



**Stretching before and after  
physical activity to prevent injury and soreness  
- a pragmatic randomised controlled trial**

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**ThinkWell**

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# A pragmatic randomised trial of stretching before and after physical activity to prevent injury and soreness

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# An international collaboration

- Norwegian Knowledge Centre for the Health Services
- The University of Sydney, Australia
-  Department of Primary Health Care, University of Oxford



# ***An experiment in citizens' epidemiology***

## **Aim**

***“to improve the health and wellbeing of citizens across the world by enabling them to make informed decisions about lifestyle, diet and health interventions through public-led health discussions, education and research, using the internet and the mass media as the fundamental tools”***



# The stretching trial...



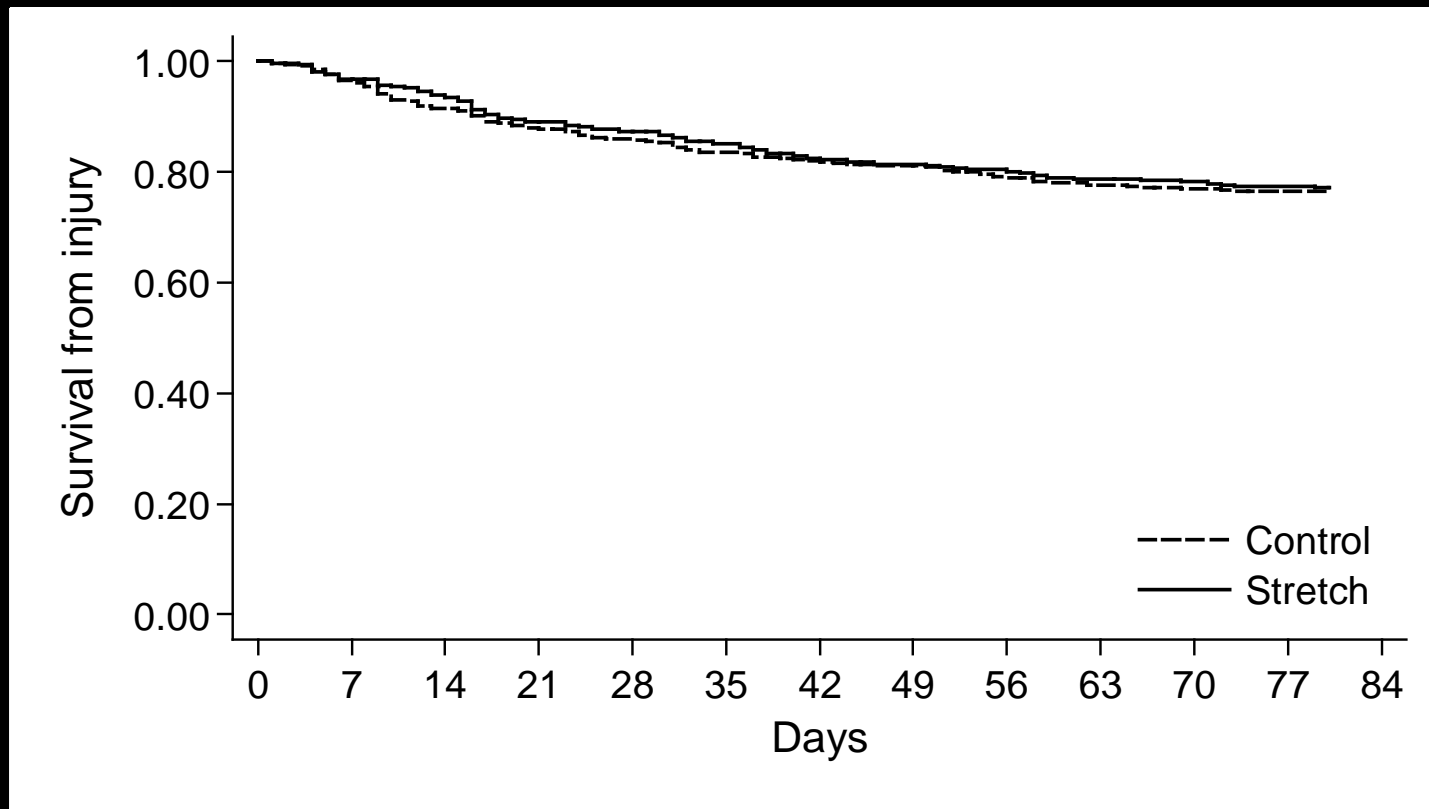
# Background

- Many people stretch before or after physical activity
- They may do so to reduce injury risk, reduce soreness, enhance performance, or increase the feeling of 'looseness'
- There have been few randomised studies of the effects of stretching



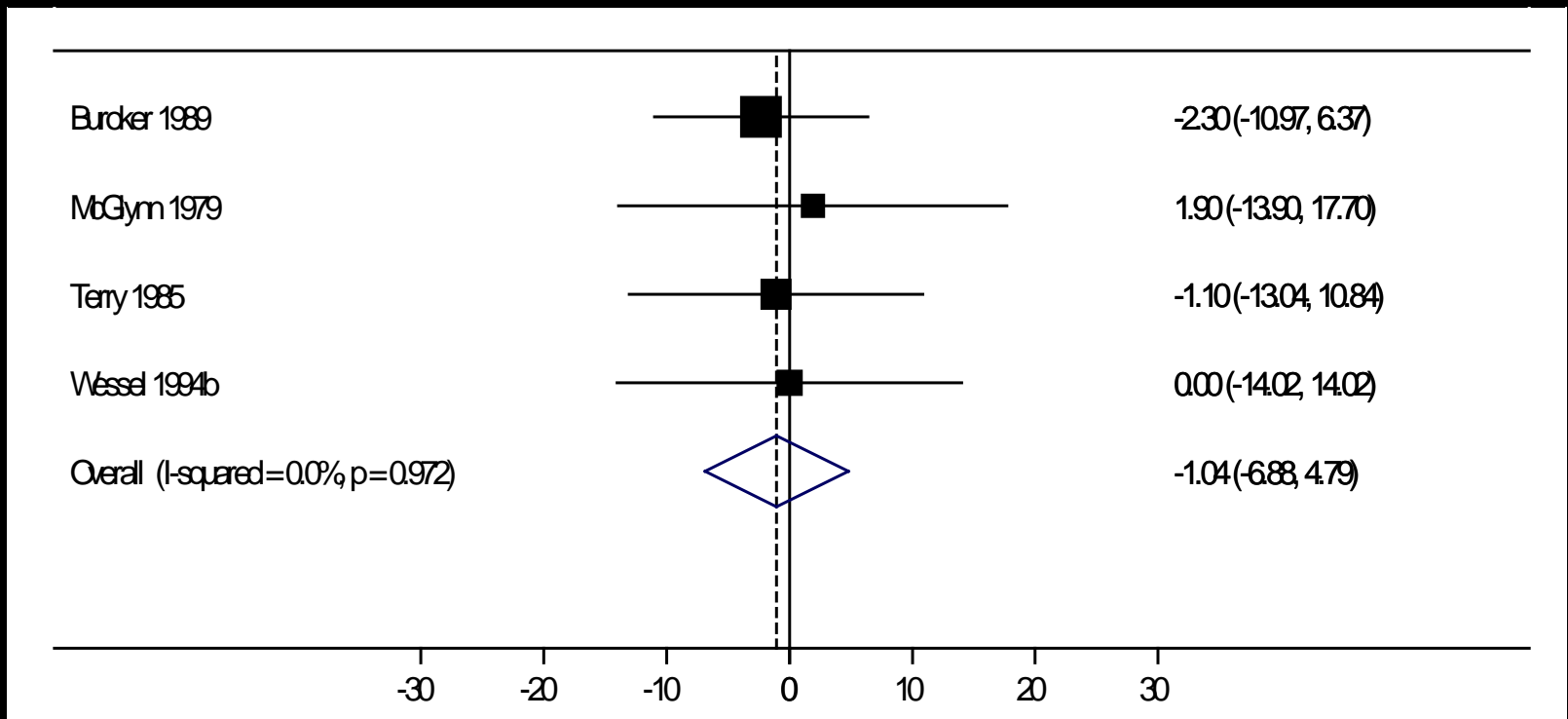
# Effect of stretching on risk of injury

- Two randomised trials on army recruits: stretching has little or no effect on injury risk. For example:



# Effect on muscle soreness

A recent systematic review concluded:  
**stretching had little or no effect on mean soreness**





# Limitations of existing studies

- Injury studies carried out on army recruits
- Muscle soreness studies carried out in laboratory setting
- Muscle soreness studies investigated effect of a very small number of sessions of stretching - longer-term effects not considered



# Primary objective

To determine if stretching before AND after vigorous physical activity reduces risk of injury or soreness in a physically active community population



# Secondary objectives

To determine effects of stretching on

- severity of soreness
- feelings of looseness

during and after activity

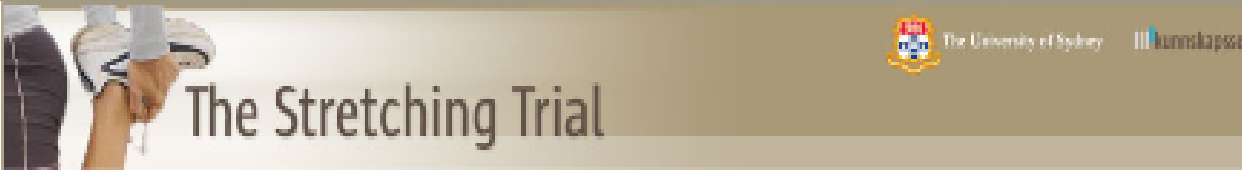
To ascertain if magnitude of effects on injury risk or soreness depend on

- age
- activity levels
- beliefs about the effectiveness of stretching



# Methods: Design

- Two-arm randomised controlled trial
- Entirely internet-based
- Concealed allocation
- Self-reported outcomes
- Pragmatic
- Unblinded



The banner for 'The Stretching Trial' features a photograph of a person's hands stretching a white sneaker. The text 'The Stretching Trial' is prominently displayed in a large, dark font. In the top right corner, the logos for 'The University of Sydney' and 'kunnskapssenteret' are visible.

**Welcome to The Stretching Trial**

**Do you stretch after exercise? Always? Never?**

A lot of people stretch before or after exercise. But if you don't, nobody could blame you. The surprising truth is that we don't actually know if stretching is beneficial. In The Stretching Trial we aim to find out. You may be one of the people who can help us find out. We are looking for regular, recreational exercisers who can participate in our trial. You need to meet a few criteria to join us, like having an e-mail address and Internet access.

The University of Sydney and the Norwegian Knowledge Centre for the Health Services are running the trial, and are co-operating with The Health Report on ABC Radio National and NRK Pula on Norwegian TV to tell people about the study.

We gratefully acknowledge the support of Pula and the New South Wales Sporting Injuries Commission.

The Stretching Trial will start in February. If you are interested, please send an email to [stretch@health.usyd.edu.au](mailto:stretch@health.usyd.edu.au)

# Methods: Participants

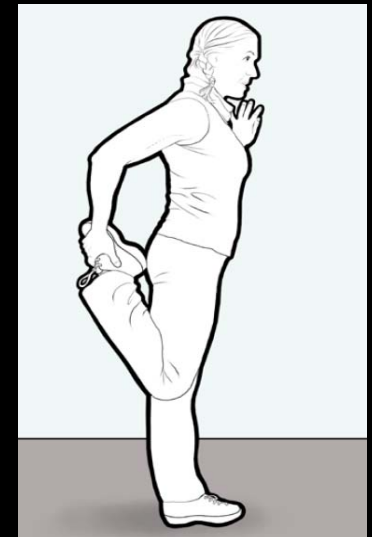
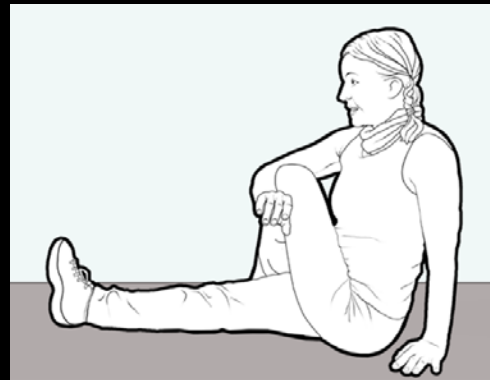
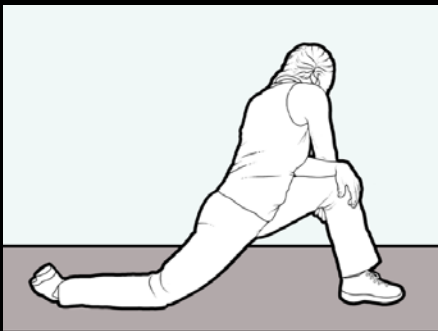
- 2,377 adults who regularly participated in physical activity
- Resident anywhere in the world, able to read and write English or Norwegian, able to regularly access web and email
- Primary mechanisms of recruitment were television, radio, newspapers, ThinkWell website and email



# Methods: Intervention



## Stretch Group:

- 7 muscle groups
- Both sides of the body
- 30 seconds
- Before and after physical activity
- (total 14 minutes)



# Methods: Outcomes

Participants reported injuries, soreness and looseness, weekly for 12 weeks:

- 1<sup>o</sup> 
- Injuries counted if they prevented at least one episode of participation in physical activity
  - Bothersome soreness
- 2<sup>o</sup> 
- Muscle, ligament and tendon injuries
  - Soreness, looseness during activity, looseness after activity (11-point numerical rating scale)



# Methods: Analysis

- Risk of *injury* analysed with Cox regression. Risk window approach allowed for left-, right- and interval-censoring
- Risk of *bothersome soreness* analysed with mixed effects logistic regression (random intercepts for participants)
- LOCF and FOCB





# Results: Completeness of reporting

	2377 randomised	
Baseline	1,220 in stretch group	1,157 in control group
Week 1	injury 82.6%, soreness 76.3%	injury 85.9%, soreness 81.4%
Week 2	injury 80.1%, soreness 75.9%	injury 83.7%, soreness 80.2%
Week 3	injury 77.2%, soreness 73.8%	injury 82.1%, soreness 78.5%
Week 4	injury 73.9%, soreness 71.3%	injury 79.9%, soreness 76.4%
Week 5	injury 73.3%, soreness 70.2%	injury 78.2%, soreness 75.0%
Week 6	injury 71.4%, soreness 66.5%	injury 77.3%, soreness 73.3%
Week 7	injury 70.2%, soreness 66.4%	injury 76.1%, soreness 72.1%
Week 8	injury 70.2%, soreness 65.6%	injury 74.7%, soreness 71.4%
Week 9	injury 68.9%, soreness 64.6%	injury 74.8%, soreness 70.3%
Week 10	injury 67.9%, soreness 63.5%	injury 73.7%, soreness 70.1%
Week 11	injury 67.3%, soreness 64.1%	injury 72.7%, soreness 69.1%
Week 12	injury 51.2%, soreness 47.2%	injury 56.5%, soreness 52.0%
OVERALL	INJURY 73.6%, SORENESS 69.7%	INJURY 78.3%, SORENESS 74.5%
ANY FOLLOW-UP DATA	INJURY 88.4%, SORENESS 97.5%	INJURY 90.4%, SORENESS 97.9%

# Results: Compliance with intervention

<b>FREQUENCY</b>	<b>Stretch group</b>	<b>Control group</b>	<b>Total</b>
Compliant	414 (38.4%)	845 (80.8%)	1259 (59.2%)
Partially compliant	655 (60.7%)	135 (12.9%)	790 (37.2%)
Non-compliant	10 (0.9%)	66 (6.3%)	76 (3.6%)



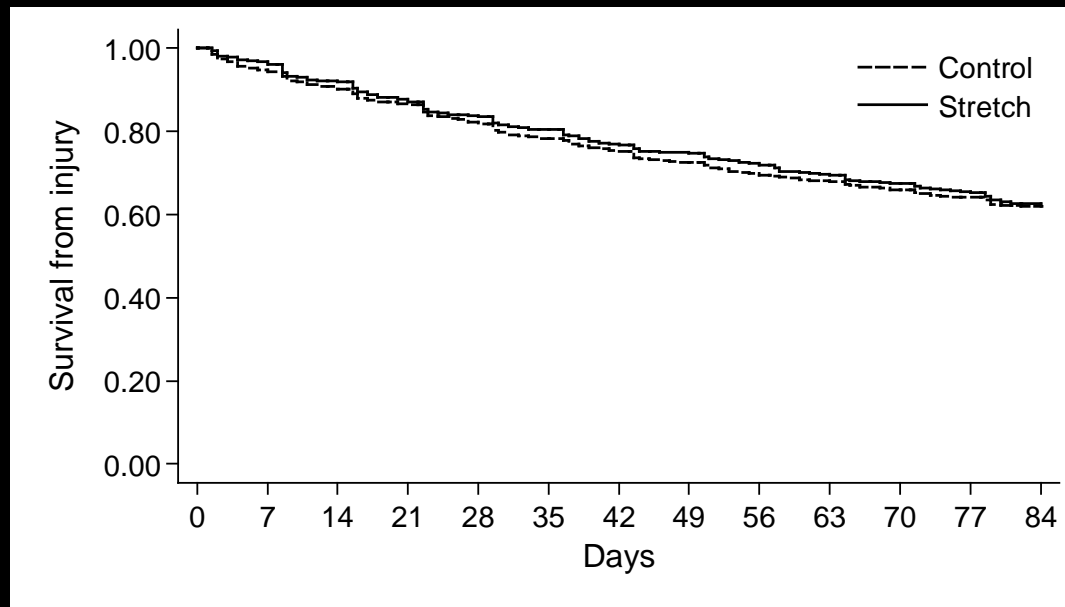
# Results: Compliance with intervention

<b>DURATION</b>	<b>Stretch group</b>	<b>Control group</b>	<b>Total</b>
Compliant	83 (7.7%)	850 (81.3%)	933 (43.9%)
Partially compliant	986 (91.4%)	132 (12.6%)	1118 (52.6%)
Non-compliant	10 (0.9%)	64 (6.1%)	74 (3.5%)



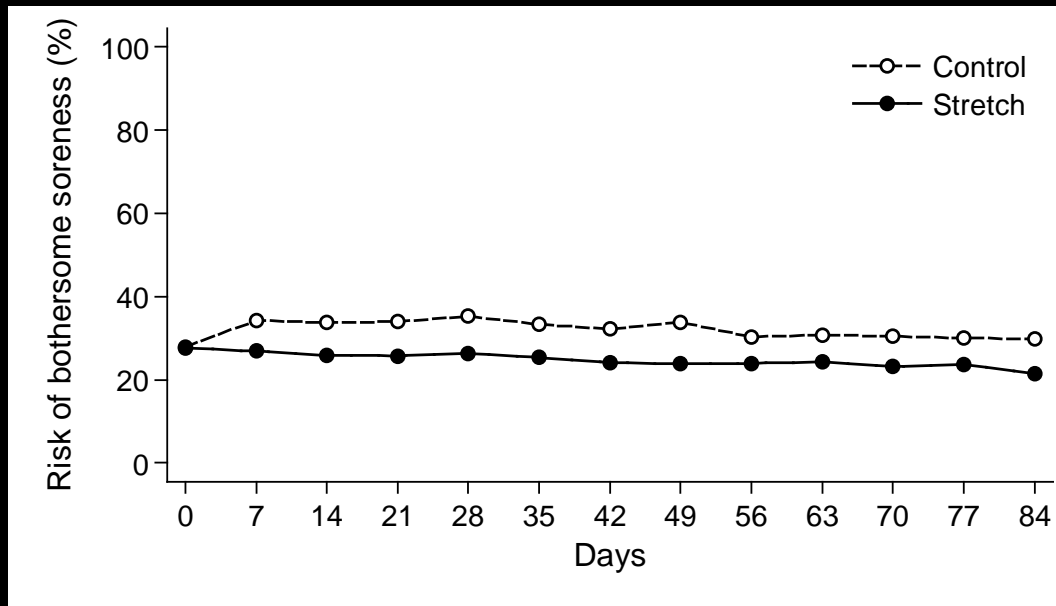
# Results: Risk of injury

- Stretch: 2.38 p.p.y. Control: 2.44 p.p.y.
- Hazard ratio = 0.97, 95% CI 0.84 to 1.13



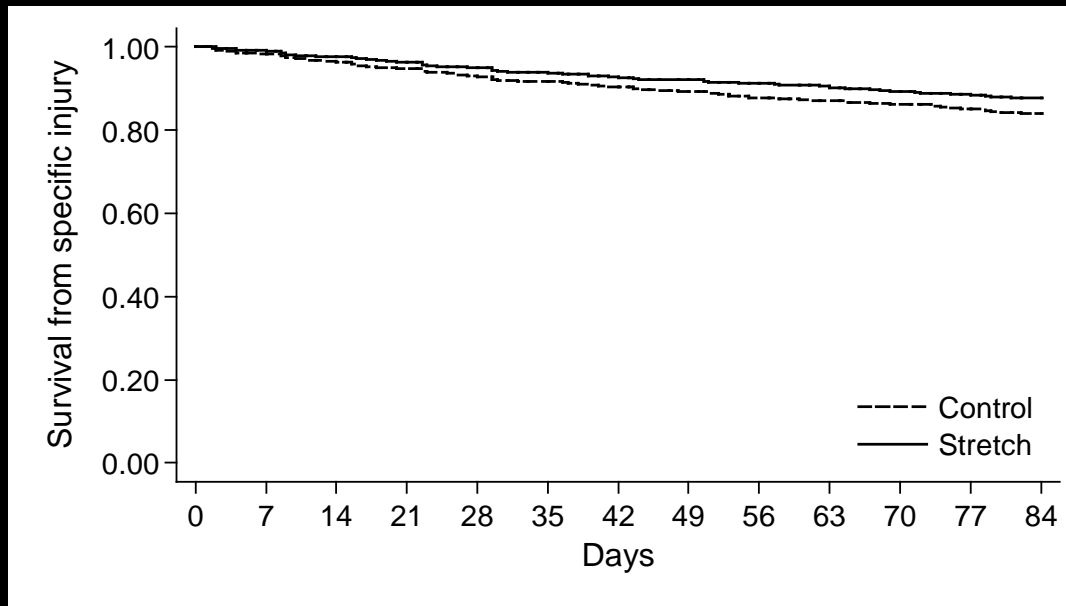
# Results: Risk of bothersome soreness

- Stretch: 24.6%. Control: 32.3%.
- OR = 0.69, 95% CI 0.59 to 0.82



# Results: Muscle/ligament/tendon injury

- Stretch: 0.66 p.p.y. Control: 0.88 p.p.y.
- HR = 0.75, 95% CI 0.59 to 0.96



# Results: Other outcomes

	<b>Stretch</b> mean (SD)	<b>Control</b> mean (SD)	<b>Effect</b> mean (95%CI)
<b>Soreness</b>	2.5 (2.2)	2.9 (2.5)	0.4 (0.2 to 0.5)
<b>Looseness during</b>	3.0 (2.1)	3.3 (2.3)	0.3 (0.1 to 0.4)
<b>Looseness after</b>	3.2 (2.2)	3.7 (2.4)	0.4 (0.3 to 0.6)



# Results: Interaction with age

- Significant age  $\times$  group interaction for injury (HR = 1.013, 95% CI 1.00 to 1.03;  $p = 0.04$ )
- Hazard ratio (95% CI) of effect of stretching on injury by age:

at 20 years	0.75 (0.56 to 1.00)
at 40 years	0.97 (0.84 to 1.13)
at 60 years	1.26 (0.94 to 1.68)





# Results: Interaction with beliefs

- Significant belief  $\times$  effect of stretching interactions for risk of soreness ( $p = 0.03$ )
- Odds ratio (95% CI) of effect of stretching on soreness risk by belief:

Strong belief	0.38 (0.20 to 0.72)
Ambivalent	0.56 (0.37 to 0.84)
Strong disbelief	0.82 (0.66 to 1.02)



# Discussion

## Potential sources of bias

- Unblinded, self-reported outcomes
- Incomplete reporting
- Only moderate compliance

## A hard-to-interpret result

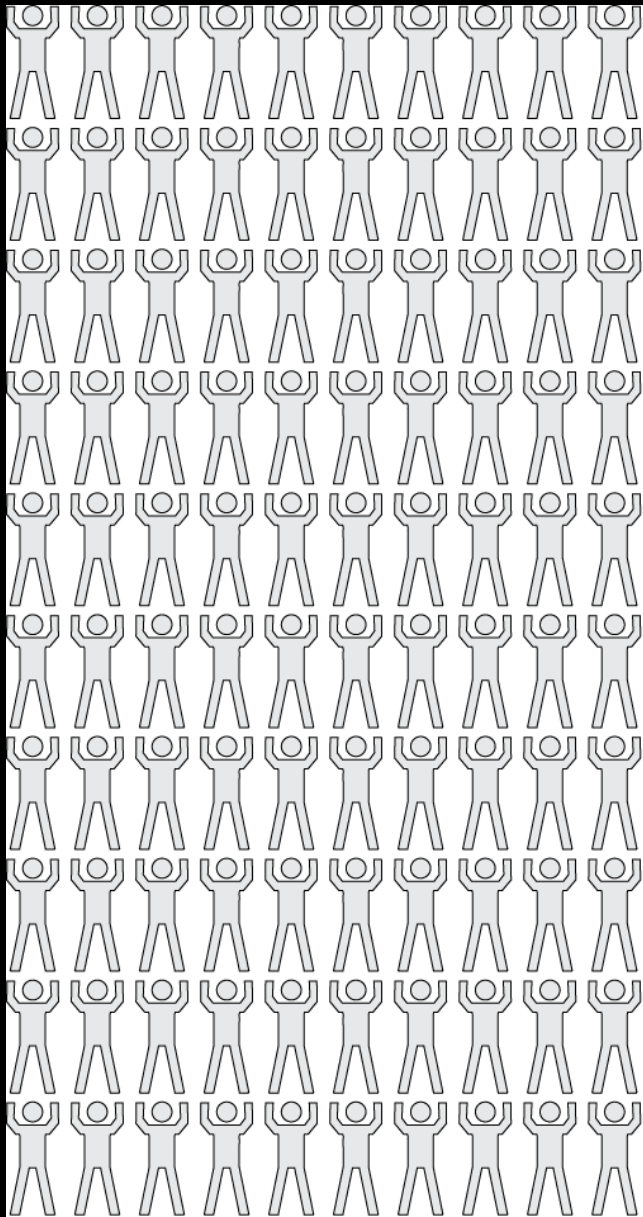
- Effect on injury apparent only in secondary outcome



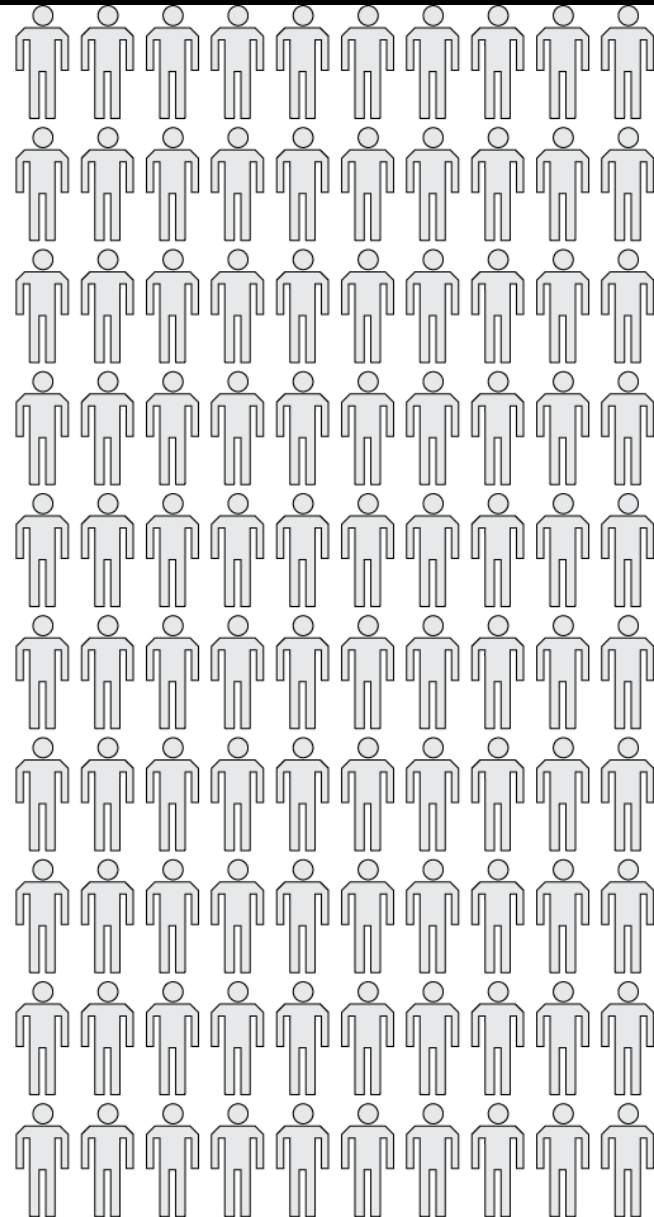
# Based on the scientific evidence to date

- Would you stretch before and after exercise?



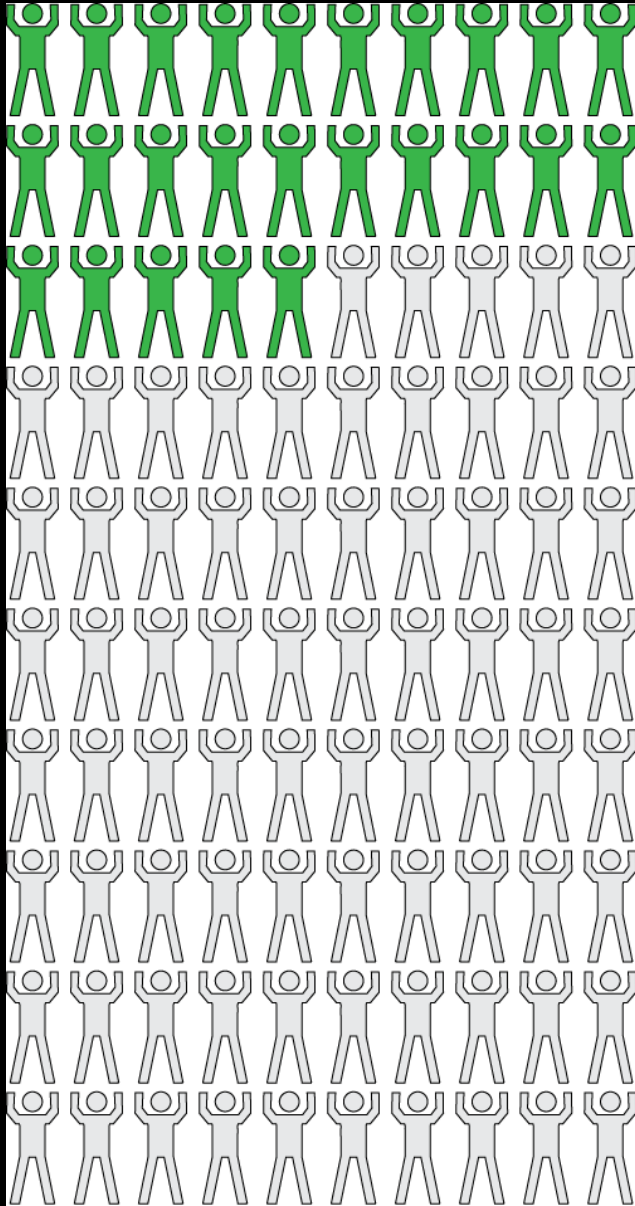


Structuring  
for 12 weeks

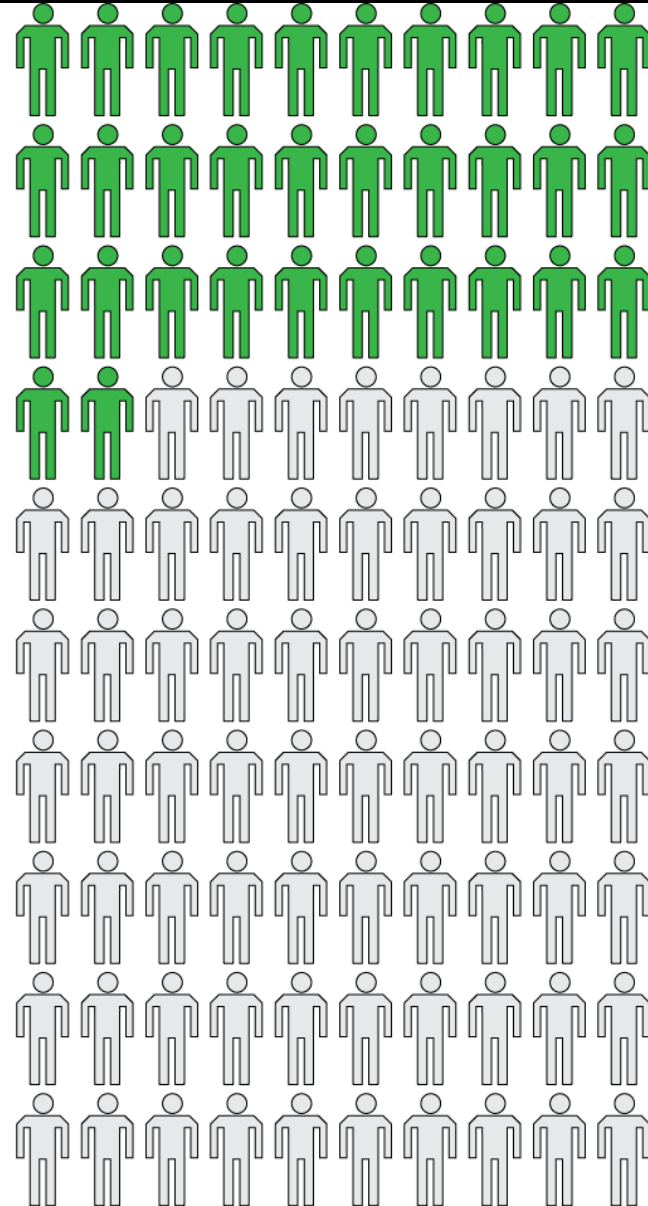


Not Structuring  
for 12 weeks

# Bothersome soreness

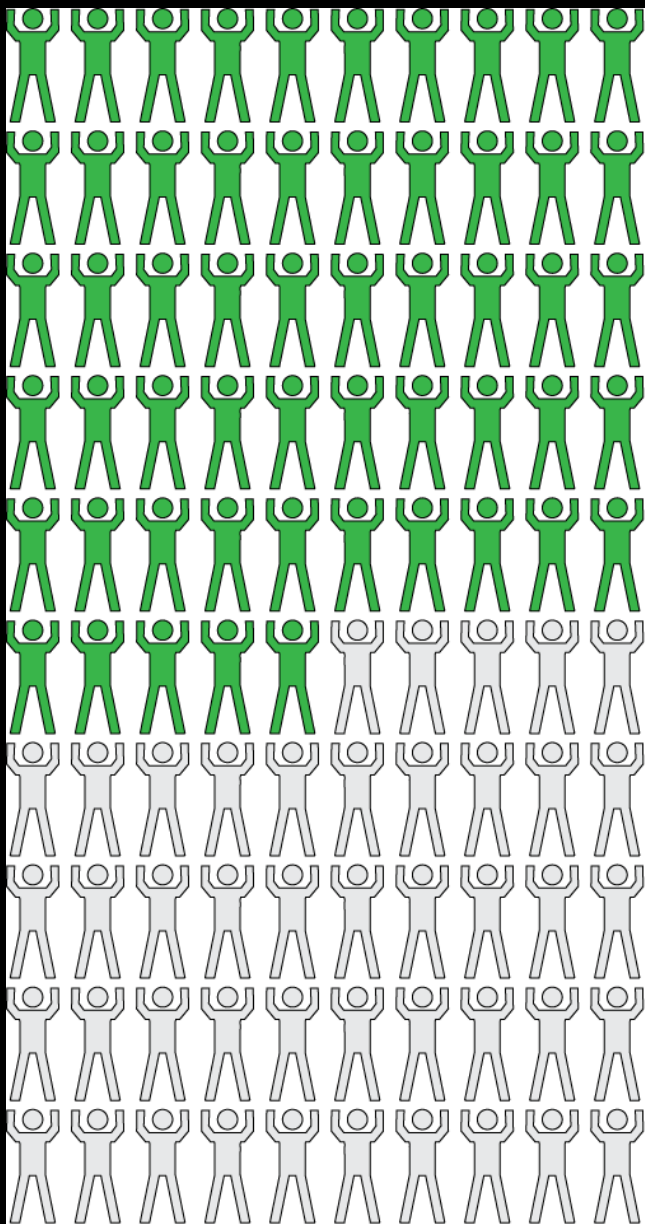


**Stretch**

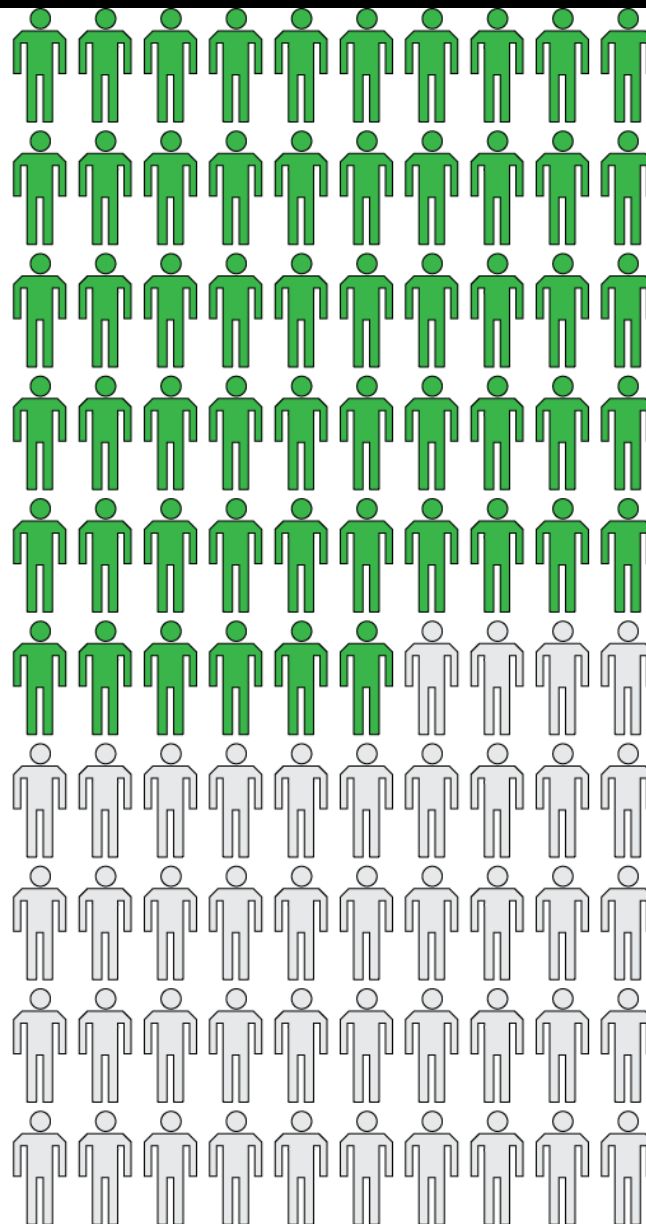


**No stretch**

# All injuries

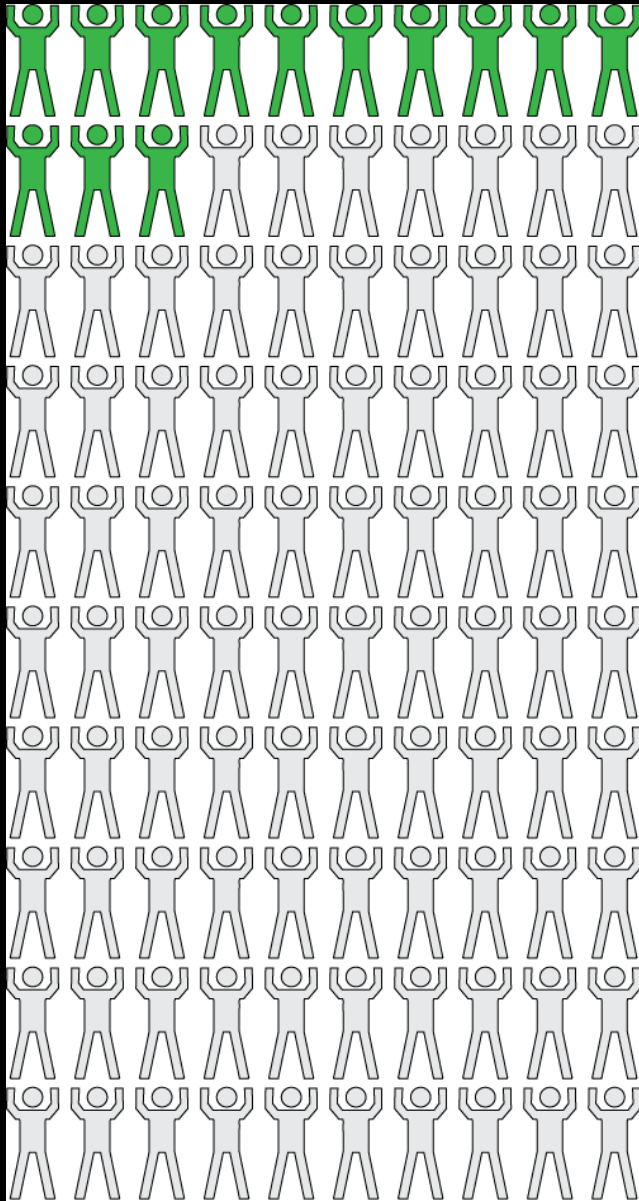


**Stretch**

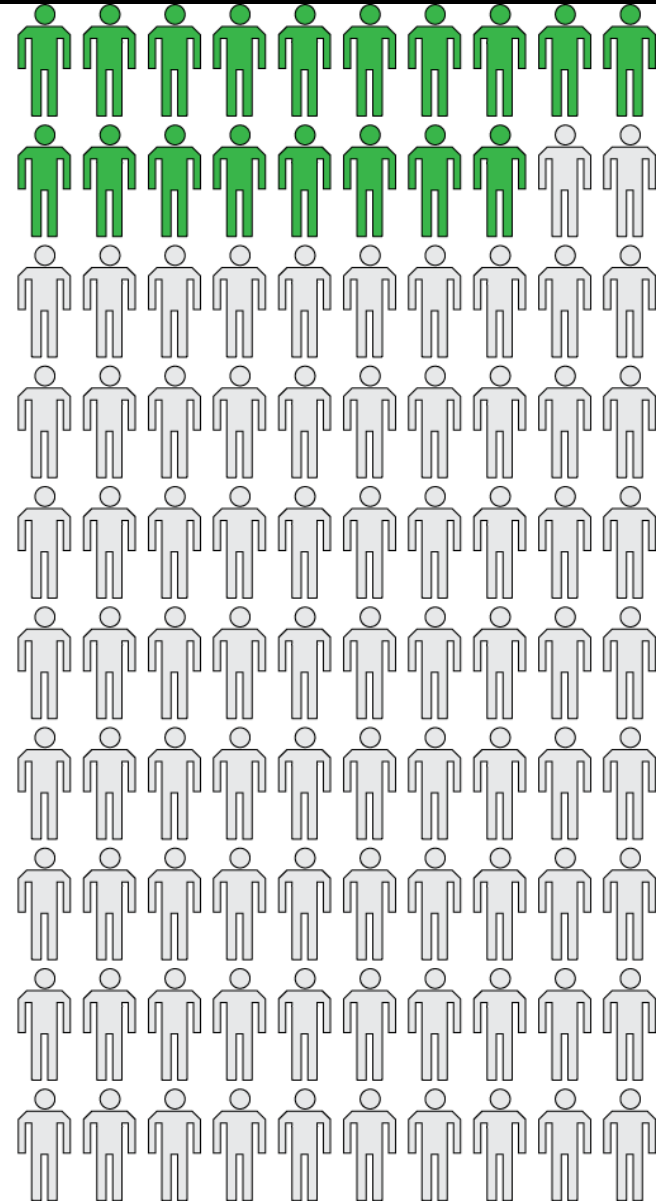


**No stretch**

# Injuries to muscles and ligaments



**Stretch**



**No stretch**

# What does a HR of 0.76 really mean?

- With a baseline incidence rate of 0.77 muscle, ligament or tendon injuries per person-year, a hazard ratio of 0.76 implies that one injury, on average, is prevented every 4.6 person-years.
- A person who stretched for 10 minutes 4 times per week would have spent the equivalent of 6.6 continuous days stretching in that time





# Result in context of what is known

- Effect on injury risk (HR and 95% CI)

	All injuries	Soft tissues OR Muscle/lig./tendon
Pope 2000 (N = 1538)	0.95 (0.77 to 1.18)	0.83 (0.63 to 1.09)
This study (N = 2377)	0.97 (0.84 to 1.13)	0.75 (0.59 to 0.96)*
<b>Pooled</b>	<b>0.96 (0.85 to 1.09)</b>	<b>0.76 (0.61 to 0.95)*</b>



# Effect on severity of soreness

(10-point scale; mean and 95% CI)

Herbert 2007 (N = 101)	0.1 (-0.4 to 0.6)
This study (N = 2377)	0.4 (0.2 to 0.5)*
<b>Pooled</b>	<b>0.4 (0.2 to 0.5)*</b>



# Conclusions from RCT

- Stretching
  - does not appreciably reduce all-injury risk
  - probably reduces the risk of some injuries
  - reduced the risk of bothersome soreness
- The effects are small
- The effect on “bothersome” soreness has large risk of bias



# Conclusions: Internet trials

- Provide a mechanism for recruiting from an international, non-clinical population
- Hard to define sampling frame
- Hard to monitor intervention
- Outcomes self-reported
- Harder to do than you might think

