazard Ratio (95% CI)	P-value
Base / Softball	131	16 (12.2)	**reference**	--
Basketball	330	70 (21.2)	1.88 (1.20-2.95)	0.006
Football	262	47 (17.9)	2.21 (1.22-4.02)	0.009
Soccer	312	46 (14.7)	1.75 (1.12-2.75)	0.02
Tennis	67	1 (1.5)	0.21 (0.03-1.39)	0.11
Track / X Country	62	9 (14.5)	1.38 (0.51-3.74)	0.53
Volleyball	246	29 (11.8)	1.10 (0.65-1.88)	0.72
Wrestling	35	5 (14.3)	1.29 (0.47-3.54)	0.63
Other[1]	99	13 (7.5)	0.87 (0.37-2.07)	0.76

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Sex, Cometitions and Specialization

Variable	n	Injured (%)	Cox Hazard Ratio (95% CI)	P-value
Sex				
Female	780	119 (15.3)	reference	--
Male	764	116 (15.2)	0.84 (0.62-1.15)	0.28
Sport Competitions				
Low (< 30)	816	112 (13.7)	reference	--
Moderate (30-60)	463	63 (13.6)	0.82 (0.58-1.15)	0.25
High (> 60)	265	60 (22.6)	1.18 (0.83-1.69)	0.36
Specialization level				
Low	918	112 (12.2)	reference	-
Moderate	418	79 (18.9)	1.51 (1.04 - 2.20)	0.03
High	207	44 (21.3)	1.85 (1.12 - 3.06)	0.02

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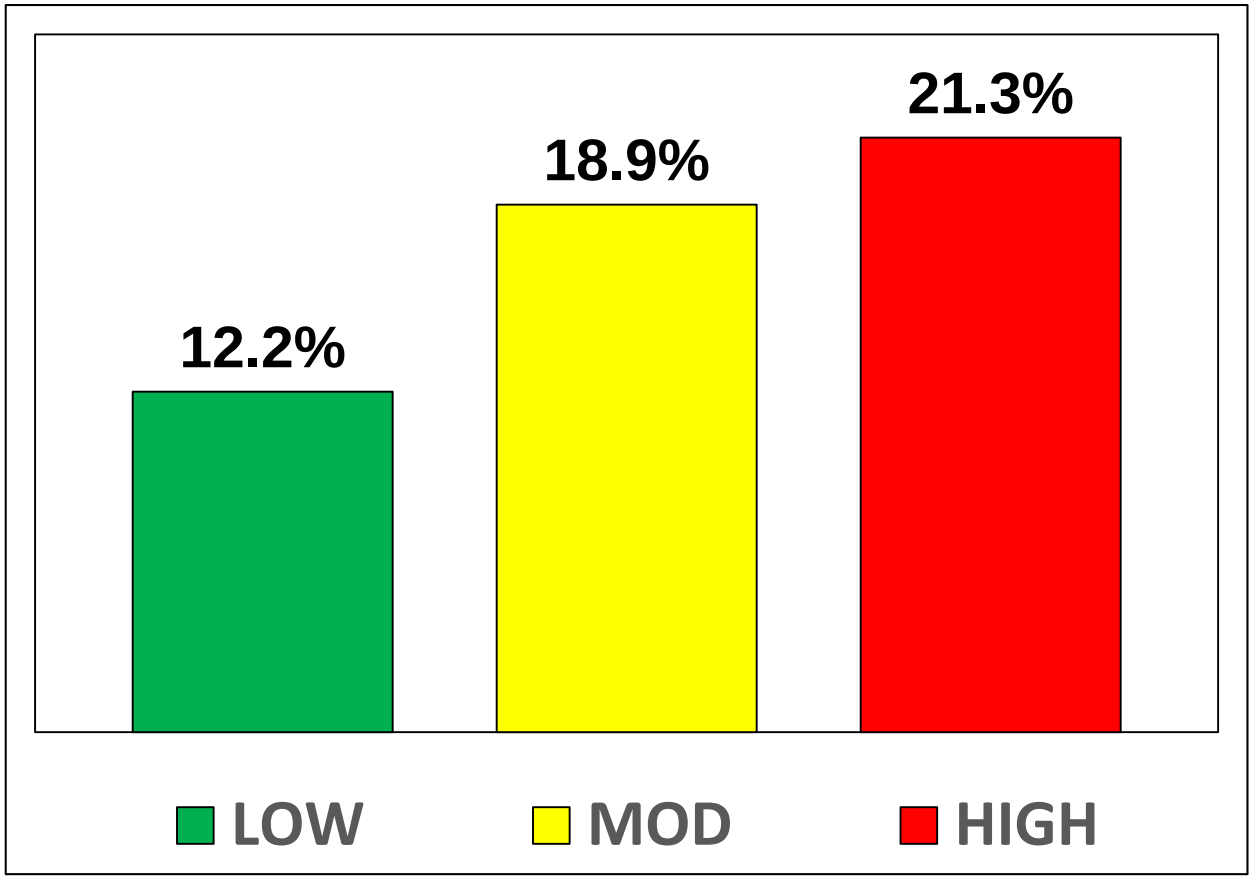
New LEI Incidence (3 pt. scale)



Multivariate Cox Hazards Ratios

MOD: 1.51 (1.04 - 2.20), p = 0.029 HIGH: 1.85 (1.12 - 3.06) p = 0.017

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LEI Characteristics

	n	Injured (%)	Cox Hazard Ratio (95% CI)	P-value
Acute LEI				
Low	895	88 (9.8)	reference	-
Moderate	391	52 (13.3)	1.25 (0.78-1.99)	0.35
High	187	24 (12.8)	1.25 (0.71-2.18)	0.44
Chronic / Repetitive				
Low	831	24 (2.9)	reference	-
Moderate	366	27 (7.4)	2.61 (1.34-5.07)	0.005
High	183	20 (10.9)	4.74 (2.04-11.05)	<0.001
Surgery - Yes				
Low	817	10 (1.2)	reference	-
Moderate	344	5 (1.5)	1.04 (0.35-3.10)	0.951
High	168	5 (3.0)	1.39 (0.30-6.36)	0.675

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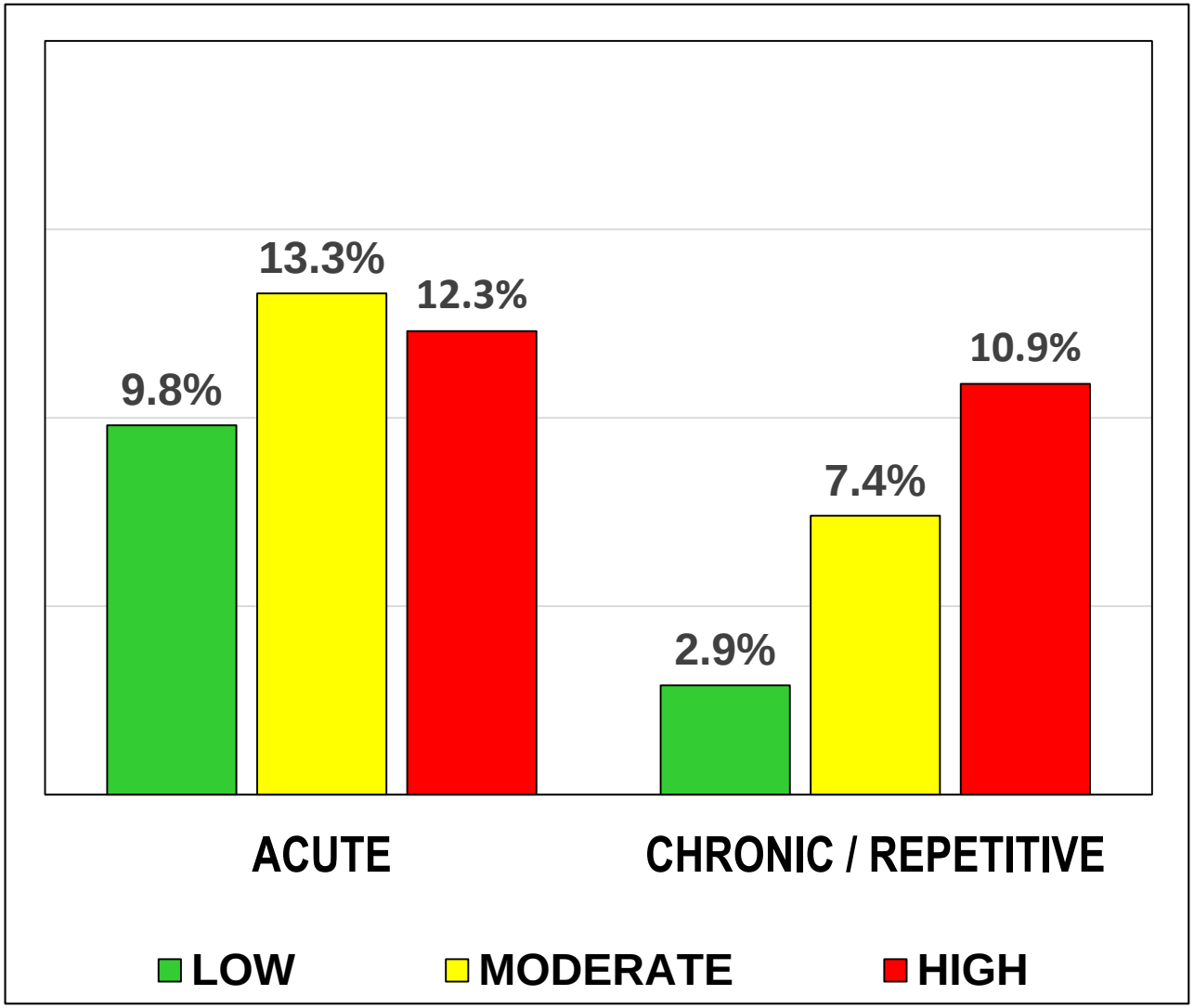
Injury Onset and Sport Specialization



Chronic / Repetitive

MOD > LOW
HR: 2.61 (1.34 – 5.07)
$p = 0.005$

HIGH > LOW
HR 4.74 (2.04– 11.05)
$p < 0.001$

Question:

Does sport specialization increase the incidence of LEI equally in both males and female athletes?

New Analyses:

A total of N = 902 subjects in paired sports (Baseball / Softball, Basketball, X–Country, Soccer, Tennis and Track)

95,444 athletic exposures

LEI for MOD subjects was not higher than LOW subjects (HR = 1.39 [0.89-2.15], p = 0.144)

LEI for HIGH subjects was higher than LOW subjects (HR = 2.10 [1.32-3.35], p = 0.002)

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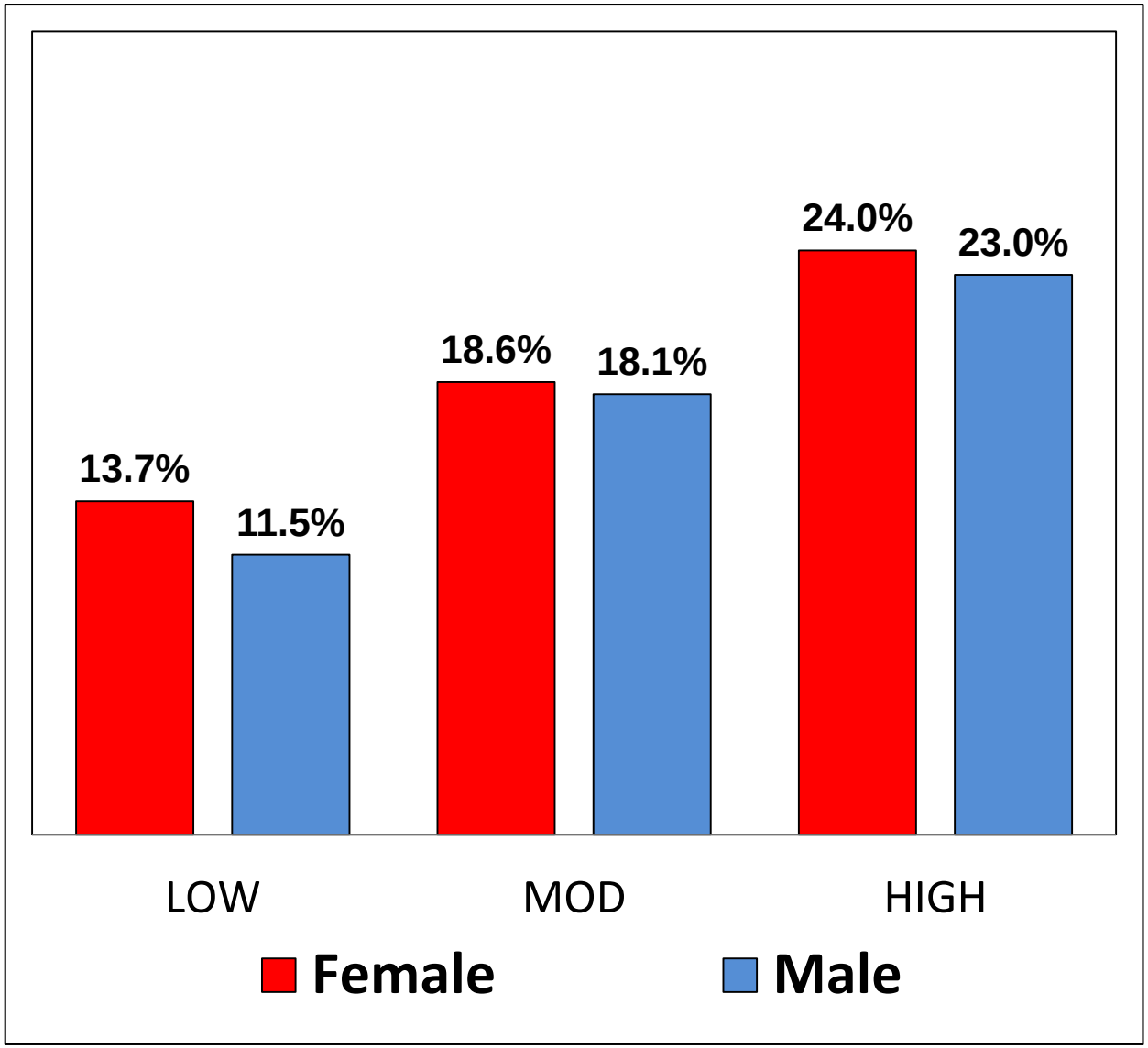
Comparison in Paired Sports



Males: 14.6%,
Female: 16.7%

HR: 0.89 (0.66 -1.20)
p = 0.452

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Discussion

The first Study to prospectively document the association between sport specialization and risk of LEI

MOD specialized > 50% incidence of LEI than LOW

HIGH specialized > 85% incidence of LEI than LOW

Relationships existed even after controlling for sex, grade in school, primary sport, competition volume, and previous history of LEI.

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Discussion

This study supports the findings of previous retrospective and case control (clinic) research.

Highly specialized athletes more likely to sustain a non-acute (gradual or recurrent) injury than athletes in the low specialization category.

Why is this important?

Sports Injury Economics

North Carolina High School Athletic Injury Study (Knowles 2013)

Direct Costs = $709

Human Capitol Costs = $2,223

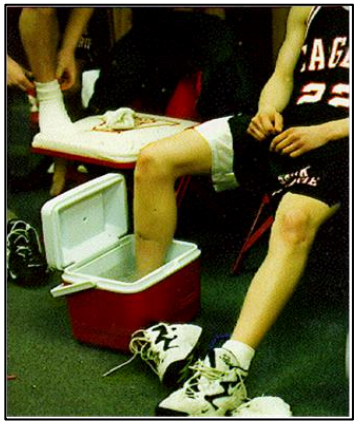
Comprehensive Costs = $10, 432

Ankle = $11,925 **Knee** = $8,868

Shoulder = $13,254 **All other** = $15,985

Economic Costs – Ankle Sprains

US CPSC NEISS 2013 Estimate (ages 14 -18)



n = 186,200 ankle sprains / strains

$283 million (direct)

$2.4 billion (indirect)

Who is this patient?

Limitations

Recall bias

All data collected in a single state

Some sports not represented

Limitations

Specialized athletes may = more skill
May played > % of a game or
a more intense level

Did not record club sport injuries

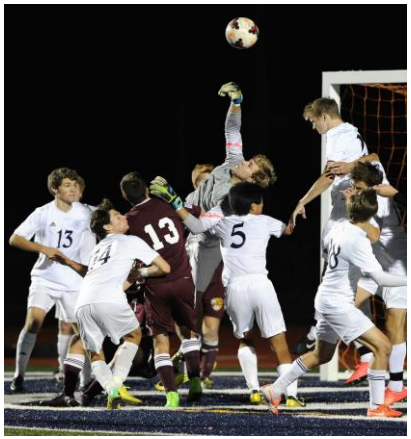
Did not measure “total sport volume” for multi sport athletes

CONCLUSIONS

Key Points

Specialized athletes:

- 2X more likely to report sustaining a previous injury
- Much higher injury “new” rate
- More likely to sustain a gradual onset / repetitive use injury
- More likely to sustain an injury when controlling for all variables



Implications to consider

50% athletes competed in their primary sport outside of school

These athletes have 1/2 to 2/3 of their primary competitions outside of school

What level of health care is provided to club athletes (not interscholastic)?

Should club sport teams and associations be required to provide the same level of sports medicine care as US high schools?

Costs of Club Sports

2014 Texas

Volleyball: $7,000 to $10,000 year.

Soccer: $4,000 or $5,000 up to $7,000 to $10,000

Girls basketball: $3,500 year – no travel

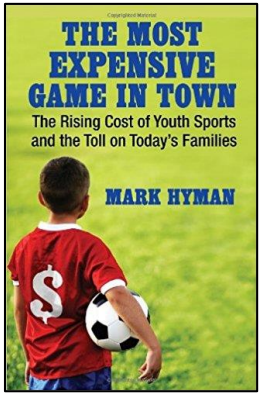
Softball: $6,000 to $8,000 per summer player

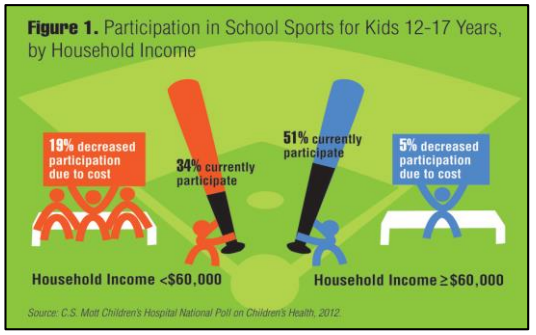
Baseball: $2,000 year - no travel

Specialization Costs to Consider

What about kids who “can’t afford” to play on a club team?

Are these kids given the message they shouldn’t participate in high school sports?





NEXT STEPS

Dissemination of Findings

Recent Mass Media:

Associated Press, ESPN, Los Angeles Times, Wall Street Journal, The Economist, Washington Post

Presentations

PRiSM Pediatric Research in Sports Medicine Society

American Medical Society for Sports Medicine
Leading Sports Medicine into the Future

NATA National Athletic Trainers' Association

AOSSM

Manuscripts

The Association of Competition Volume, Club Sport Participation, and Sport Specialization with Sex and History of Lower Extremity Injury in High School Athletes. *SportsHealth*

A Prospective Study on the Impact of Sport Specialization on Lower Extremity Injury Rates in High School Athletes. *American Journal of Sports Medicine*

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Future Research

Upper Extremity Injuries

Target: Baseball, Softball, Swim, Tennis & Volleyball
Sample: US high schools (50 states)
Subjects: N = 5000+
Data Collection: Web based

Longitudinal Studies

Target: 10,000 youth athletes
Sample: Multi-state
Subjects: 8 yr. – 10yr. male and female
Data Collection: 10 Years

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2015
NCAA
FINAL
FOUR
INDIANAPOLIS

Thank You!

Wisconsin River, Sauk County WI, USA

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5/6/2017

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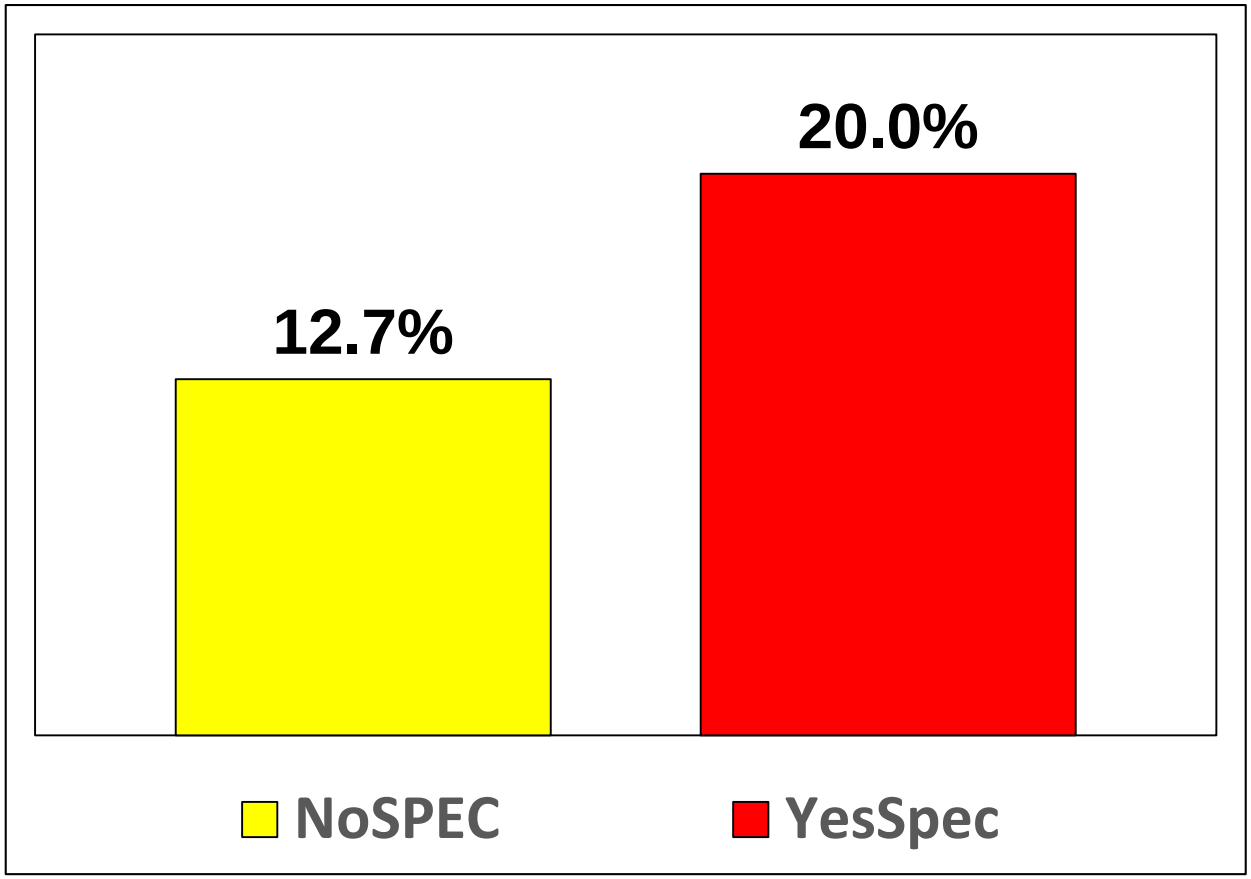
New LEI Incidence



Odds Ratio = 1.73 (1.29 - 2.31), *p* = 0.01

Multivariate Cox Hazards Ratio = 1.52 (1.11 – 2.06) *p* = 0.008

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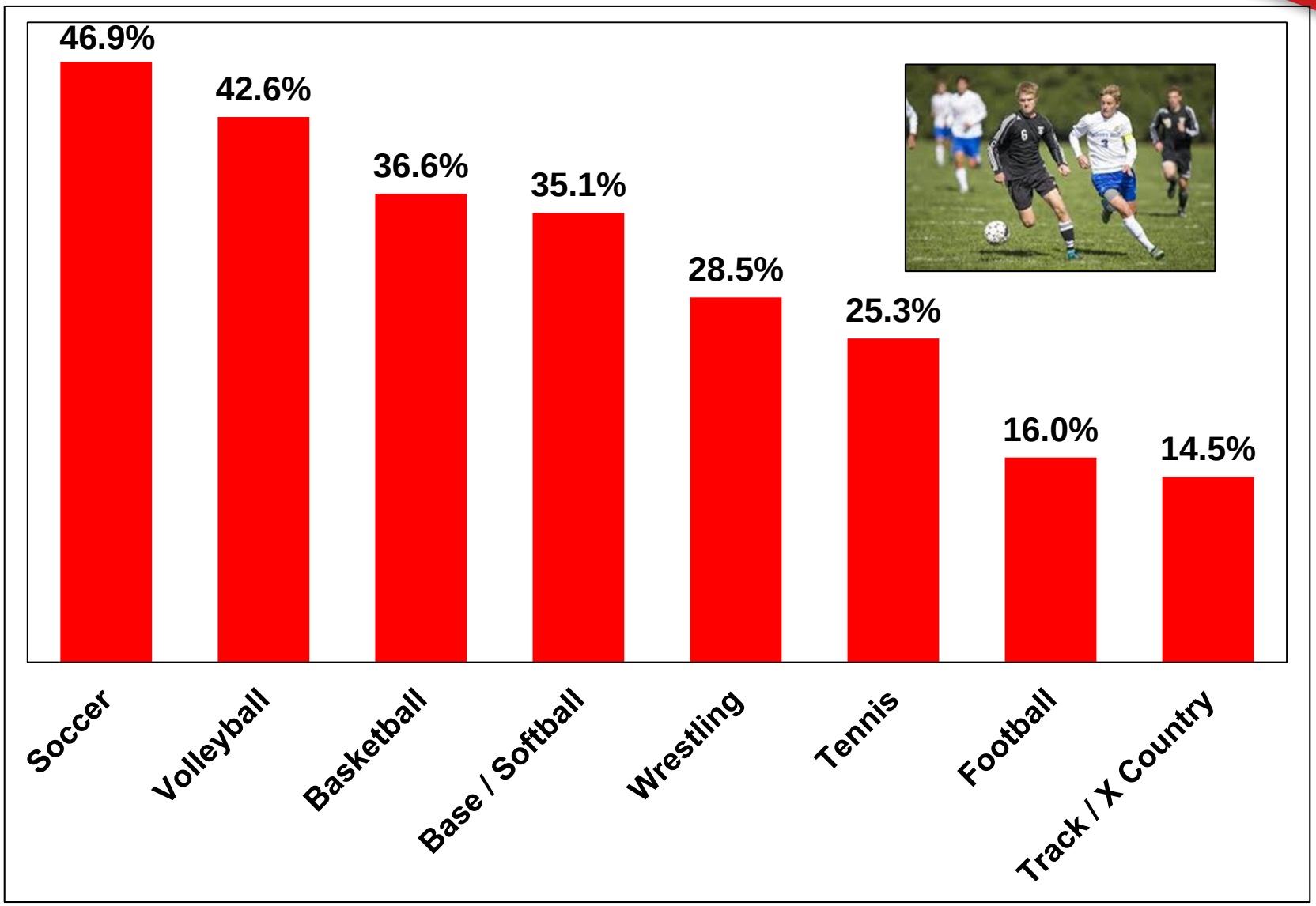
% YesSPEC by Sport



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