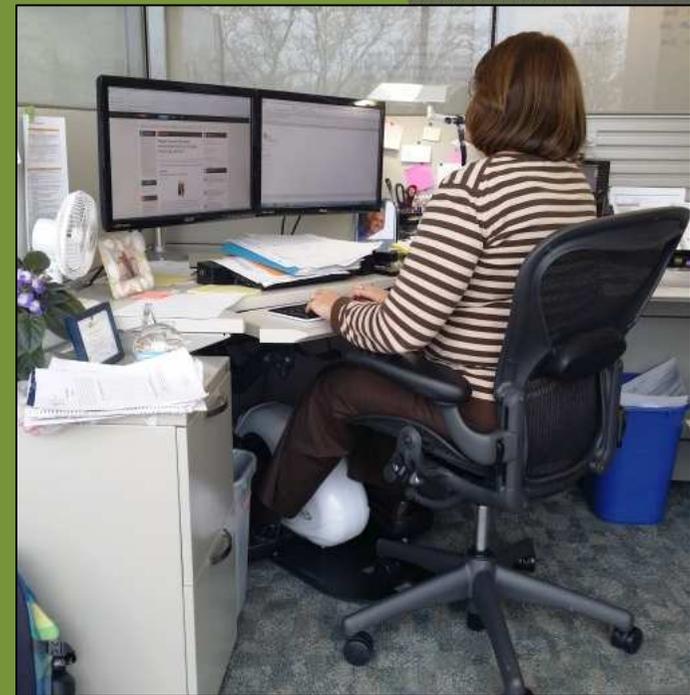


# THE EFFECT OF ACTIVE MOTION SITTING ON WORKER PRODUCTIVITY AND OCCUPATIONAL SEDENTARINESS

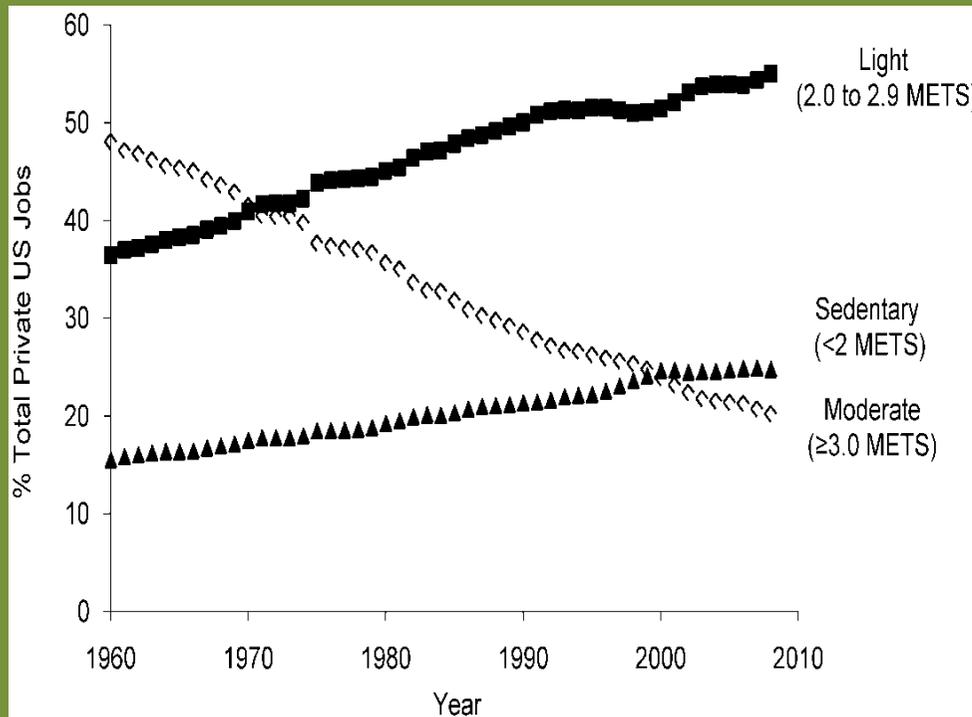
CHRISTOPH LEONHARD, PHD ABPP  
TCSP@XULA  
AND LUCAS J. CARR, PHD  
UNIVERSITY OF IOWA



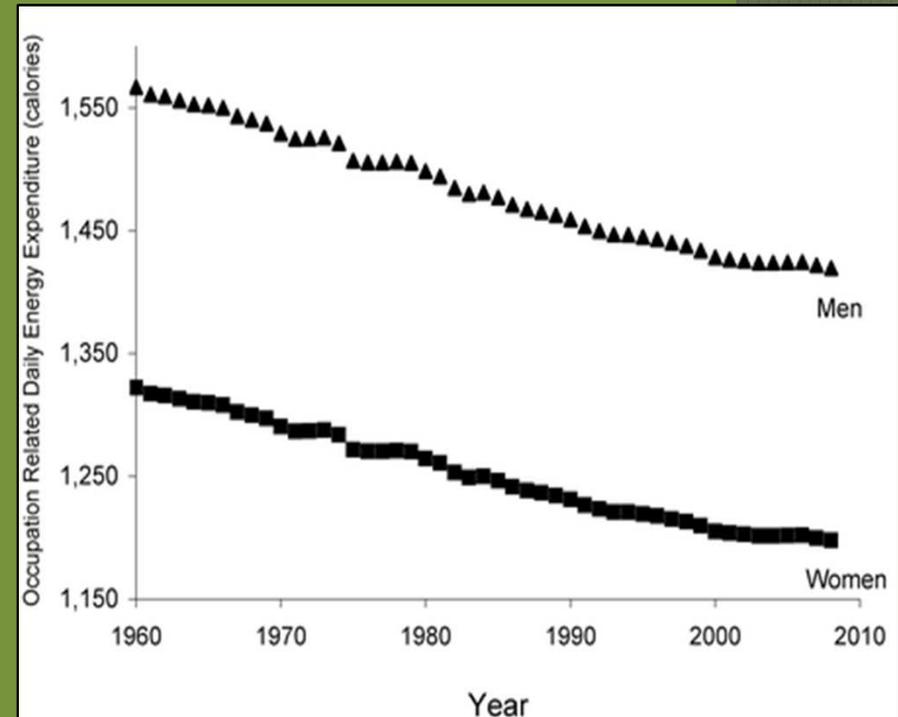
XAVIER UNIVERSITY  
of Louisiana



# Work Environment Impacts Health of Workers and is becoming Increasingly Sedentary

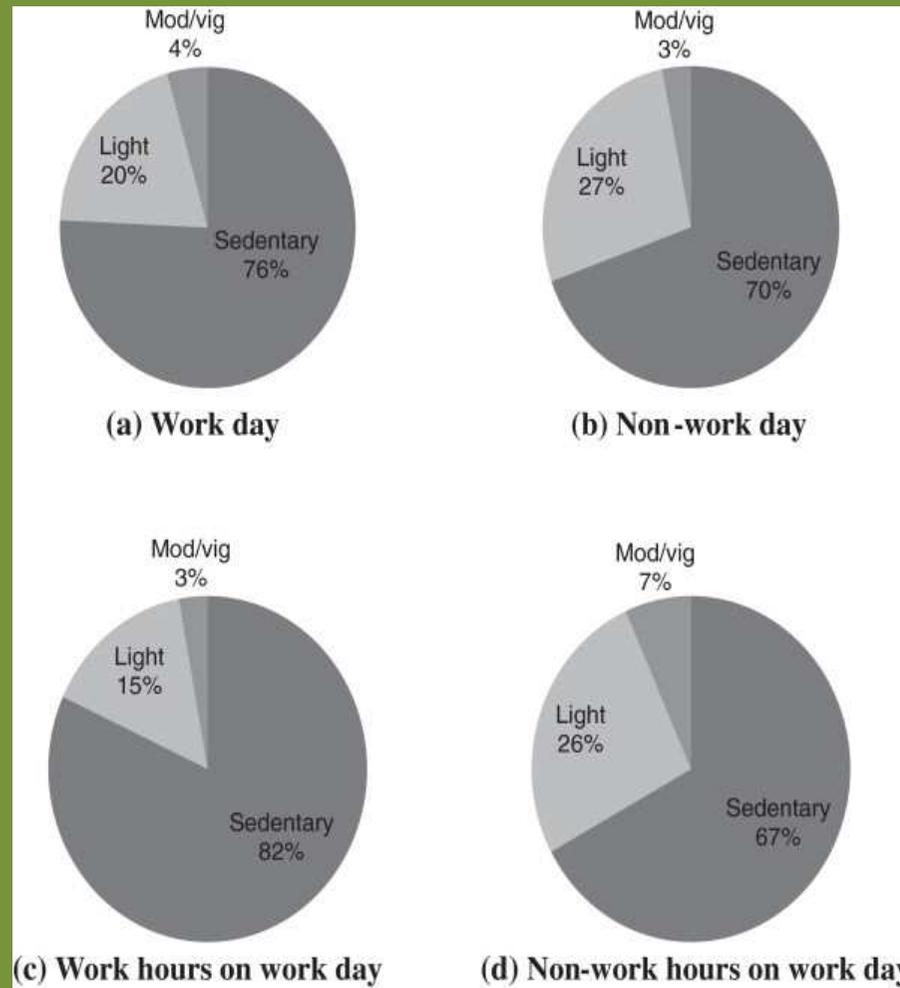


Sedentary jobs ↑ 83% since 1960



EE ↓ 100 kcals/day since 1960

# Service Workers are Highly Sedentary while at Work



# Sedentary behavior is an INDEPENDENT risk factor for adverse health and work outcomes

Chronic Disease Risk  
Mortality

Cognitive function

Mental distress

Musculoskeletal disorders

Work Productivity

Biswas A, et al., *Ann Intern Med*, 2015

Hu FB.. *Lipids*, 2003

Voss et al., *Mental Health & Physical Activity*, 2014

Hamer et al., *MSSE*, 2014.

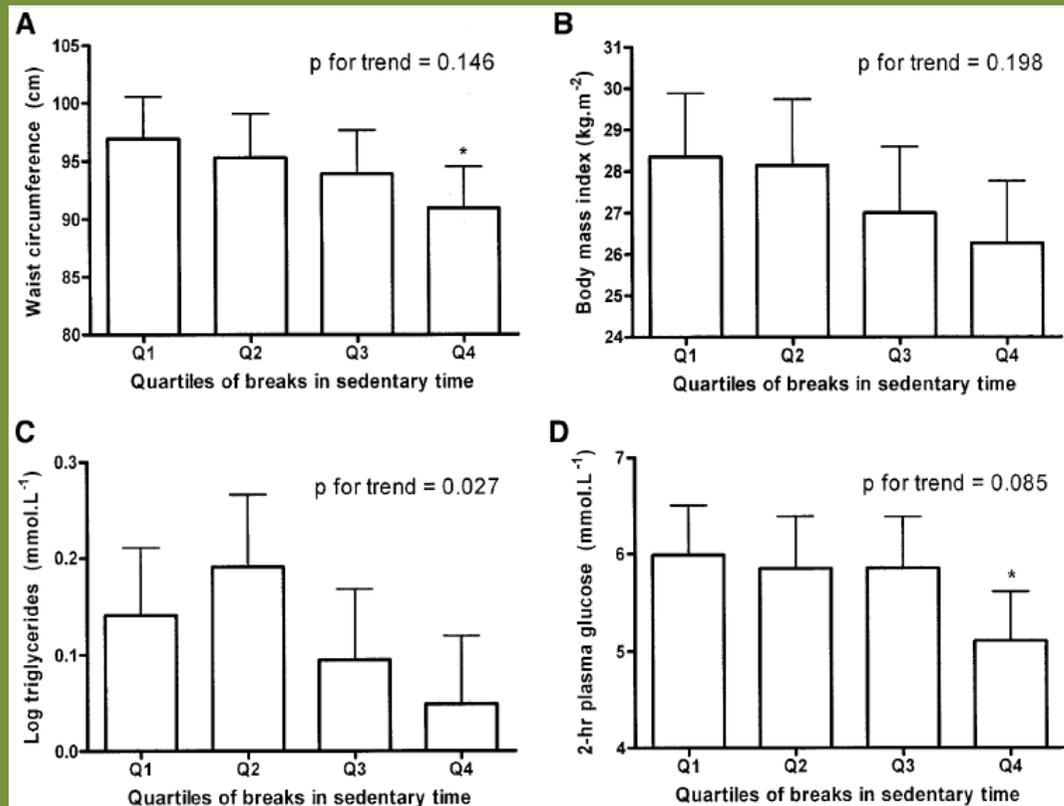
Mouchacca et al., *BMC Public Health*, 2013

Hamer et al., *BMJ Open*, 2014.

Liao and Drury, *Ergonomics*, 2000

Haynes and Williams, *Indust Ergo*, 2007

# Interrupting Sedentary Time Associated with Improved Health and Work Outcomes



Healy et al., *Diabetes Care*, 2008

Pronk et al., *J Occup Environ Med*, 2004

# ... and interrupting Sedentary Time Improves Work Outcomes

**TABLE 2**  
Ordinary Least-Squares Regression Results\*

Independent Variable	Dependent Variable	$\beta$ -coefficient	(P) value	Interpretation of the Effect on Work Performance
Moderate physical activity	Quality of work performed	0.0574	0.0017	Improvement
Moderate physical activity	Overall job performance	0.0517	0.0047	Improvement
Vigorous physical activity	Overall job performance	0.0538	0.0039	Improvement
Cardiorespiratory fitness (estimated $VO_{2max}$ )	Quantity of work performed	0.0118	0.0454	Improvement
Cardiorespiratory fitness (estimated $VO_{2max}$ )	Extra effort exerted	0.2098	0.0299	Improvement
BMI (obesity; $\geq 30$ and $\leq 40$ kg/m <sup>2</sup> )	Getting along with coworkers	-0.239	0.0156	Decrement
BMI (severe obesity; $\geq 40$ kg/m <sup>2</sup> )	Work loss days	1.0155	0.032	Decrement

\* Only significant associations derived as a result of all regression analyses completed are presented in the Table; BMI, body mass index; analyses adjusted for age, sex, and education.

Healy et al., *Diabetes Care*, 2008  
Pronk et al., *J Occup Environ Med*, 2004

*“Sedentary work tasks are a **hazardous exposure** which increases workers’ risk of adverse health outcomes and thus should be mitigated.”*



# Worksites have taken narrowly focused approach to advance health of workers

## Health Promotion/Wellness

Promote lifestyle behaviors outside work that advance health

## Health Safety/Protection

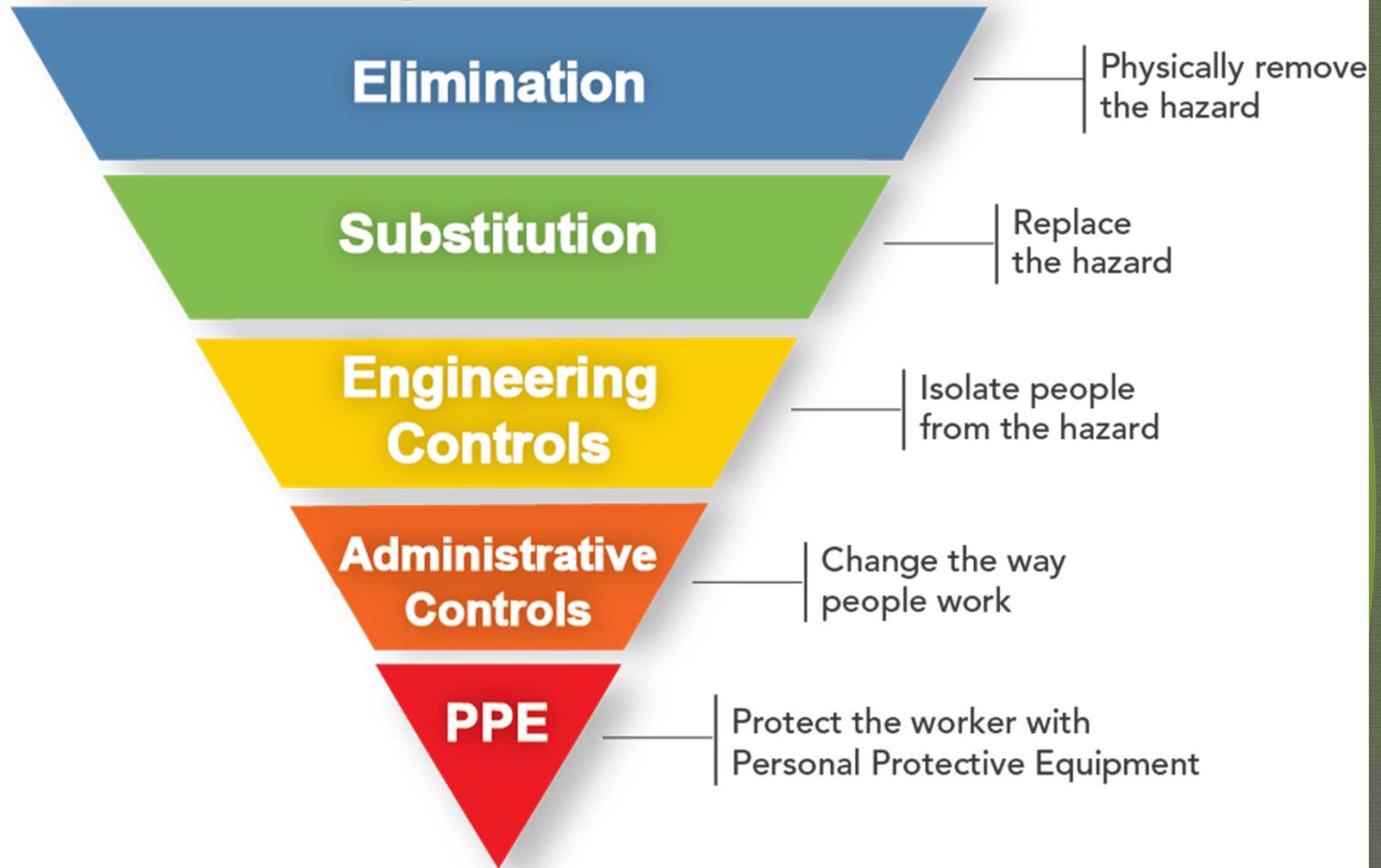
Reduce exposure to risk factors at work to protect health

# Hierarchy of Controls

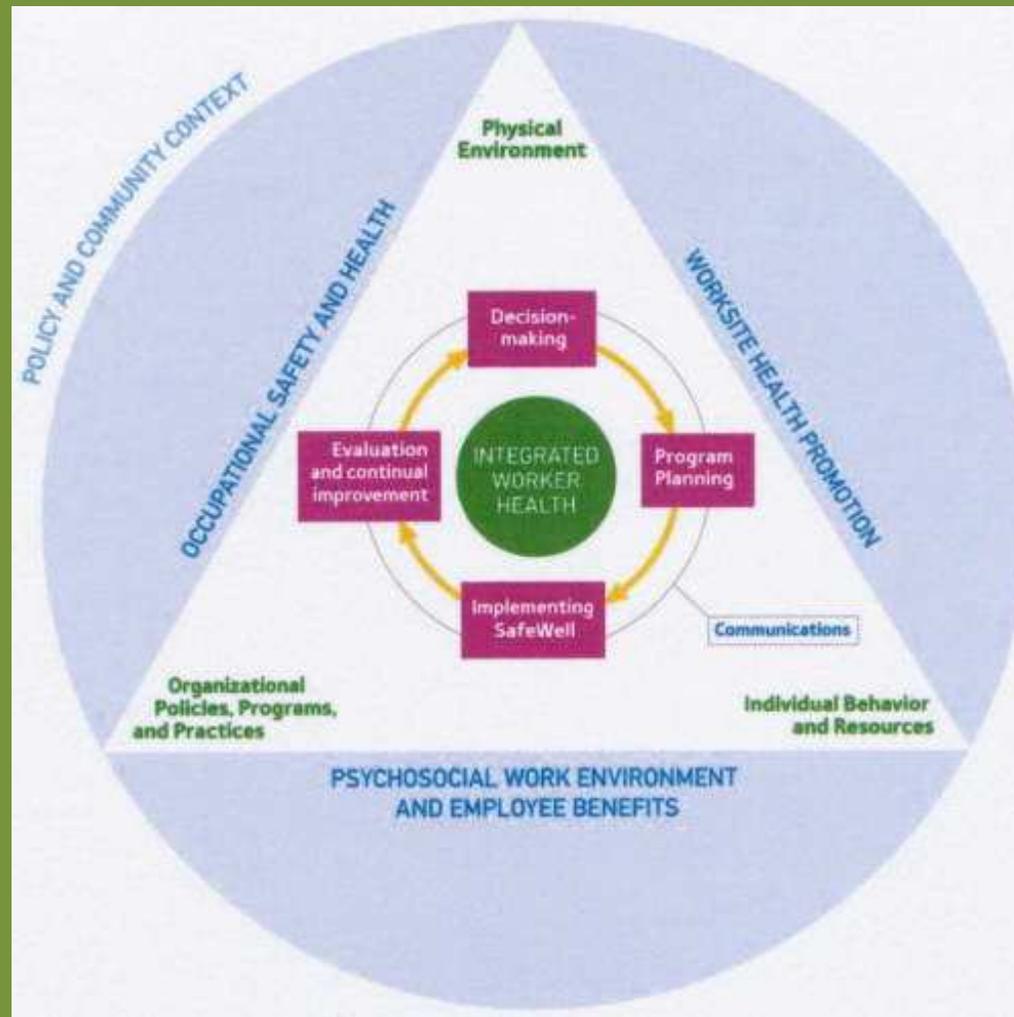
Most effective



Least effective



# Total Worker Health™



# Total Worker Health™ Interventions

- Currently unclear whether integrated interventions are more effective than non-integrated interventions.
- Few TWH interventions have focused on needs of sedentary workers.

Anger et al., Occup Health Psychol, 2014  
Sorensen et al., J Public Health Policy, 2003

# Purpose and Hypothesis

To test the efficacy of an integrated TWH intervention against a non-integrated intervention on:



Occupational sedentary behavior



Occupational physical activity behavior



Cardiometabolic health outcomes

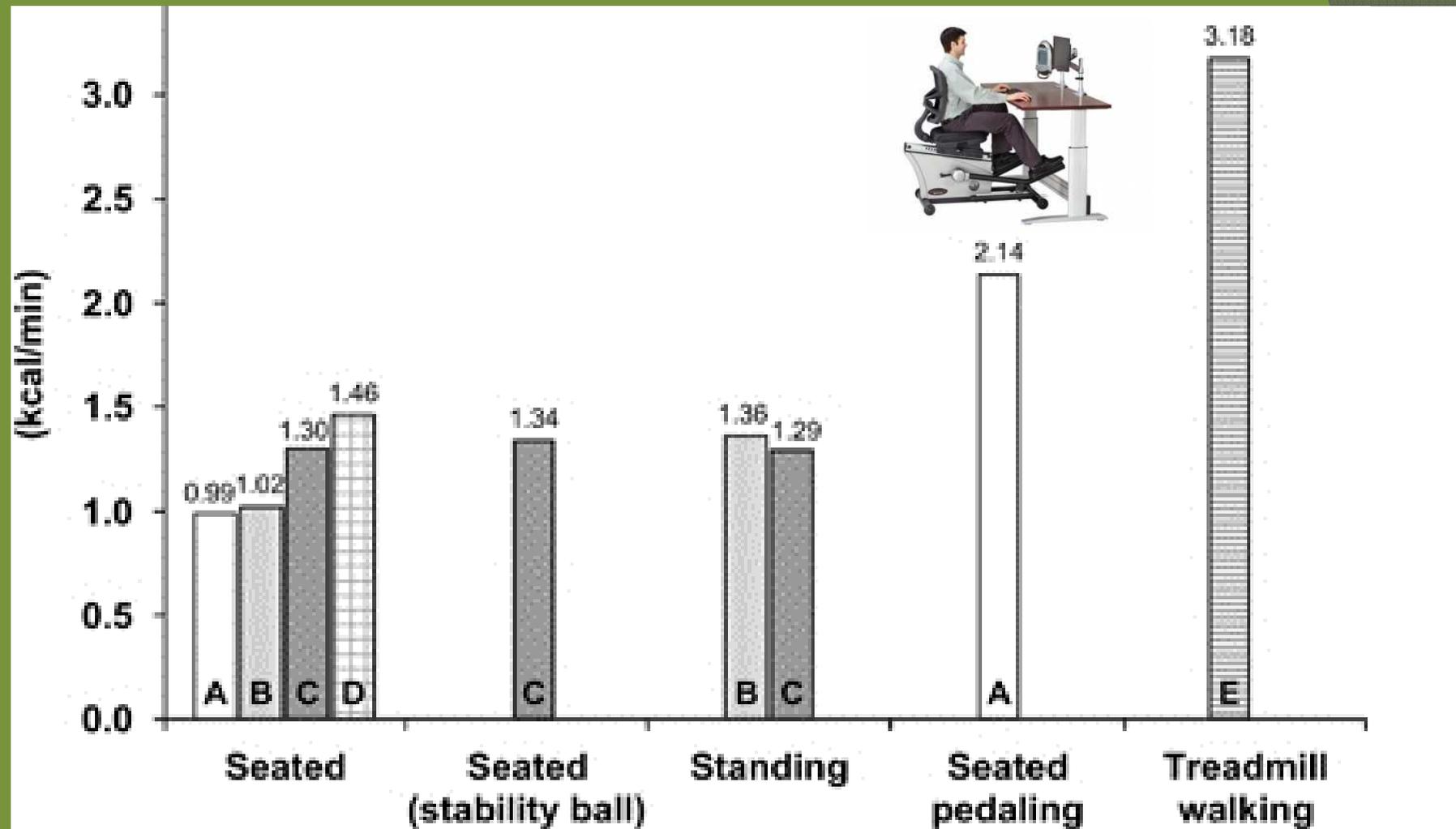


Work productivity

# Step 1: Identify Source of Hazard

# Step 2: Apply Engineering Controls to Mitigate Source of Hazard

# Activity Permissive Workstations For Increasing Occupational Energy Expenditure

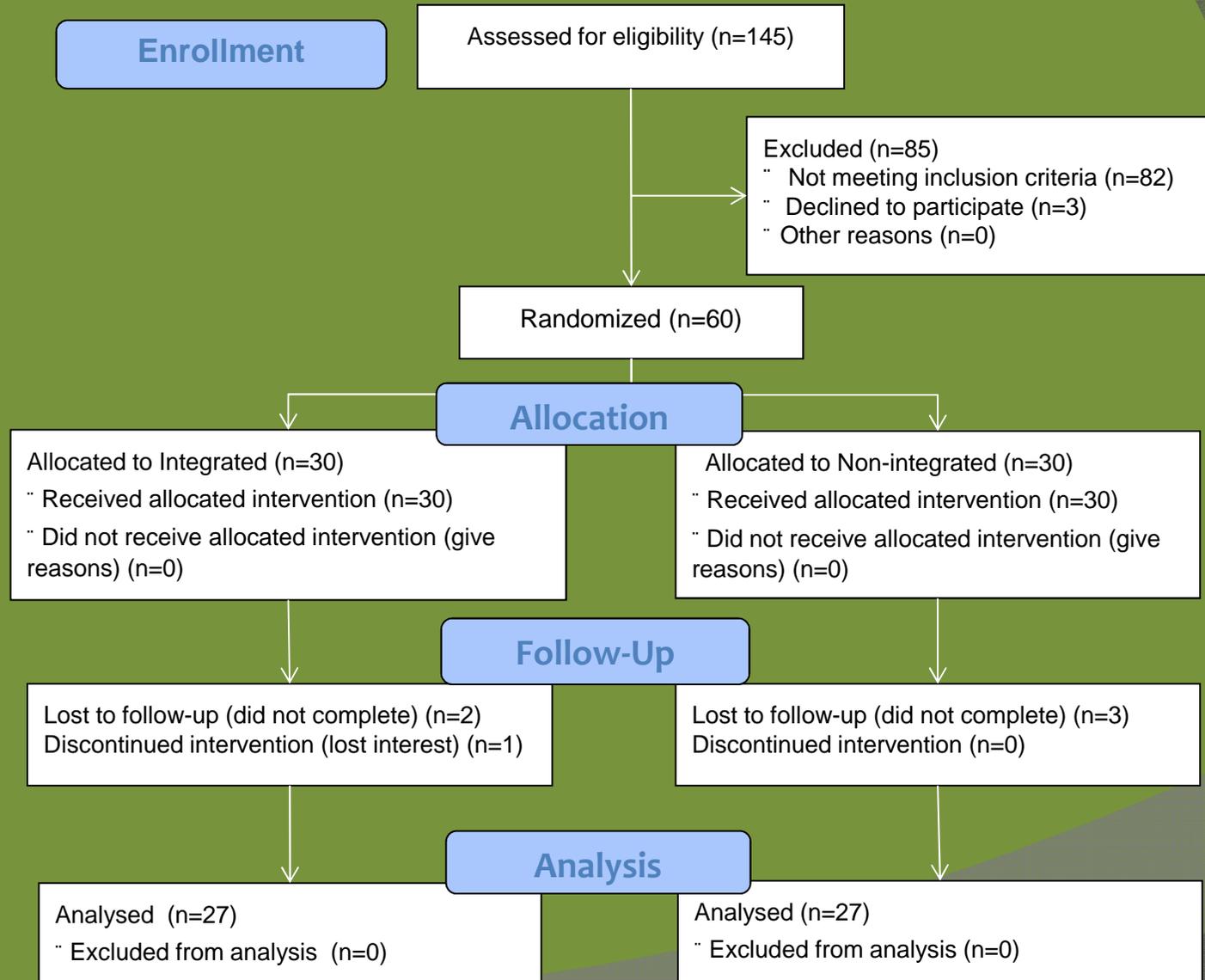


# Measures



1. **Occupational sedentary/physical activity behavior**
  - GENEActiv monitor for 5 work days
2. **Cardiometabolic outcomes**
  - Weight, body composition, Resting heart rate, Blood Pressure, Waist Circumference, estimated cardiorespiratory fitness
3. **Work productivity**
  - WHO Health and Work Performance Questionnaire (HPQ)

# CONSORT Flow Diagram



# Participants

- 54 overweight ( $\text{BMI} > 25.0 \text{ kg/m}^2$ ), full-time (35 hrs/week) employees working in sedentary (sit  $> 75\%$  day) jobs
- Allocated to either:
  - Integrated Intervention (N=27)
  - Non-integrated Intervention (N=27)

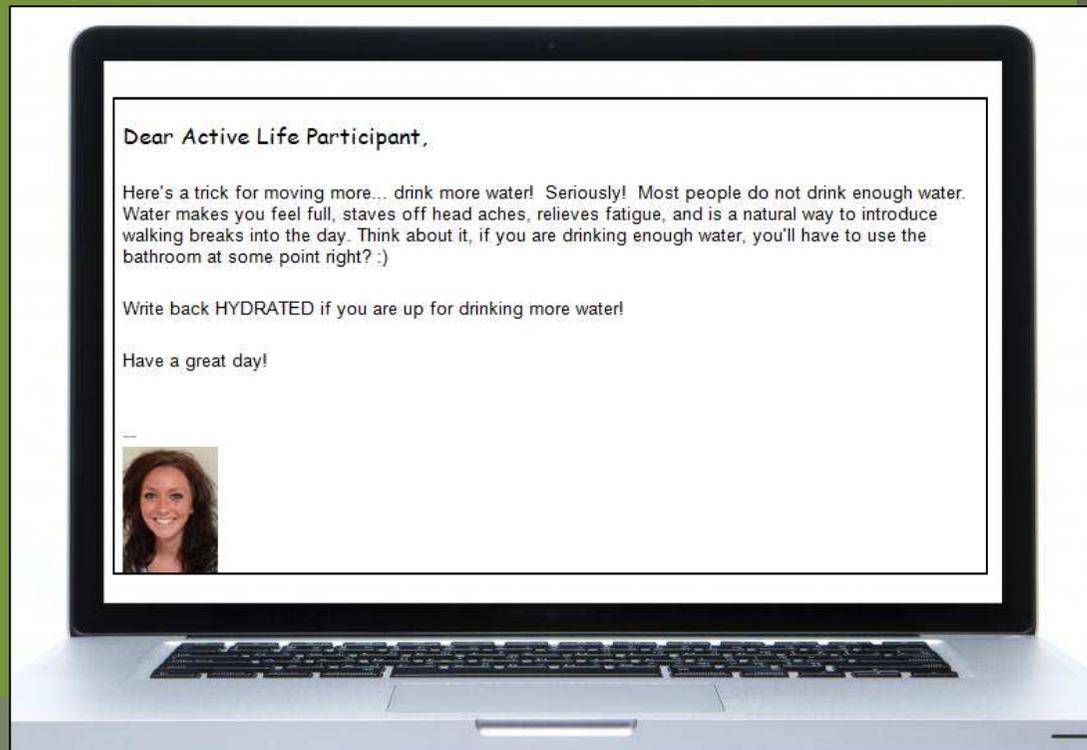


# Non-Integrated Group

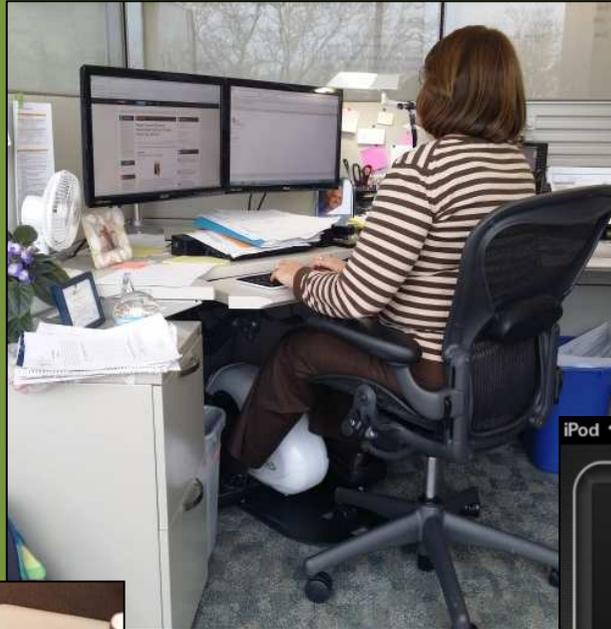


30 minute Ergonomic Workstation Optimization Intervention at baseline

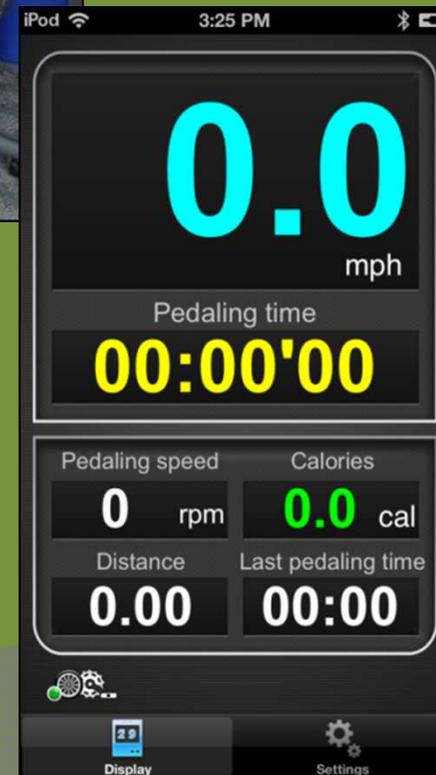
3 emails/week (16 weeks) reinforcing ergonomic evaluation messages



# Integrated Intervention



- Self monitoring
- Goal setting



**activeLifeTrainer**

# Baseline characteristics between groups

	Non-Integrated (N=27)	Integrated (N=27)	p-value
Age (years)	45.0±10.7	45.2±10.9	0.95
Female (%)	70.0	70.0	1.00
Height (cm)	168.6±7.9	169.0±11.1	0.84
Weight (lbs)	206.4±29.6	215.9±42.7	0.18
Body Mass Index	33.0±5.6	34.5±6.8	0.23
Non-Hispanic (%)	100.0	100.0	1.00
White (%)	85.2	96.0	0.70
College Graduate (%)	81.0	67.0	0.36
Income >\$50,000 (%)	67.0	44.4	0.50
Years worked at current job	11.3±10.3	11.1±9.5	0.92
Average hours worked/week	38.1±6.7	40.8±5.4	0.13

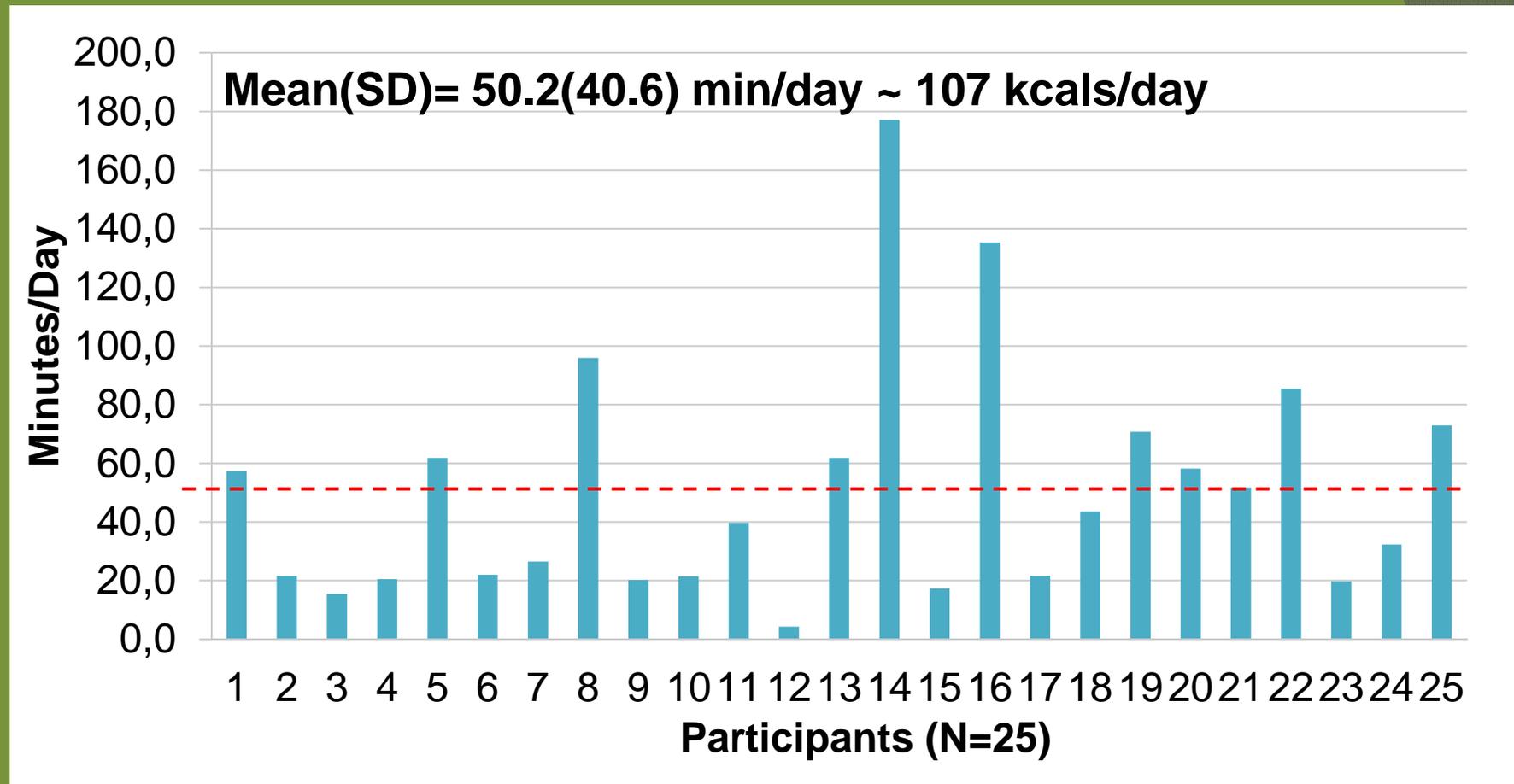
# Occupational sedentary and physical activity

	Baseline	Post-Intervention	Mean Difference <sup>a</sup> (95% CI)	Within Group P value	Group x Time Effect p-value
<b>Total Physical Activity at Work (average counts/work day)</b>					0.14
<b>Non-integrated</b>	91266(25098)	91124(25088)	-142 (-10623 to 10339)	0.98	
<b>Integrated</b>	84665(20999)	94417(26556)	9751 (1067 to 18436)	<b>0.03*</b>	
<b>Percent Work Time Sedentary (% workday)</b>					0.08
<b>Non-integrated</b>	86.0(4.4)	86.4(4.6)	0.4 (-1.0 to 1.8)	0.57	
<b>Integrated</b>	86.8(4.3)	84.8(5.9)	-2.0 (-4.4 to 0.3)	0.09	
<b>Percent Work Time in Light Intensity Physical Activity (% work day)</b>					<b>0.04**</b>
<b>Non-integrated</b>	4.7(2.8)	4.3(2.9)	-0.4 (-1.1 to 0.2)	0.29	
<b>Integrated</b>	4.2(1.5)	4.9(2.2)	0.7 (-0.2 to 1.7)	0.08	
<b>Percent Work Time in Moderate Intensity Physical Activity (% work day)</b>					0.38
<b>Non-integrated</b>	7.8(2.0)	7.9(2.2)	0.07 (-0.7 to 0.8)	0.85	
<b>Integrated</b>	8.0(3.4)	9.1(5.2)	1.1 (-1.1 to 3.2)	0.32	
<b>Percent Work Time in Vigorous Intensity Physical Activity (% work day)</b>					0.44
<b>Non-integrated</b>	1.5(1.0)	1.5(0.9)	-0.0 (-0.3 to 0.3)	0.84	
<b>Integrated</b>	1.0(0.7)	1.3(0.7)	0.3 (-0.0 to 0.5)	0.10	

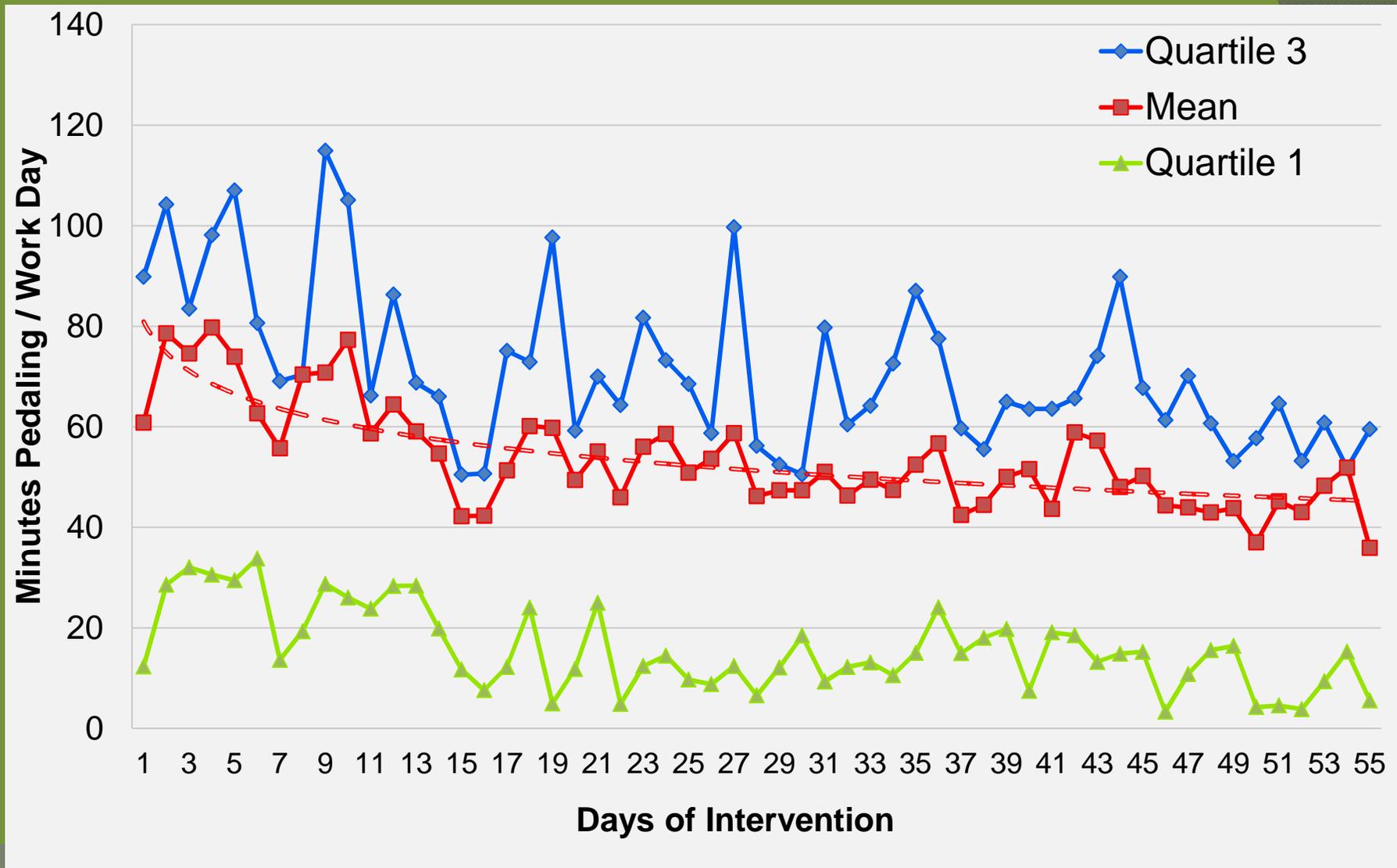
Associations between active workstation adherence and changes in cardiometabolic and work productivity outcomes for integrated intervention completers (N=27).

	<b>Average Pedal Time/day (min)</b>	<b>Average # of Pedal Bouts/Day</b>	<b>Average Pedal Speed (rpm)</b>
Delta Weight (lbs)	R= -0.41; p=0.04	--	--
Delta Fat Mass (lbs)	R= -0.48; p=0.02	--	--
Delta % Body Fat	R= -0.45; p=0.02	R= -0.41; p=0.04	--
Delta Resting Heart Rate (bpm)	R= -0.49; p=0.01	R= -0.45; p=0.02	--
Delta Waist Circumference (cm)	--	--	R= -0.48; p=0.02
Concentration while at work	R= 0.50; p=0.01	--	--
Days missed due to physical/mental health past 4 weeks	R=-0.41; p=0.03	--	--

# Average min pedaled/work day amongst Integrated Intervention completers (N=27)



# Daily pedaling trends over 16 wks amongst Integrated Intervention completers (N=27)



# Conclusions

- Integrated intervention increased occupational light intensity PA but did not improve cardiometabolic or work productivity outcomes
- Adherence → 50 min/work day → 107 kcals/day
- Trends hint at maintenance
- 70% employees elected to keep active workstation
- Better adherence associated with better health and work productivity outcomes

# Future Work

- Long-term follow up to test maintenance & health effects
- Further explore impact on worker productivity, cognition, and state / trait worker affectivity.
- Further develop integration into business culture in various industries and company sizes.
- Use sensor based data to develop supportive integrated corporate wellness approach.

# Acknowledgements



## Our participants

ACT, Inc. and Sandy Stewart

## Research Staff

McKenzie O'Neill  
Alex Ferrer  
Maggie Swift  
Roberto Benzo  
Sanjana Ramesh

## Colleagues

Dr. Sharon Tucker, PhD  
Dr. Nathan Fethke, PhD  
Dr. Fred Gerr, MD  
Dr. Christoph Leonhard, PhD

## Funding Support

Healthier Workforce Center for Excellence (HWCE) at the University of Iowa. #No.U19OH008858; Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health