

# The Science of Sedentary Behaviour and Cardiometabolic Health in Adults



## Interventions

David Dunstan

# Acknowledgements



John Belletierre



Paddy Dempsey



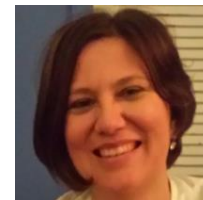
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**Deakin University:** Marj Moodie, Tony La Montagne

**Curtin University:** Leon Straker, Pieter Coenen



# NHMRC Centre of Research Excellence on Sitting Time and Chronic Disease Prevention

## Theme 3 Interventions



Salmon



Eakin



Timperio

Generating new knowledge & building capacities for informing programs, practice & policy across key life-stages & population-health settings

Children

Youth

Adults

Older adults

Developing innovative measurement capacities

Identifying mechanisms & dose-response relationships

Developing & testing novel interventions

Home

School

Workplaces

Aged care



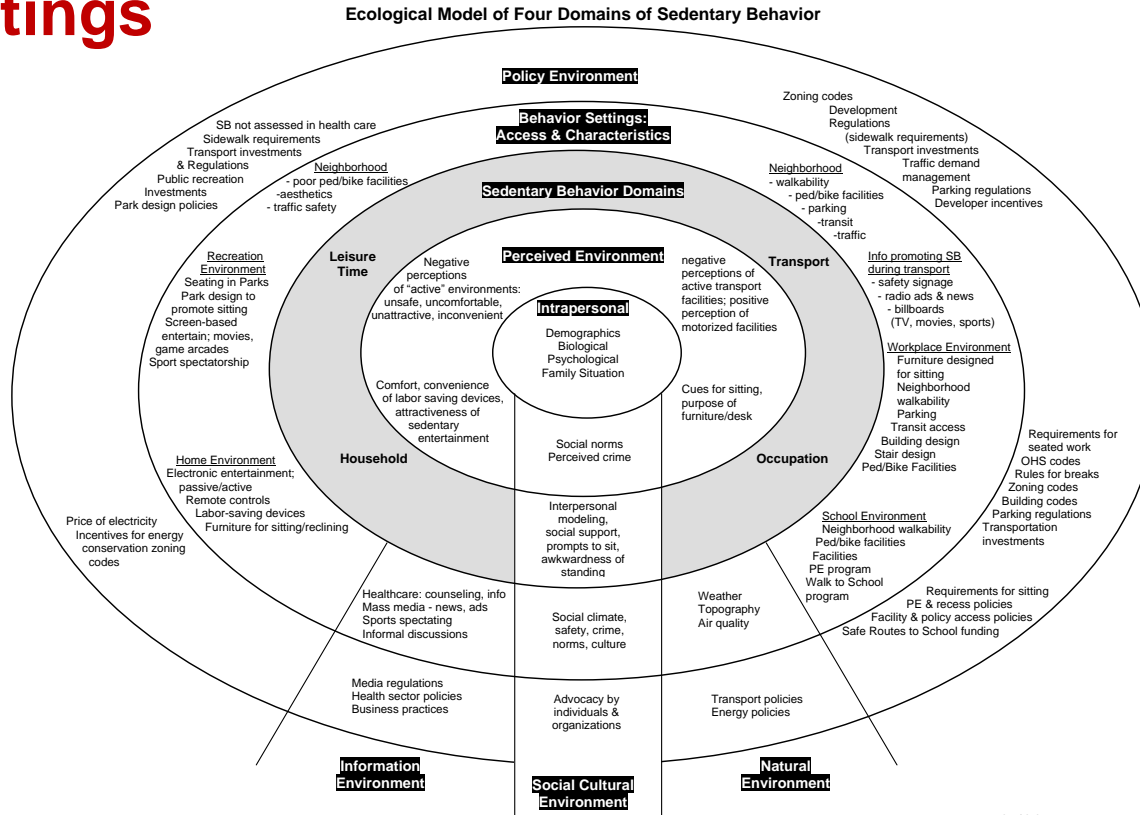
**DEAKIN**  
UNIVERSITY AUSTRALIA



**THE UNIVERSITY  
OF QUEENSLAND**  
AUSTRALIA



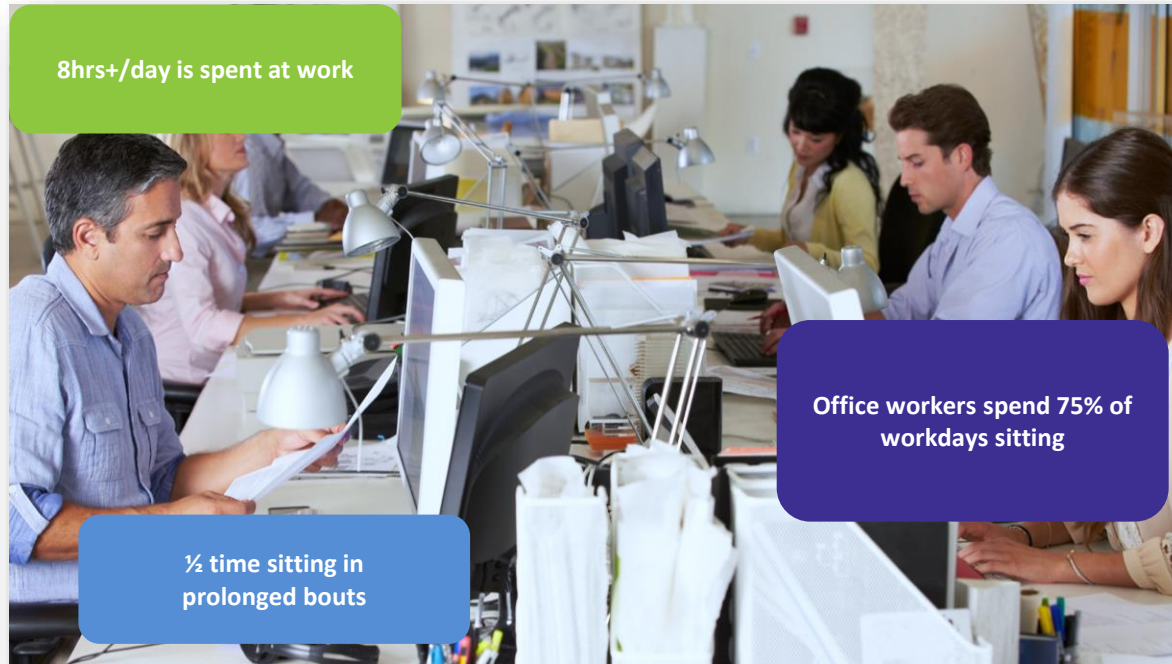
# Key point: Sedentary Behaviour occurs across multiple settings



07-20-05

Source: Owen, N, Sugiyama, T, Eakin, EG, Gardiner, PA, Tremblay, MS and Sallis JF. (2011)  
Adults' sedentary behavior: Determinants and interventions *Am J Prev Med*, 41, 189-196.

# Office workplace = Lots of sitting



Source: Thorp A et al. (2012) *Int J Behav Nutr Phys Act* 9: 128

# Stand Up Australia

Program of research investigating the benefits of reducing prolonged sitting time in the workplace



THE UNIVERSITY OF QUEENSLAND

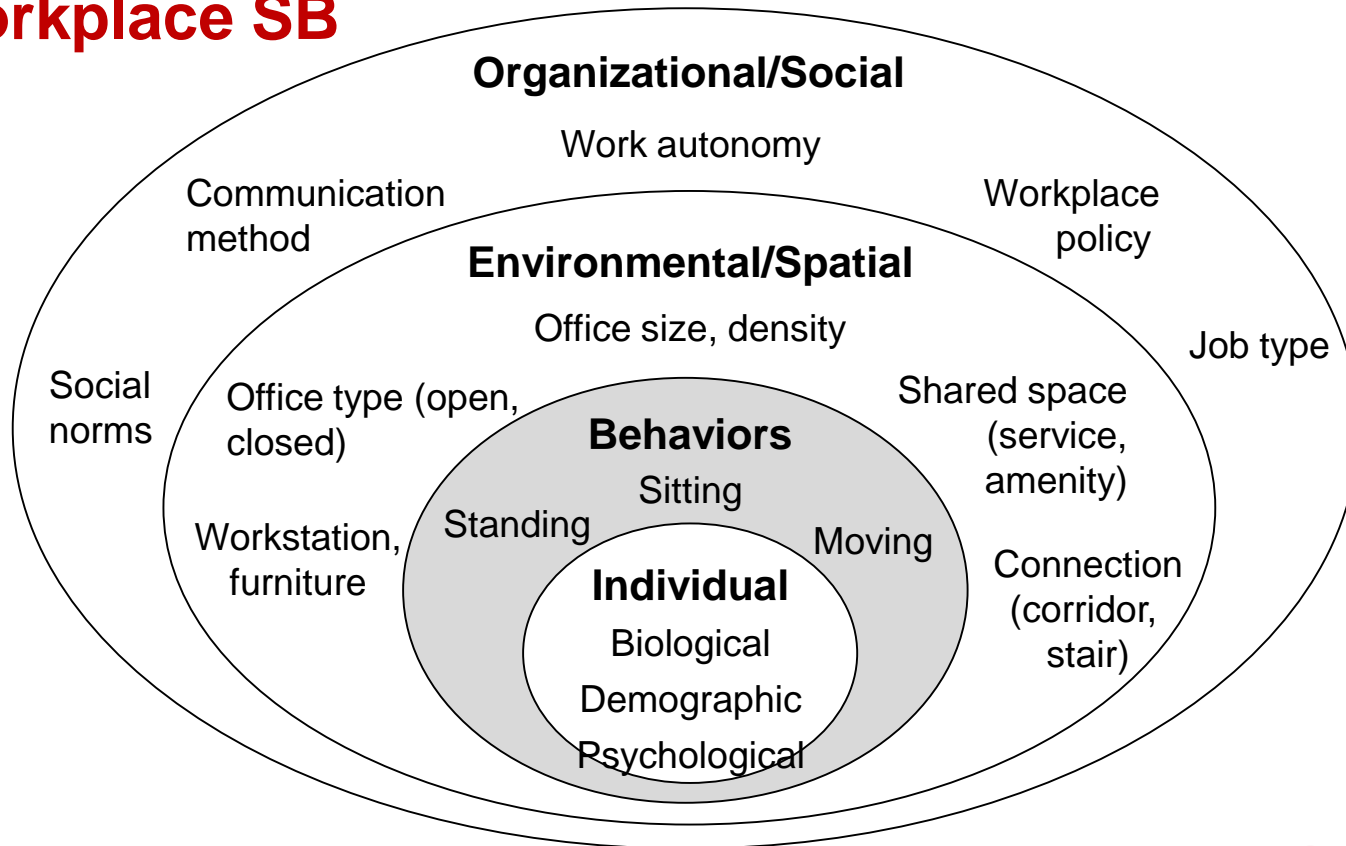
A National collaboration between the

- University of Queensland
- Baker Heart and Diabetes Institute
- University of Melbourne
- Deakin University
- Government and Non-Government
- Partner Organisations





# Multiple influences on workplace SB



Source: Sugiyama, T, Hadgraft, N, Healy GN, Owen, N, Dunstan, DW. (2018) Perceived availability of office shared spaces and workplace sitting: moderation by organizational norms and behavioral autonomy *Environ Behav*, (in press).

# Key workplace intervention messages

## **Stand Up**

 sitting  standing  stepping

- ✓ Reduce the length of sitting bouts, increase standing

## **Sit Less**

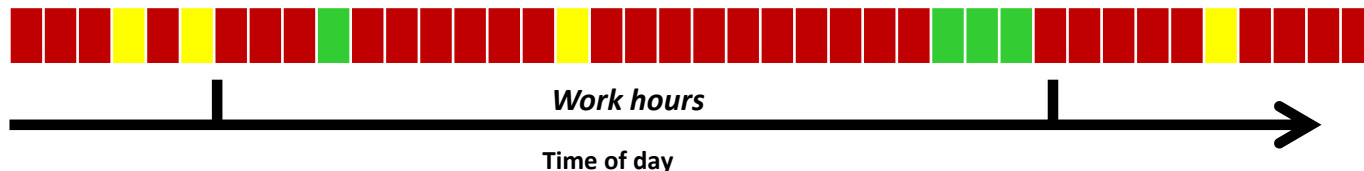
- ✓ Reduce total workplace sitting time & the number of sitting bouts

## **Move More**

- ✓ Increase moving time

*Make changes throughout the day (in and out of the workplace)*

Baseline



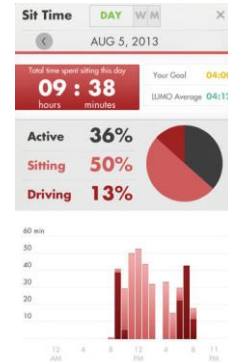
Source: Neuhaus M, Healy, GN et al. (2014) *Int J Behav Nutr Phys Act*: 11: 21



- Management consultation
- Team champion training
- Staff information session
- Management emails to staff



- Information session
- Written material
- Individual Coaching
- Support Phone Calls
- Self-monitoring tools



# Stand Up Australia Intervention Program



	Organisational	Individual	Physical environment	Supportive Technology	
Stand Up Comcare					
Stand Up Victoria					
Stand Up CPRC					
Stand Up UQ					
Stand Up Lend Lease					
Stand Up Bupa					
Stand Up Vancouver					
Stand Up DHS Tweed					
Stand Up Vodafone					

# Stand Up Victoria



- Cluster-RCT in one organisation
- Multi-component (org, environment, individual)
- Assessments @ baseline, 3-months, 12 months
  - activPAL & GT3X+, fasting blood, questionnaire
  - Cost-effectiveness analysis



Dunstan et al. BMC Public Health 2013, 13:1057  
<http://www.biomedcentral.com/1471-2458/13/1057>



## STUDY PROTOCOL

Open Access

### Reducing office workers' sitting time: rationale and study design for the *Stand Up Victoria* cluster randomized trial

David W Dunstan<sup>1,3,4,7\*</sup>, Glen Wiesner<sup>1</sup>, Elizabeth G Bakin<sup>1</sup>, Makie Neuhaus<sup>2</sup>, Neville Owen<sup>1</sup>, Anthony D LaMontagne<sup>2</sup>, Marj Moodie<sup>2</sup>, Elisabeth AH Winkler<sup>2</sup>, Brianna S Fjeldsoe<sup>2</sup>, Sheleigh Lawler<sup>2</sup> and Genevieve N Healy<sup>2,8\*</sup>

#### Abstract

**Background:** Excessive time spent in sedentary behaviour (sitting or lying with low energy expenditure) is associated with an increased risk for type 2 diabetes, cardiovascular disease and some cancers. Desk-based office workers typically accumulate high amounts of daily sitting time, often in prolonged unbroken bouts. The *Stand Up Victoria* study aims to determine whether a 3-month multi-component intervention in the office setting reduces workplace sitting, particularly prolonged, unbroken sitting time, and results in improvements in cardio-metabolic biomarkers and work-related outcomes, compared to usual practice.

**Methods/Design:** A two-arm cluster-randomized controlled trial (RCT), with workplaces as the unit of randomization, will be conducted in 16 workplaces located in Victoria, Australia. Work units from one organisation (Department of Human Services, Australian Government) will be allocated to either the multi-component intervention (organisational, environmental [height adjustable workstations], and individual behavioural [strategies] or to a usual practice control group. The recruitment target is 160 participants (office-based workers aged 18-65 years and working at least 0.6 full time equivalent per week). At each assessment (0 [baseline], 3 [post intervention], and 12 months [follow-up]), objective measurement via the activPAL3 activity monitor will be used to assess workplace sitting time (primary outcome); prolonged sitting time (sitting time accrued in bouts of ≥30 minutes); standing time; sit-to-stand transitions; and, moving time. Additional outcomes assessed will include: non-workplace activity; cardio-metabolic biomarkers and health indicators (including fasting glucose, lipids and insulin; anthropometric measures (blood pressure; and, musculoskeletal symptoms); and, work-related outcomes (presenteeism, absenteeism, productivity, work performance). Incremental cost-effectiveness and identification of both workplace and individual-level mediators and moderators of change will also be evaluated.

**Discussion:** *Stand Up Victoria* will be the first cluster-RCT to evaluate the effectiveness of a multi-component intervention aimed at reducing prolonged workplace sitting in office workers. Strengths include the objective measurement of activity and assessment of the intervention on markers of cardio-metabolic health, health- and work-related benefits, as well as the cost-effectiveness of the intervention, will help to inform future occupational practice.

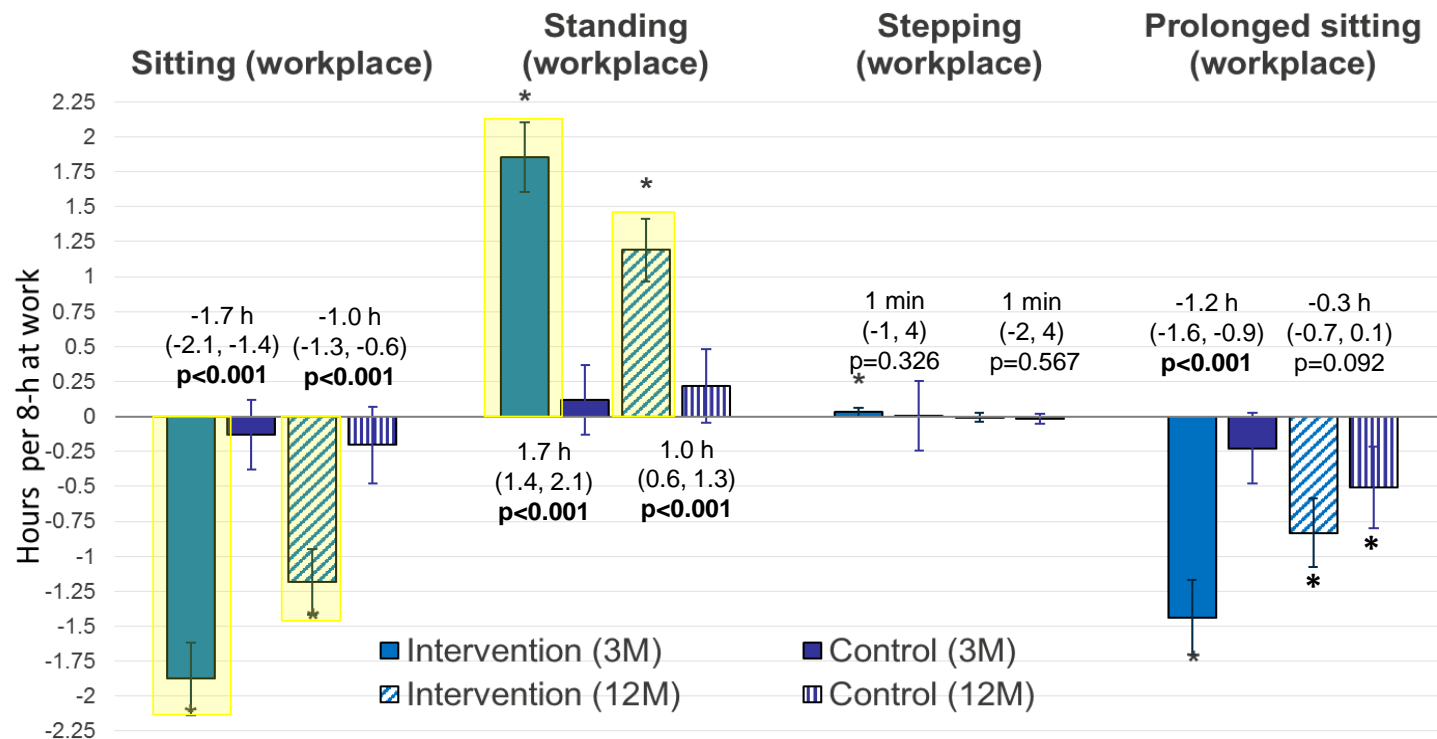
**Trial registration:** ACTRN121100742996

**Keywords:** Sedentary behaviour, Workplace, Randomized intervention, Office workers, Cardio-metabolic biomarkers, Activity permission device, Accelerometry, Physical activity

CIs: David Dunstan, Genevieve Healy, Neville Owen, Elizabeth Eakin, Anthony LaMontagne, Marj Moodie

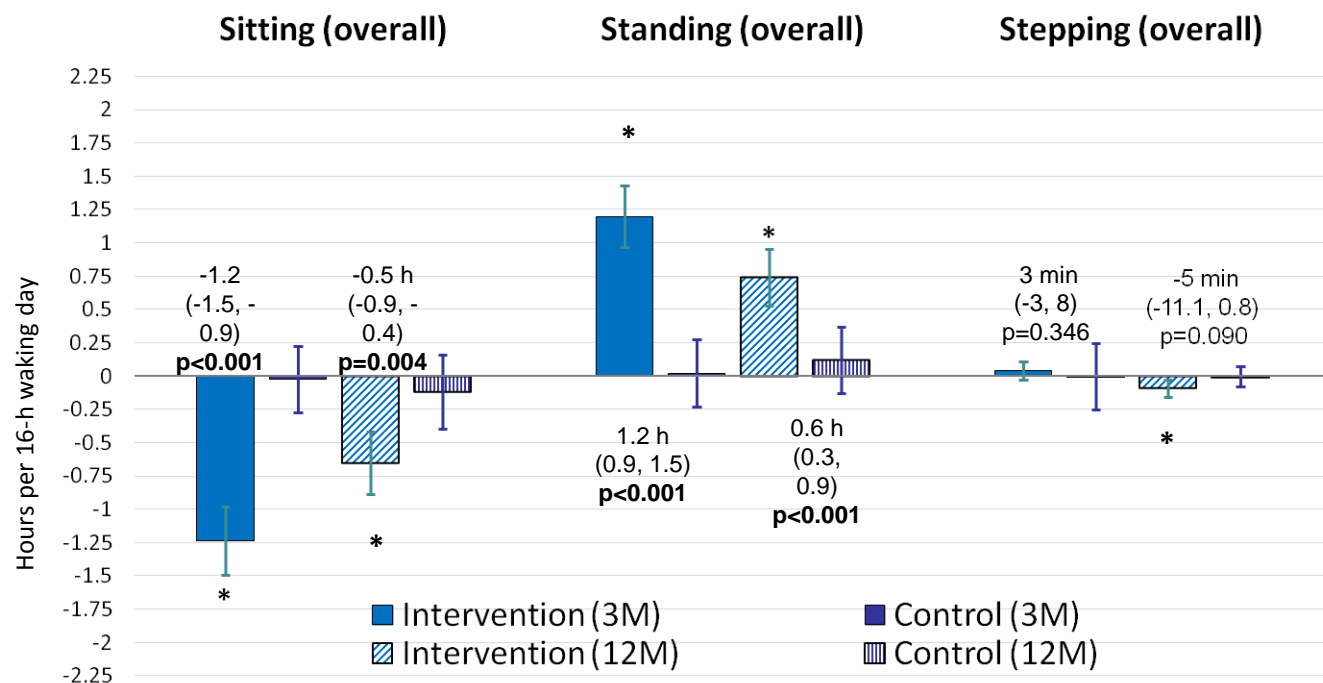


# Large reductions in workplace sitting can be achieved



Healy et al. 2016, MSSE

# Achieved change across the day (work and non-work)



# Other key findings from Stand Up Victoria

- Positive long term lx impact on fasting glucose and clustered cardio-metabolic risk
- Greatest benefits for long-term changes and with increasing ambulation
- Acceptable and feasible
- Effects on sitting time were weaker in those with pre-existing back pain

Sources: Healy et al., MSSE 2017; Winkler et al., MSSE 2017; Hadgraft et al., IJBNPA 2017; Coenen et al., Int Arch Occup Environ Health 2017

## EPIDEMIOLOGY

### A Cluster RCT to Reduce Workers' Sitting Time: Impact on Cardiometabolic Biomarkers

GENEVIEVE N. HEALY<sup>1,2,3</sup>, ELISABETH A. H. WINKLER<sup>1</sup>, ELIZABETH G. EAKIN<sup>1</sup>, NEVILLE OWEN<sup>1,2,4,5,6</sup>, ANTHONY D. LAMONTAGNE<sup>7</sup>, MARJ MOODIE<sup>7</sup>, and DAVID W. DUNSTAN<sup>1,2,5,6,8</sup>

Hadgraft et al. *International Journal of Behavioral Nutrition and Physical Activity* (2017) 14:73  
DOI 10.1186/s12966-017-0530-y

International Journal of Behavioral  
Nutrition and Physical Activity

## RESEARCH

## Open Access

### Reducing occupational sitting: Workers' perspectives on participation in a multi-component intervention



Nyssa T. Hadgraft<sup>1,2\*</sup>, Lisa Willenberg<sup>3</sup>, Anthony D. LaMontagne<sup>4</sup>, Keti Malkoski<sup>5</sup>, David W. Dunstan<sup>1,2,6,7,8,9</sup>, Genevieve N. Healy<sup>10,11</sup>, Marj Moodie<sup>4</sup>, Elizabeth G. Eakin<sup>10</sup>, Neville Owen<sup>1,9,10,12,13</sup> and Sheleigh P. Lawler<sup>10</sup>

Int Arch Occup Environ Health (2017) 90:609–618  
DOI 10.1007/s00420-017-1223-1



## ORIGINAL ARTICLE

### Pre-existing low-back symptoms impact adversely on sitting time reduction in office workers

Pieter Coenen<sup>1,2</sup> · Genevieve N. Healy<sup>1,3,4</sup> · Elisabeth A. H. Winkler<sup>3</sup> · David W. Dunstan<sup>1,4,5,6,7,8,9</sup> · Neville Owen<sup>1,4,12</sup> · Marj Moodie<sup>10</sup> · Anthony D. LaMontagne<sup>11,12</sup> · Elizabeth A. Eakin<sup>3</sup> · Leon M. Straker<sup>1</sup>

# Key findings across Stand Up Australia

The interventions are...

- ✓ Acceptable to employees & organisations

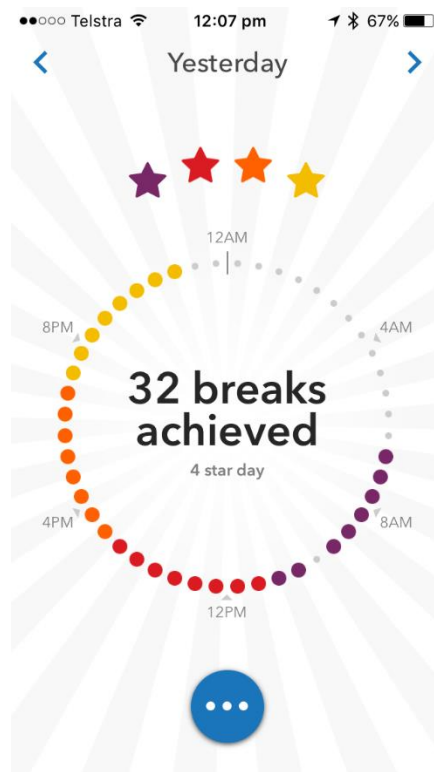
Result in...

- ✓ Reductions in prolonged sitting
- ✓ Benefits to indicators of heart health
- ✓ No detrimental impact on productivity

**Physical environment** key for sustainable change, but needs to be underpinned by **relevant policies**, **raising awareness**, & building a **supportive culture**

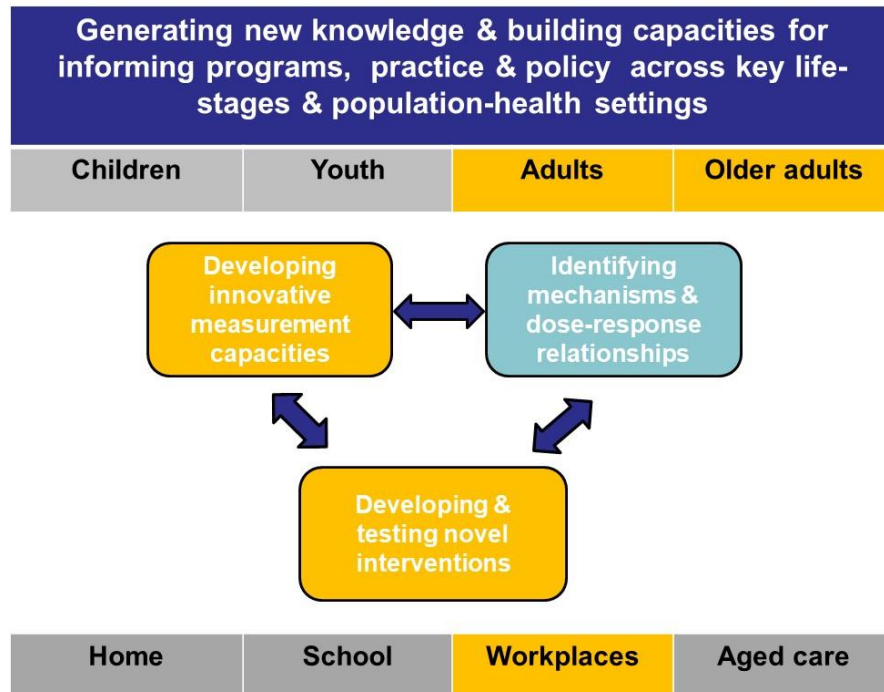


# Development of supportive technology



[www.riserecharge.com](http://www.riserecharge.com)

# Evidence integration



## Sedentary Behaviour Interventions

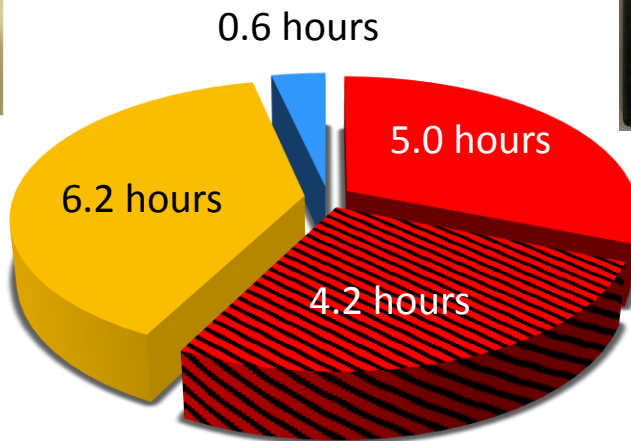
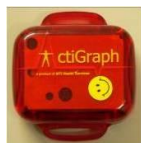
**WHAT** to change?

**WHICH** outcome?





**HOW** to change across multiple settings?

**WHO** to target?

# WHAT is it that we want to change?



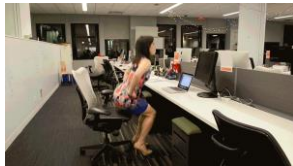
activPAL3 and Actigraph data from 739 Australian adults aged 35+ years from the AusDiab3 study

-  Moderate-vigorous intensity activity
-  Light intensity activity
-  Sitting in <30 min bouts
-  Prolonged sitting in ≥30 min bouts

# WHAT behaviours could replace prolonged sitting?

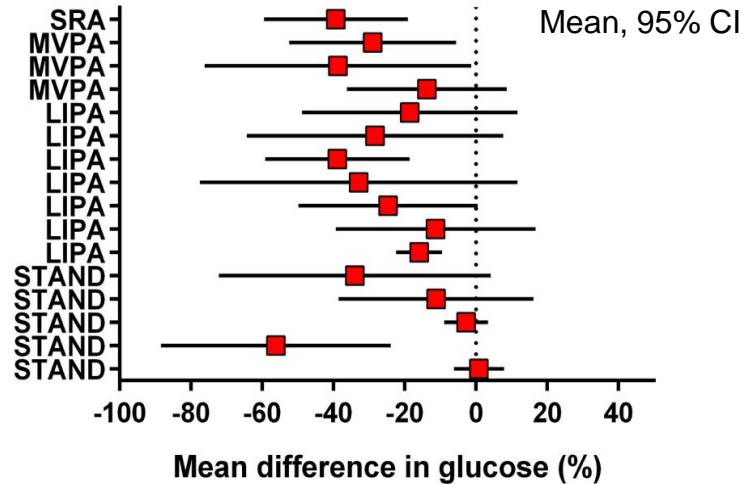


**Prolonged sitting  
counter-measures**



**% Change in postprandial glucose (vs prolonged sitting)**

**Type of break vs Sitting**



SRA – Simple Resistance Activities

MVPA – Moderate-intensity walking

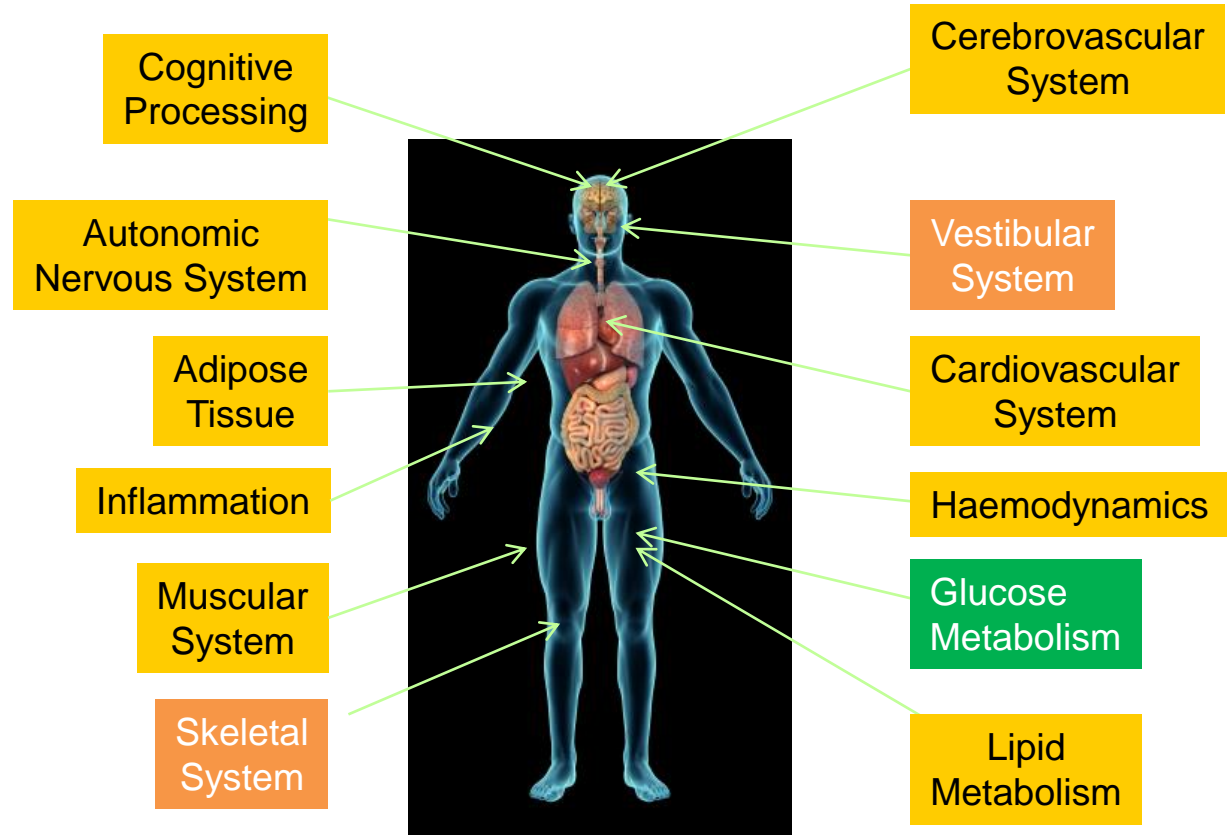
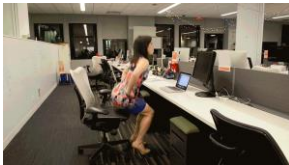
LIPA – Light-intensity walking

STAND – Standing

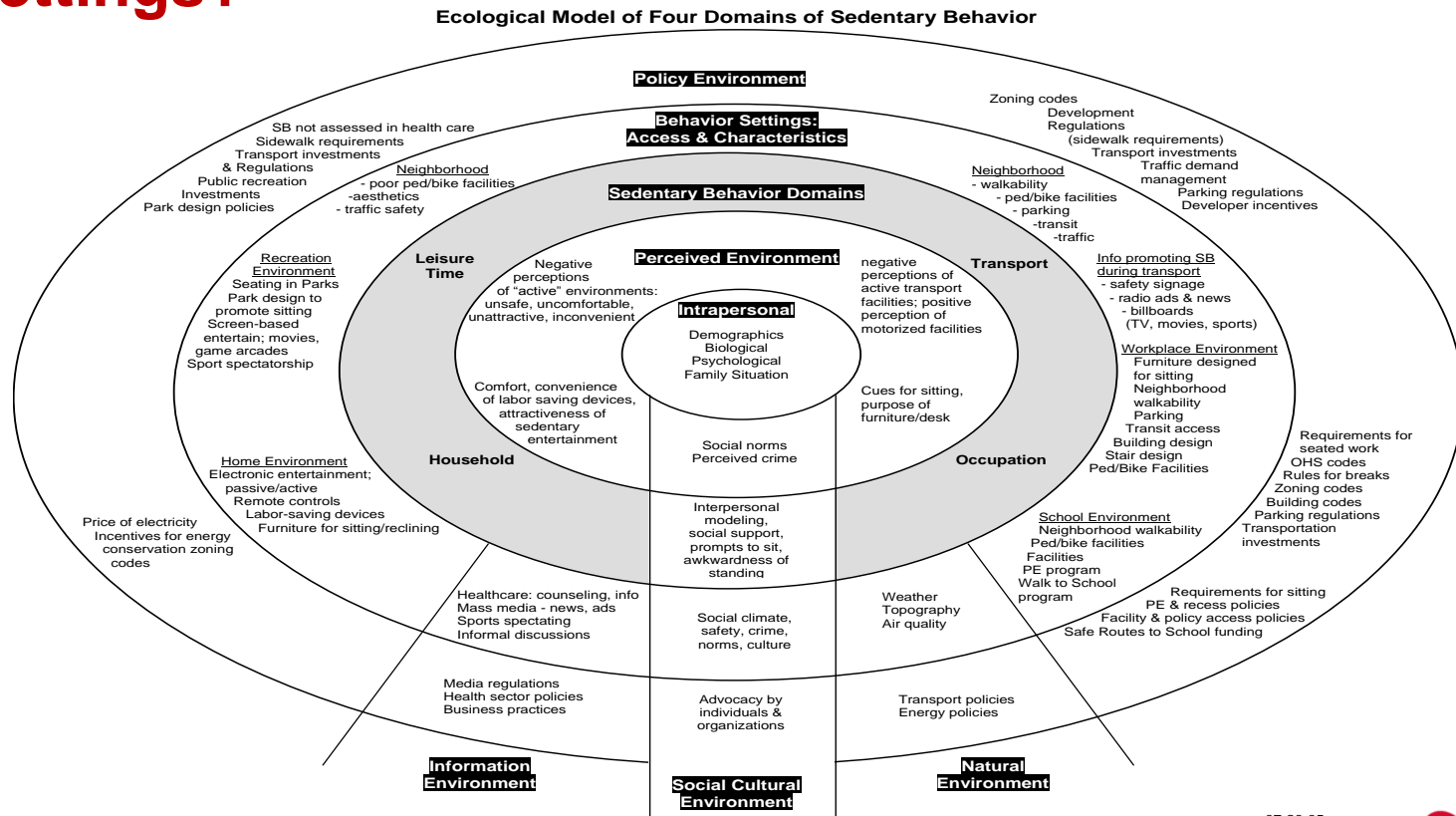
# WHICH outcome?



**Prolonged sitting  
counter-measures**



# HOW to change prolonged sitting across multiple settings?

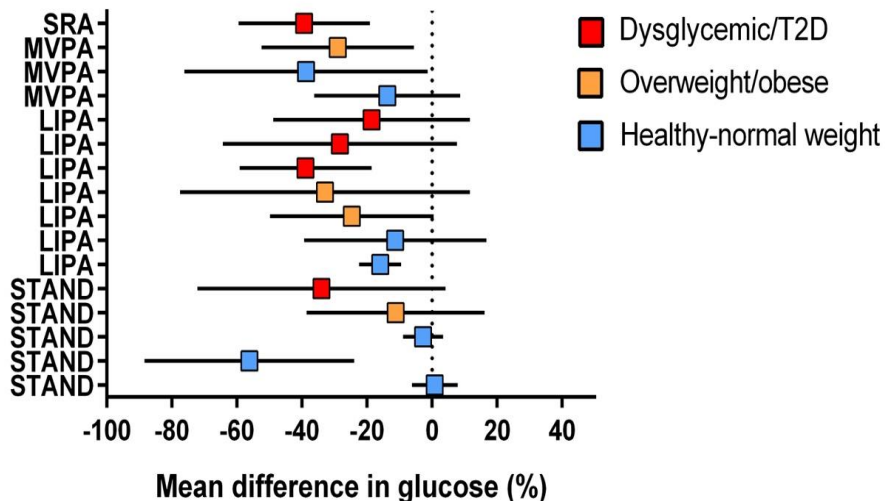


07-20-05

Source: Owen, N, Sugiyama, T, Eakin, EG, Gardiner, PA, Tremblay, MS and Sallis JF. (2011) Adults' sedentary behavior: Determinants and interventions *Am J Prev Med*, 41, 189-196.

# High risk groups WHO could be targeted?

Type of break vs Sitting



SRA – Simple Resistance Activities

MVPA – Moderate-intensity walking

LIPA – Light-intensity walking

STAND – Standing

## Prolonged uninterrupted sitting elevates postprandial hyperglycaemia proportional to degree of insulin resistance

Paddy C. Dempsey PhD<sup>1,2</sup> | Robyn N. Larsen PhD<sup>1</sup> | Elisabeth A. H. Winkler PhD<sup>3</sup> | Neville Owen PhD<sup>1,2,3,4,5</sup> | Bronwyn A. Kingwell PhD<sup>1,4</sup> | David W. Dunstan PhD<sup>1,3,4,6,7,8</sup>

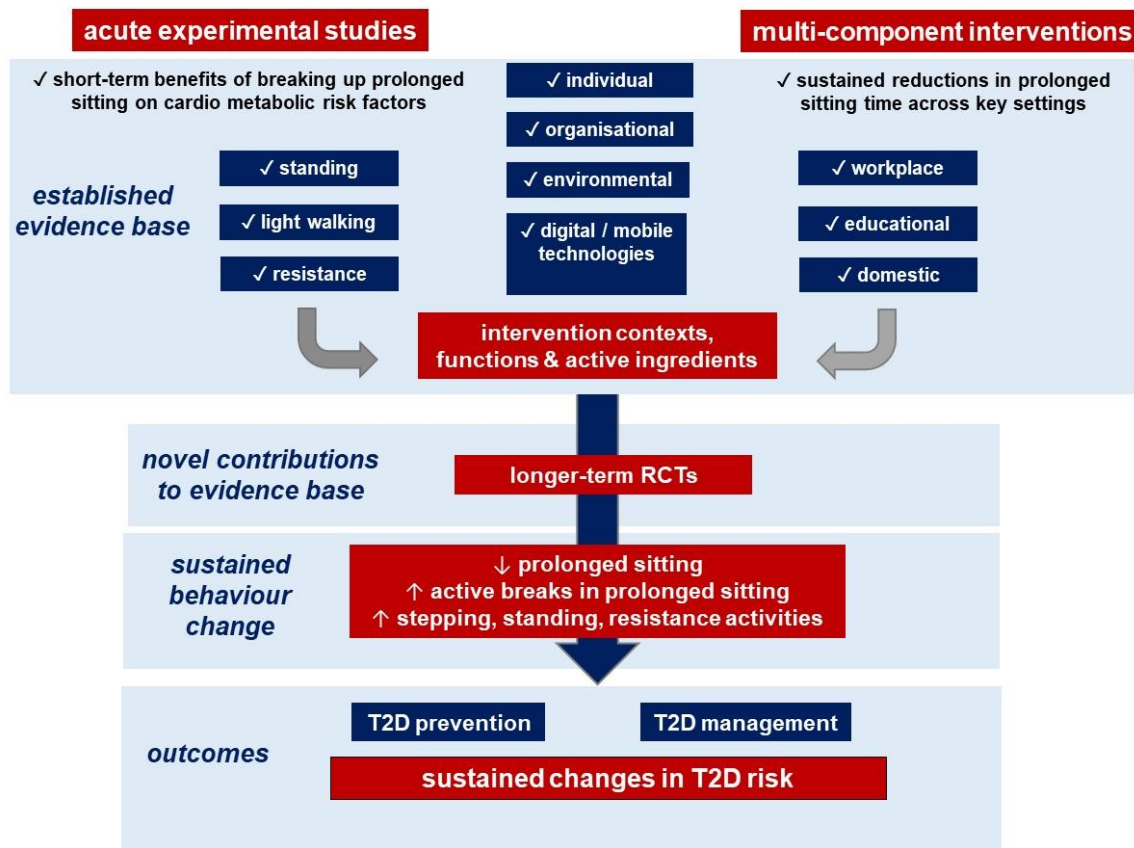
Prolonged uninterrupted sitting is related adversely to cardiometabolic risk markers and postprandial hyperglycaemia, relative to sitting interrupted by regular brief activity breaks. However, whether the magnitude of hyperglycaemic responses to prolonged sitting is dependent upon the underlying degree of insulin resistance remains unclear. Data were pooled from 3 randomized cross-over laboratory-based trials ( $n = 62$ ) that examined the postprandial blood glucose- and insulin-lowering effects of prolonged sitting vs sitting interrupted by regular brief activity breaks in overweight/obese adults who had normal or impaired glucose metabolism (2 trials) or type 2 diabetes not treated by insulin (1 trial). **Corrected for study effects, the magnitude of differences in postprandial glucose and insulin responses between the 2 conditions was significantly exacerbated with poorer baseline levels of fasting glucose, insulin and/or surrogate markers of  $\beta$ -cell function and insulin resistance. This suggests that those with higher underlying levels of insulin resistance may derive greater metabolic benefits from regularly interrupting prolonged sitting than their healthier counterparts.** If these findings can be replicated, they may have implications for future targeting and optimization of physical activity/sedentary behaviour interventions in the prevention and management of type 2 diabetes.

Source: Dempsey PC *et al.* (2018) *Diab Obes Metab* 20: 1526-1530





# Type 2 diabetes prevention and management



# Key points



**Application across high-risk (clinical population) groups?**



**Can we successfully intervene within other behavior settings?**



**How can we achieve sustained behavior change for optimal benefits?**  
**- ? role of supportive technology**

# Key points



**Application across high-risk (clinical population) groups?**



**Can we successfully intervene within other behavior settings?**



**How can we achieve sustained behavior change for optimal benefits?**

**- ? role of supportive technology**