

# Sitting and Standing

“Goes together like  
Peas and Carrots”\*

\* Forrest Gump - 1994



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## Supreme Court Takes Stand on Suitable Seating

Ben Hancock, *The Recorder*  
April 4, 2016 | 2 Comments

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Justice Carol Corrigan, California Supreme Court  
Jason Doly / *The Recorder*



LOCAL / L

# California's top court tells employers to give workers a chair



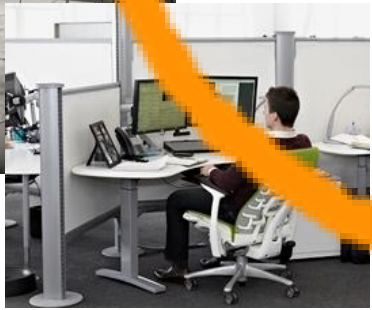
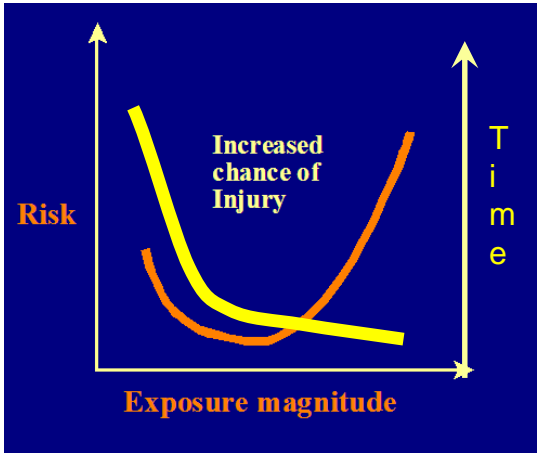
Workers whose jobs can be done at least partly while sitting should not be forced to stand, the California Supreme Court said Monday. Above, a worker at a Target store. (Jeff Chiu / Associated Press)



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# Ergonomics for Prolonged Sitting

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**Sitting for prolonged periods of time can be a major cause of back pain, cause increased stress of the back, neck, arms and legs and can add a tremendous amount of pressure to the back muscles and spinal discs. Additionally, sitting in a slouched position can overstretch the spinal ligaments and strain the spinal discs.**

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## OSH Answers Fact Sheets

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### Overview

**Why is there so much fuss being made about sitting?**

**Can work in a sitting position affect your health?**

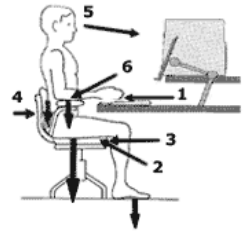
**How does the work in a sitting position affect blood circulation?**

**Can work in a sitting position cause injuries that affect movements?**

Limited mobility contributes to injuries in the parts of the body responsible for movement: the muscles, bones, tendons and ligaments. Another factor is the steady, localized tension on certain regions of the body. The neck and lower back are the regions usually most affected. Why? Prolonged sitting:

- reduces body movement making muscles more likely to pull, cramp or strain when stretched suddenly,
- causes fatigue in the back and neck muscles by slowing the blood supply and puts high tension on the spine, especially in the low back or neck, and
- causes a steady compression on the spinal discs that hinders their nutrition and can contribute to their premature degeneration.

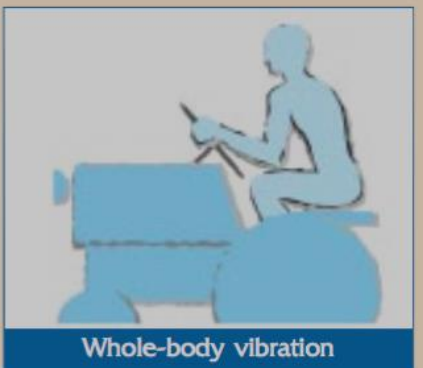
over time  
back pain.  
comfortable as  
upper  
(e.g.  
, move



Examples of physical loadings at work which may be dangerous to health:



Kneeling for long duration



Whole-body vibration



Sitting for long duration

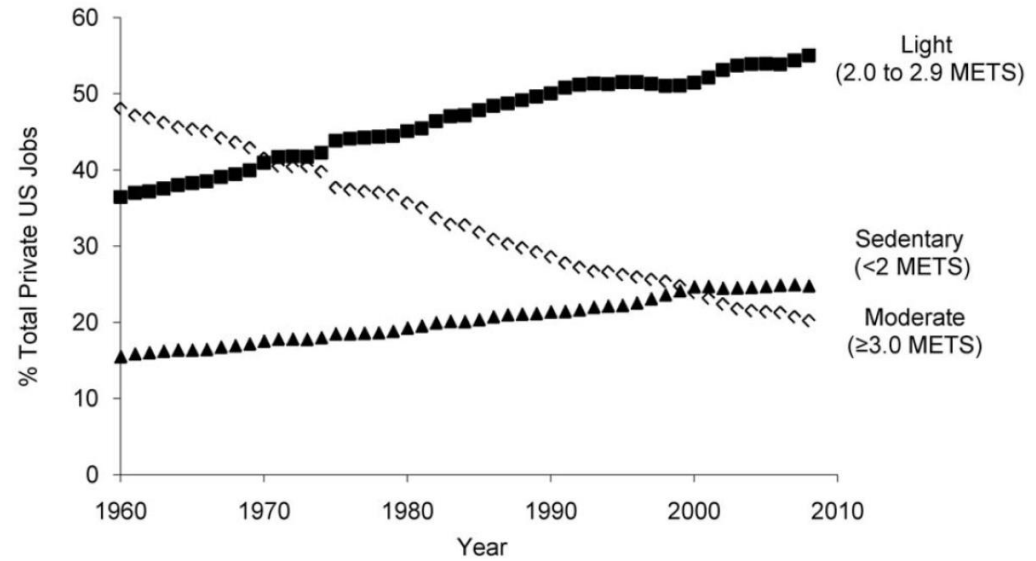
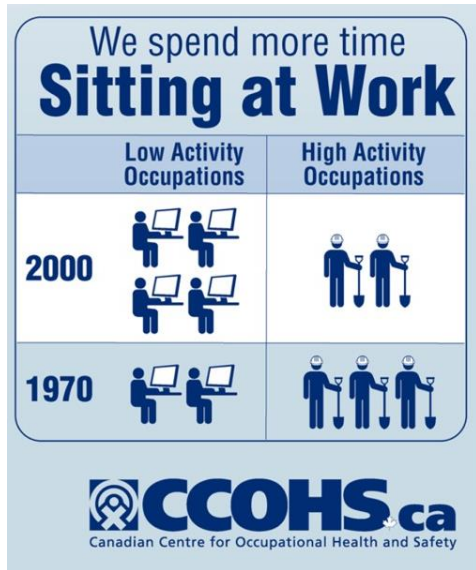


PROTECTING WORKERS' HEALTH SERIES NO 5

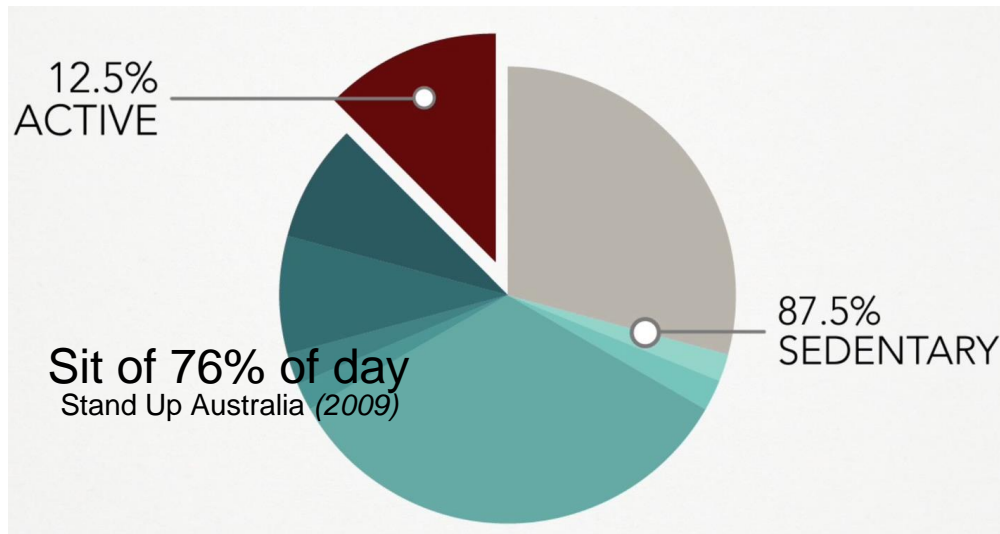
# Preventing Musculoskeletal Disorders in the Workplace

Risk factor information and preventive measures for employers, supervisors and occupational health trainers

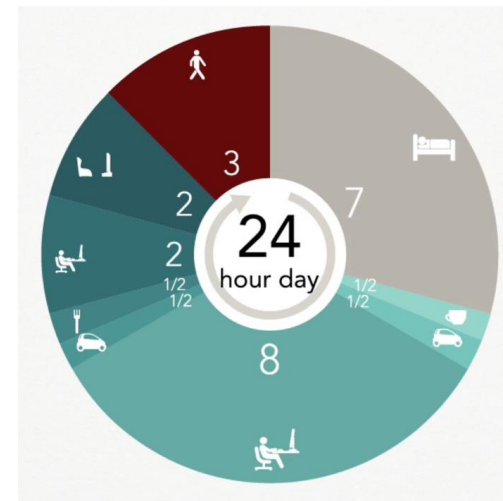




Church et al. PLoS ONE (2011)



Images from Focal (2016)



Sedentary 8-9 hours a day

Matthews et al. Am J Epidemiol 2008

# Is there an association between temporal patterns of sitting and low-back pain? A cross-sectional study

Mette Korshøj (presenter), Nidhi Gupta, Julie Lagersted-Olsen, David Hallman, Marie Birk Jørgesen, Andreas Holtermann

**Introduction.** Low-back pain (LBP) is a major global health challenge. Sitting is a suggested risk factor for LBP among blue-collar workers. Previously, information on sitting time has been collected by self-reports, which are imprecise and biased compared to objective measurements. Therefore, we aimed at investigating the association between objectively measured sitting time and LBP among blue-collar workers.

**Methods.** The analysis is based on the DPHACTO cohort, and included 601 Danish blue-collar workers recruited from the cleaning, manufacturing and transport sector. Cross-sectional information on LBP intensity (range 0-10) was collected by questionnaire. Objective measurements of sitting were collected using two accelerometers (ActiGraph GT3X+) worn on the thigh and trunk during 1-5 workdays. Sitting time was split into occupational and leisure time and analyzed as the total duration, and divided in temporal patterns of uninterrupted long (> 30 min), moderate (> 5 – 30 min) and short (< 5 min) bouts by the exposure variation analysis method. Association between sitting and LBP intensity was analyzed using univariate ANOVA adjusted for age, sex, smoking, BMI, job seniority and occupational lifting and carrying activities. Additionally, total sitting was adjusted for physical activities (standing, walking, running, walking in stairs and biking) and sitting in opposite domain (occupational/leisure); and temporal pattern variables were mutually adjusted for other lengths of sitting bouts.

**Results.** No associations were seen between total sitting time and LBP (occupational  $B=0.017$ ,  $p=0.53$ ; leisure  $B=0.008$ ,  $p=0.76$ ). No associations seen between long (occupational  $B=-0.002$ ,  $p=0.97$ ; leisure  $B=0.010$ ,  $p=0.75$ ), moderate (occupational  $B=0.025$ ,  $p=0.50$ ; leisure  $B=0.006$ ,  $p=0.90$ ), or short (occupational  $B=0.035$ ,  $p=0.63$ ; leisure  $B=-0.009$ ,  $p=0.95$ ) bouts of uninterrupted sitting and LBP.

**Discussion.** Objectively measured sitting time was not associated with LBP among blue-collar workers, pointing toward other factors being attributed to LBP. Thus, this finding needs to be investigated in prospective designs.

# Where is the Disconnect?

- Seated postures associated with:
  - Higher loading in passive tissues and joints
  - Laxity changes in these structures
  - Alteration of muscle responses





- Low-back problems after standing over 50% of the work shift. Waters and Dick *Rehabilitation Nursing* 40(3) (2015)
- 5 hr of standing work induced lower extremity muscle fatigue, even with regular rest breaks and persisted at least 30 min post- work. Garcia & Martin, *Human Factors*, In Press (2016)
  - 55 Minutes of standing to 5 minutes sitting



# ■ Discomfort and standing work in Europe

■ **Thomas Laeubli (presenter), Maria Gabriela Garcia Rodriguez, Maggie Graf**

■ **Background.** Although it is generally known that long periods of standing produce dis- comfort, the emphasis in health promo on tends towards recommending people to sit less, and little attention is paid to the problem of standing at work. This is surprising, as standing at work is the most common physical risk in European workplaces according to the results of the European Working Conditions Survey (EWCS).

■ **Methods.** The data for 30,000 full-time workers in the European Working Conditions Survey was analyzed.

■ **Results.** The analysis showed that almost half of the workers in Europe stand at work for more than three quarters of their working me. It revealed strong and highly **Significant correlations between the amount of time spent standing at work, back pain** and pain in the legs. Additionally, long periods of standing at work were found to be associated with reports of working in ring or painful postures. A significant interaction was found between age and both backache and muscular pains in the lower limbs. Older workers were found to more frequently report both types of pain than younger workers, and this was greater in the groups that stand for longer periods of time.

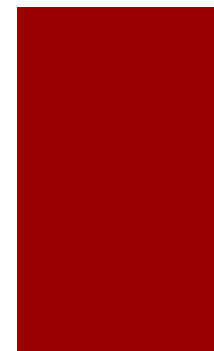
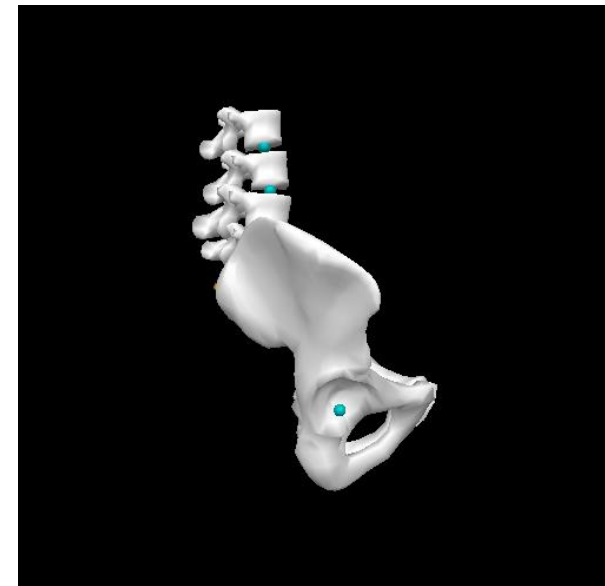
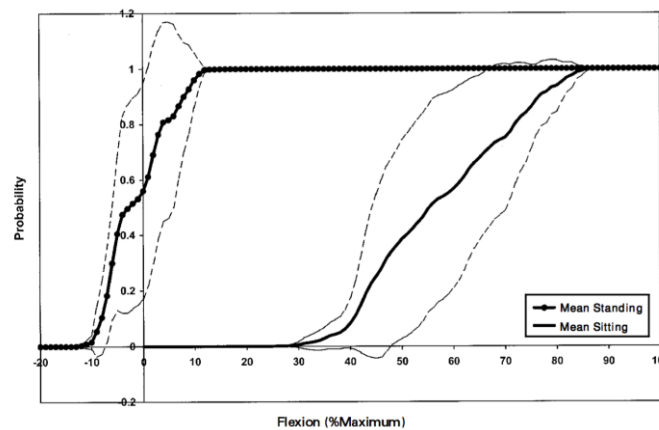
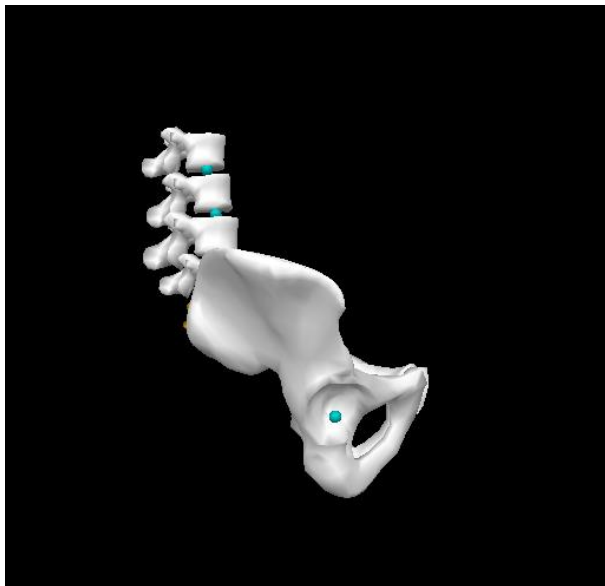
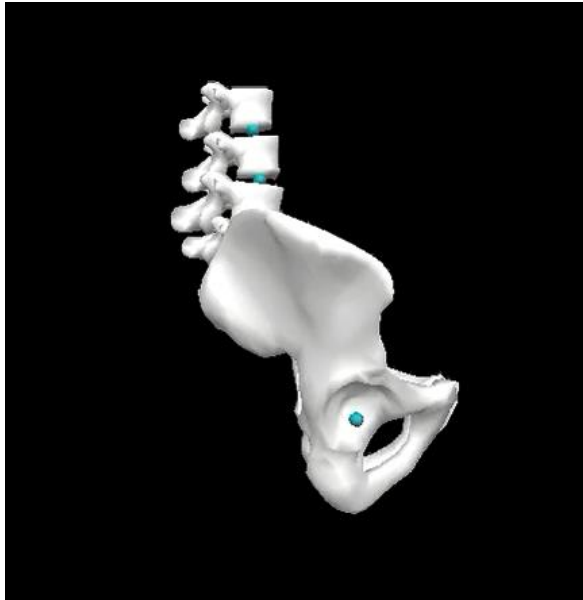
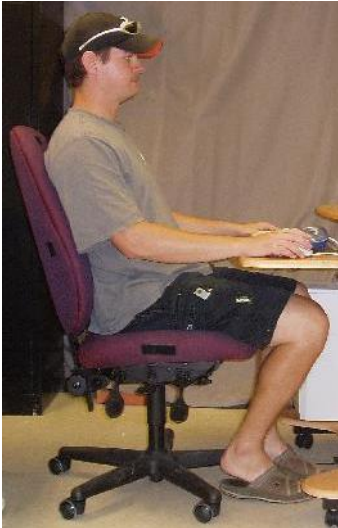
■ **Discussion.** As prolonged sitting has been linked to an increased risk of cardiovascular diseases and cancer, the ques on of an appropriate balance between sitting, walking and standing is essential for the work of practitioners working on the prevention of musculo- skeletal disorders.

# Sitting and Standing = LBP?



- When “quality” of standing is factored into the evaluation:
  - > 30 minutes OR 2.1 (Andersen et al., 2007)
  - > 2 hours Females OR 2.9 Males 1.6 (MacFarlane et al., 1997)
  - Constrained standing Prevalence 30% vs 17% (Tissot et al., 2009)
- Limited evidence of “quality” of seated exposures
  - Leisure + Work combined increased LBP reporting (Nourbakhsh et al., 2001)
  - Constrained seated driving postures 6x increase in lost time (Porter & Gyi, 2002)

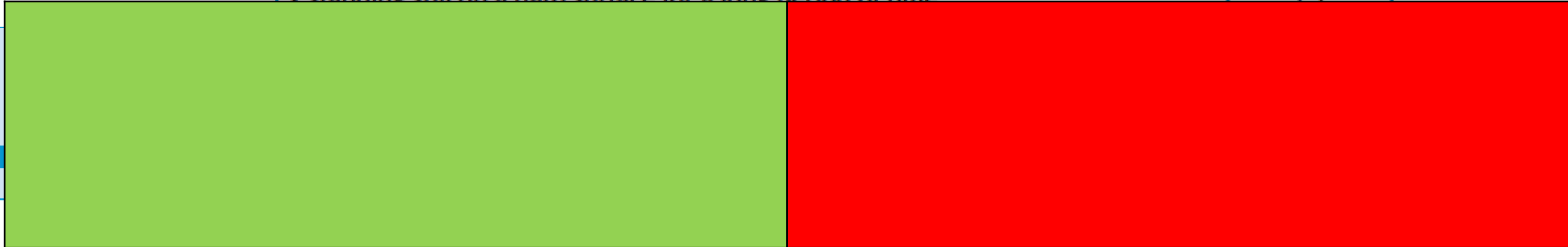
# Why Mix Sitting and Standing?



# Ergonomic Guidelines

OHSCO's Musculoskeletal Disorders Prevention Series  
 Parts 3A&B: MSD Prevention Toolbox

|                      |  |                          |
|----------------------|--|--------------------------|
| <b>Fixed Posture</b> | • sitting for long periods without standing (office work, driving, etc.) | <input type="checkbox"/> |
|                      | • standing still on a hard surface for a long period of time             | <input type="checkbox"/> |



**Lifts Less than 4 hours**      **Lifts more than 4 hours**

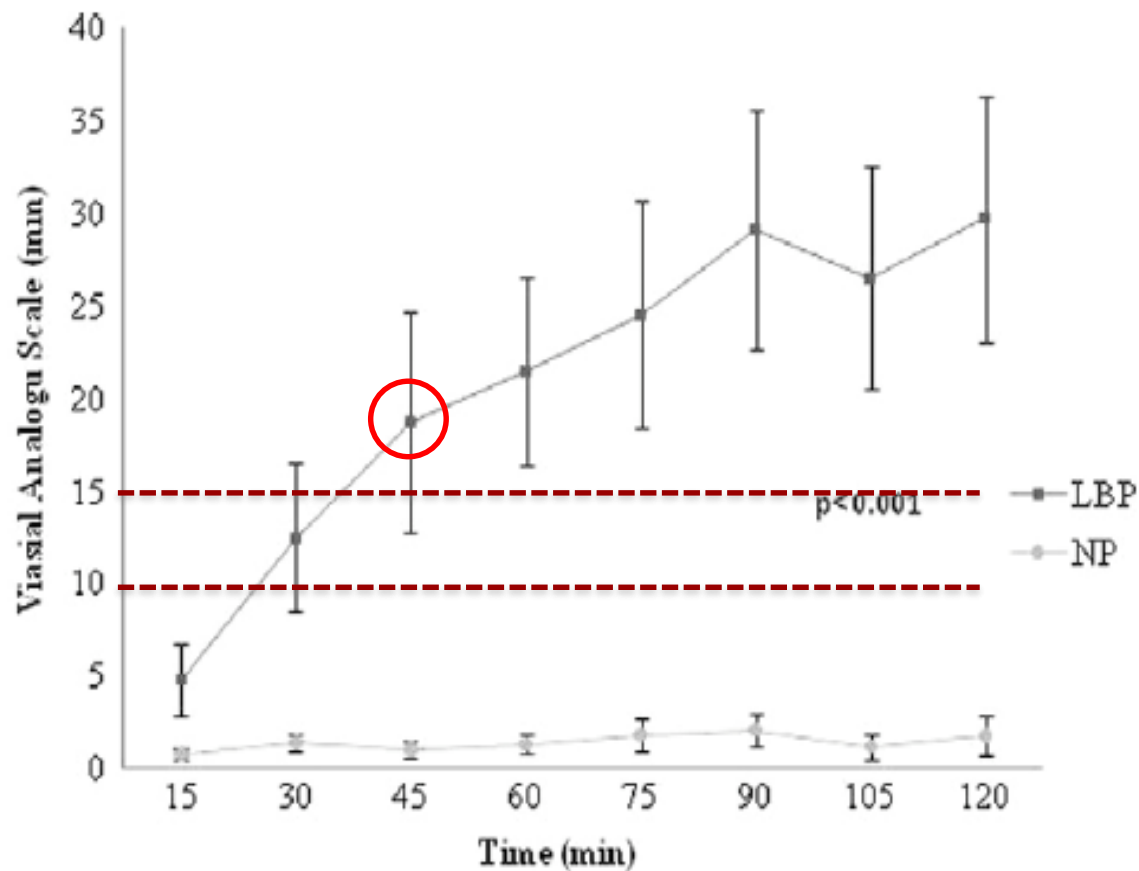
TABLE 1

| Green = safe stress<br>No action required  | Amber = some risk<br>Action recommended  | Red = health risk<br>Direct action required   |
|--|--|---|
| Not more than 1 hour of continuous standing and not more than 4 hours of standing in total | More than 1 hour of continuous standing <u>or</u> more than 4 hours of standing in total | More than 1 hour of continuous standing <u>and</u> more than 4 hours of standing in total |

1. Knibbe JJ, Knibbe NE, Geuze L. Werkpakket Beter! [Practical Tools for Ergonomic Preventive Interventions in Hospitals]. Utrecht, the Netherlands: Sectorfondsen Zorg en Welzijn; 2003:9-12.



# Prolonged Standing and LBP



- **Greater than 30 minutes** of constrained standing associated with LBP reporting (Anderson et al. 2007)
- **~30% LBP** prevalence in workers who stand in a constrained posture (Tissot et al. 2009)
- Lab studies show at least **40%** report low back pain

Nelson-Wong & Callaghan J EMG & Kin 20 (2010)

Gallagher, Wong, Callaghan Gait and Posture (2012)

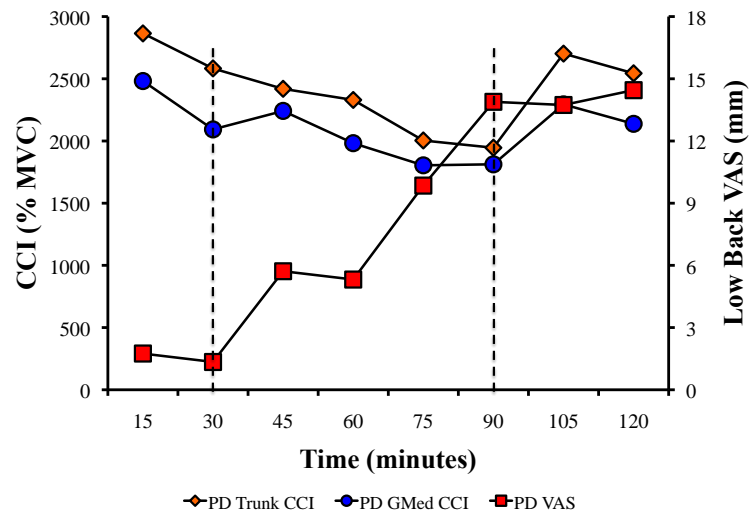
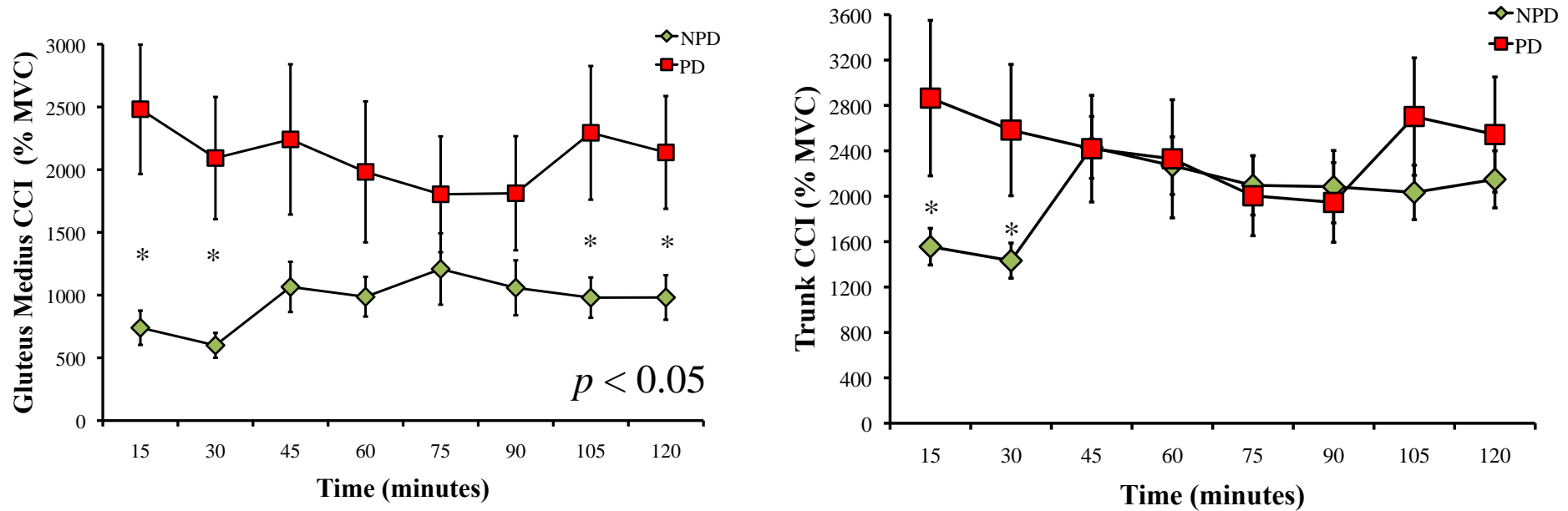
Marshall et al. Hum Move Sci 30 (2011)

Sorenson et al. Clin J Pain (2015)

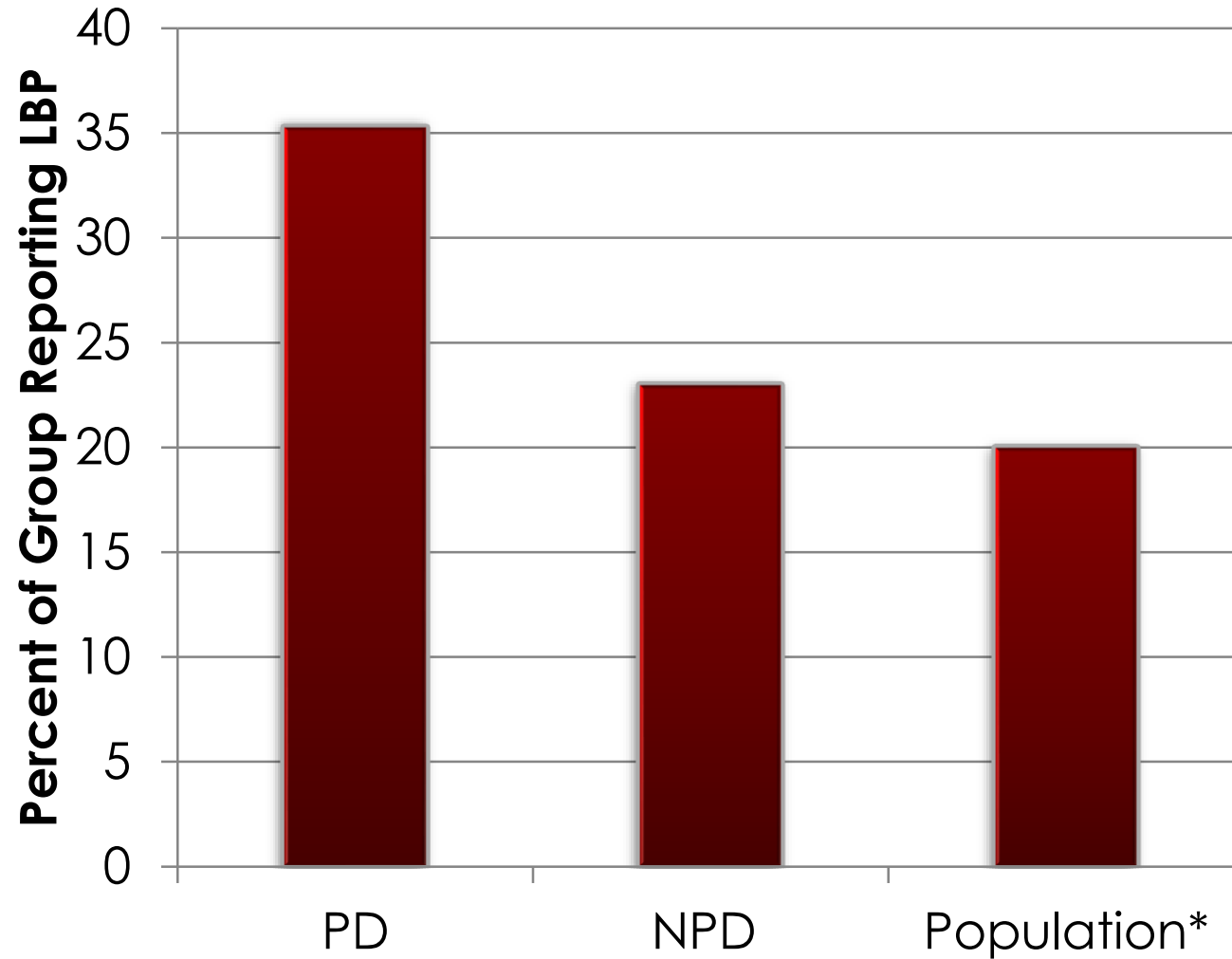
Sorenson et al. Man Ther (2015)

Gregory & Callaghan Gait & Posture (2008)

# PD had Higher Muscle Co-contraction than NPD



# Is it Important? *Longitudinal*



OR > 3

*Nelson-Wong & Callaghan, Spine (2014)*

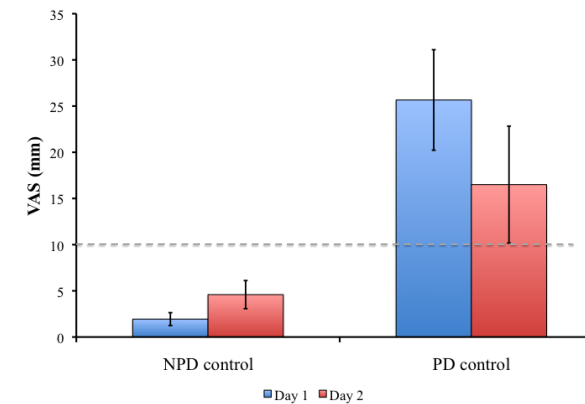
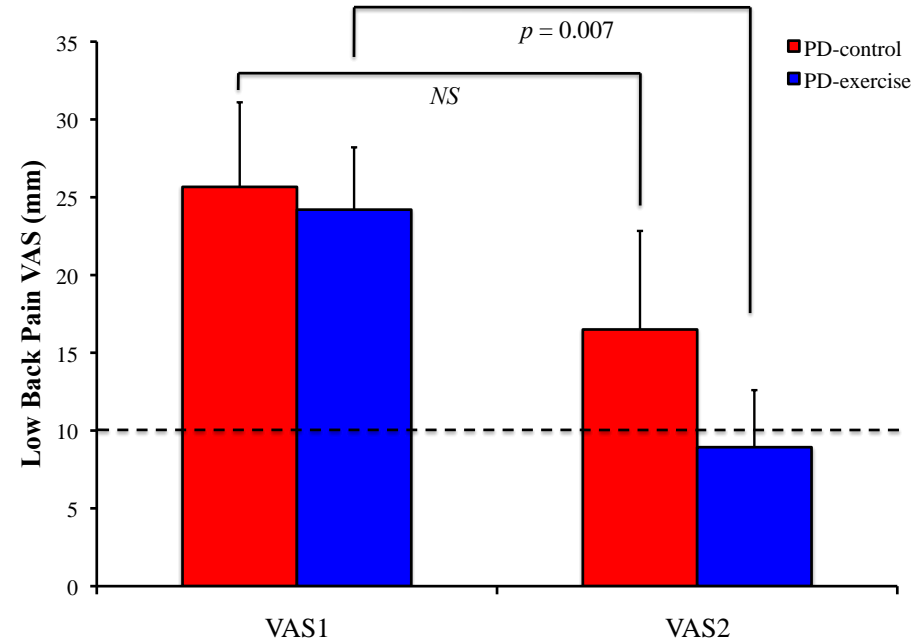
*\*Kolb et al., Spine (2011)*



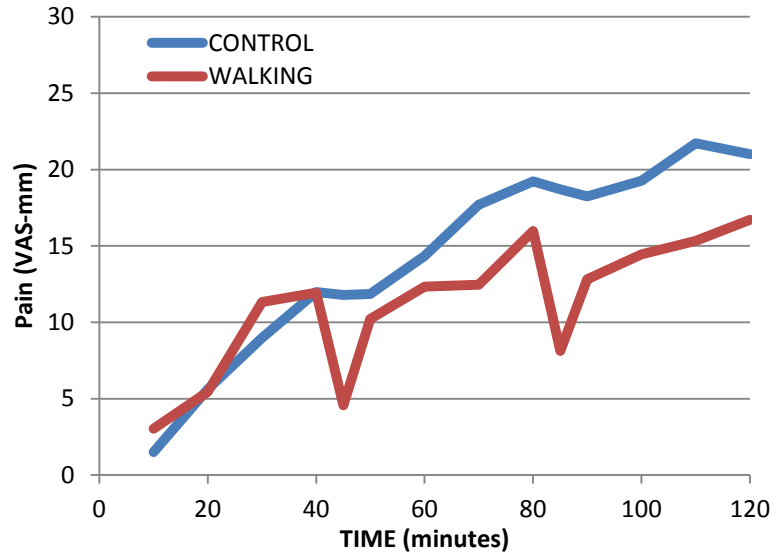
# Changing Responses - Implementing Sit-Stand



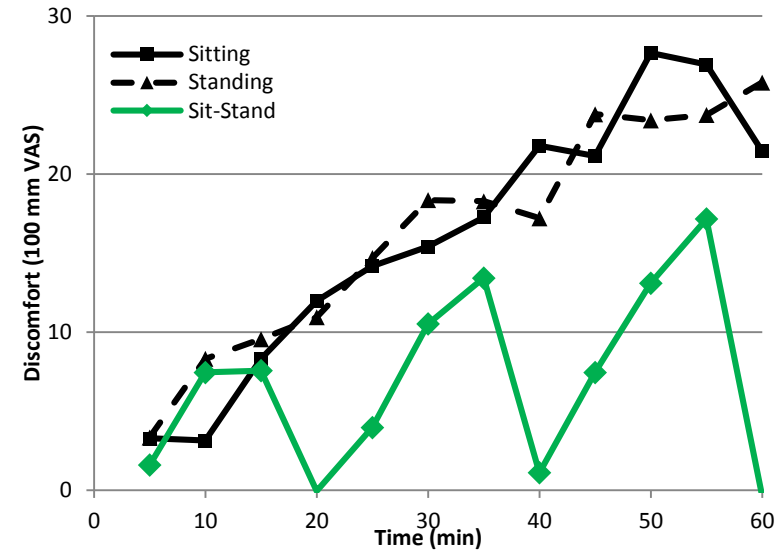
# Response to Exercise Intervention



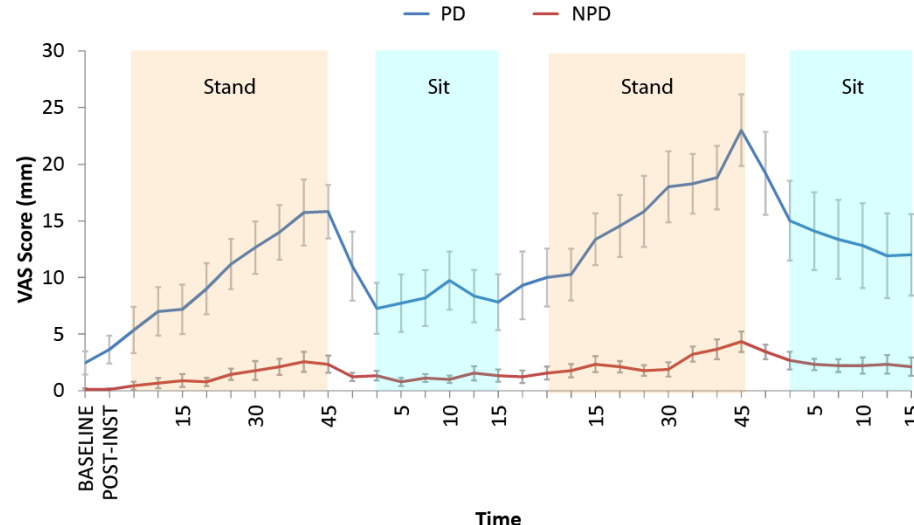
# Standing & Sitting as Rotation



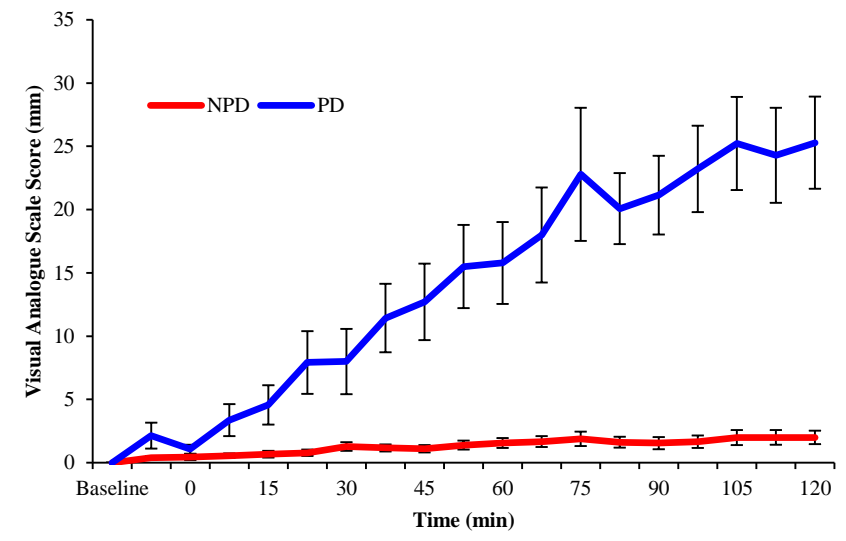
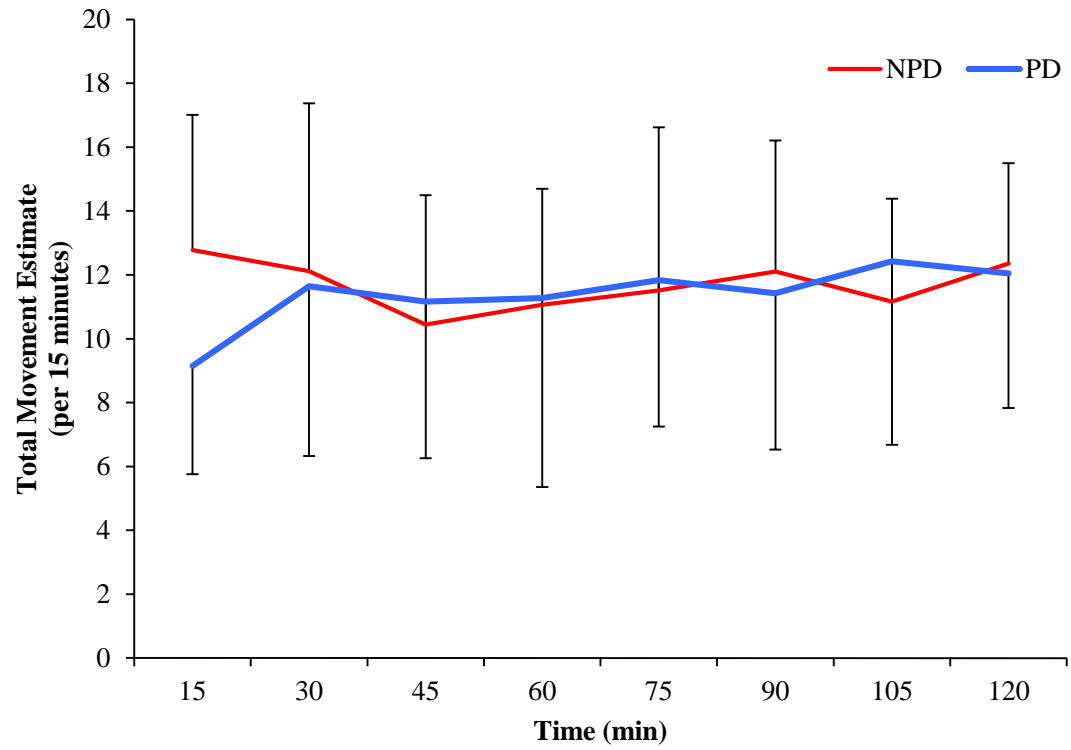
De Carvalho & Callaghan, *Applied Ergo* 2016s



Karakolis & Callaghan, *Ergonomics*, 2016

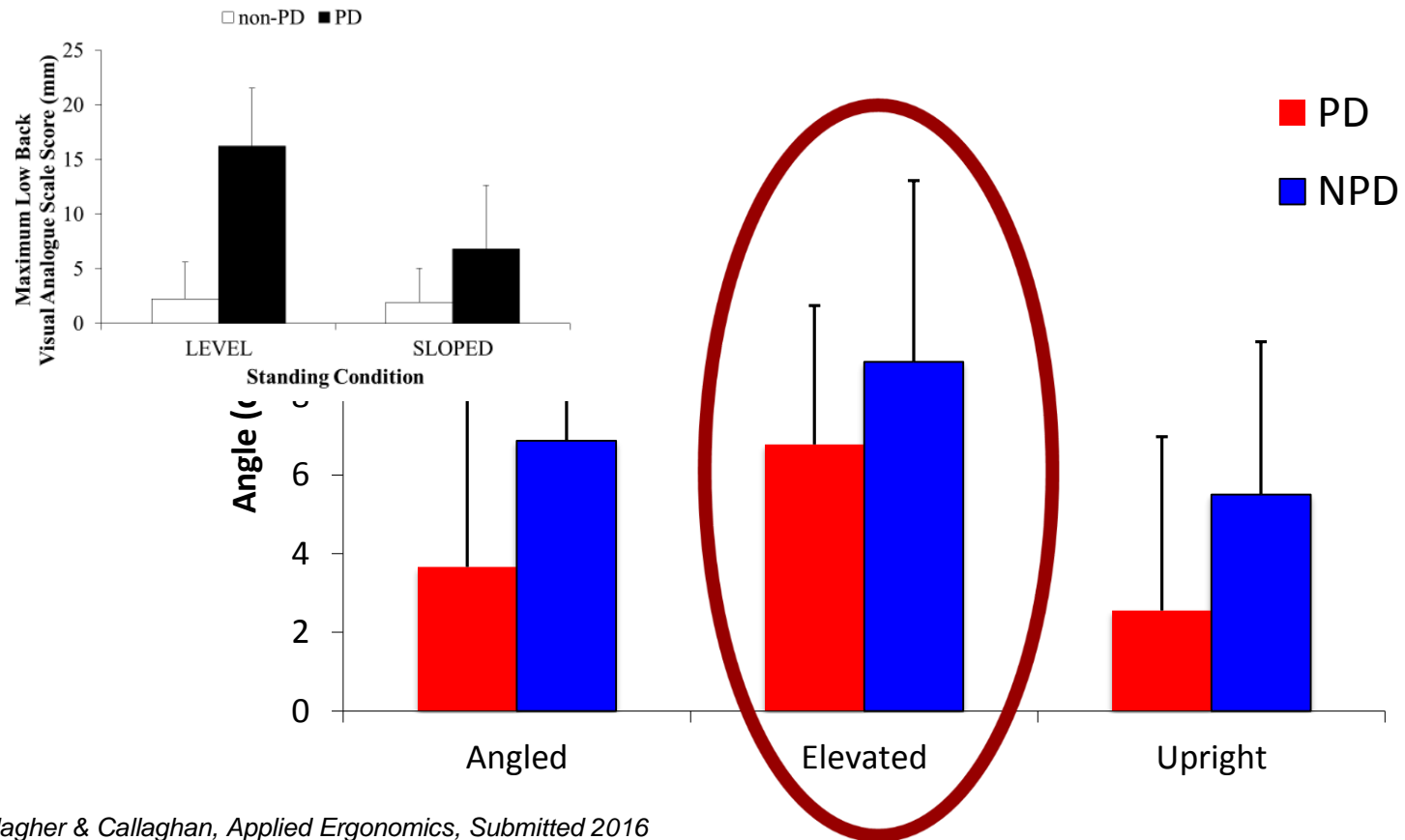


Gallagher & Callaghan, *Ergonomics* 2014



# Feet Interventions and Impact

- 16 subjects
- 7 NPD, 9 PD (56%)

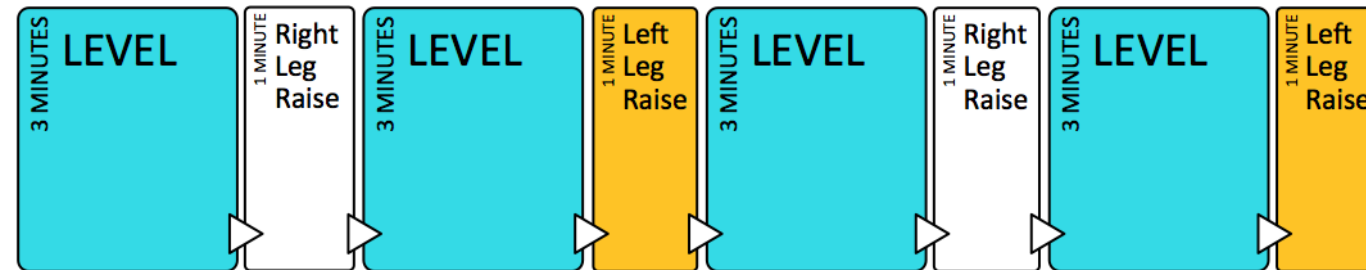
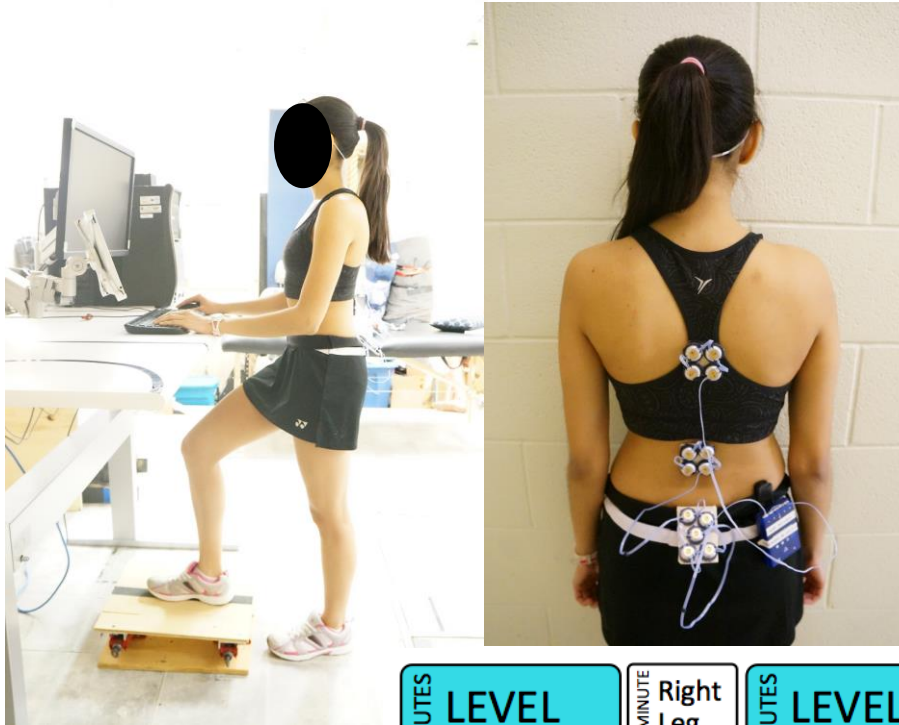


Gallagher & Callaghan, *Applied Ergonomics*, Submitted 2016

Gallagher & Callaghan, *Clinical Biomechanics*, Submitted 2016

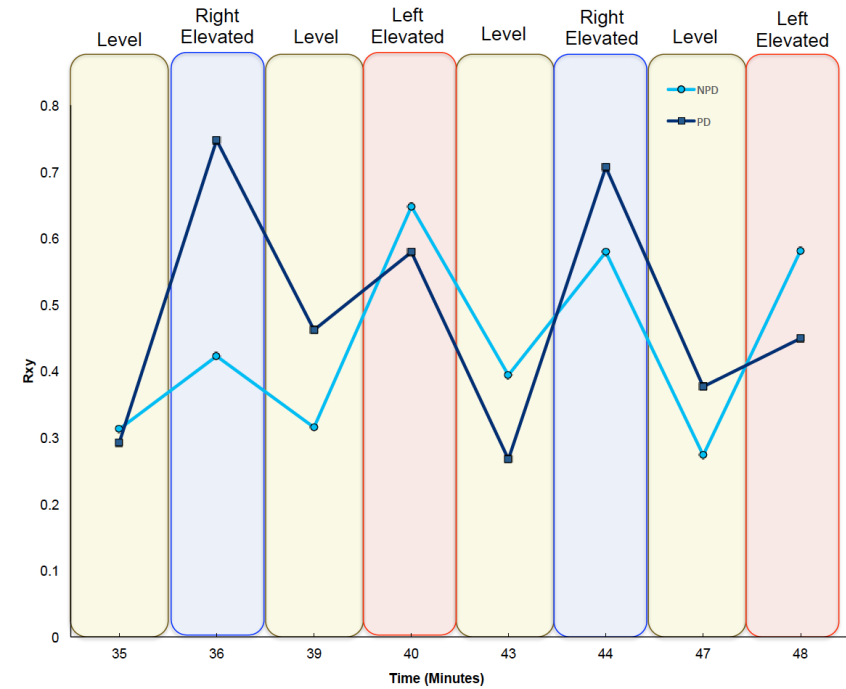
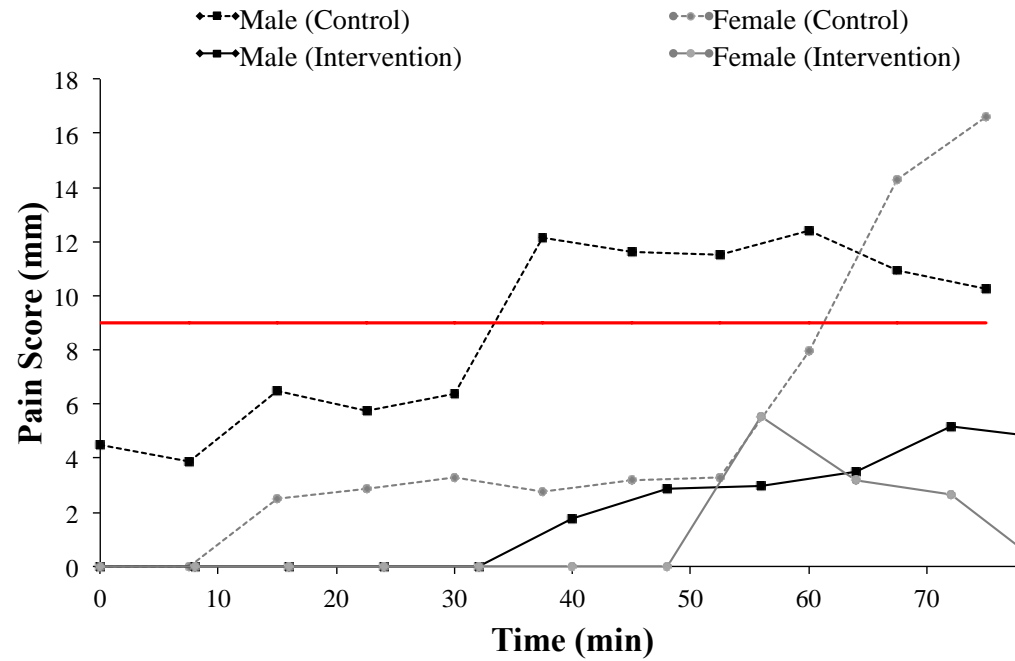


# Foot Rest Intervention



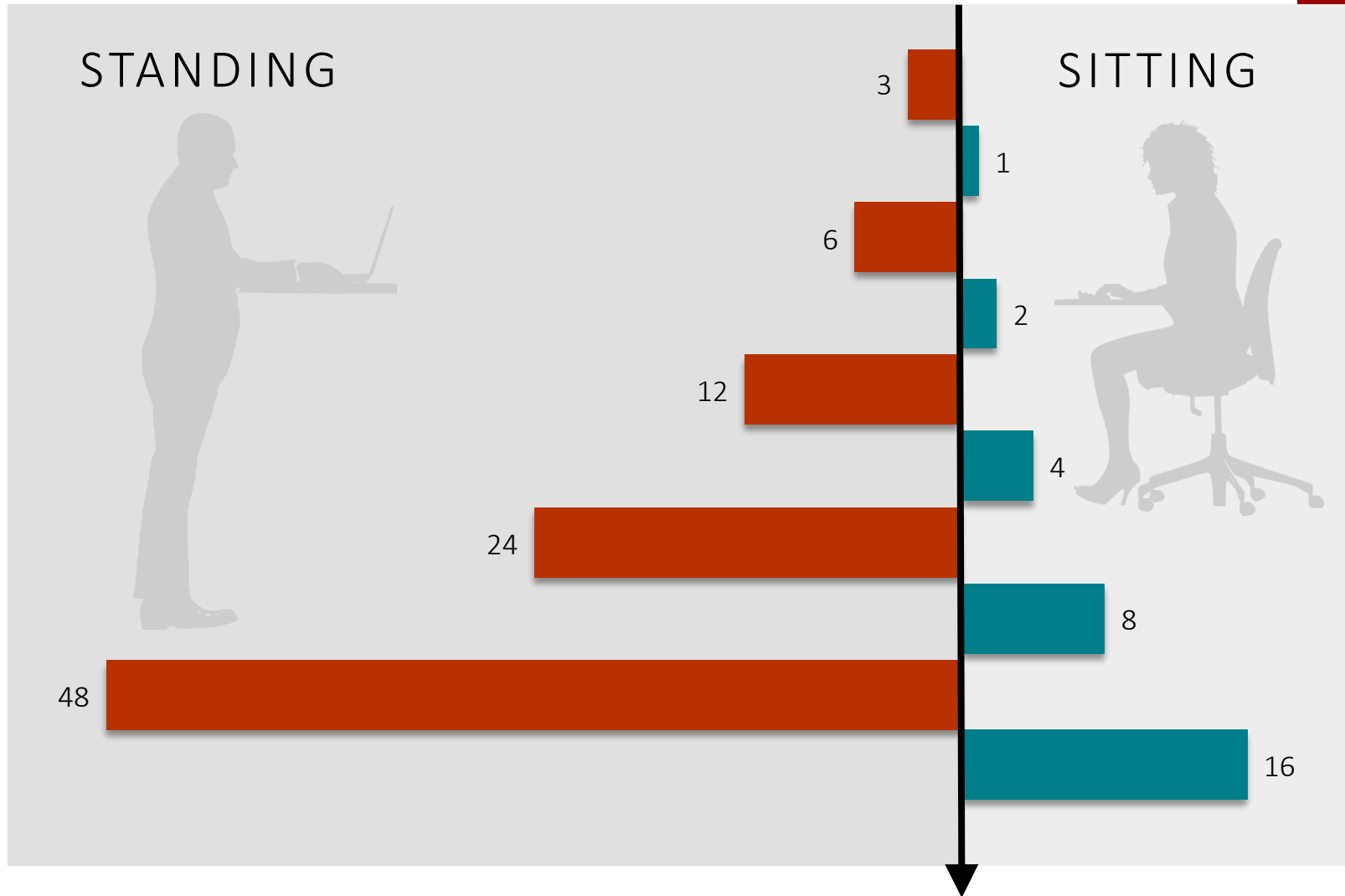
16min X 5 = 80min TOTAL

# Pain Response



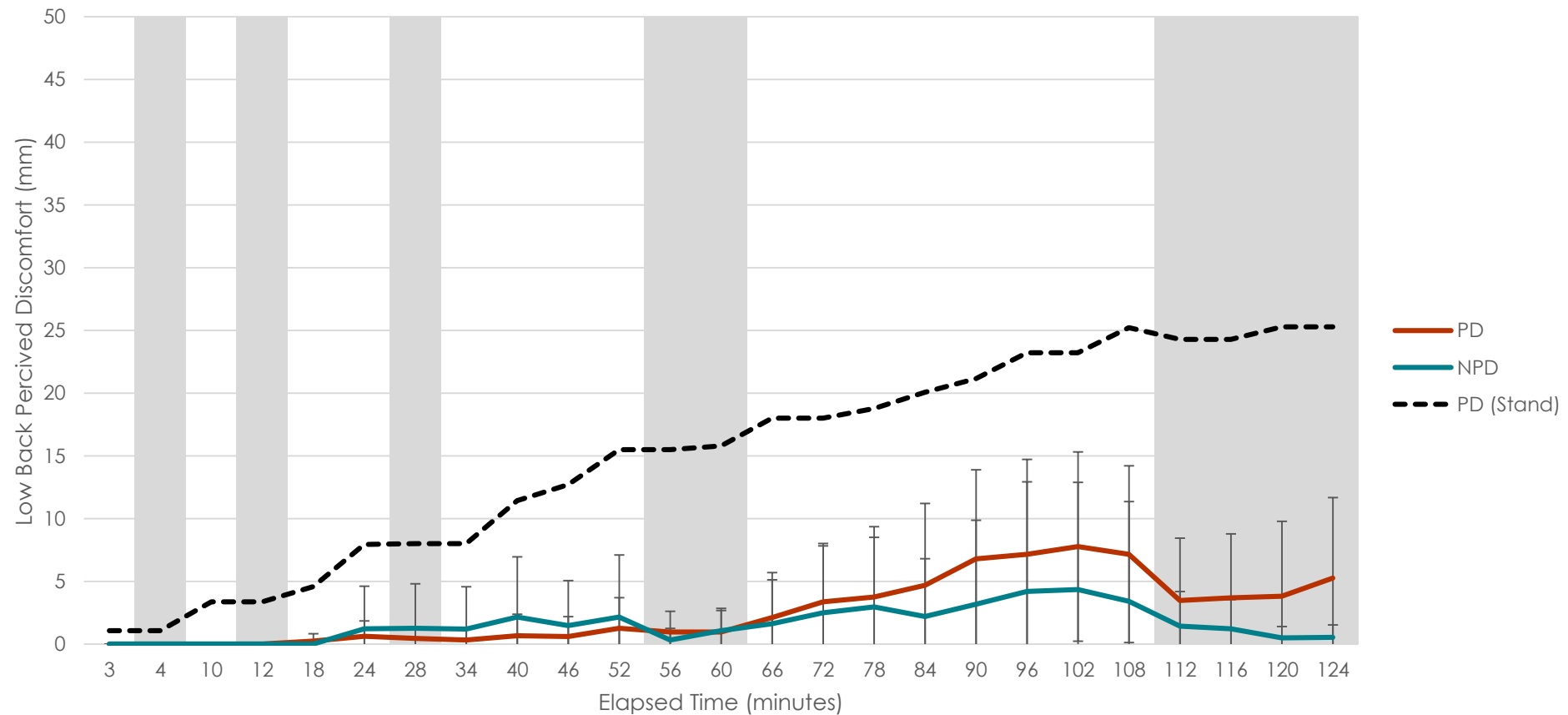
- No significant difference between previously categorized pain and non-pain developers lumbar spine angle  $p = 0.138$

# Progressive Exposure Model

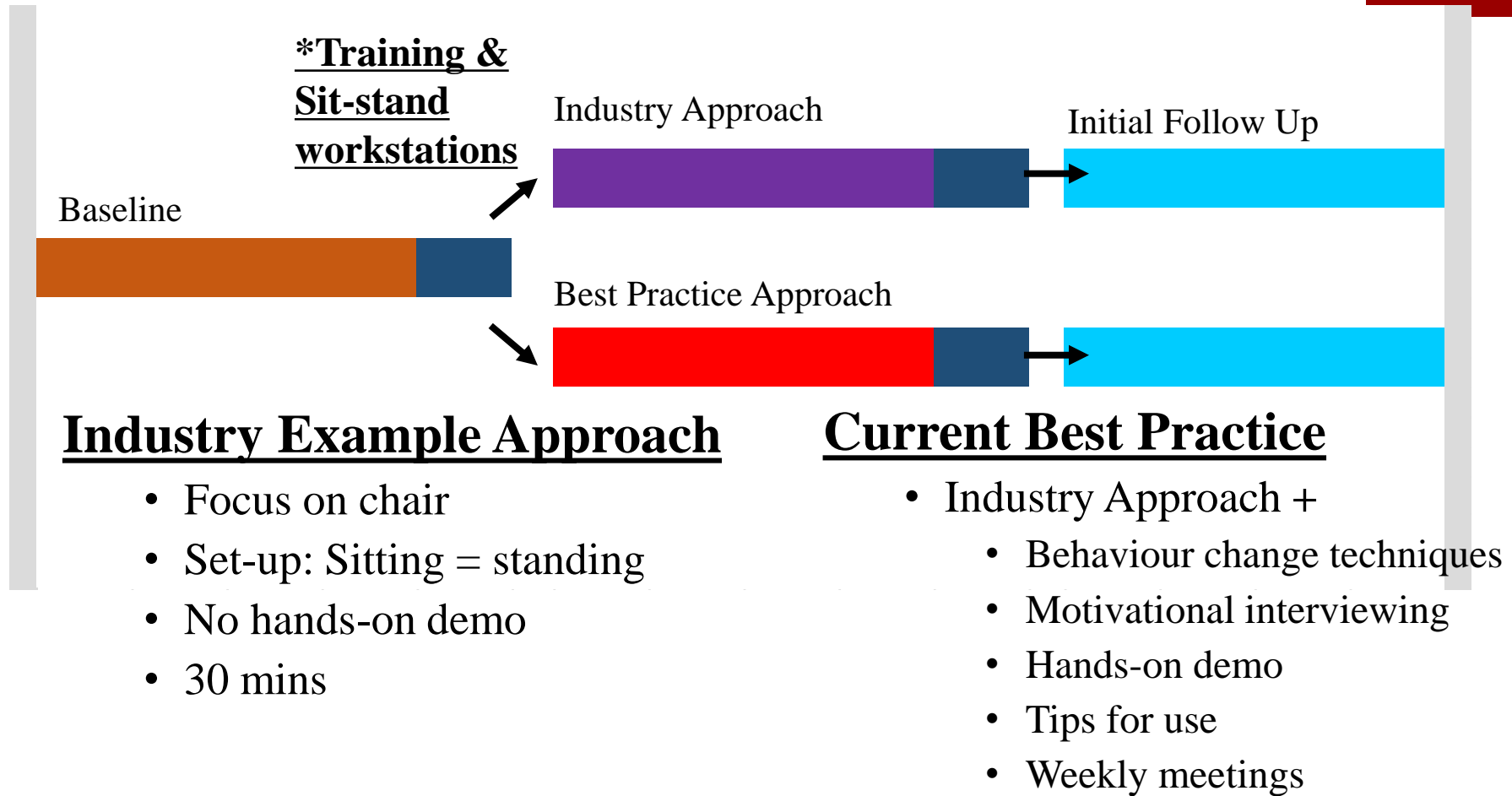


# Low back pain response

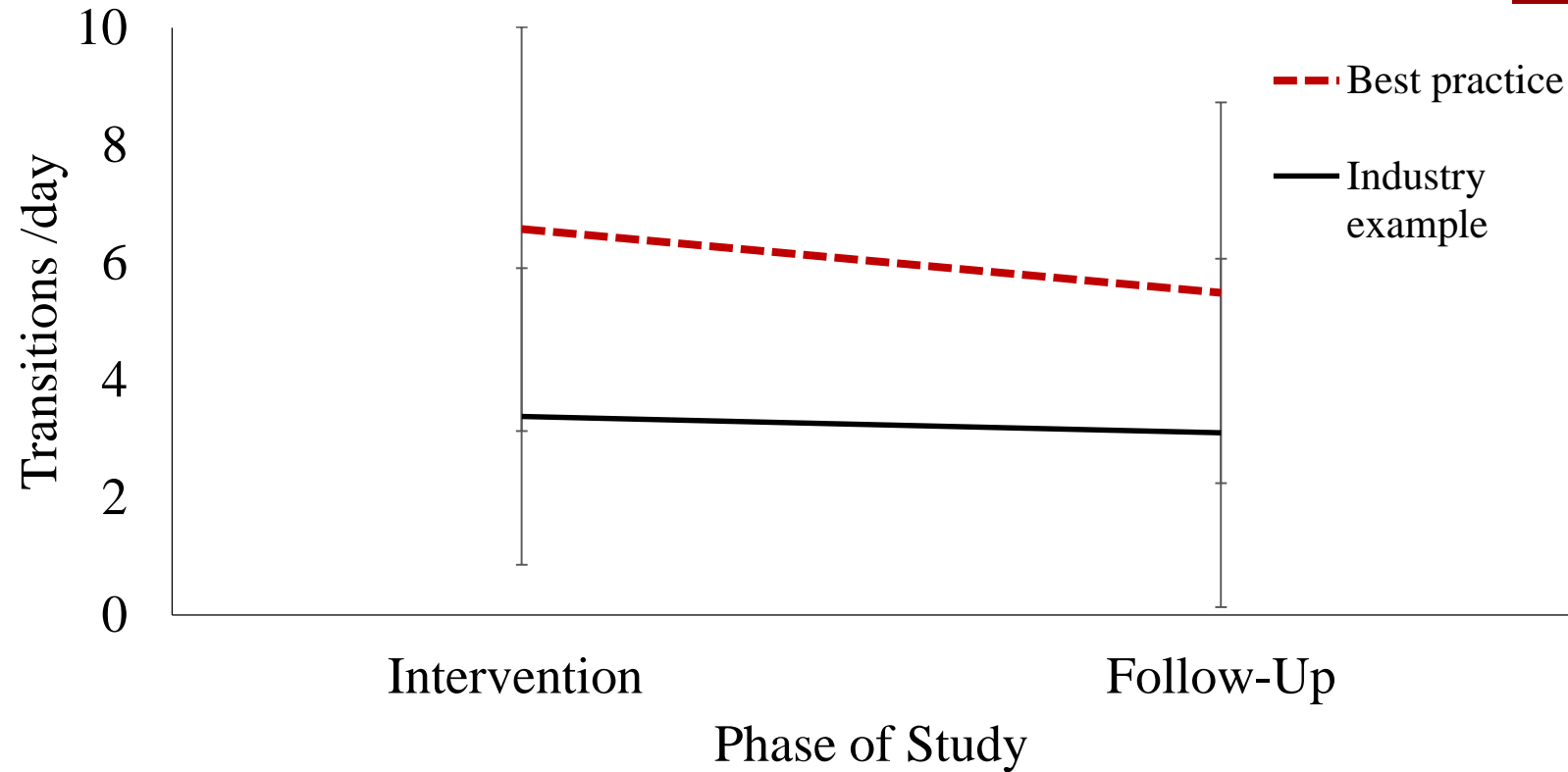
■ Pain group-by-time



# Methods

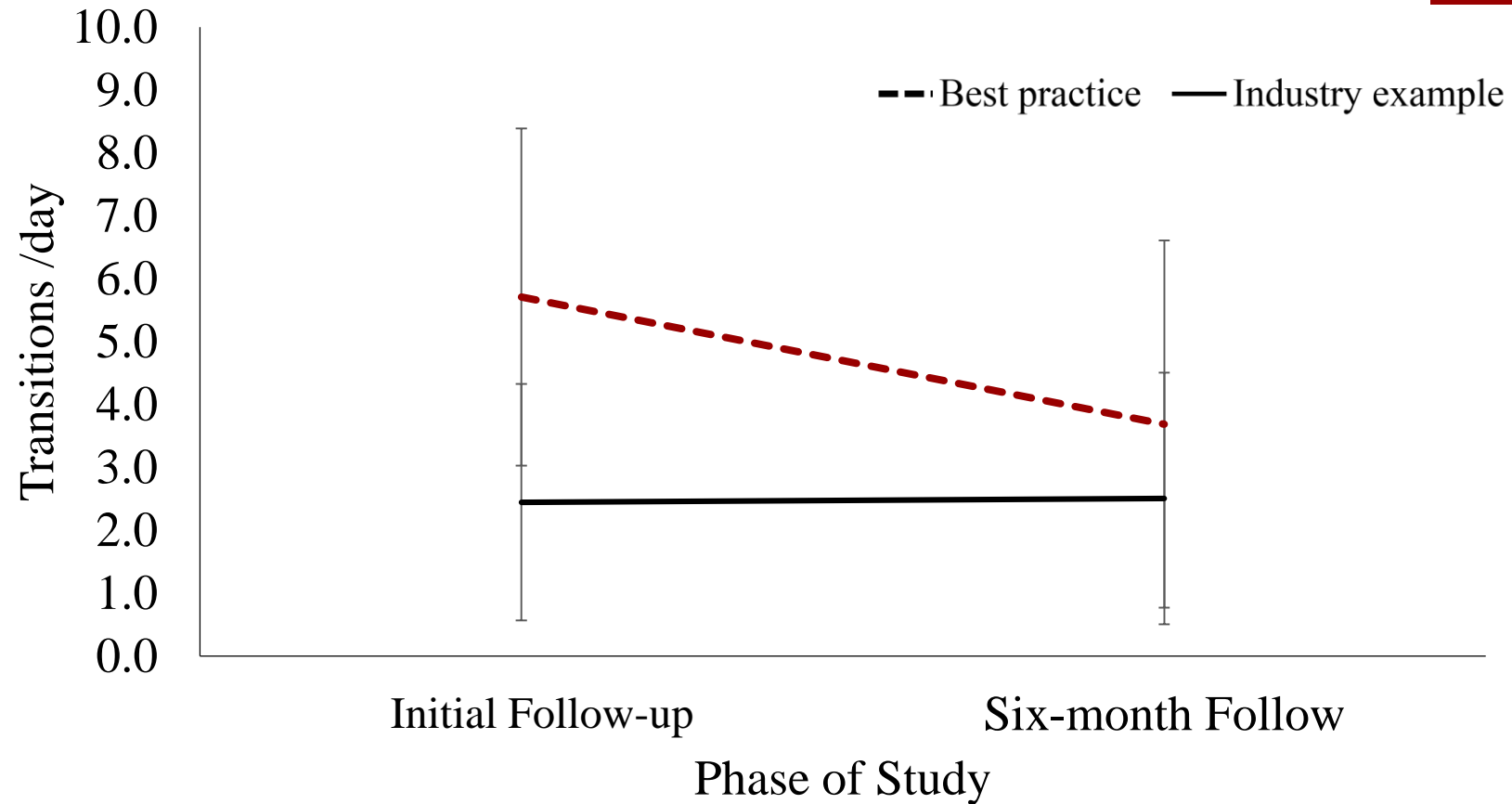


# Sit-stand transitions/day



Group\*Phase  $p = 0.0386$

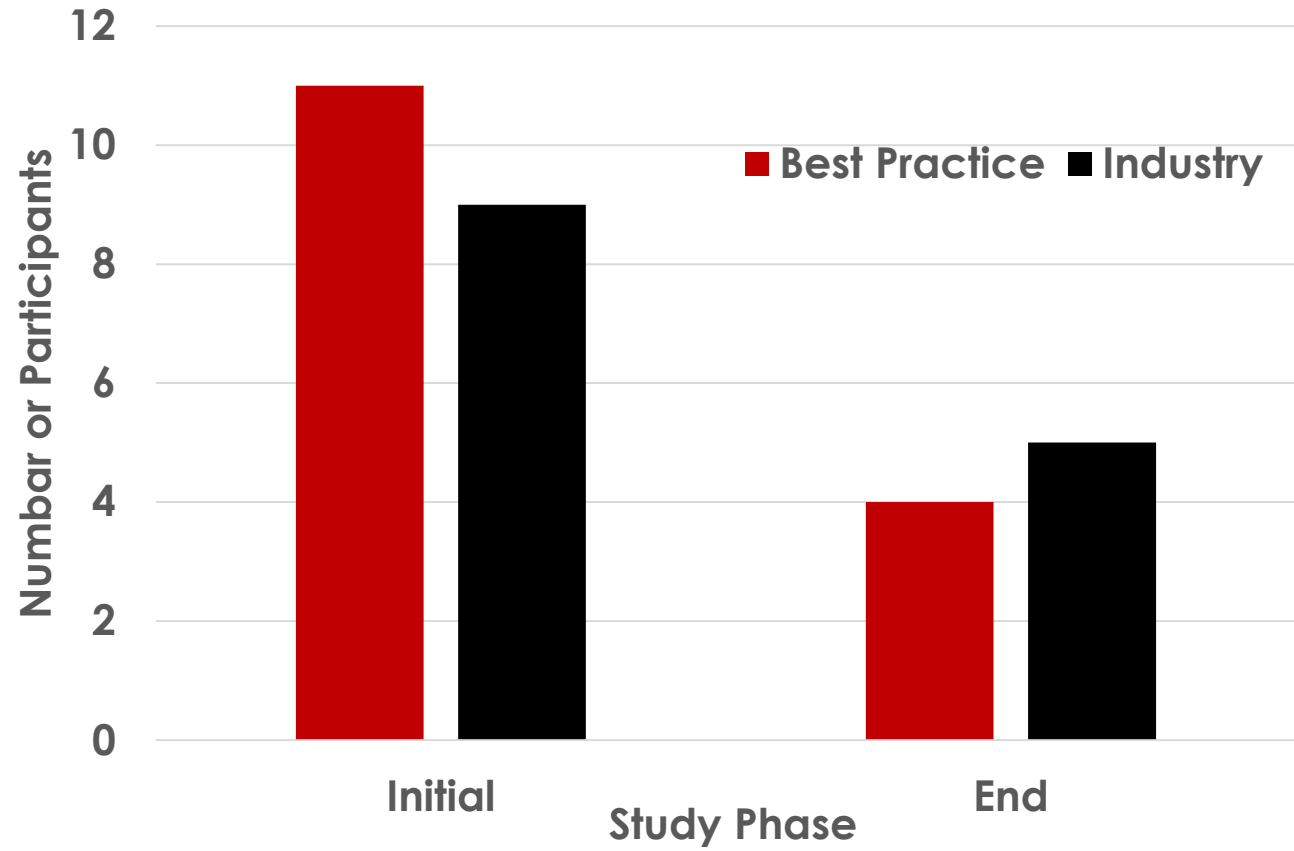
# Transitions: Six Month Follow-Up



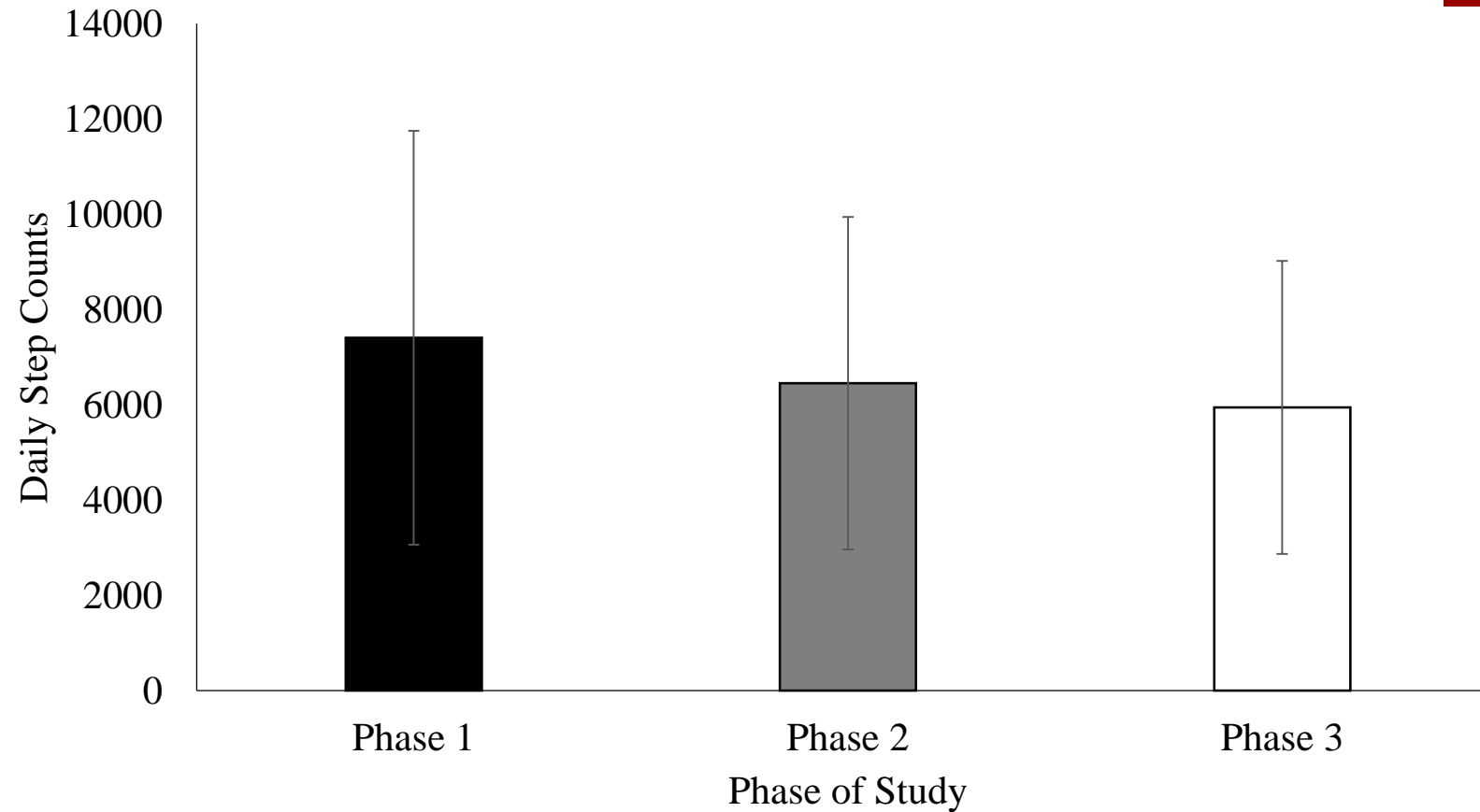
Group\*Phase  $p < 0.0001$



# Pain Developers - AHABD Test



# Fitbit Steps – main effect of Phase



Phase \* $p < 0.0001$

# Take Home messages

- 1) Standing and *Sitting?* in constrained conditions can accelerate LBP for some individuals ≈50%
- 2) Individual (pre-existing) risk factors are important considerations when evaluating the potential for LBP associated with standing :



# Take Home messages

- 3) Not a single ratio solution for all individuals
  - Sit Stand alone does not reduce LBP
  - 4 Hours could be an upper target to balance health and MSK benefits
    - Or a ratio in the work day of 1:1
- 4) Once Pain has initiated it is residual or cumulative



# Take Home messages

- 5) Interventions
  - Exercise can alter individuals predisposed to LBP from Standing exposure
  - Driving from the feet has potential
    - Sloped, Elevated
  - Strategies to induce movement early?

*Move Early Move Often<sup>SM</sup>*

