Prevention of Concussions

Carolyn Emery PT PhD

8th Annual Concussion Research Symposium- Virtual

Biomarkers, Prevention and Treatment of Concussion

Friday, Feb 26, 2021

9:00 am- 2:00 pm

Sport Injury Prevention Research Centre

IOC Research Centre

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Public Health Burden of Concussions in Youth

- > 2.8M concussions annually in North America
    - **1 in 5 lifetime risk**
    - **50% <19 years**
    - **In youth, >60% in sport (rugby, ice hockey, tackle football)**
    - **1 in 10 youth** will sustain a concussion annually
    - 30% are recurrent
- 30% symptomatic for months (e.g., headache, dizziness, depression, sleep, cognitive, social isolation)

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Sport-related Concussions

High School Survey (N=24 Alberta high schools, n=1971 students, ages 14-19)

Dr. Amanda Black

	Lifetime Prevalence		Prevalence In the Past Year
♂	**28.4%** 95% CI 21.7%-36.3%	Males reporting at least one concussion	**14.0%** 95% CI 10.0%-19.1%
♀	**22.1%** 95% CI 19.6%-24.7%	Females reporting at least one concussion	**9.9%** 95% CI 7.8%-12.6%

McCallum et al 2020

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The Personal Cost of Youth Sport-related Concussion

Sport-related Concussion in Youth

Predictable

Preventable

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Prevention

UPSTREAM SHIFT IN OUR APPROACH TO MANAGEMENT

Primary Prevention	Secondary Prevention	Tertiary Prevention
HEALTHY Prevent or reduce the risk of injury	**SUSCEPTIBLE** Early diagnosis/ Prevention of injury recurrence	**REHABILITATION** Preventing long term consequences of injury

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Sport Injury Prevention Research

1. Surveillance (extent of injury problem)

2. Find the risk factors (cause)

Extrinsic

Intrinsic

3. Develop an intervention (validation)

4. Introduce the Intervention (implementation)

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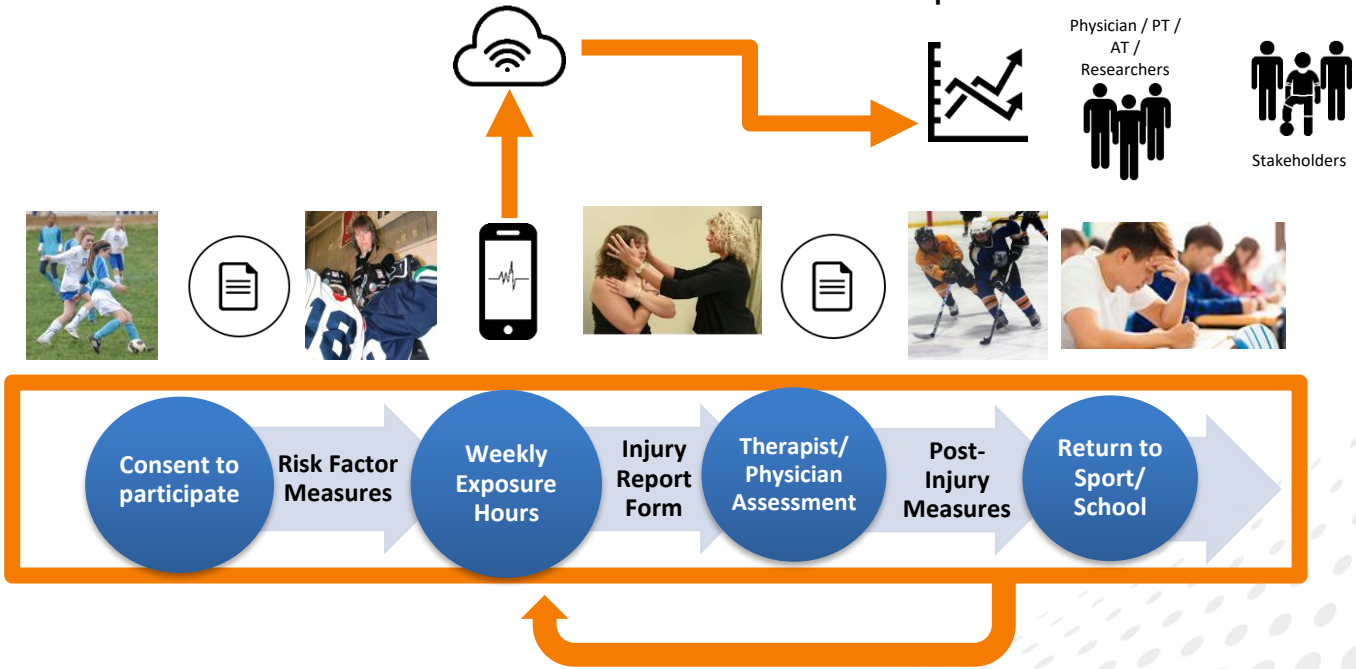
Adapted from van Mechelen 1992

SHRED Concussions

Surveillance in **H**igh Schools and Community Sport to **RED**uce Concussions and their Consequences



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SHRED Concussions: Targets for Prevention

Rule Changes

- Head contact rules
- Tackle rules
- Heading the ball
- No contact practices

Equipment

- Mouth guards use
- Helmet fit
- Wearable technology

Training Strategies

- Neuromuscular and sensorimotor training strategies
- Contact and tackle training

Highlighting Community Partnerships

CANADA

CANADA

CANADA

SPORT CANADA

RUGBY CANADA

Volleyball Canada

CANADA BASKETBALL

Research informing rule and policy change

Partnerships and Knowledge Translation

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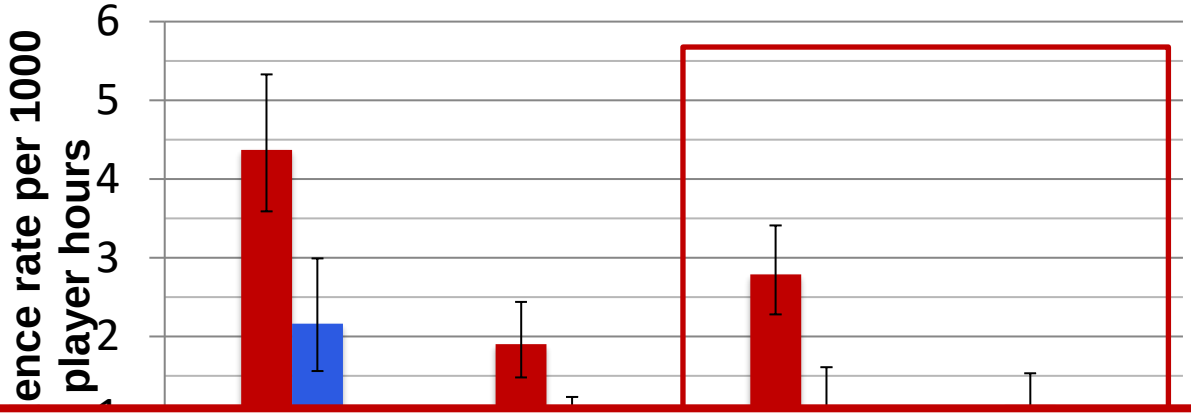
Rules: Ice Hockey National Policy Change Pee Wee



Estimated reduction of >4800 concussions in Canada annually in 11-12 year olds

Game Injury: IRR = **0.50** (95% CI; 0.33 – 0.75)* ↓ **50%**

Severe Injury(>7 days): IRR = **0.40** (95% CI; 0.24 – 0.68)* ↓ **60%**

Concussion: IRR = **0.36** (95% CI; 0.22 – 0.58)* ↓ **64%**

Severe Concussion (>10 days): IRR = **0.56** (95% CI; 0.31 – 1.01) ↓ **44%**

*Adjusted for cluster, year of play, previous injury/concussion, level of play, position, attitudes toward body checking, player size, exposure hours offset

Black et al 2016

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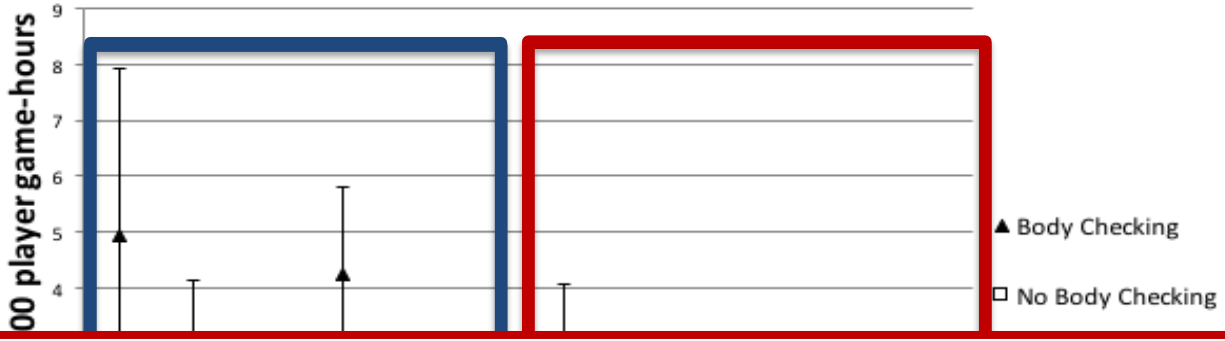
Rules: Ice Hockey Policy Change non-elite Bantam (13-14) BC and Alberta



Estimated reduction of >6000 injuries in Canada annually in 13-14 year olds

Injury: IRR † = **0.46** (95% CI; 0.28 – 0.75) → **54% reduction**

Severe Injury: IRR = 0.42 (0.23 to 0.77) → **58% reduction**

Concussion: IRR = **0.61** (95% CI; 0.31 – 1.19) → **39% reduction**

Severe Concussion: 0.62 (0.25 to 1.54) → **38% reduction**

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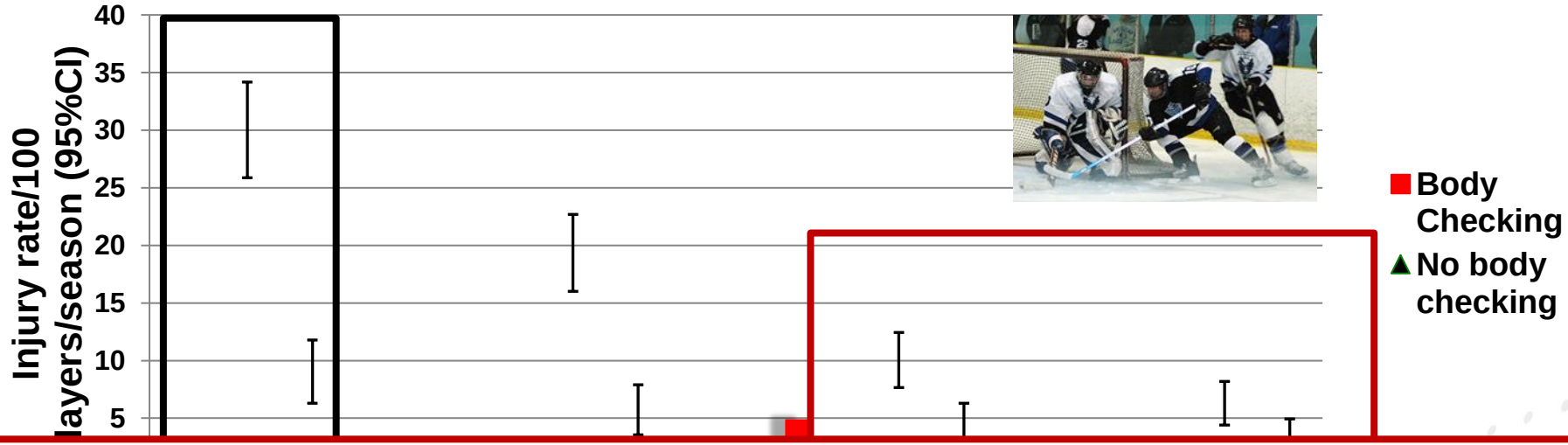
†Clustering by team and player, previous injury/concussion history, year of play

Emery et al 2019

Rules: Ice Hockey Policy Change non-elite Midget (15-17 years)



Estimated reduction of >1760 concussions in Canada annually in 15-17 year olds

Concussion: IRR*= **0.36** (95% CI: 0.21-0.63) → **64% reduction**

Severe Concussion: IRR* = 0.41 (95% CI: 0.21-0.80) → **59% reduction**

*Clustering by team and adjusted for: year of play, position, previous injury/concussion

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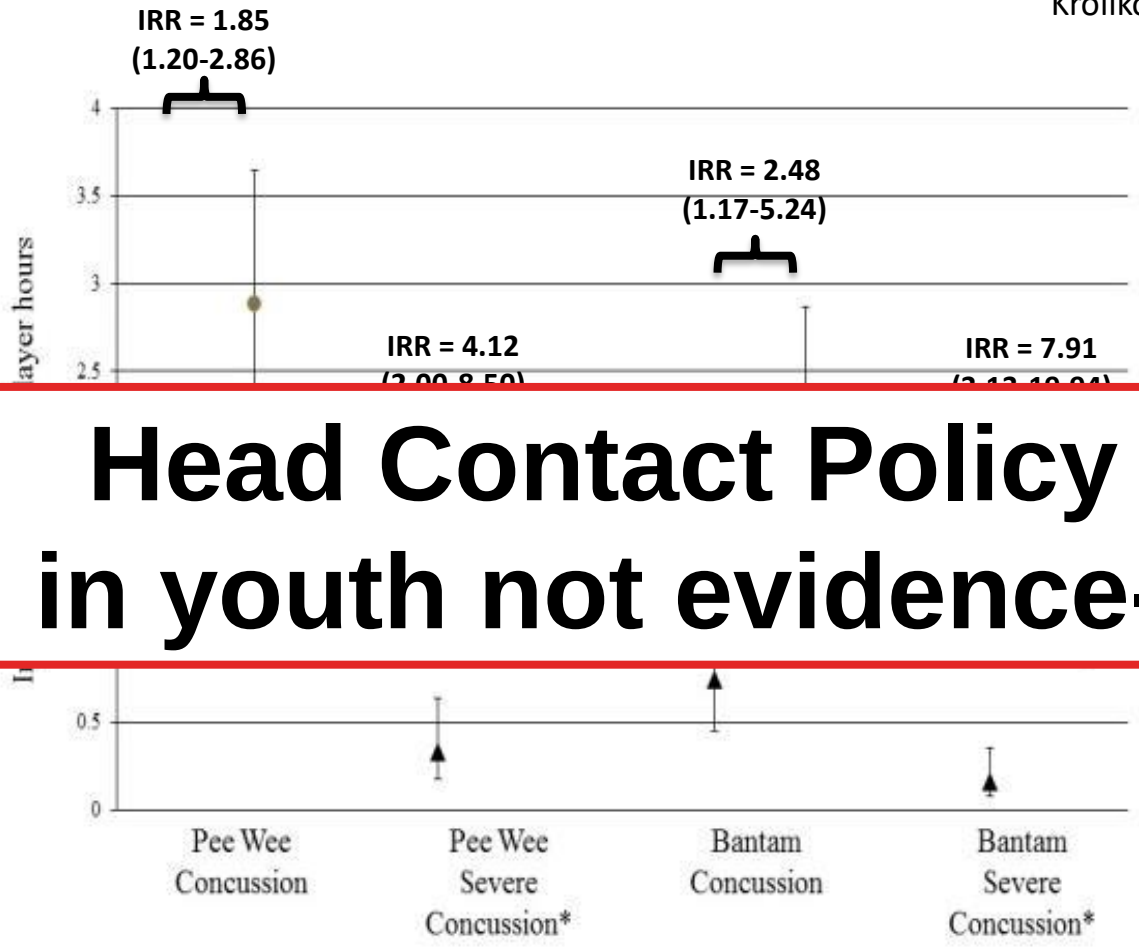
Emery et al 2020

Rules: "Zero tolerance for head contact" rule enforcement

Krolikowski et al 2017



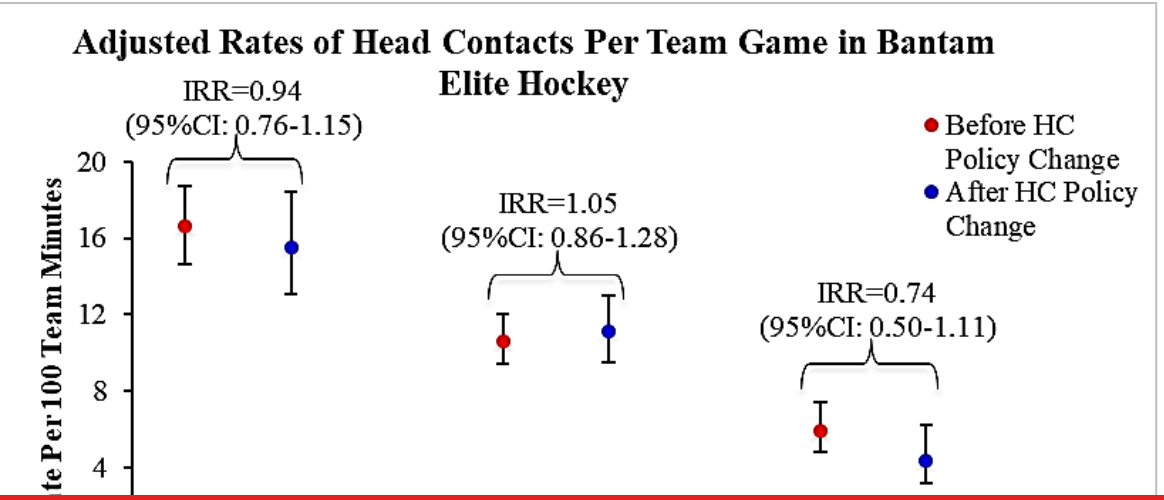
Head Contact Policy Change in youth not evidence-informed

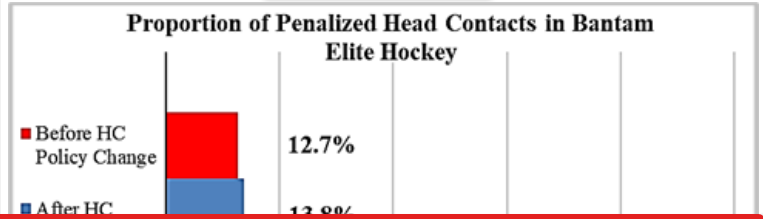
Canadian youth ice hockey.

Ages 11-14

Rules: Video Analysis "Zero Tolerance for Head Contact"

Williamson R, Kolstad A, Krolikowski M, Nadeau L, Goulet C, Hagel B, Emery CA 2020

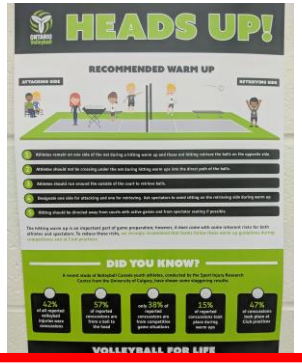


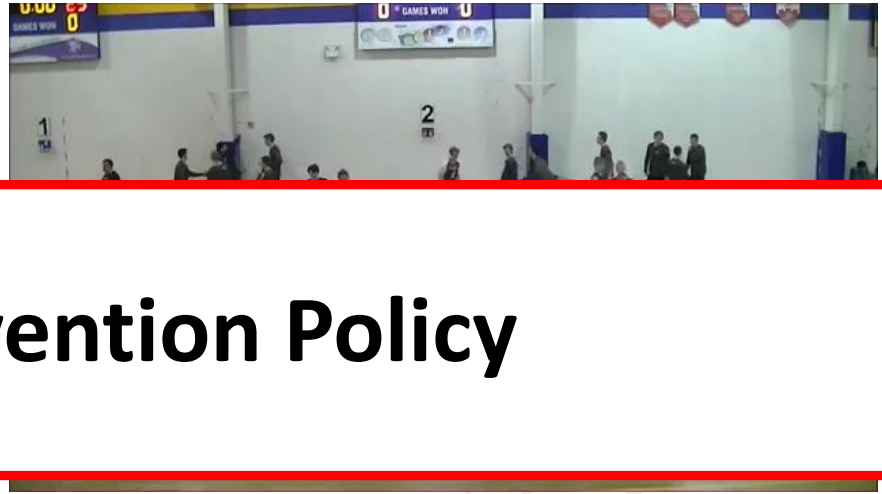


HC incidence and HC enforcement did <u>not</u> differ with policy implementation

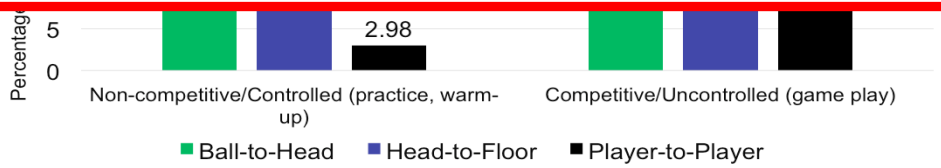
Rules: Volleyball Hitting Warmup

Derek Meeuwisse





Informing Prevention Policy



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Meeuwisse et al 2018

Rules: Revised Laws for Rugby Tackle Height?

Does reducing the height of the tackle through law change in elite men's rugby union (The Championship, England) reduce the incidence of concussion? A controlled study in 126 games

BJSM 2019

Keith A Stokes[1, 2], Duncan Locke[2, 3], Simon Roberts[1], Lewis Henderson[2], Ross Tucker[4], Dean Ryan[5], Simon Kemp[2]

The maximum tackle height was lowered from the line of the shoulders on the ball carrier to the line of the armpits

Tacklers contacted the ball carrier's head 30% less often

Tacklers aiming to tackle lower suffered more concussions

Relevance for youth?

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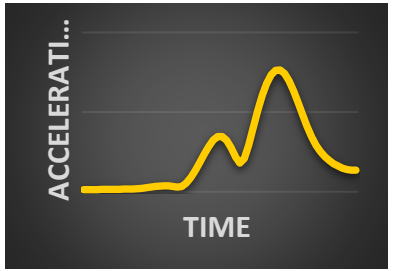
Rules: Head Contact Biomechanics

Darren Stefanyshyn

Christian Clermont

- Boil & Bite Mouthguard - Prevent Biometrics®
- Inertial Measurement Units
  - Accelerometers
  - Gyroscopes
  - 3.2kHz Sampling Frequency
- Head Impact Biomechanics
- Video analysis (e.g., non-contact practices)



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Equipment: Mouth Guard Use Youth Ice Hockey


B Hagel


D Chisolm

Nested case-control (ages 11-17) within cohort

Cases = concussion

Controls = non-concussion injury

Odds Ratio = 0.36 (95% CI 0.17-0.73)

→64% reduction in the odds of concussion with MG

Adjusted for Level of Play, Position, Concussion Hx, Age group, mechanism, Cohort, Body Checking League, Session type (practice vs game)

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Equipment: Helmet Fit – Youth Ice Hockey

Helmet fit criteria developed and evaluated (n=60)

- 67%-100% agreement for fit criteria

Self-Reported Questions				
1. How does the helmet fit?	Excellent	Good	Fair	Poor
2. How comfortable is the helmet?	Excellent	Good	Fair	Poor
Assessor Observations				
3. Helmet fits snugly on all sides			Yes	No
4. Helmet covers the base of the skull			Yes	No
5. Chin strap fastened			Yes	No
6. Chin strap not loose			Yes	No
7. Crown of helmet is 1-2 fingers above eyebrows			Yes	No
8. Helmet does not impinge neck movement			Yes	No
9. Helmet does not cover eyes when pressing down			Yes	No
10. Facemask does not slip when pulled left/right			Yes	No
11. Facemask does not slip when pulled up/down			Yes	No
12. Helmet cannot be removed without undoing chin strap			Yes	No
13. All snaps and screws in place			Yes	No
14. All padding in place			Yes	No
15. Liner not cut/shaved			Yes	No
16. Liner not worn/broken/cracked			Yes	No
17. Shell appears in good condition			Yes	No
18. Standard sticker is visible*			Yes	No
19. Helmet does not have “cage hang” (loose facemask straps)			Yes	No

Patton D et al 2019

Cohort Study: Helmet Fit Criteria

		Non-injured Players (n=54)		
		<2 Missing Criteria	>1 Missing Criteria	Total
Concussed Players (n=54)	<2 Missing Criteria	20	7	27
	>1 Missing Criteria	17	10	27
	Total	37	17	54

OR	95% CI	P-value
2.67	1.04-6.81	0.040

Gamble A et al 2020

Equipment and Concussion Prevention

Can proper equipment protect against concussion across multiple collision-based sport?


Brent Hagel


Ash Kolstad

Mouthguard Use

Yes Use

No Use

Helmet Facemask Type

Full Cage

Full Shield

Cage-Shield Combo

Mouthguard Type

Dentist-Fit

Off-the-Shelf

Virtual & In-Person Helmet Fit Assessments

Example: does the facemask fit?

Assesses:
Helmet mobility
Helmet position
Chin strap fit
Facemask fit
Helmet age

Good Fit

Poor Fit

Training: Neuromuscular warm-up

IOC Consensus on the Developing Youth Athlete

Bergeron et al 2015, Emery et al 2015

Neuromuscular warm-up

Aerobic - running, bounding, lateral shuffle

Strength - eccentric hamstring, quadriceps, calf, hip and trunk

Agility/technical/coordination – sport-specific jump and landing drills, zigzag, partner drills

Balance - single leg, dynamic, partner drills, ball drills, balance pad, wobble board

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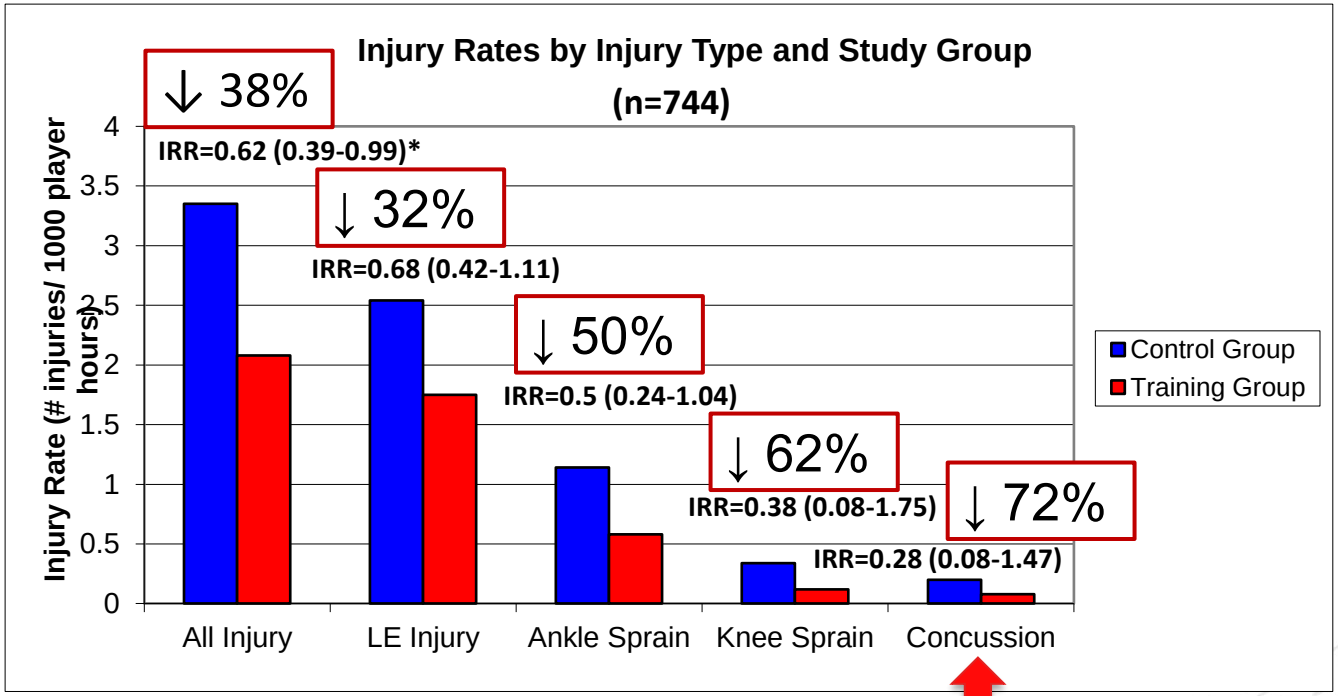
Training: Neuromuscular warm-up Soccer

Emery et al BJSM 2010



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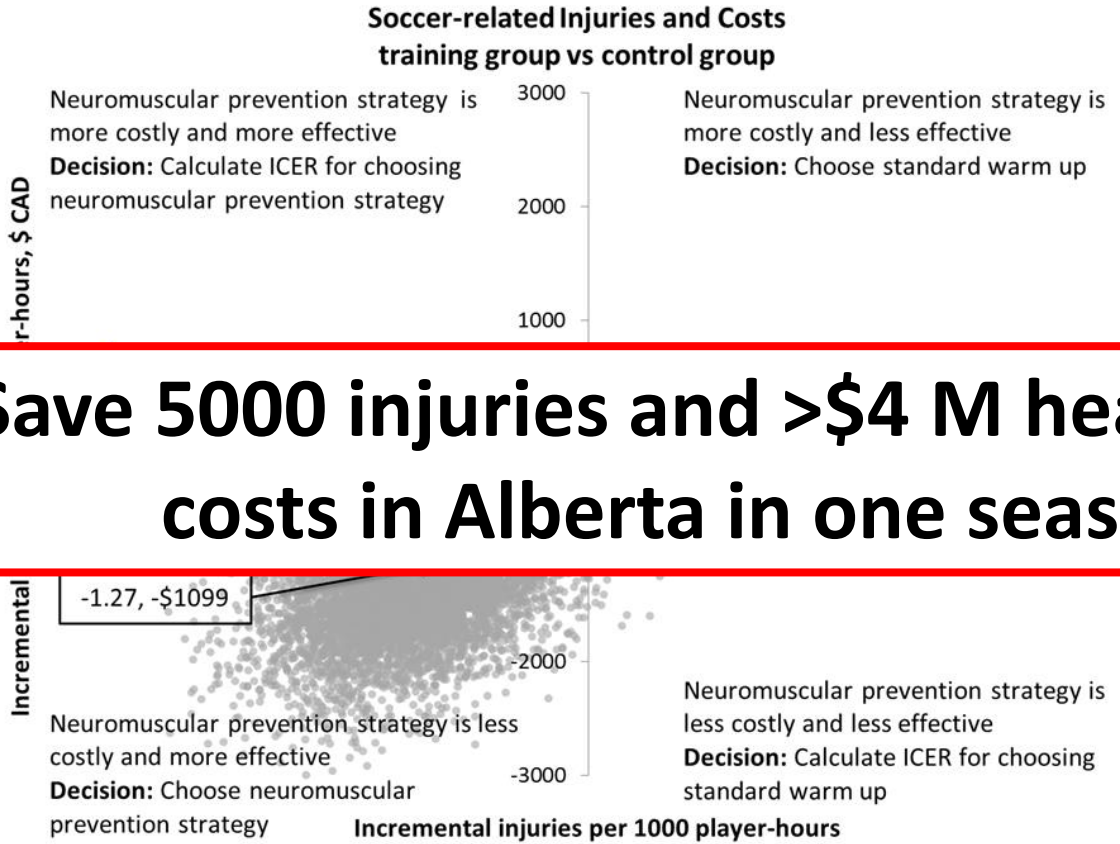
Emery et al 2010

D Marshall

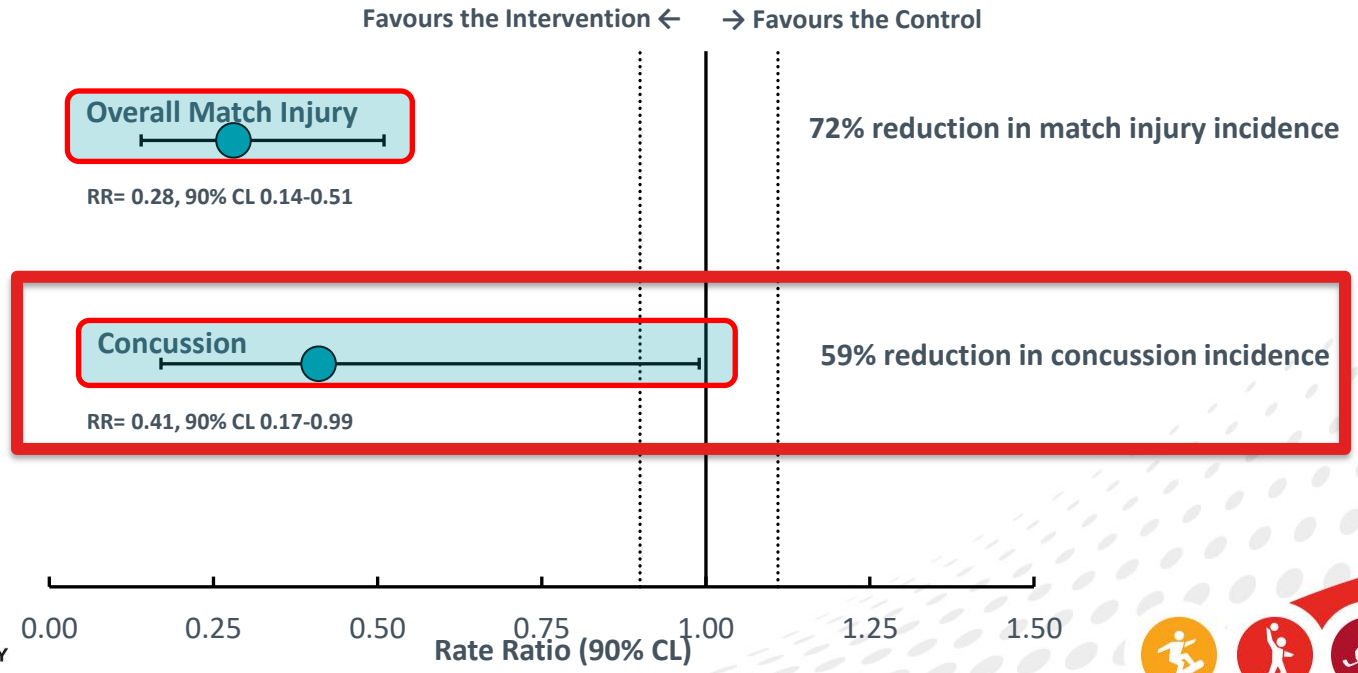
Cost-effectiveness Plane



Save 5000 injuries and >$4 M healthcare costs in Alberta in one season

Schoolboy Rugby - NMT(≥3 times per week)

Hislop et al 2017 Comparing those schools that carried out the programme at least 3 times per week…



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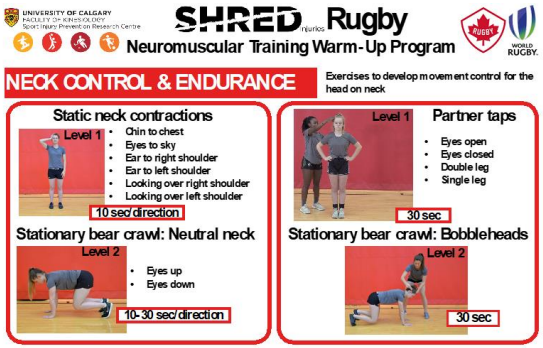
Knowledge Translation

- **>80 workshops delivered to >1200 participants**
  - Teachers
  - Coaches
  - Clinicians
  - Sport directors
  - Recreation leaders
  - Personal trainers
  - Fitness instructors



- **Implementation evaluation**
  - Pre and post workshop
  - 6-month and 12-month follow-up

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SHRED Injuries Rugby: A Multifaceted Approach to Prevention

Neuromuscular Training Warm-up

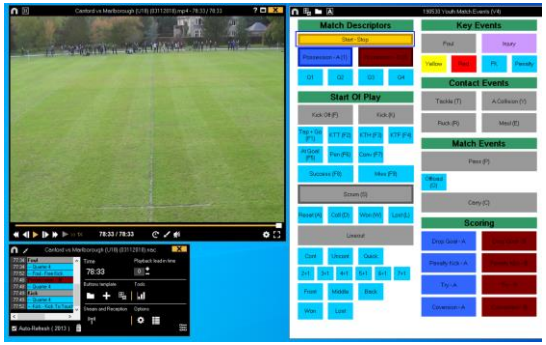
SHRed Injuries Rugby endorsed by SIPRC, UBath, England Rugby, and World Rugby

Equipment – MGs and headgear

Dr. Stephen West

Isla Shill

Video Analysis - rule change



Identify match events, tackle characteristics and head impacts

Identify match events leading to suspected injury

Video analysis - tackle training

Establish and improve practices in coach delivery of safe and effective tackle training

SHRED

Surveillance in
High Schools to
REDuce
Concussions

Concussions

Concussion Prevention, Detection, Diagnosis, Prognosis, and Management in Youth

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SHRED Concussion Aims:

1

To establish a **concussion surveillance** program nationally in schools to evaluate concussion burden and predictors of recovery

2

To integrate multimodal tools for concussion to develop and validate models to **detect concussion and predict recovery in youth**

3

To **evaluate** the implementation, effectiveness, and sustainability of novel sport-specific and school-based **prevention strategies in youth**

4

To provide a platform for recruitment of youth to treatment studies aimed to **prevent long-term consequences of concussion**

SHRED Concussion Participants

- 6,000 high school sport participants (ages 13-18)
- 60 high schools and/or sport clubs (~12/province x 5 provinces)
  - British Columbia, Alberta, Manitoba, Ontario, Quebec
- 1200 students/province
- 3-years - ~600+ concussions/year

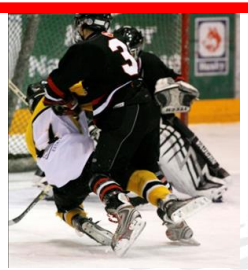
SHRED Concussions

- **Move upstream towards primary and secondary prevention** to have the greatest public health impact

Informing Prevention Practice and Policy

SHRED Concussions in Youth Sport

25% by 2025



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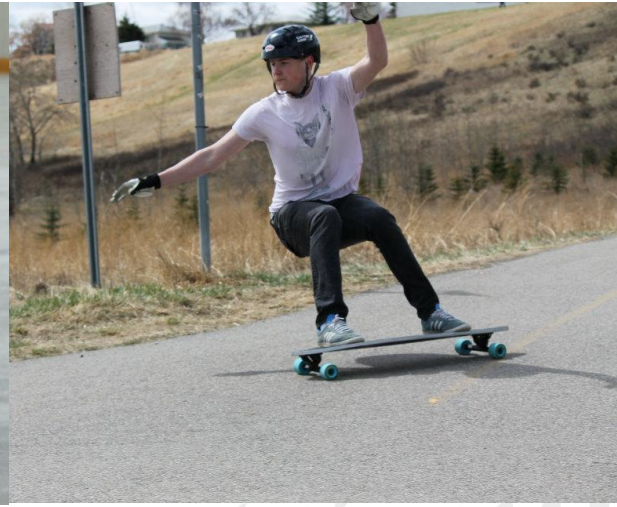
BASKETBALL ALBERTA

WORLD RUGBY



Questions?

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