Preventing Joint Injury & Subsequent Osteoarthritis:

A Population Health Prospective

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Public Health Burden of Injury in Alberta

The leading cause of death and hospit_____ ____ ___uth under 19 years is uninte_____ _____

Every _____
38_____n to ER
_____hospitalized

Every 3 days
1 child dies

Sport related injury is the leading cause of injury ages 11-18 (30%)

Injuries in Youth Sport and Recreation

- **Sport participation** is the leading cause of injury, accounting for **30% of all injuries** reporting to ER or requiring medical attention in youth

- **1 in every 3 youth** (ages 11-18) in Alberta will seek medical attention for a sport injury this year

- **Lower extremity injuries** account for 60% of all injuries in youth sport

- 60% of these are **knee and ankle joint** injuries

Canada

Medical Attention Injuries

Most Serious Injuries
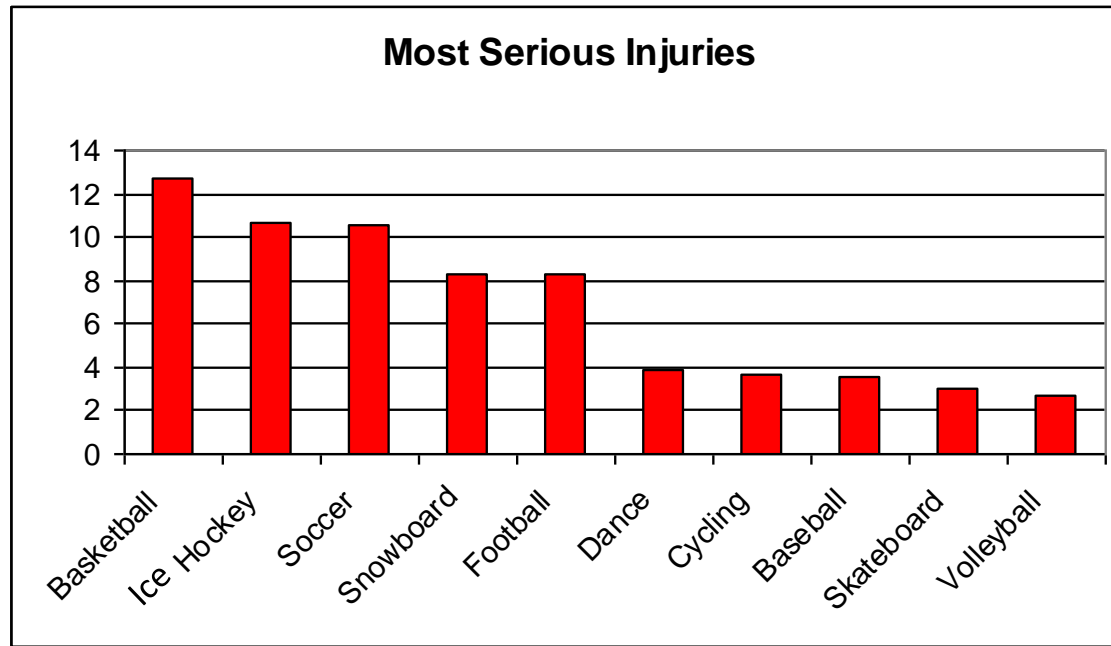
Emery et al 2006, 2008

Injury in previous year:

- **35 medically treated** injuries/100 adolescents (ages 11-18)

- **8 injuries treated in the ER**/100 adolescents (ages 11-18)
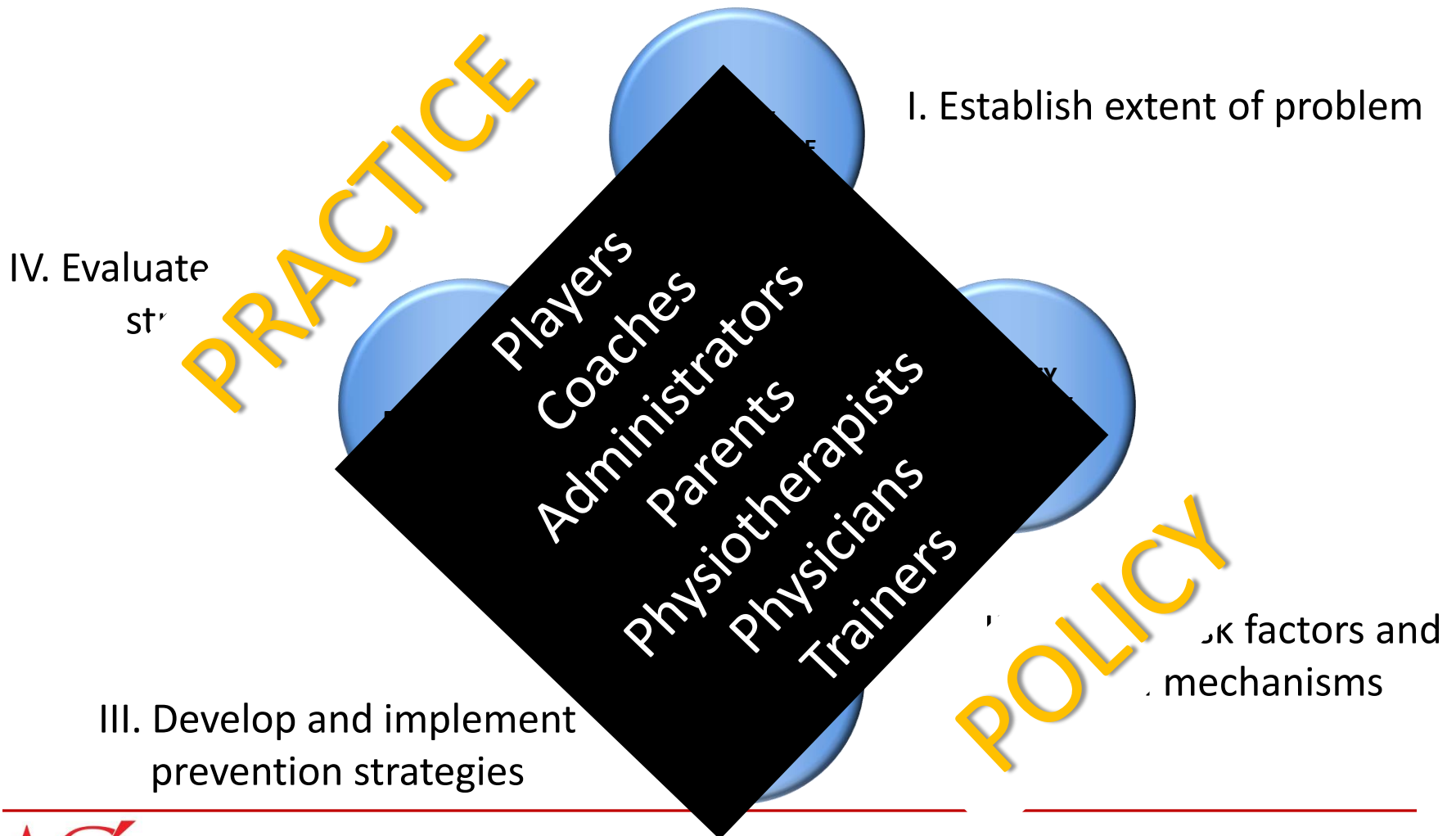
Consequence of Youth Sport Injury

- ↓Participation in sport (8% annually)

- ↓Performance

- ↓ Physical activity = ↑   overweight/obesity

- Knee & ankle injury   ➔   osteoarthritis (4X)

- Health care & indirect costs are high

- Psychosocial outcomes

COSTS

Osteoarthritic Knee

Sport Injury Prevention

Primary Prevention of Post-traumatic OA

PRACTICE

POLICY

I. Establish extent of problem

IV. Evaluate
st

Players
Coaches
Administrators
Parents
Physiotherapists
Physicians
Trainers

factors and
mechanisms

III. Develop and implement
prevention strategies

Risk Factors for Youth Soccer Injury

1 in 4 will be injured this outdoor season

- Previous Injury
- Games > Practices
- Female > Male (knee injuries)
- More elite levels of play
- Older age group (>14 years)
- High risk single leg squat

Arthritis Alliance of Canada
Alliance de l'arthrite du Canada

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Solution – Neuromuscular Training Warm-up

Warm-up

- aerobic, dynamic stretching, agility

Strength

- hamstring, quadriceps, calf, hip/trunk

Agility/technical/coordination

- jumps, lateral shuffle, bounding, zigzag

Balance

- single leg, dynamic, foam pad, wobble board

IOC Consensus on Youth Athlete Development

Randomized controlled trial (RCT) evidence

Objective:

To summarize the evidence ~~strategies in youth sport~~ vention
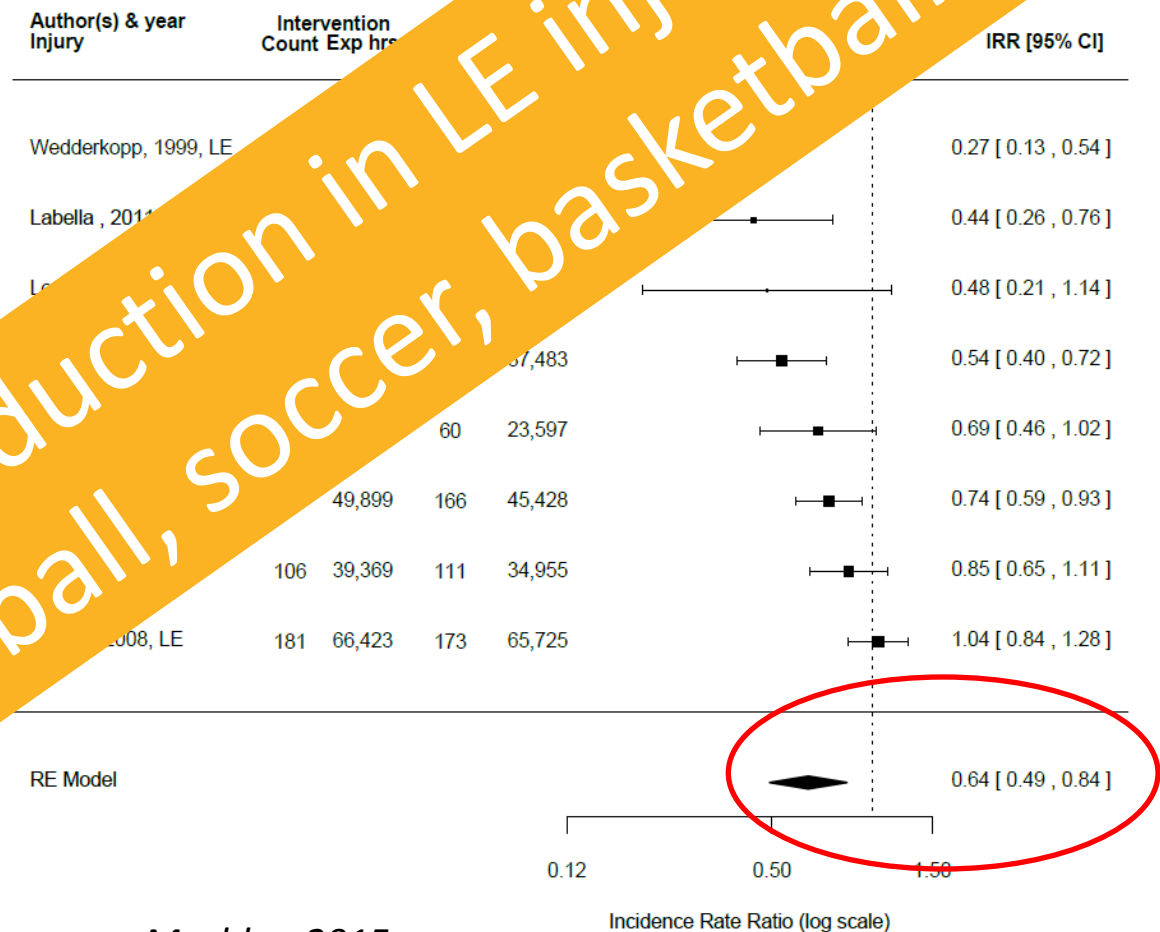
Results:

25 original
14 RCT ~~Neuromuscular Training Warm-up~~ strategies
in ~~handball, American~~ handball, American football,
Bas~~ketball, Australian~~ rules football, multi-sport

36% reduction in LE injury risk handball, soccer, basketball

Systematic Review & Meta-analysis

Sport Injury Prevention

NMT- Youth Lower Extremity Injury Out...

Author(s) & year Injury	Intervention Count Exp hrs				IRR [95% CI]
Wedderkopp, 1999, LE					0.27 [0.13 , 0.54]
Labella , 2011					0.44 [0.26 , 0.76]
L...					0.48 [0.21 , 1.14]
			37,483		0.54 [0.40 , 0.72]
		60	23,597		0.69 [0.46 , 1.02]
	49,899	166	45,428		0.74 [0.59 , 0.93]
	106	39,369	111	34,955	0.85 [0.65 , 1.11]
...08, LE	181	66,423	173	65,725	1.04 [0.84 , 1.28]
RE Model					0.64 [0.49 , 0.84]

0.12   0.50   1.50

Incidence Rate Ratio (log scale)

36% reduction in LE injury risk handball, soccer, basketball

Emery, Roy, Whittaker, Nettle-Aguirre, van Mechlan 2015
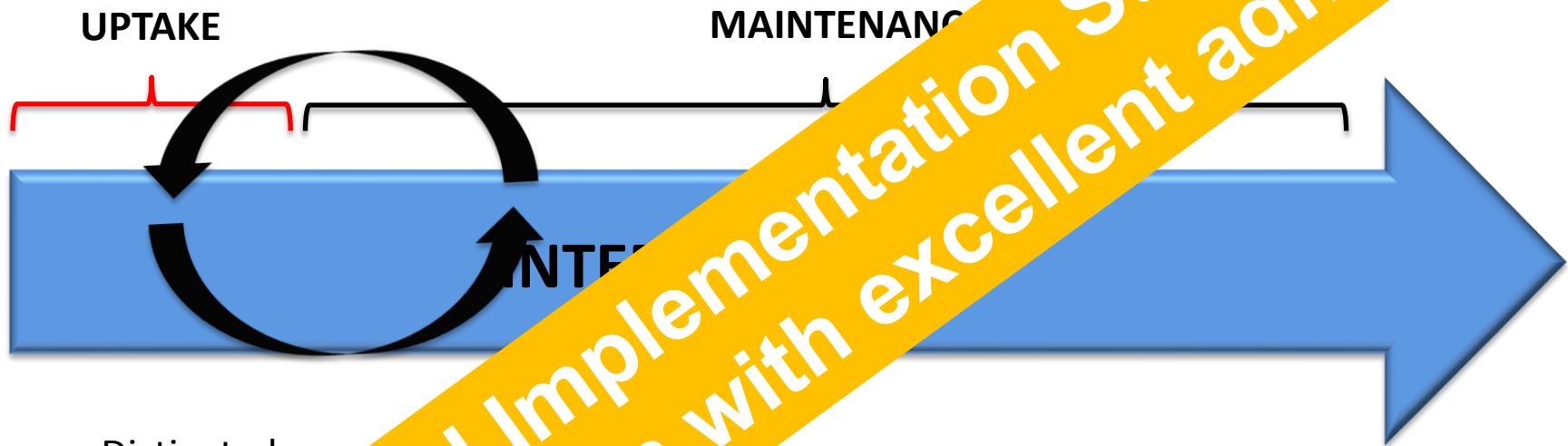
Soccer Evidence

FIFA 11+

- Coach workshops

- Coach delivery – knowledge, time, space, flexibility

- Player Champion

- Focus on prevention and performance

- Sport Association mandate

- Translate to other sports and school physical education setting

Adapting Implementation

Sport Injury Prevention

UPTAKE   **MAINTENANCE**

- Distinct phases
- Uptake ≠
- Beha   ach workshop content may facilitate longer term
- coach risk perception, self-efficacy, expectations, action plan, barriers

McKay et al 2013

Targeted Implementation Strategy: >50% reduction with excellent adherence

Recommendations

Prevention of Youth Sport Related Joint Injury

1. Implementation of evidence-informed injury prevention strategies in youth sport and recreation
   - community stakeholder engagement
   - coach, teacher and clinician workshops
   - social media
   - policy change
   - legislation

2. Continue interdisciplinary evaluation of injury prevention programs, protective equipment, policy changes and legislation to inform implementation and maintenance that will have broader reach and a greater public health impact

3. Greater focus on secondary prevention and rehabilitation to prevent long-term consequences
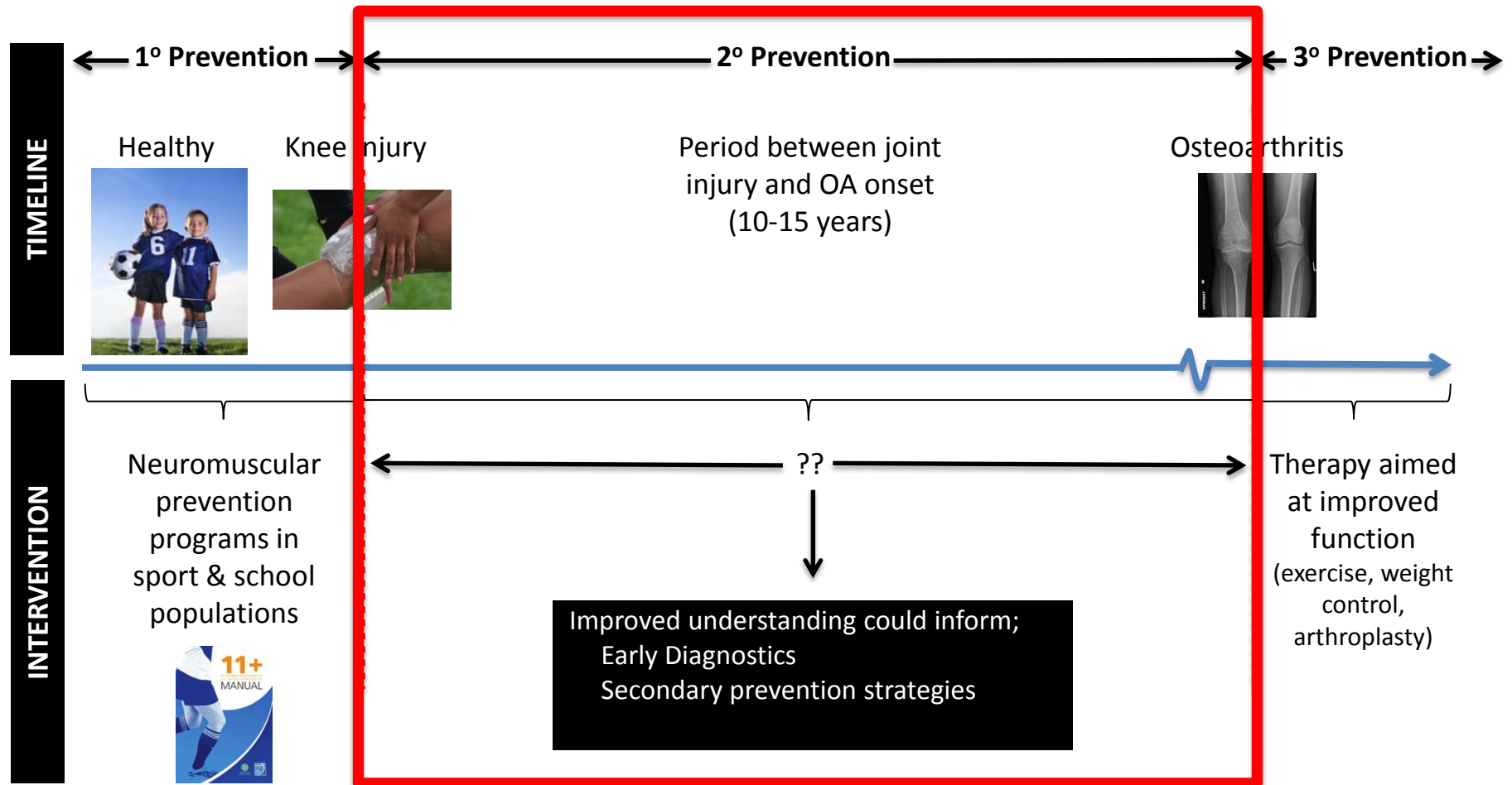
Get on with it!

Prevention of Post-traumatic OA
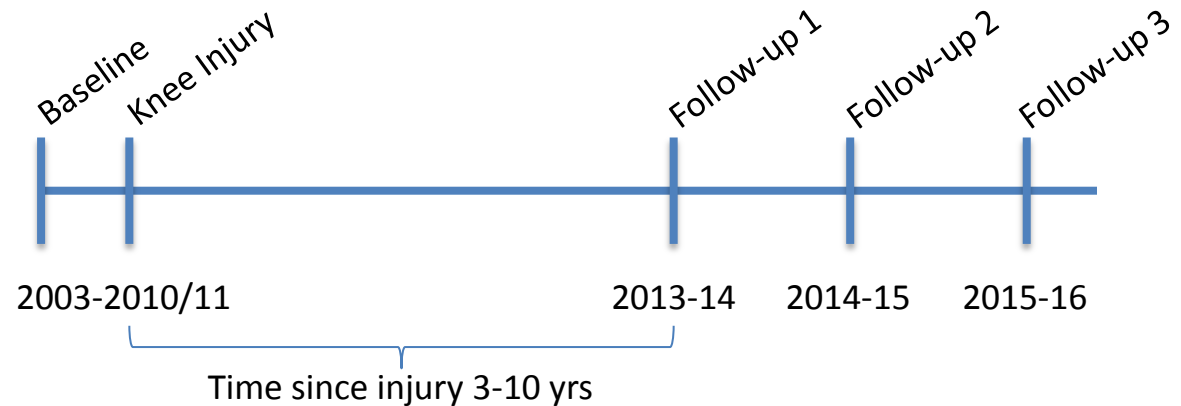
Timeline of Events & Interventions

Chu et al 2013, Uthman et al 2013, Bennell et al 2014, Emery et al 2015
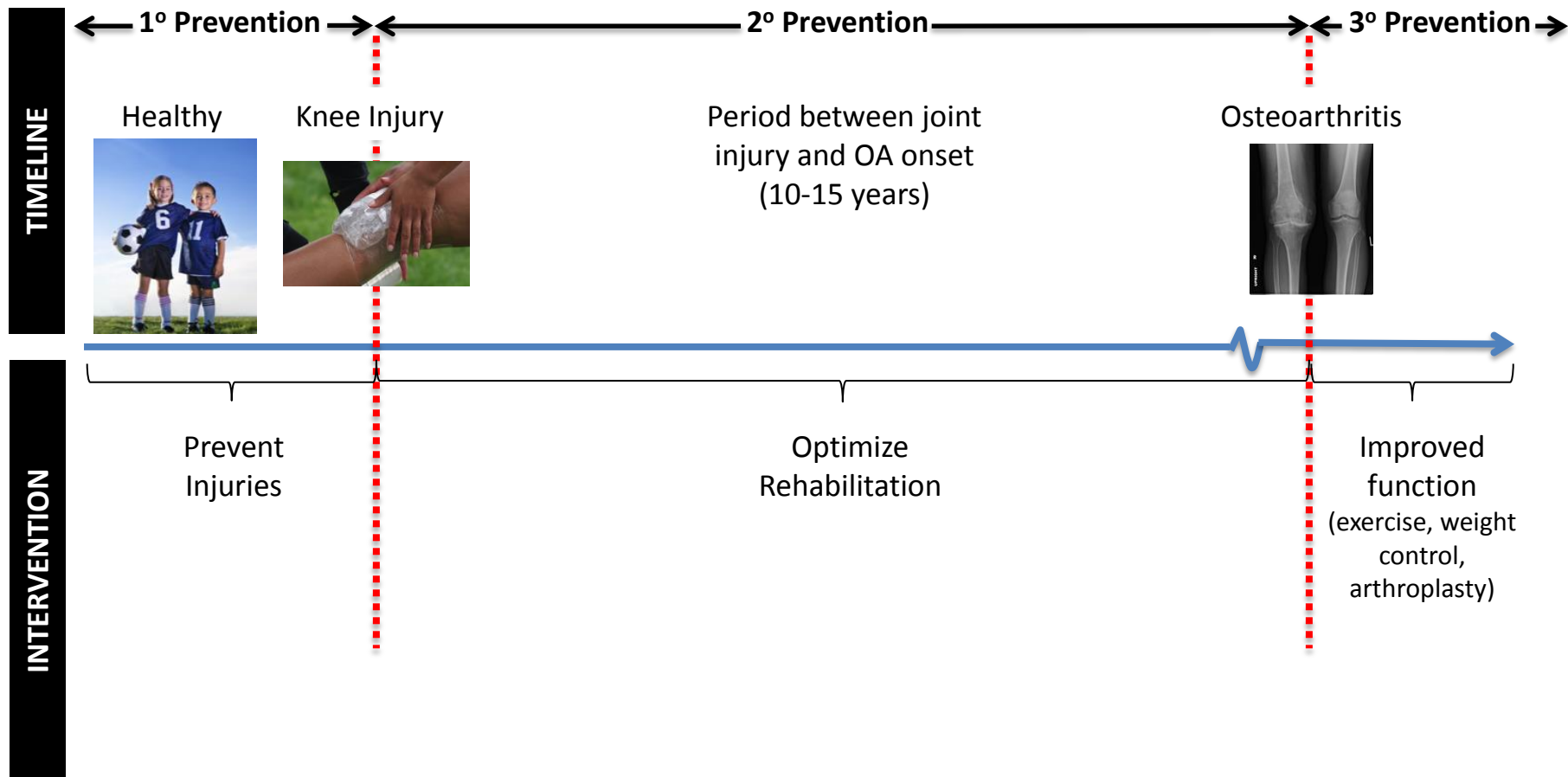
Prevention of Post-traumatic OA

Timeline of Events & Interventions

Alberta Youth PrE-OA Study

Overview

Whittaker et al 2015

Baseline — Knee Injury — Follow-up 1 — Follow-up 2 — Follow-up 3

2003-2010/11 — 2013-14 — 2014-15 — 2015-16

Time since injury 3-10 yrs

Ongoing longitudinal cohort study

200 participants (15-26 years of age)
- 100 with an sport-related knee injury sustained ≤ 18 years of age. [Age of injury: Median, range; 16 years (9-18)]
- 100 age, sex and sport matched controls
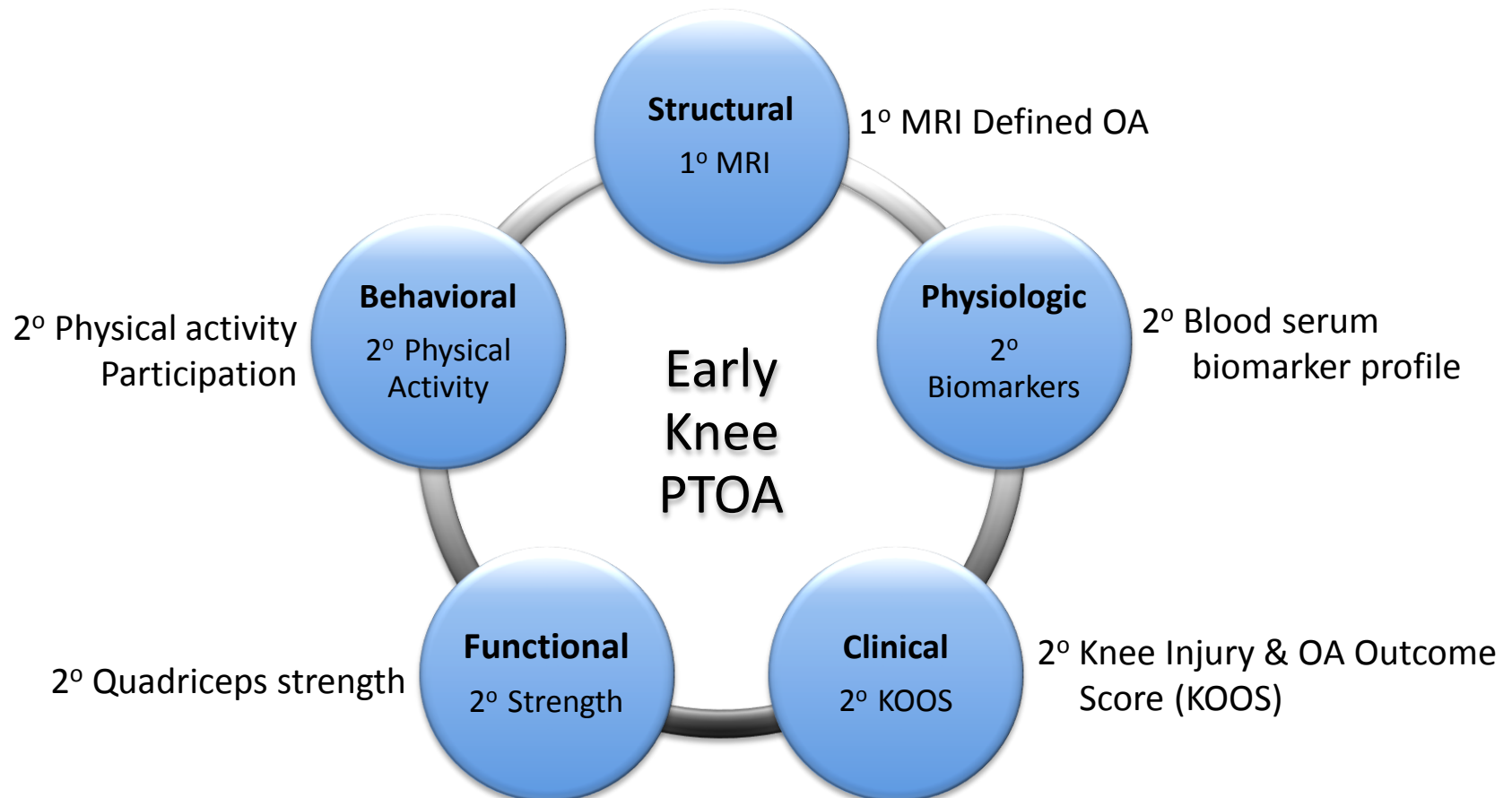
Followed on a diverse number of outcomes annually for a minimum of 3 yrs.

CIHR IRSC
Canadian Institutes of Health Research Instituts de recherche en santé du Canada

Arthritis Alliance of Canada
Alliance de l'arthrite du Canada

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Alberta Youth PrE-OA Study

Objective(s)

Do youth/young adults with a history of knee injury (sustained ≤ 18 yrs) differ from healthy matched (age, sex, sport) controls 3-10 yrs post-injury?

Structural
1º MRI

1º MRI Defined OA

Physiologic
2º Biomarkers

2º Blood serum biomarker profile

Behavioral
2º Physical Activity

2º Physical activity Participation

Early Knee PTOA

Clinical
2º KOOS

2º Knee Injury & OA Outcome Score (KOOS)

Functional
2º Strength

2º Quadriceps strength

Cohort Characteristics

Follow-up 1 (n=200, 100 matched pairs)

Characteristics	Uninjured n=100	Injured n=100
Sex (% female)	55	55
Age (yrs; median, range)	22 (15-26)	22 (16-26)
Age at Injury (yrs; median, range)	-	16 (9-18)
Injury to Follow-up 1 (yrs; median, range)	-	6.9 (3-10)
# Index Knee Surgeries	0	63*
# Contralateral Knee Injuries	0	23[§]
# Contralateral Knee Surgeries	0	15[φ]

*54 ACL reconstructions, [§] [φ]11 of these were ACL reconstructions

MRI Defined OA

Primary Outcome (n=76, 38 matched pairs)
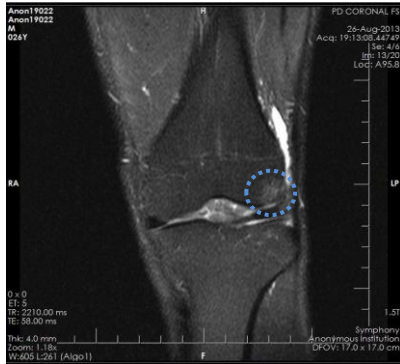
MRI defined OA (Culvenor et al 2015)
Osteophyte AND full-thickness cartilage loss
OR
1 of the above plus 2 of the following;
Sub-chondral bone marrow lesion
Meniscal disruption
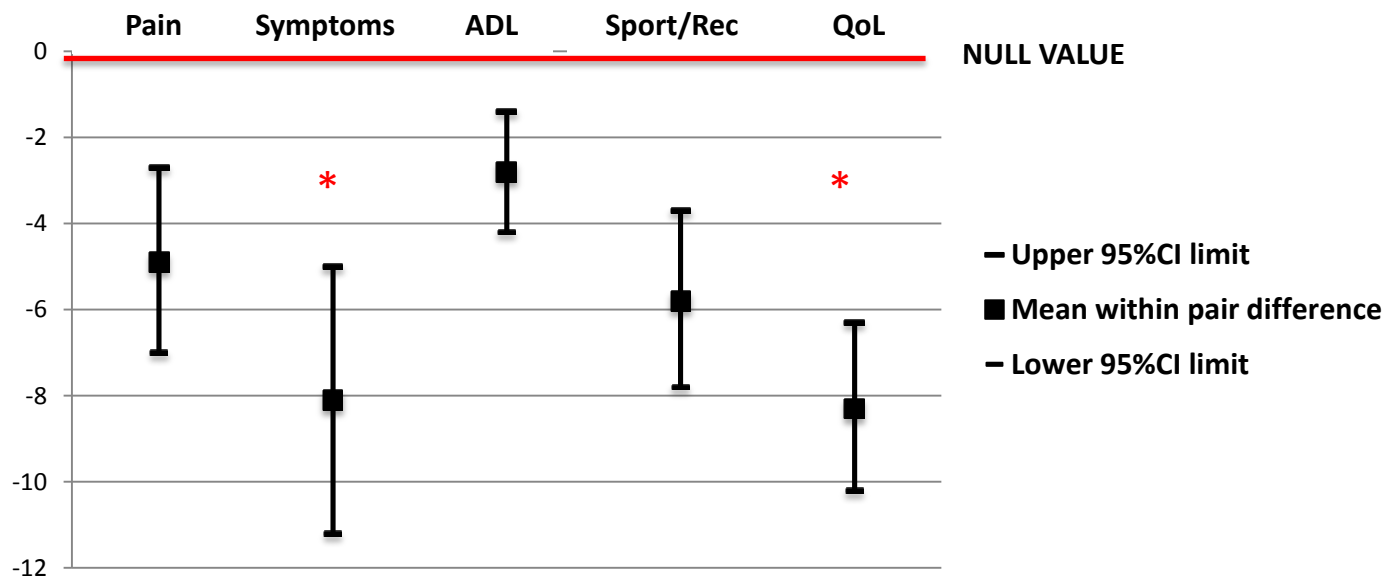Partial thickness cartilage loss

Injury Detail	Uninjured (n=38)	Injured[§] (n=38)
MRI defined OA (#/%)	3 (8%)	13 (36%)
Radiographic OA (KL grade ≥2; #,%)	---	5 (13%)

Surgery / Injury Type	Unadjusted Conditional Odds Ratio, (95%CI)
Knee Injury	6.0 (1.3,26.8)*
Knee Surgery	9.0 (1.1,71.0)*
3º ACL[φ]	7.0 (0.9,56.9)
3º ACL &/or meniscal injury	10.0 (1.2,78.1)*

KOOS

2° Outcome (n=200, 100 matched pairs)

Outcome		Uninjured Median (range)	Injured Median (range)	Pair Difference Mean (95%CI)
KOOS (higher score = better)	Pain	100 (69.4-100)	88.9 (52.8-100)	-4.9(-7.0,-2.7)*
	Symptoms	96.4 (64.3-100)	85.7 (32.1-100)	-8.1 (-11.2,-5.0)*
	ADL	100 (86.8-100)	98.6 (63.2-100)	-2.8 (-4.2,-1.4)*
	Sport/Rec	100 (75.0-100)	94.4(47.2-100)	-5.8 (-7.8,-3.7)*
	QoL	100 (83.3-100)	91.7(63.9-100)	-8.3(-10.2,-6.3)*

Whittaker et al 2015

Physical Activity
2º Objective (n=200, 100 matched pairs)

Outcome		Uninjured Median (range)	Injured Median (range)	Pair Difference Mean (95%CI)
Physical Activity Participation	Total weekly METS φ	52 (7-124)	52 (0-166)	-3.0 (-10.8, 4.8)
	No Sport participation in last year (%)	4	13	---
Aerobic Fitness	VO_2max (ml/kg^2) φ	43.1 (20.6-59.6)	39.8 (20.1-59.6)	-2.4 (-4.5,-0.2)*

φ Estimated from Godin Leisure Time Questionnaire

Injured participants are 2.1 time more likely to be in the lower 25th percentile of total physical activity than controls (COR; 95%CI 1.1,4.0)

Toomey et al 2015

Toomey et al 2015, Whittaker et al 2015

Adiposity

Exploratory Outcomes (n = 200, 100 matched pairs)
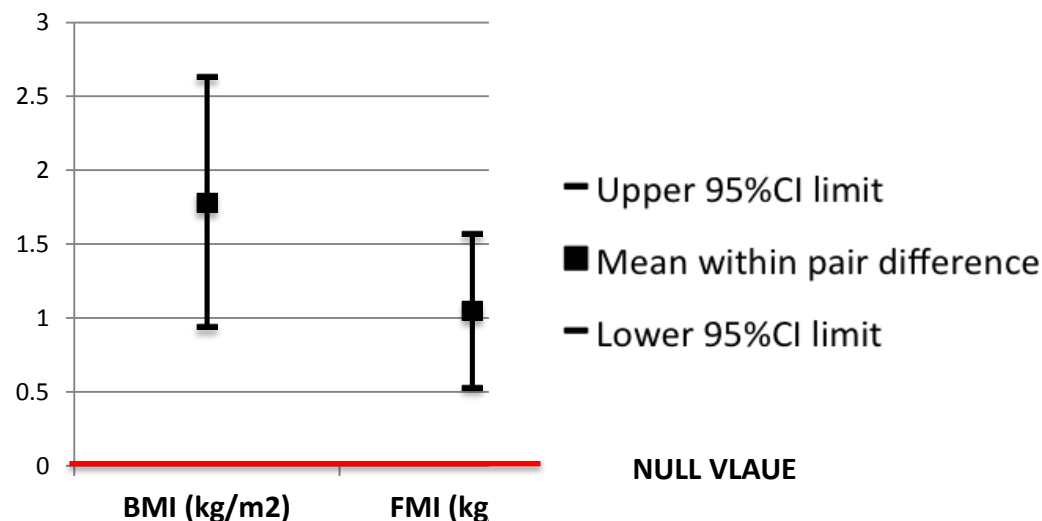
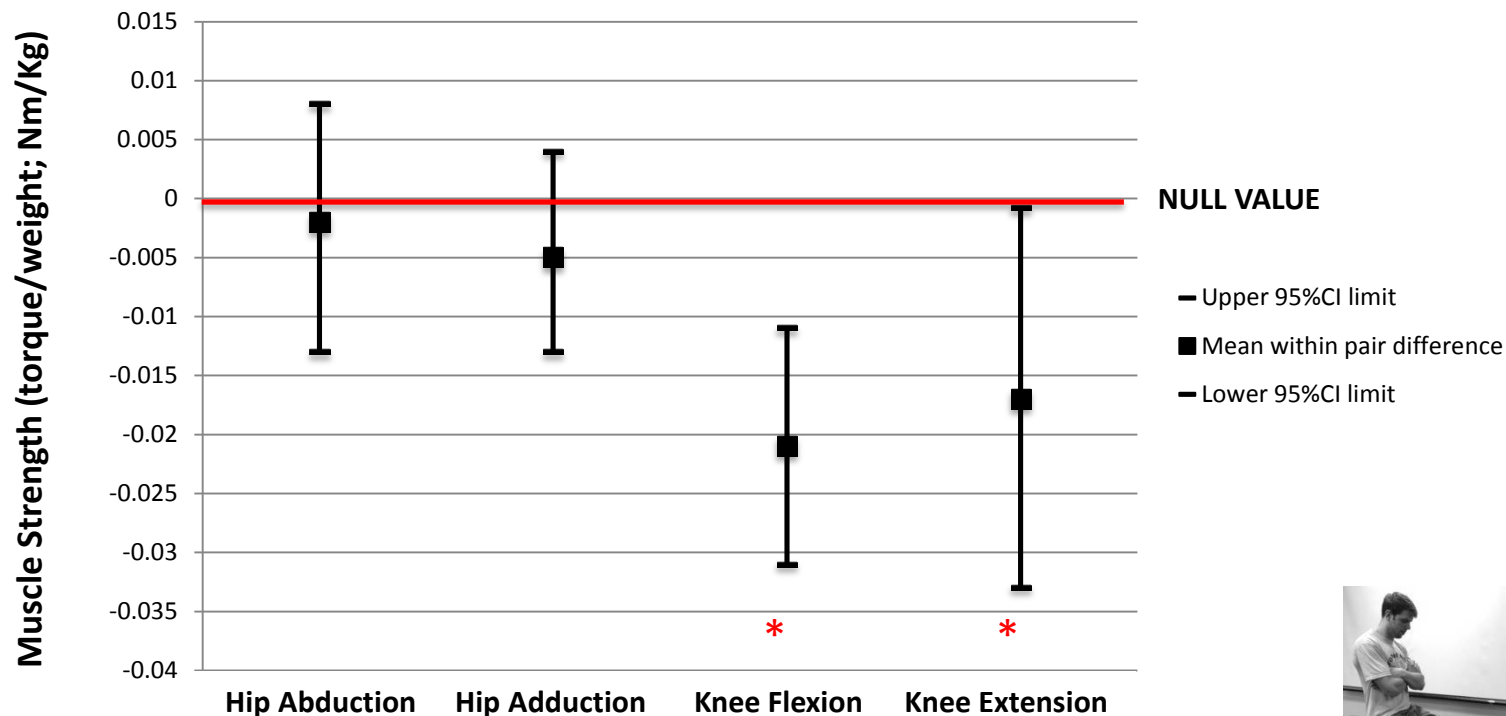| Outcome		Uninjured Median (range)	Injured Median (range)	Pair Difference Mean (95%CI)
Adiposity	BMI (kg/m^2)	23.5 (18.1-31.3)	25.0 (18.9-38.9)	1.78 (0.94,2.63)*
	Fat Mass Index (kg/m^2)	4.5 (2.1-11.2)	5.6 (1.7-16.4)	1.05 (0.53,1.57)*
	Abdominal fat (g)	1240 (560-3750)	1480 (586-4926)	460 (220, 690)*

Toomey et al 2015

Index Leg Strength

2°/Exploratory Objectives (n = 200, 100 matched pairs)

Y-axis: Muscle Strength (torque/weight; Nm/Kg)
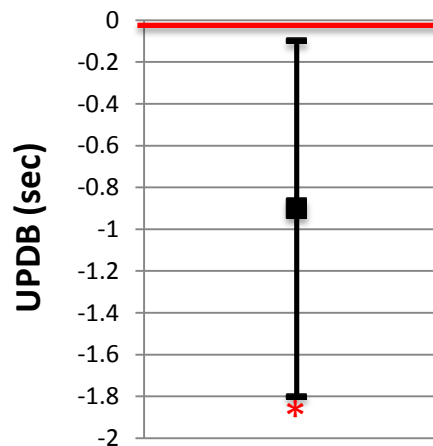
NULL VALUE

- Upper 95%CI limit
- Mean within pair difference
- Lower 95%CI limit

X-axis categories: Hip Abduction, Hip Adduction, Knee Flexion *, Knee Extension *

Whittaker et al 2015

Functional Performance

Exploratory Outcomes (n = 200, 100 matched pairs)

- — Upper 95%CI limit
- ■ Mean within pair difference
- — Lower 95%CI limit
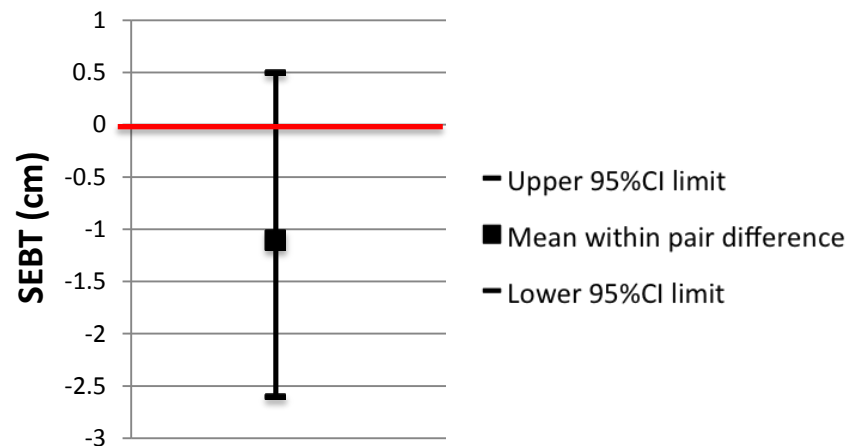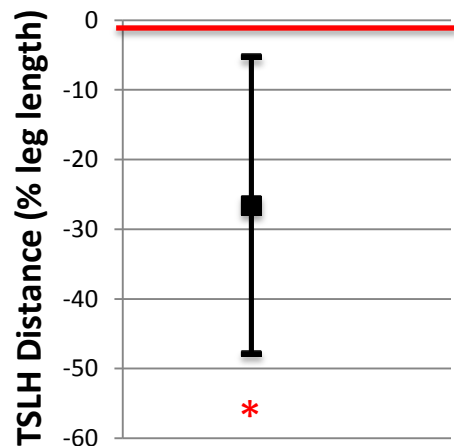
Triple Single Leg Hop   Unipedal Balance   Star Excursion Balance

Whittaker et al 2015

Biomechanics

Exploratory Outcomes (n = 100, 50 matched pairs)

Laboratory balance tests: Injured participants have increased sway and make fewer postural adjustments during single leg balance.
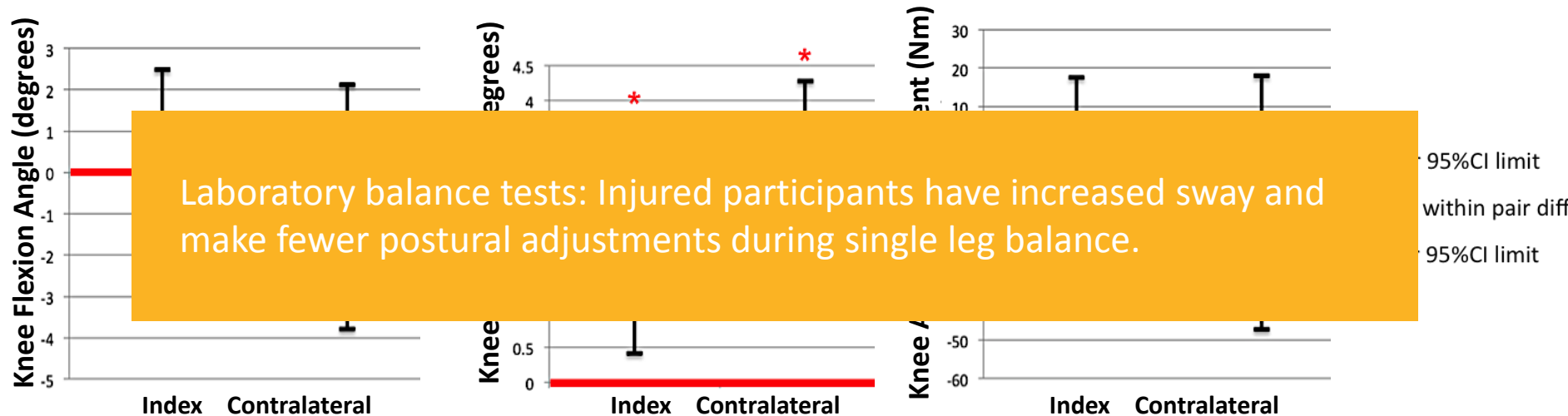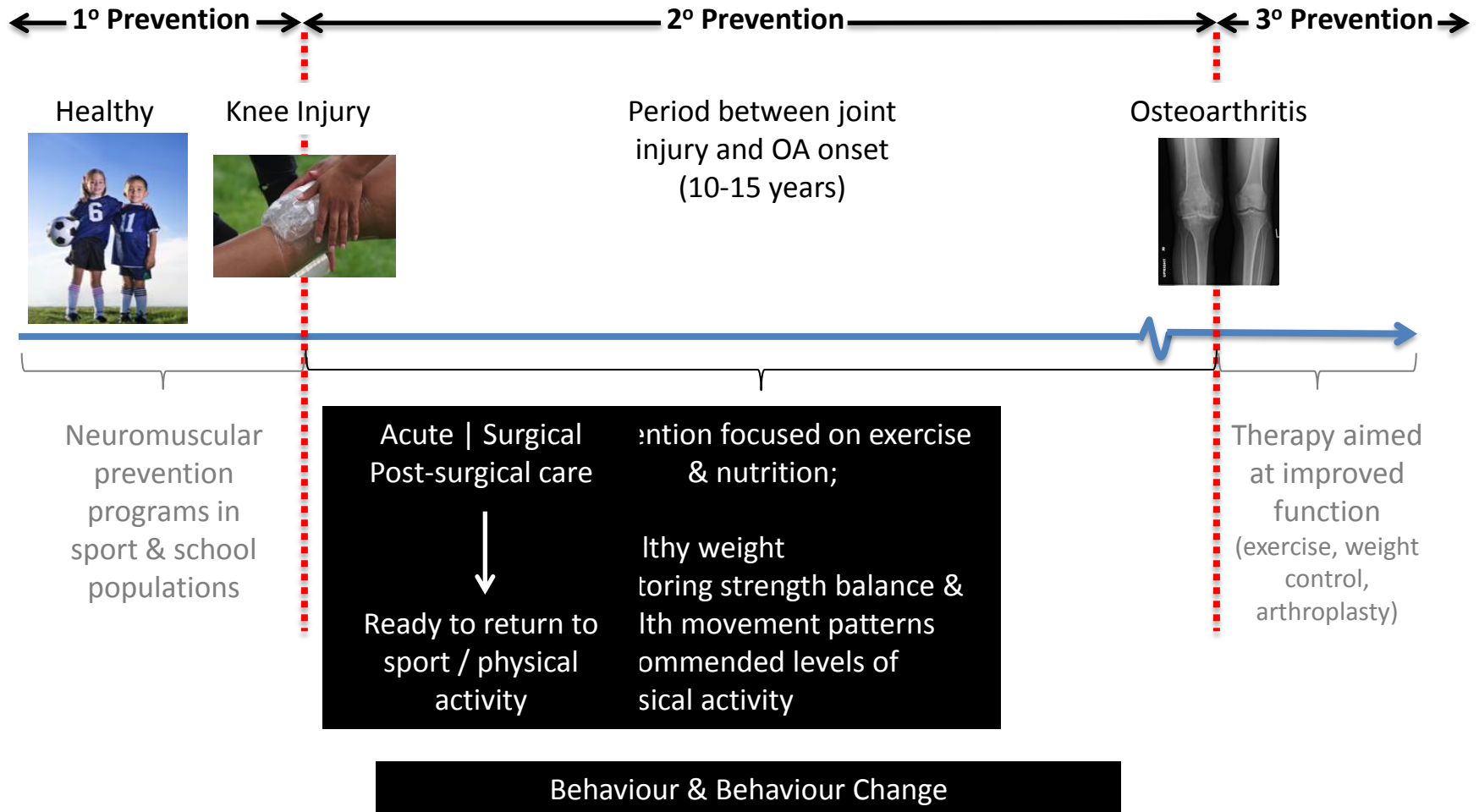
Single Leg Squat
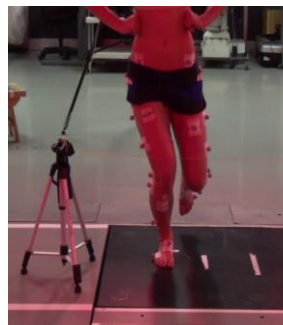
Lorenzen et al 2015, Baltich et al 2015, Whittaker et al 2015

Prevention of Post-traumatic OA

Timeline of Events & Interventions

Thank You