

The image features a stylized, abstract background in various shades of pink and magenta. The background is composed of overlapping, rounded, organic shapes that resemble brain tissue or cellular structures. The text "PINK CONCUSSIONS" is centered in the middle of the image in a bold, white, sans-serif font.

PINK CONCUSSIONS

Sex and Gender Differences in Brain Injury – and Why it Matters?

Katherine Price Sloan Snedaker, LCSW
PINK Concussions

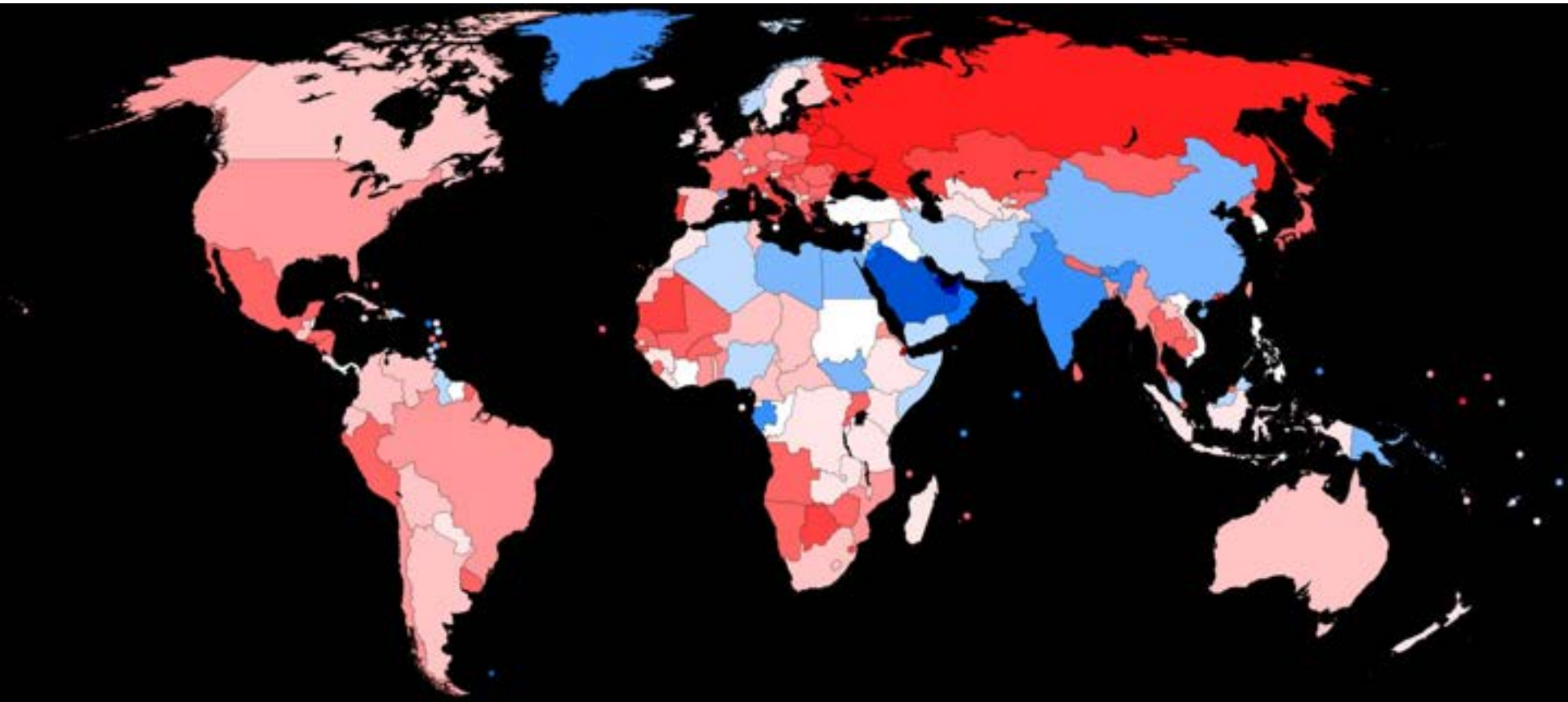
Learning Objectives

- Describe three ways in which brain injuries (including concussion) in women differ from males.
- Articulate factors that may account for sex and gender differences in TBI incidences, severity, and recovery.
- Understand the urgent need to develop “better” practices in the care and education of women with brain injury to facilitate recovery and positive long-term outcome



Why study Women?

The sex ratio
for the entire world population
is approximately
101 males to 100 females
(2020 est.)



Sex ratio by country for total population.
Blue represents **more men and boys**,
red **more women and girls** than the world
average of 1.01 males/female.



Why “Male-only” Studies?

Concussion/mTBI has long been viewed through a masculine perspective.



Traumatic brain injury (TBI) in general occurs about **twice** as often in males as it does in females.

Source: Faul et al., 2010



In American on the Football Field

Predominantly male doctors/researchers studied male athletes playing male sports.

The football fields of our nation have been a vast proving ground or laboratory for the study of tragic neurological sequelae of head and neck trauma in man."

Dr. Richard Schneider in 1967



In the laboratory, men decided...

Since the "menstrual cycle" of the female animals affected the results...

(In animals, it is called the Estrous Cycle)

Solution = ONLY male animals



NO FEMALE LAB ANIMALS IN TBI RESEARCH



July 2022

Literature Review

Article

Full-text available

Under-representation of female athletes in research informing influential concussion consensus and position statements: an evidence review and synthesis

July 2022 · [British Journal of Sports Medicine](#) 56(17):bjsports-2021-105045 · [Follow journal](#)

DOI: [10.1136/bjsports-2021-105045](#)

Lab: [USAFA Concussion Lab](#)

 Christopher D'Lauro ·  Emily Jones · Lily MC Swope · [Show all 6 authors](#) ·  Julianne D Schmidt

Concussion Research is Leaving Women Out

How the under-representation of women in concussion research impacts concussion care and management.

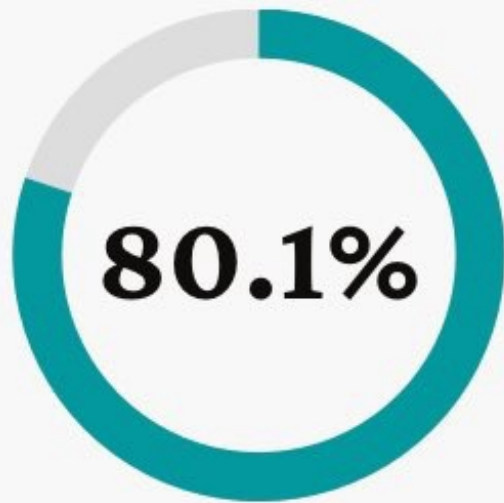
.....

Consensus and position statements play an important role in patient care. These publications are used to guide concussion care and management.

This study looked at the 3 most influential position and consensus statements published for sport-related concussions:

- The International Conference on Concussion in Sport (ICCS)
- National Athletic Trainers' Association (NATA)
- American Medical Society for Sports Medicine (AMSSM)





They found that roughly **80%** of all data came from males.

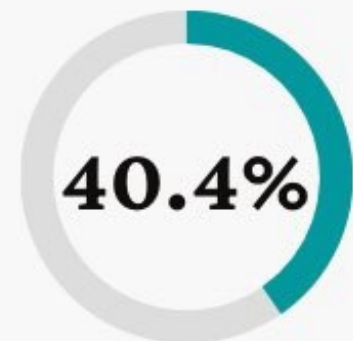


There were 69 all-male studies

The majority of studies cited were all-male studies, accounting for over 40%.

The next largest group used mostly male participants accounting for 33.3% of studies.

Only 24% of the studies across all 3 position and consensus statements were roughly equal between male and female participants.



There were 2 all-female studies

Only 1.2% of studies included all female participants.

Only 2 studies (1.2%) included mostly female participants.



Why is this important?

- Under-representation of female athletes in concussion research could result in clinical care and management guidelines that are more targeted to male athletes.
- Not only does this impact female athletes, but it could impact non-binary and transgender athletes as well.



What can we do?

- Design and conduct future research studies that include all females participants as well as studies with diverse gender representation.
- Provide research funding specifically to close this gap.
- Have diverse authorship teams.
- Acknowledge the limitations of studies that under-represent non-male athletes.



D'Lauro C, Jones ER, Swope LM, Anderson MN, Broglio S, Schmidt JD. Under-representation of female athletes in research informing influential concussion consensus and position statements: an evidence review and synthesis. British Journal of Sports Medicine. Published Online First: 18 July 2022. doi: 10.1136/bjsports-2021-105045

Infographic Created By:
Rachel S. Johnson, PhD, ATC



@RachelJohnsonAT



@rachel.johnson.at

How will being a Woman
create obstacles
for healing
after brain injury?

How will being a Woman
create obstacles
for healing
after brain injury?

Sex + Gender =

SEX vs GENDER

Definition of SEX

The American Medical Association defines sex on the basis of biological differences, including reproductive anatomy and chromosomes, with demographic variables including female, male, and intersex.



Definition of GENDER

Gender is self-defined, relates to one's societal roles and expectations, and encompasses the totality of one's internal psychological, emotional, social, and overall sense of identity with numerous demographic variables, including woman, man, and nonbinary, among others.



How will being a Woman
create obstacles
for healing
after brain injury?

Sex + Gender =
Woman's Experience



Why is this Urgent?



2009

Iraq

Ashton



Landstuhl Regional Medical Center in Germany

Brain Injury Awareness Day 2018





2009

Iraq

2024

Los Angeles



PINK Concussions 2023 Sports Award

presented in Dublin to
Neil and Morven Cattigan
in Memory of their Daughter

Siobhan Cattigan

11 April 1995 – 26 November 2021





irishtimes.com

Concussion a significant problem that goes under-reported in women...
Data suggests that in sports with similar rules female athletes sustain more concussions than their male counterparts



Cattigans bravely make voice heard

We often talk about "bravery" in sport, especially rugby. What word, then, should we use to describe the act of standing up to address a conference hall full of strangers as a bereaved and grieving father?

Huge kudos to Neil Cattigan for the fortitude he showed in delivering intensely raw and personal testimony to the International Brain Injury Association congress in Dublin last week on the occasion of the presentation of an award by the PINK Concussions female brain injury advocacy group in memory of his late daughter, Siobhan. Neil and his wife Morven continue to

fight for an independent review into the events which led up to the sudden death of the former Scotland forward at the age of 26 in November 2021. Siobhan's parents also want to see the development of female-specific education, research and protocols around rugby brain injuries.

As has been the case from the outset of this sorry saga, both of these things are entirely within the SRU's gift to offer the Cattigans and Ann Taylor, Siobhan's partner who was also in Dublin last week. The pain will always be there, but that doesn't mean that nothing can be done.

Neil Cattigan's Remarks at the March 2023 Award Presentation

“We firmly believe that all women need to be treated as worthy of research, specialist medics, facilities, monitoring and welfare. Basically, treated as men are.

If Siobhan had been male, if Siobhan had been referred to Birmingham and had access to the world-leading trauma neurosurgeon and state of the art neurological equipment, If Scottish rugby's Chief Medical Officer had not left her to the mercy of an underfunded and understaffed NHS, Siobhan would be with us.

The SRU took her into private care, fixed her broken bones, assessed, scanned and treated her privately but when her brain was broken, they quite literally looked the other way.

She was refused private medical care, despite our desperate pleas. ...”

Is it time for a Female-Specific Concussion Protocol?

PINK Concussions Debate in Dublin
March 30, 2023

Hosted at  INTERNATIONAL
BRAIN INJURY
ASSOCIATION

Top medical experts will debate if female-specific changes are needed in Sports for:

1. Concussion Management Protocols
2. Access to Medical Care
3. Modifications in "rule-specific engagement"

For more info see, PINKconcussions.org



Katherine Snedaker



Prof Dr med. Inga Koerte



Dr Chris Giza



Dr. Christina Master



Dr Marshall Garrett



Dr Abby Bretzin



Dr Willie Stewart



PINKconcussions.org





Restricted access Research article First published online January 6, 2016

"I Was Able to Still Do My Job on the Field and Keep Playing": An Investigation of Female and Male Athletes' Experiences With (Not) Reporting Concussions

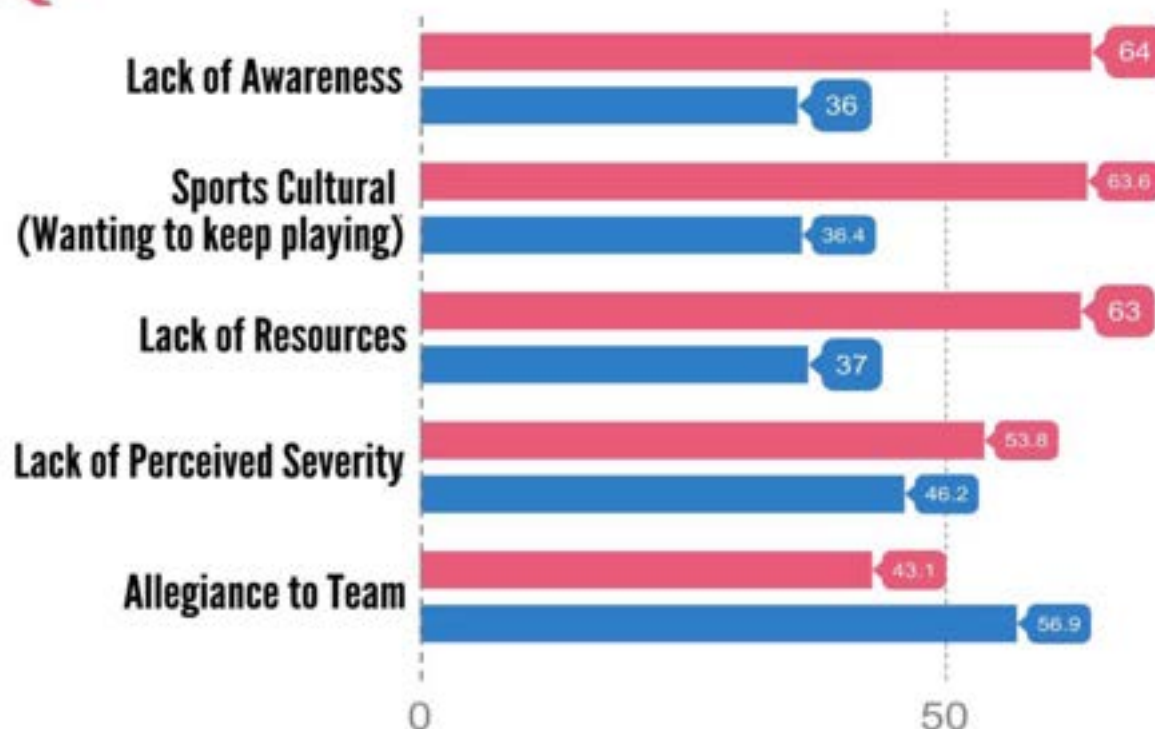
[Jimmy Sanderson](#) [Melinda Weathers](#), [Katherine Sordaker](#), and [Kelly Gramlich](#) [View all authors and affiliations](#)

[Volume 5, Issue 3](#) <https://doi.org/10.1177/2167479515623455>

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Why DIDN'T you report your symptoms?



100

Factors Affecting Recovery Trajectories in Pediatric Female Concussion

Desai, Natasha MD, CAQSM^{*}; Wiebe, Douglas J. PhD[†]; Corwin, Daniel J. MD[‡]; Lockyer, Julia E. MS[§]; Grady, Matthew F. MD, CAQSM^{§,¶}; Master, Christina L. MD, CAQSM^{§,¶}

[Author Information](#) 

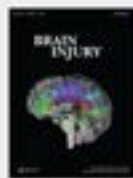
Clinical Journal of Sport Medicine 29(5):p 361-367, September 2019. | DOI:
10.1097/JSM.0000000000000646

Female athletes seek specialty medical treatment later than male athletes for sports-related concussions (SRC), and this delay may cause them to experience more symptoms and longer recoveries.

The median days to presentation for a subspecialty evaluation was 15 for females with SRC and 9 for males.

- females returned to school later (4 vs. 3 days)
- returned to exercise later (13 vs. 7 days)
- had neurocognitive recovery later (68 vs. 40 days)
- had later vision and vestibular (balance) recovery (77 vs. 34 days)
- returned to full sport far later (119 vs. 45 days)

When researchers limited the analysis to those female and male patients that presented to the specialty practice for evaluation within the first 7 days of injury, the differences between males and females on all outcomes disappeared.



Gaps in concussion management across school-aged children

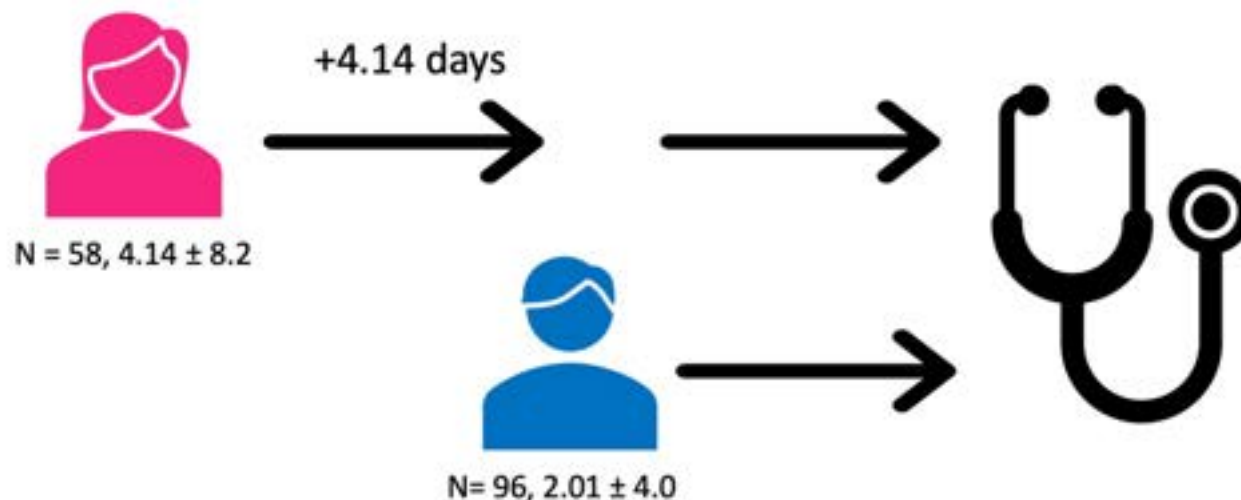
Katherine Price Snedaker, Jennifer P. Lundine , Angela H. Ciccio , Mohammad Nadir Haider & Katy H. O'Brien 

Pages 714-721 | Received 05 May 2021, Accepted 24 Jan 2022, Published online: 07 Feb 2022

 Cite this article  <https://doi.org/10.1080/02699052.2022.2034954>

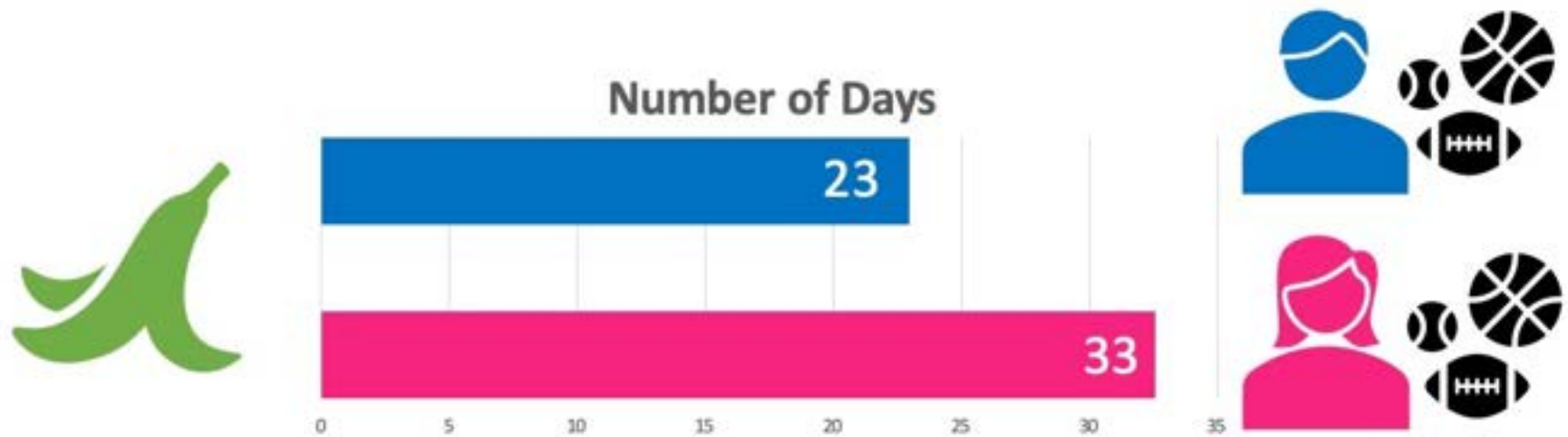
 Check for updates

How many days were between injury and diagnosis?

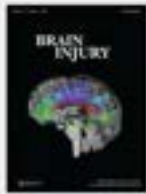


Elementary/Middle School Students Females had a longer delay compared to Males: Average 4.14 days

How many days were between the injury and the doctor clearing the student to full return to school?



In Elementary + Middle School Group, Evaluation and Clearance was significantly quicker for **male** than for **female** students: 22.95 vs. 32.57 days



Submit an article

Journal homepage

702

Views

11

CrossRef
citations to date

30

Altmetric

Research Article

Concussion reporting, return to learn, and return to play experiences in a sample of private preparatory high school students

Dana Waltzman , Jill Daugherty, Katherine Snedaker, Jason Bouton & David Wang

Pages 1193-1201 | Received 15 Nov 2019, Accepted 05 Jul 2020, Published online: 22 Jul 2020

Cite this article <https://doi.org/10.1080/02699052.2020.1793388>

Check for updates

2019

Total Students 2,043

Boys 968

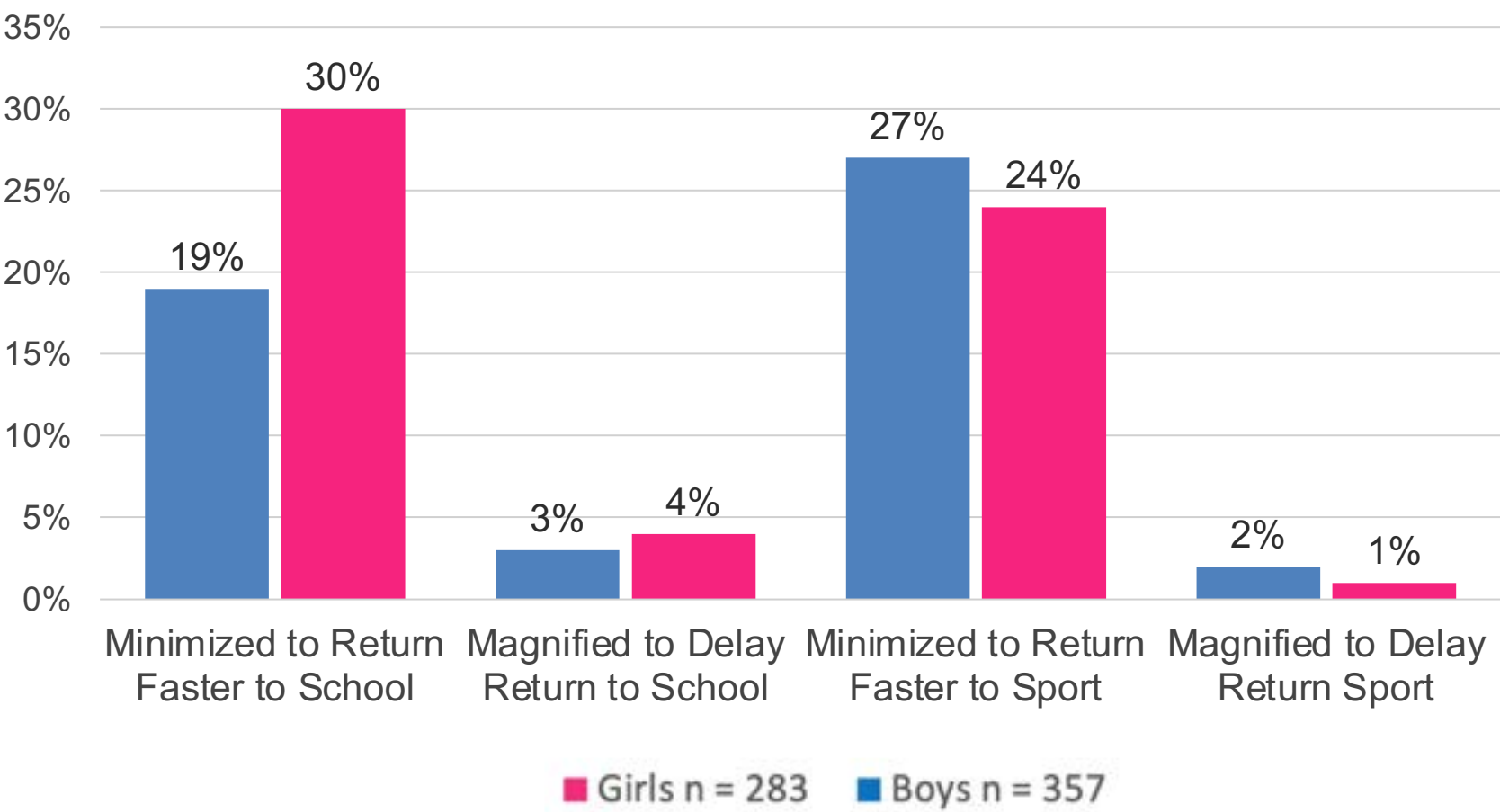
Girls 1,075

9th to 12th grade

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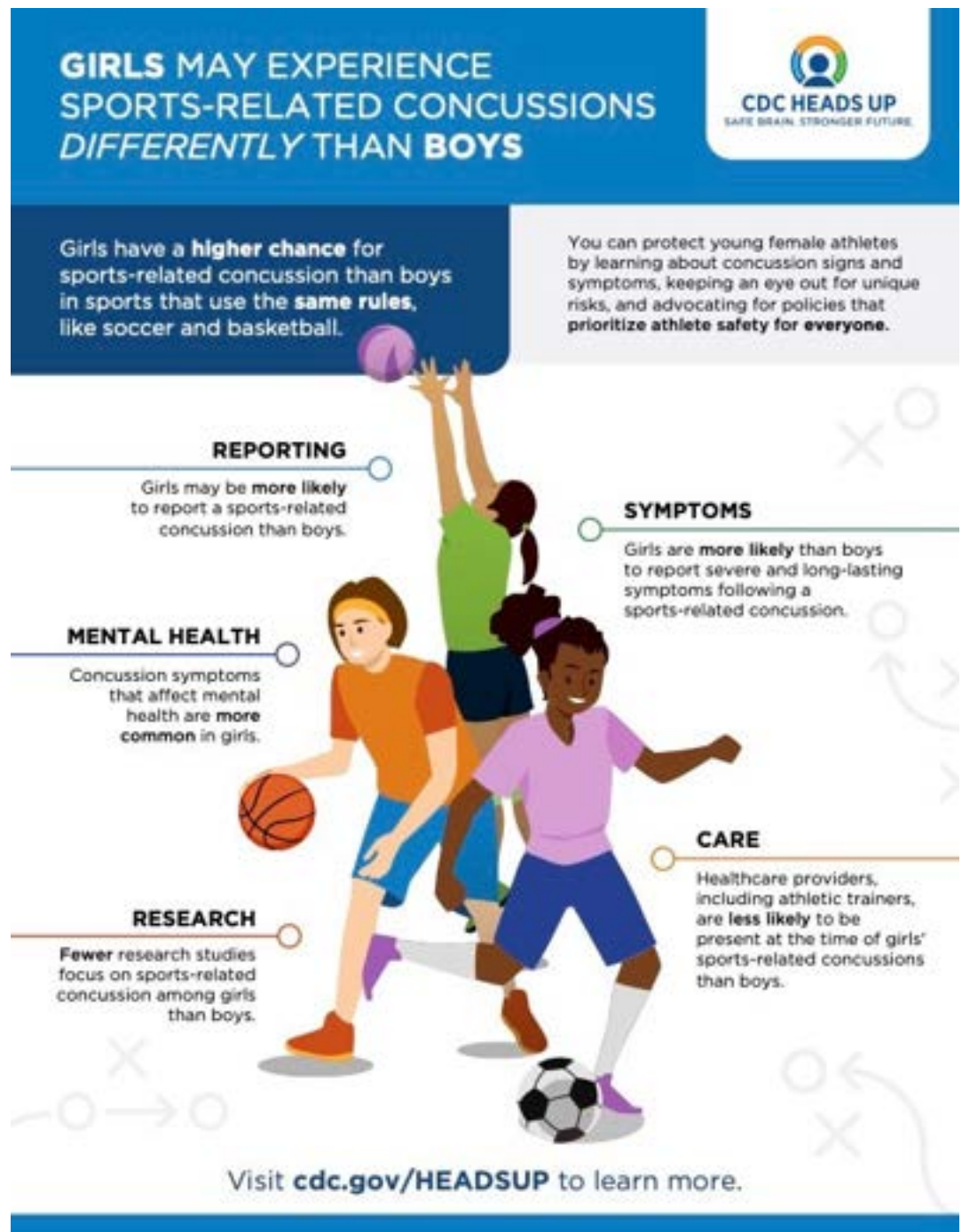


Students who Pretended to Minimize or Exaggerate Symptoms



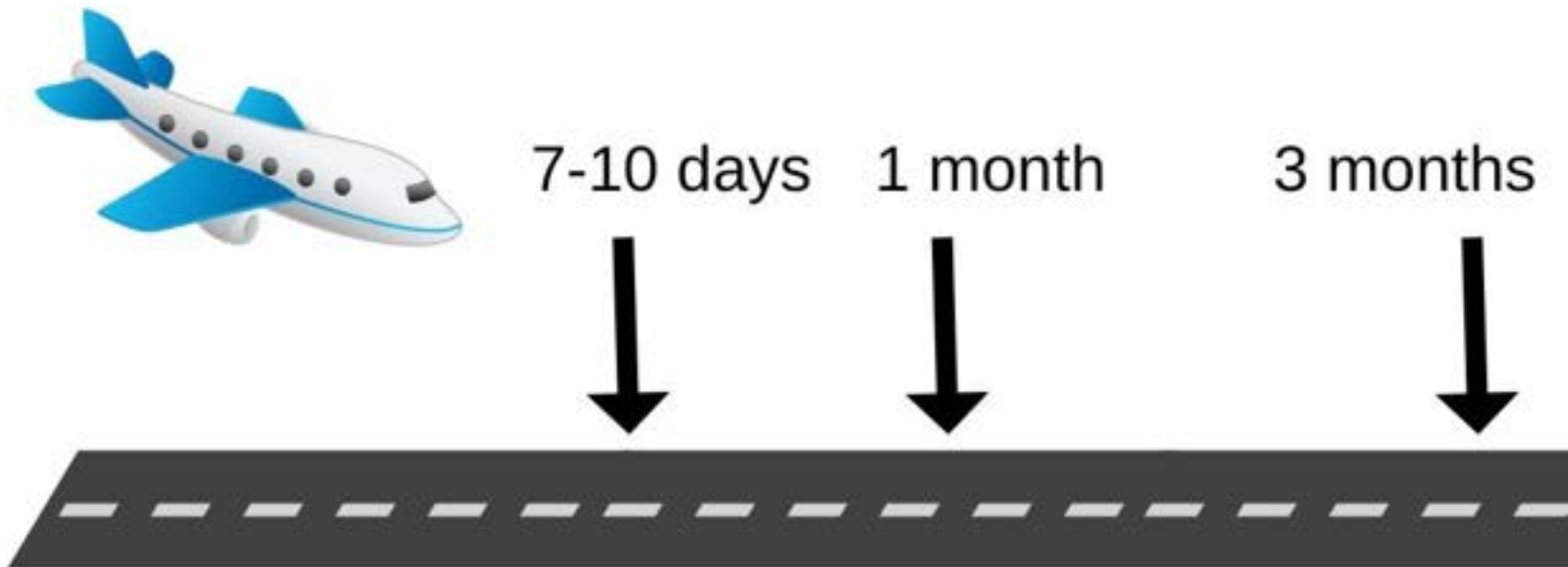
Sept 2023

CDC releases
1st handout
specific to
“Concussions in
Girls”



Gender-Based Violence
Family Violence
Domestic Violence
IPV

How long to recover?



"You are not bad,
crazy,
stupid,
or malingering. "



Looking for answers



The First Research

From starting in 1999, a decade of research showed female athletes...

- Sustain more concussions at a higher rate than their male counterparts
- Report a higher number, and more severe, symptoms than males
- Have longer recovery periods than males

2012 American Medical Society for Sports Medicine Position Statement: Concussion in Sport

- Recent data suggest that in sports with similar rules female athletes **sustain more concussions** than their male counterparts.
- In addition, female athletes experience or **report a higher number and severity of symptoms** as well as a **longer duration of recovery** than male athletes in several studies.

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2010



SportsCAPP.com

Sports Concussion Awareness & Preparedness Program

- **Educational hub** to provide current info to help change attitudes, training and response to youth sport concussions in practices and games
- **Roadmap** to help recreational teams, town leagues and private schools use free resources to create concussion policy and bring awareness into their programs for players, coaches and parents



2012



- **Informational hub** for research, resources & answers for female concussions from sports, accident, abuse or military service
- **Source for facts** about female concussions which are hard to find buried as they are in sub-sections of larger research reports
- **Advocacy Group** to reach fathers and mothers of female athletes and provide concussion awareness specific to girls' vulnerability and education about concussion recovery

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Brain Injury in Women from

- Sports
- Domestic Violence
- Military Service











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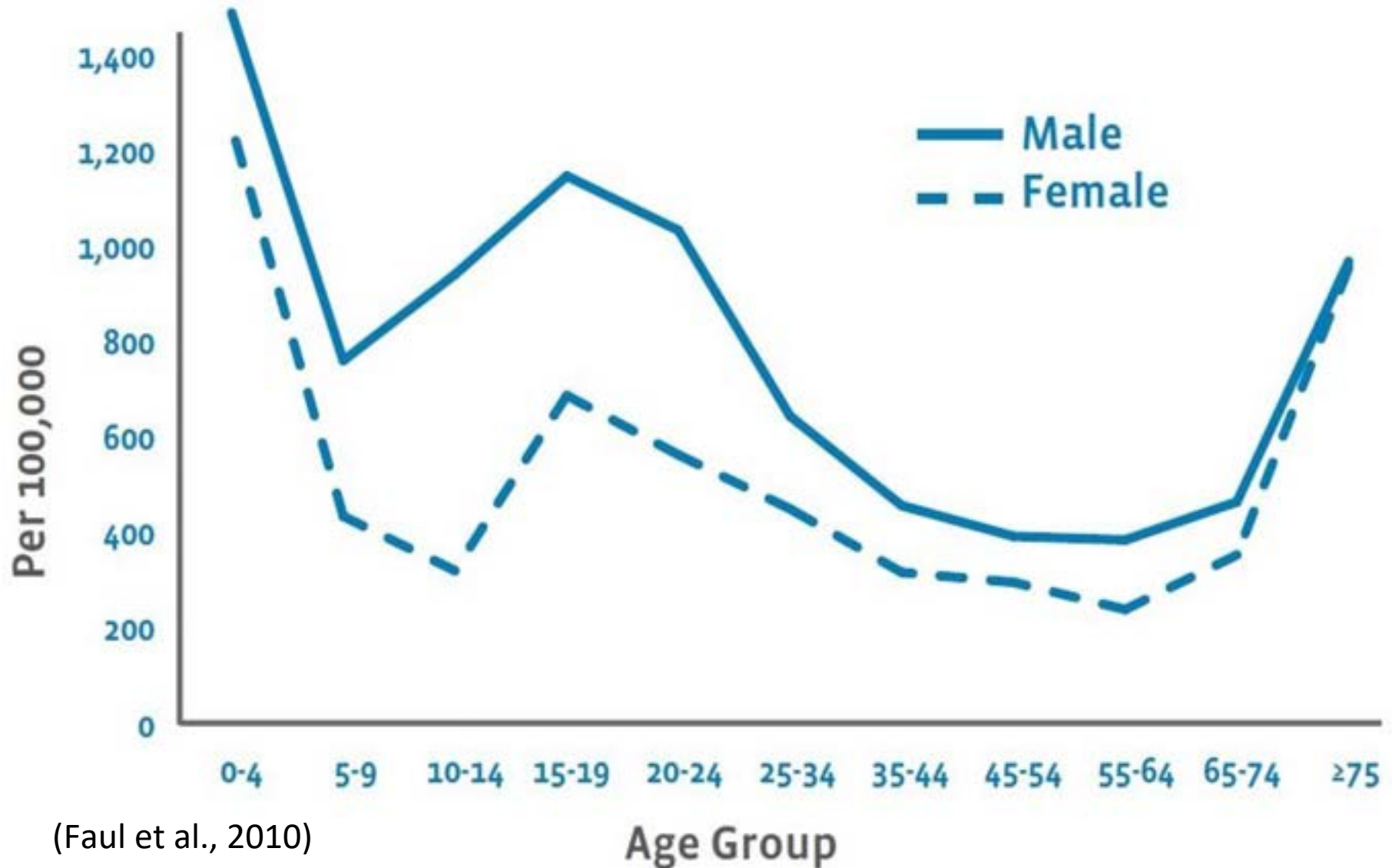


Traumatic brain injury (TBI) in general occurs about **twice** as often in males as it does in females.

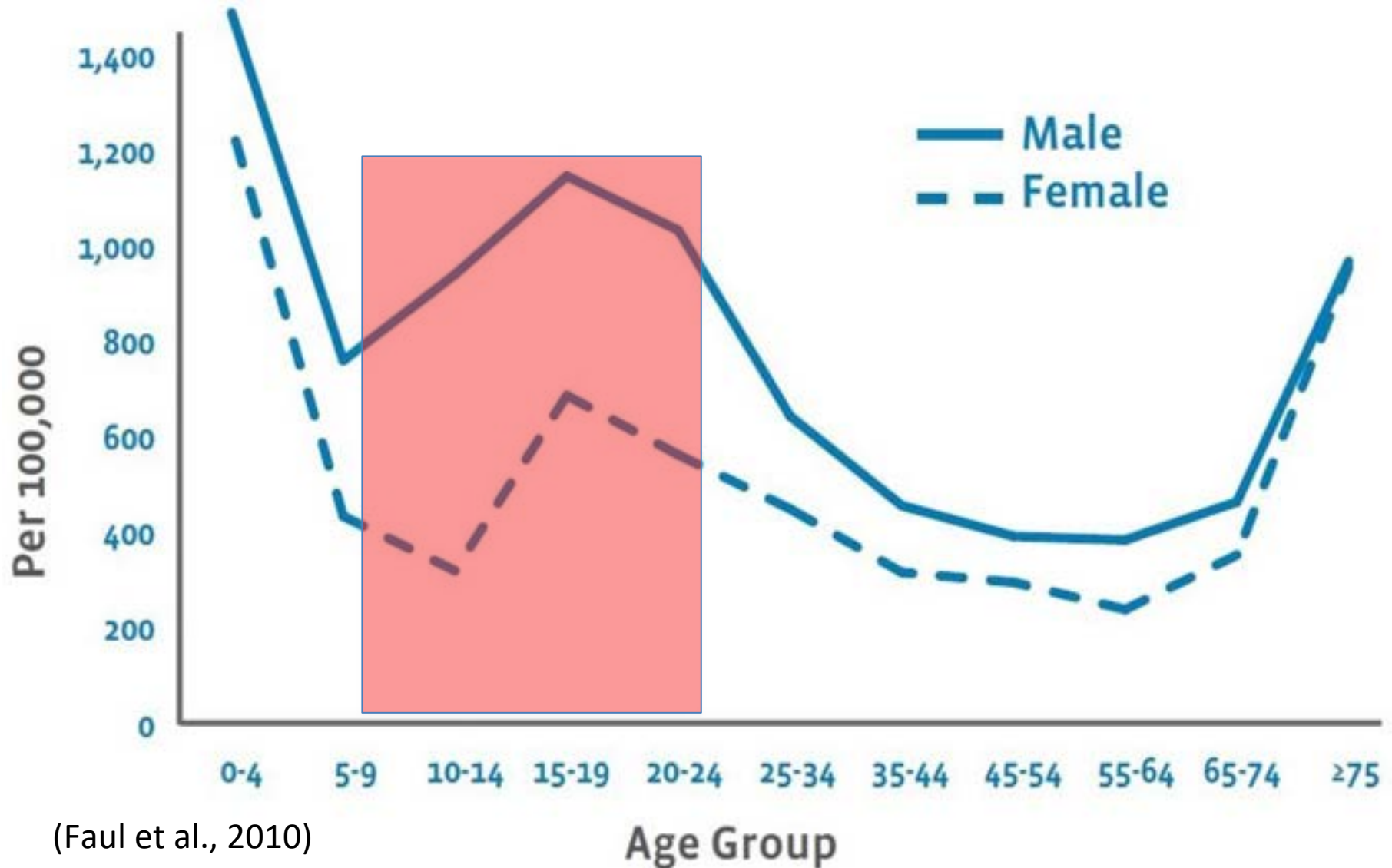
Source: Faul et al., 2010



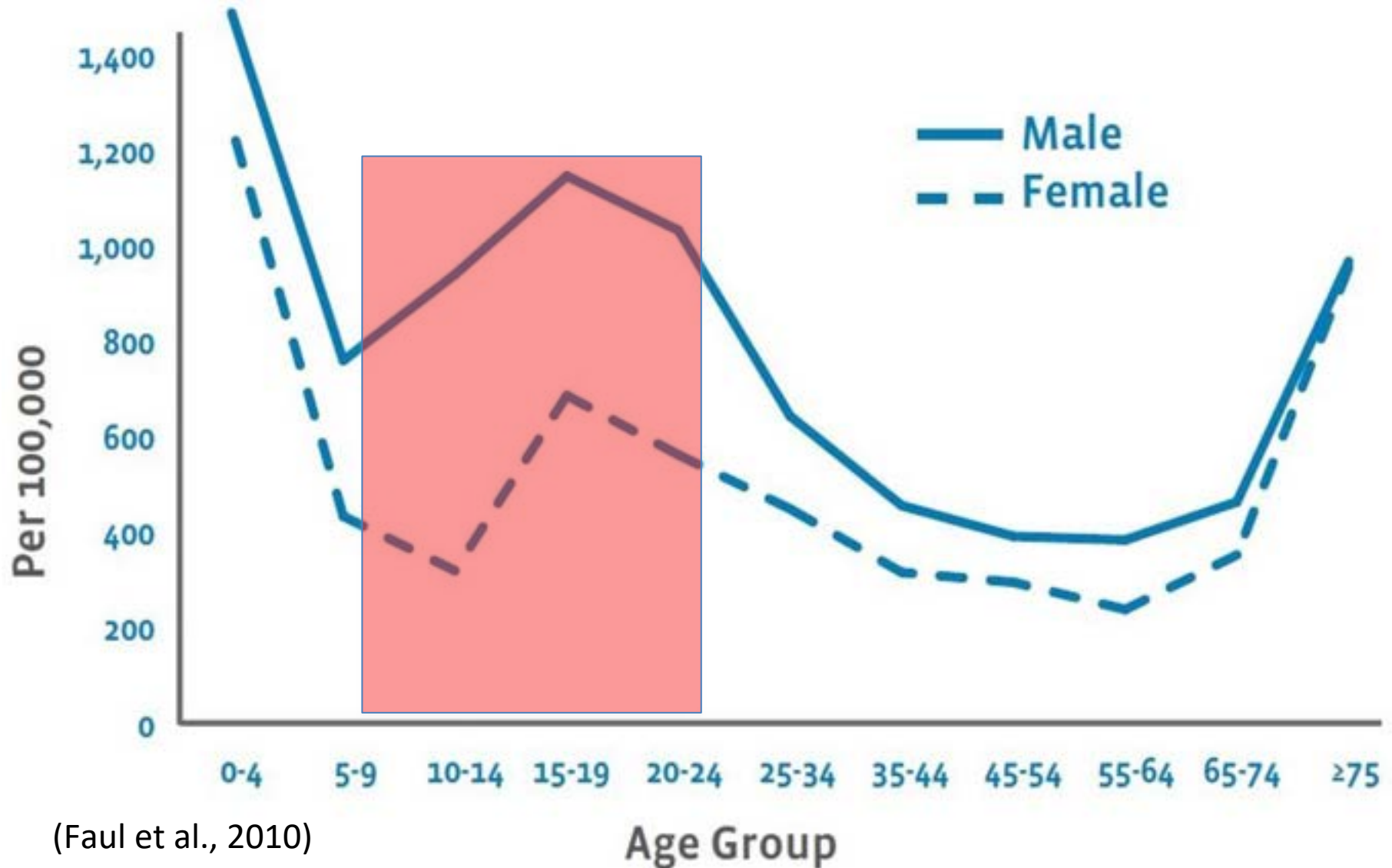
Females Experience Fewer TBIs Overall



Females Experience Fewer TBIs Overall



Females Experience Fewer TBIs Overall





Jumping Off Roof Into Pool

The Female Life Cycle



What injuries might not show up at the ER?

Who might not go to the ER?



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Sex Differences

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Why?

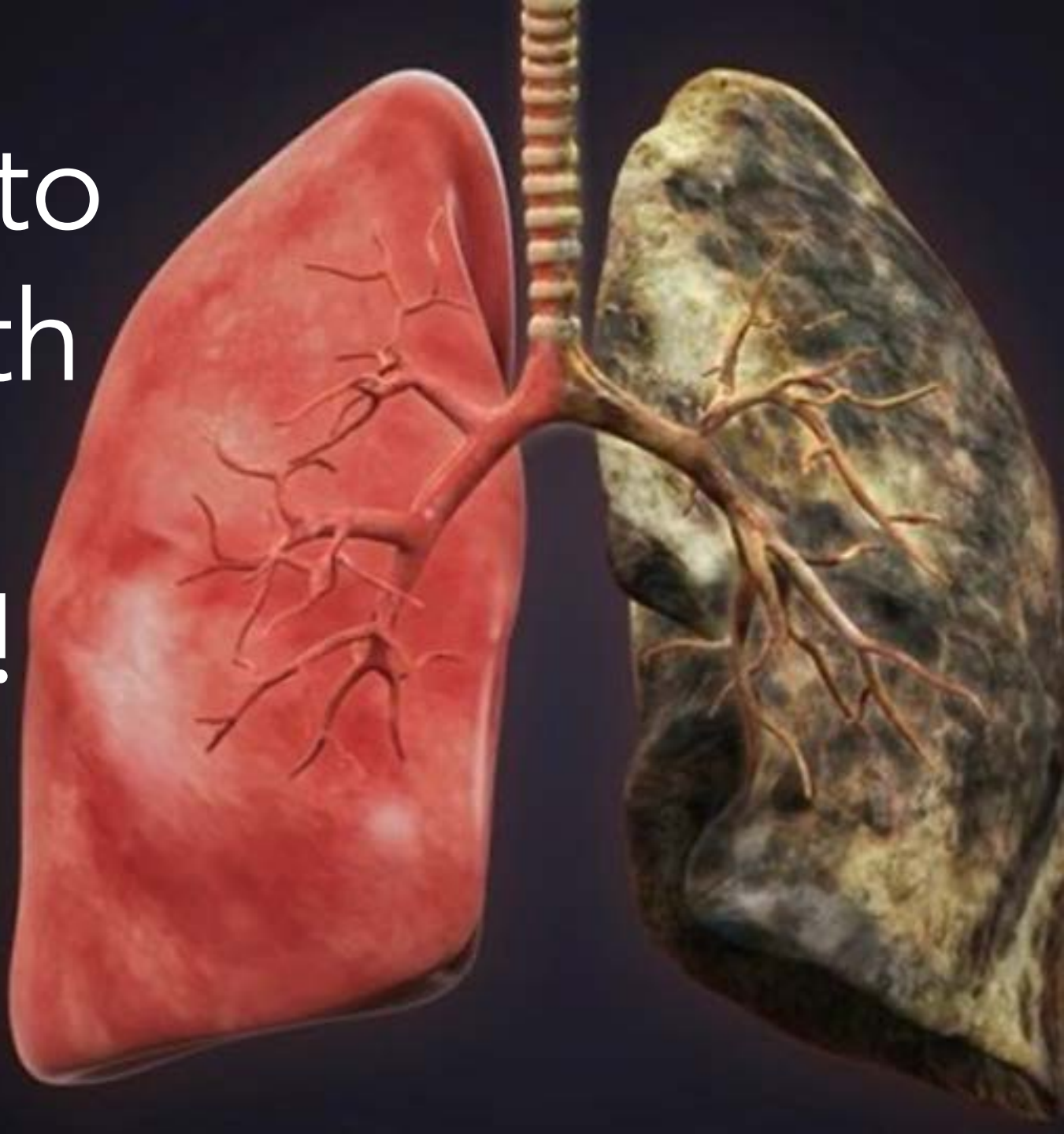
- Women are more likely to report?
- Neck-head ratio
- Women are less motivated to return to _____



Sex Differences (Biological)

- Brain Structure = Axon differences
- Menstrual and endocrine dysfunction
- Head to Neck Ratio

A photo
is worth
1,000
words!

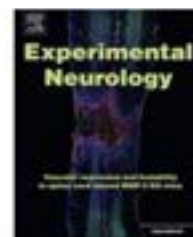




Contents lists available at ScienceDirect

Experimental Neurology

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



Research Paper

Newfound sex differences in axonal structure underlie differential outcomes from in vitro traumatic axonal injury



Jean-Pierre Dollé^a, Andrew Jaye^a, Stewart A. Anderson^b, Hossein Ahmadzadeh^c, Vivek B. Shenoy^c, Douglas H. Smith^{d,*}

^a Penn Center for Brain Injury and Repair, Department of Neurosurgery, University of Pennsylvania, 220 South 33rd Street, 283 Towne Building, Philadelphia, PA 19104, USA

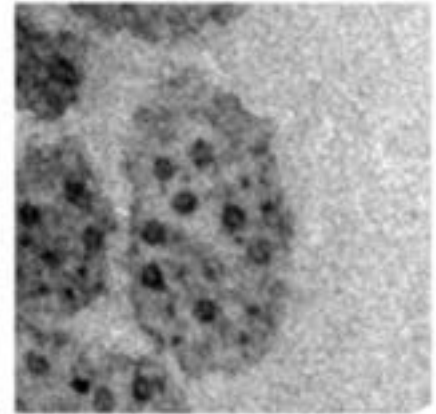
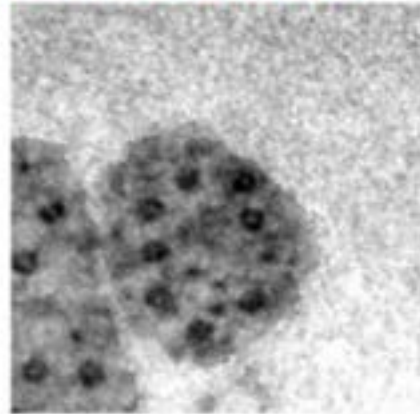
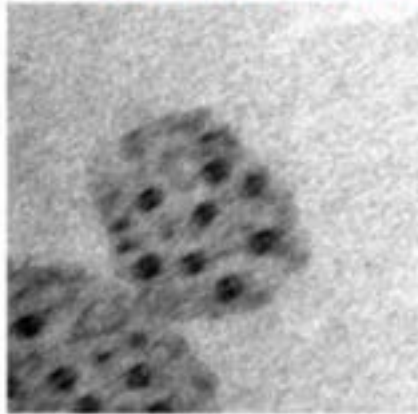
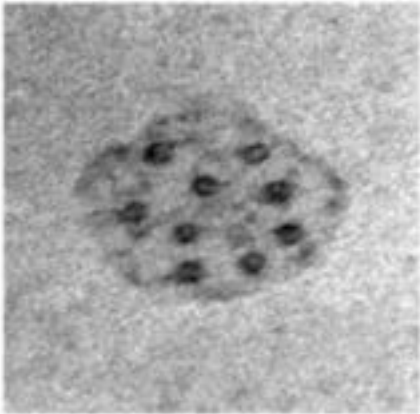
^b Department of Psychiatry, Children's Hospital of Philadelphia, Philadelphia, PA 19104, USA

^c Department of Materials Science and Engineering, 3231 Walnut Street, Room 309, The Laboratory for Research on the Structure of Matter, University of Pennsylvania, Philadelphia, PA 19104, USA

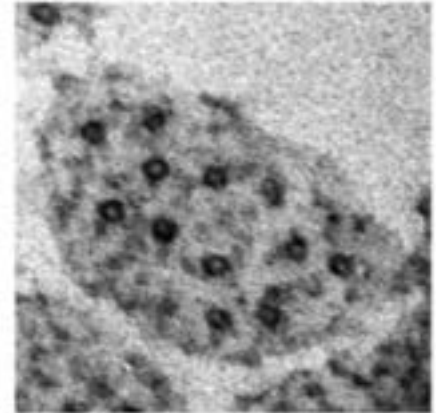
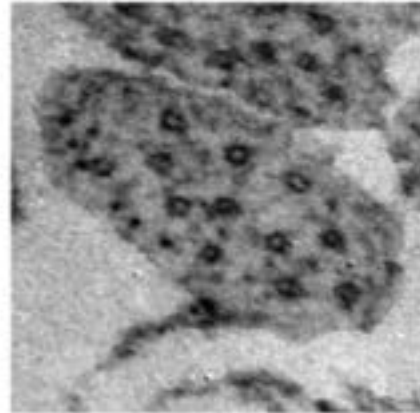
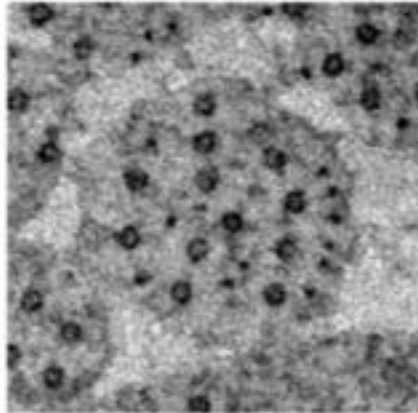
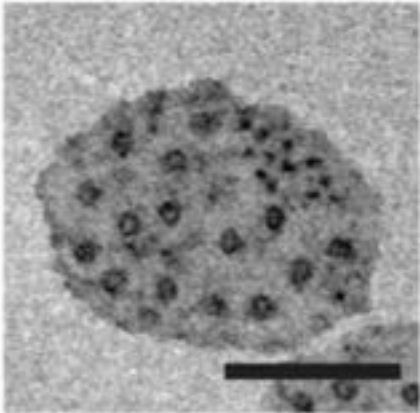
^d Penn Center for Brain Injury and Repair, Department of Neurosurgery, University of Pennsylvania, 3320 Smith Walk Hayden Hall 105, Philadelphia, PA 19104, USA

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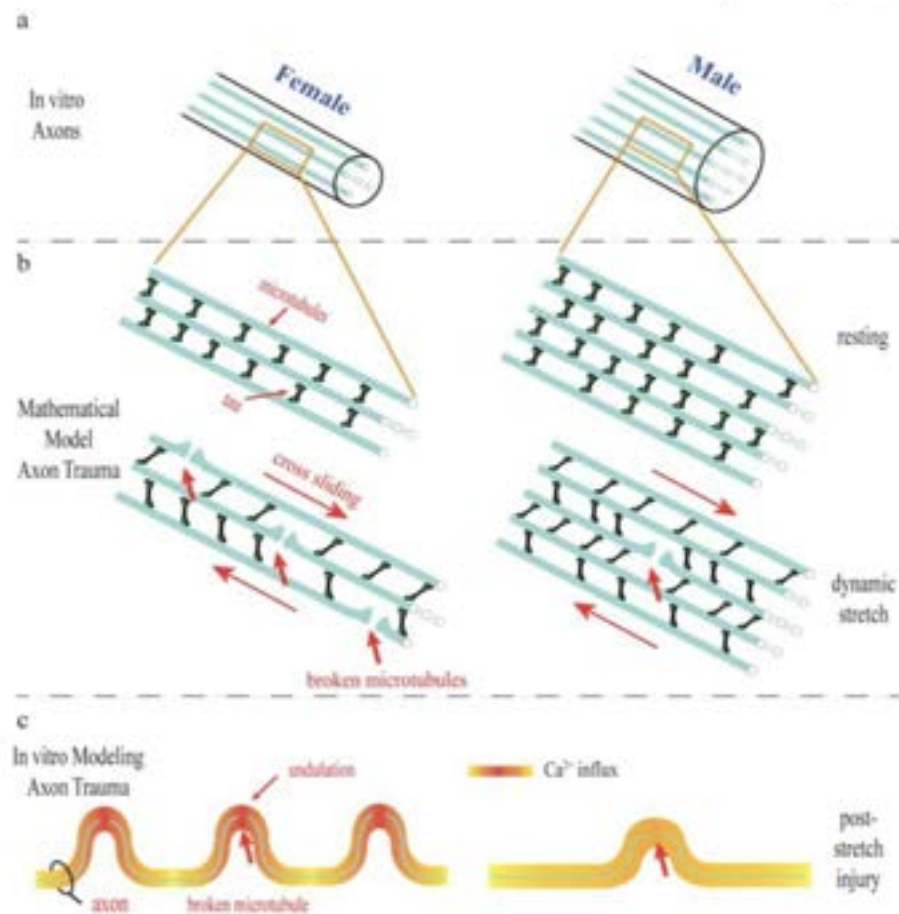
Human Female Axons



Human Male Axons



Dolle et al., Exp. Neurol. 2018



- ◆ Given the same type of head impact, female axons have much more microtubule breakage and a greater influx of ions than male axons. The pathological soup this creates pushes female axons towards degeneration and dysfunction, rather than recovery.

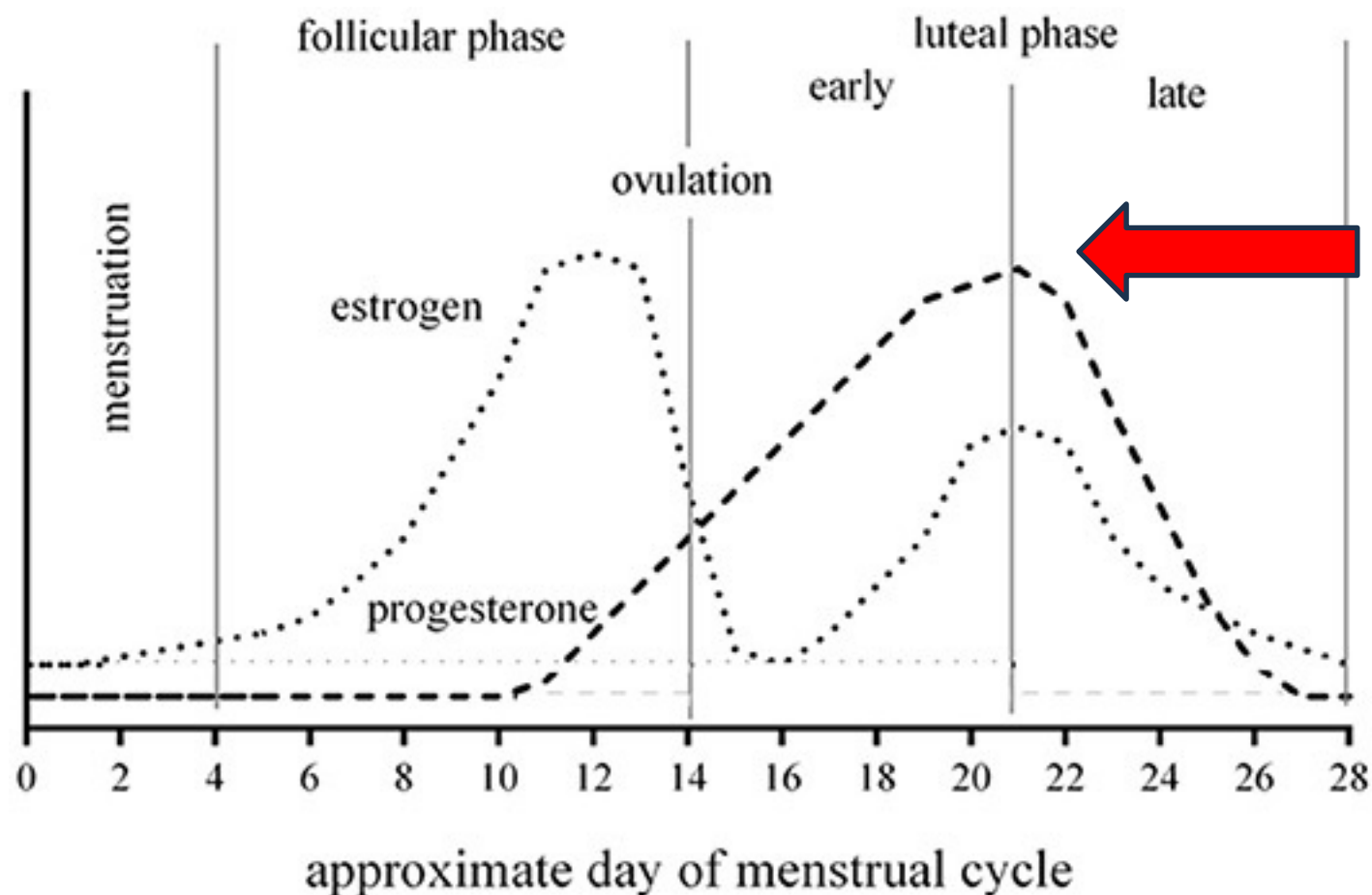
Dr Doug Smith, vice-chairman of neurosurgery University of Pennsylvania

Menstrual Phase as Predictor of Outcome After Mild Traumatic Brain Injury in Women

Wunderle, Kathryn BA; Hoeger, Kathleen M. MD, MPH; Wasserman, Erin BA; Bazarian, Jeffrey J. MD, MPH

[Author Information](#) 😊

Journal of Head Trauma Rehabilitation 29(5):p E1-E8, September/October 2014. | DOI: 10.1097/HTR.0000000000000006



Neuroendocrine Disorders after TBI

Examples:

Growth Hormone Deficiency

Adrenocorticotrophic Hormone (ACTH) Deficiency

Gonadotropin Deficiency

Pituitary Diabetes Insipidus

Syndrome of Inappropriate Anti-Diuretic
Hormone Secretion

Thyroid Stimulating Hormone (TSH) Deficiency

Hyperprolactinemia



ORIGINAL RESEARCH article

Front. Neurol., 22 January 2020 | <https://doi.org/10.3389/fneur.2019.01410>



Epidemiology of Pediatric Traumatic Brain Injury and Hypothalamic-Pituitary Disorders in Arizona

J. Bryce Ortiz^{1,2†}, Alona Sukhina^{1,2†}, Baran Balkan³, Gevork Harootunian⁴, P. David Adelson^{1,2}, Kara S. Lewis², Oliver Oatman⁵, Vignesh Subbian³, Rachel K. Rowe^{1,2,6} and Jonathan Lifshitz^{1,2,6*}

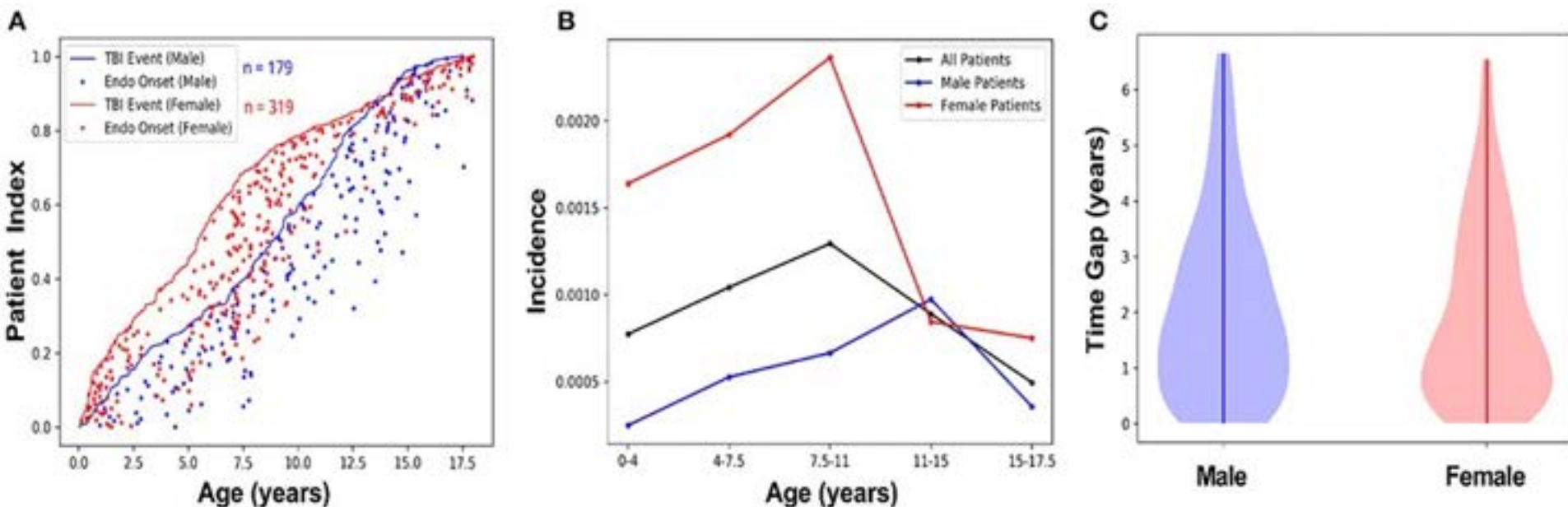
ICD-9 code data from over 600,000 Arizona pediatric patients

- Female subjects were more likely to present with a central endocrine diagnosis after a TBI diagnosis compared to male subjects

Female vs Male 64.1 vs. 35.9%

Pediatric TBIs affecting endocrine function by Sex

- Female subjects show a higher incidence, and an early age of onset, of hypothalamic-pituitary disorder following TBI compared to male subjects





Casual Conversations 24 🍷
Dr. Beth McQuiston
97 views • 1 year ago

Casual Conversations 23 🍷
Dr. Tracey Covassin - Pione...
71 views • 1 year ago

Casual Conversations 22 🍷
#PINKbrainPledge & VA's...
30 views • 1 year ago

Casual Conversations 21 🍷
Dr. Ron Savage
67 views • 1 year ago

Casual Conversations 20 🍷
Dr. Yelena Goldin
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Dr. Kyla Pearce
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164 views • 1 year ago

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170 views • 1 year ago

Casual Conversations 2: Dr. Maheen Mausoo Adamson
182 views • 1 year ago

Casual Conversations 1: Drs. Eve Valera & Jonathan...
277 views • 1 year ago

How can this help in care of women?

- Need to ask patient with if changes in her menstrual cycle?
- Have endocrinologist test for menstrual and endocrine dysfunction with sex-specific panels.

Gendered Differences

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Women with TBI are more likely affected by...

- Poverty
- Social isolation
- Lack of family support
- Lack of transportation
- Community resources

Yelena Goldin, Ph.D., Co-chair, Girls and Women with Acquired Brain Injury Task Force of the American Congress of Rehabilitation Medicine, Congressional Briefing, DC, 2016





Less Return to Work

- Less likely to receive or complete vocational rehabilitation.
- Lower rates of returning to work after TBI.
- Need for feminine roles of child rearing and household managements to be viable rehabilitation goals.

Less Sexual and Reproductive Health

- Significantly higher rates of menstrual and endocrine dysfunction.
- Fatigue, cognitive and functional difficulties represent strong obstacles in the area of family planning and parenting.

Source: Goldin, 2016





Abuse and Violence

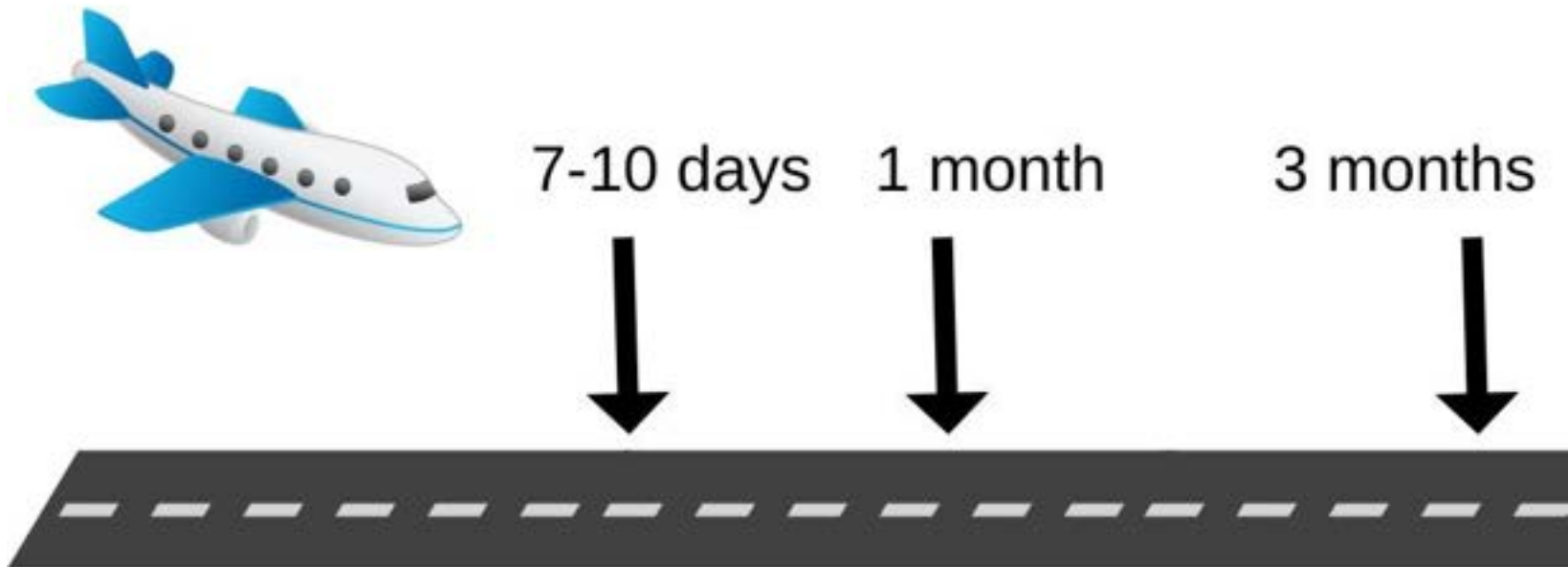
- Women with disabilities are significantly more likely to be victims of abuse and violence.
- Women, regardless of disability status, are more likely to be victims of intimate partner violence, which almost always leads to potential TBI and often multiple/repeat injuries.

Source: Goldin, 2016



Believing patients

How long to recover?



Summary for Female Clients

Sex differences (Biological)

Axon differences

Symptom Constellation

Headaches

Menstrual and endocrine dysfunction

How will her TBI symptoms create obstacles for her physical & mental health?

- Extended Recovery period?
- If endocrine dysfunction...Fertility?

Summary for Female Clients

Sex difference/Biological

- How will fatigue, cognitive and functional difficulties create obstacles for her in the area of employment, family planning and caregiving parenting?
- Test for menstrual and endocrine dysfunction with sex-specific panels

Summary for Female Clients

Gender differences (Social)

- What barriers exist for her as she faces the world with a brain injury?
- How will her symptoms create obstacles as she is judged by family, work, school and her community?



**PINK
Concussions**

**Partner-
Inflicted
Brain Injury**

(PIBI)

Task Force

The Mission of the Task Force

To improve the lives of those impacted by violence by creating an ongoing safe and inclusive space for

- learning
- inspiration
- collaboration

among those working in brain injury and gender-based violence.

Join the Virtual Task Force

- Sign up for the task force at **www.PINKconcussions.org/violence**
- Save the last Tuesday of every month at 2-3 PM EST
- 1-2 Expert Guest Speakers
- Mini-presentations from members
- Playback the recording of any missed call

Join PINK

- **Social Media**
- E-news letters
- Events
- YouTube → Podcast



References

Faul M, Xu L, Wald MM, Coronado VG. Traumatic Brain Injury in the United States: Emergency Department Visits, Hospitalizations and Deaths 2002 – 2006. Atlanta (GA): Centers for Disease Control and Prevention, National Center for Injury Prevention and Control; 2010.

Br J Sports Med 2013 Jan American Medical Society for Sports Medicine position statement: concussion in sport, Kimberly G Harmon¹, Jonathan A Drezner, Matthew Gammons, Kevin M Guskiewicz, Mark Halstead, Stanley A Herring, Jeffrey S Kutcher, Andrea Pana, Margot Putukian, William O Roberts

Yelena Goldin, Ph.D., Co-chair, Girls and Women with Acquired Brain Injury Task Force of the American Congress of Rehabilitation Medicine, Congressional Briefing, DC, 2016

Ortiz JB, Sukhina A, Balkan B, Harootunian G, Adelson PD, Lewis KS, Oatman O, Subbian V, Rowe RK, Lifshitz J. Epidemiology of Pediatric Traumatic Brain Injury and Hypothalamic-Pituitary Disorders in Arizona. Front Neurol. 2020 Jan 22;10:1410. doi: 10.3389/fneur.2019.01410. PMID: 32038466; PMCID: PMC6988738.

Broshek DK, Kaushik T, Freeman JR, Erlanger D, Webbe F, Barth JT. Sex differences in outcome following sports-related concussion. J Neurosurg. 2005 May;102(5):856-63. doi: 10.3171/jns.2005.102.5.0856. PMID: 15926710.

Daugherty, J., Waltzman, D., Snedaker, K.P., Bouton, J., Zhang, X. and Wang, D. (2020), Concussion Experiences in New England Private Preparatory High School Students Who Played Sports or Recreational Activities. **J School Health**, 90: 527-537. <https://doi.org/10.1111/josh.12899>

Dana Waltzman , Jill Daugherty , Katherine Snedaker , Jason Bouton & David Wang (2020): Concussion reporting, return to learn, and return to play experiences in a sample of private preparatory high school students, **Brain Injury**, DOI: 10.1080/02699052.2020.179338

Eric G. Post, Traci R. Snedden, Katherine Snedaker, Jason Bouton, David Wang, Differences in Sport-Related Concussion History, Reporting Behavior, and Return to Learn and Sport Timelines in Public versus Private High School Student Athletes, **Brain Injury**, 10.1080/02699052.2021.1890217, (1-8), (2021)

Valera, Eve M. PhD; Joseph, Annie-Lori C. BA; Snedaker, Katherine LCSW; Breiding, Matthew J. PhD; Robertson, Courtney L. MD; Colantonio, Angela PhD; Levin, Harvey PhD; Pugh, Mary Jo PhD; Yurgelun-Todd, Deborah PhD; Mannix, Rebekah MD, MPH; Bazarian, Jeffrey J. MD; Turtzo, L. Christine MD, PhD; Turkstra, Lyn S. PhD; Begg, Lisa DrPH; Cummings, Diana M. PhD; Bellgowan, Patrick S. F. PhD Understanding Traumatic Brain Injury in Females: A State-of-the-Art Summary and Future Directions, **Journal of Head Trauma Rehabilitation**: January 2021 - Volume 36 - Issue 1 - p E1-E17 doi: 10.1097/HTR.0000000000000652



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