

Physical Activity and Heart Health: Should a 'whole of day' approach be the focus in today's sitting-centric society?

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Regular exercise is good for us – in many ways

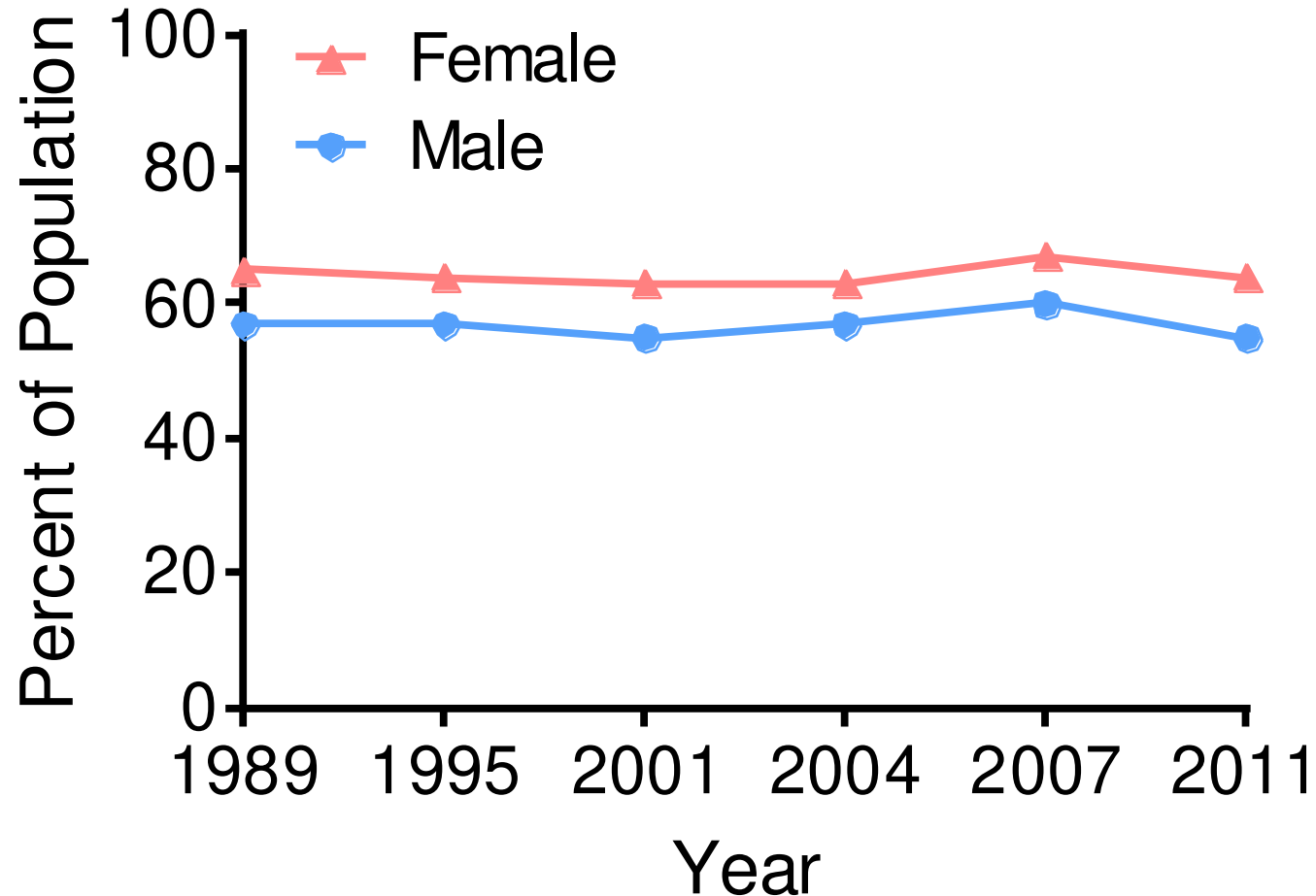


- ✓ Improved cardiorespiratory and muscular fitness
- ✓ Lower risk of type 2 diabetes
- ✓ Lower risk of metabolic syndrome
- ✓ Lower risk of early death

≥ 150 min/week moderate/vigorous PA = **ACTIVE**

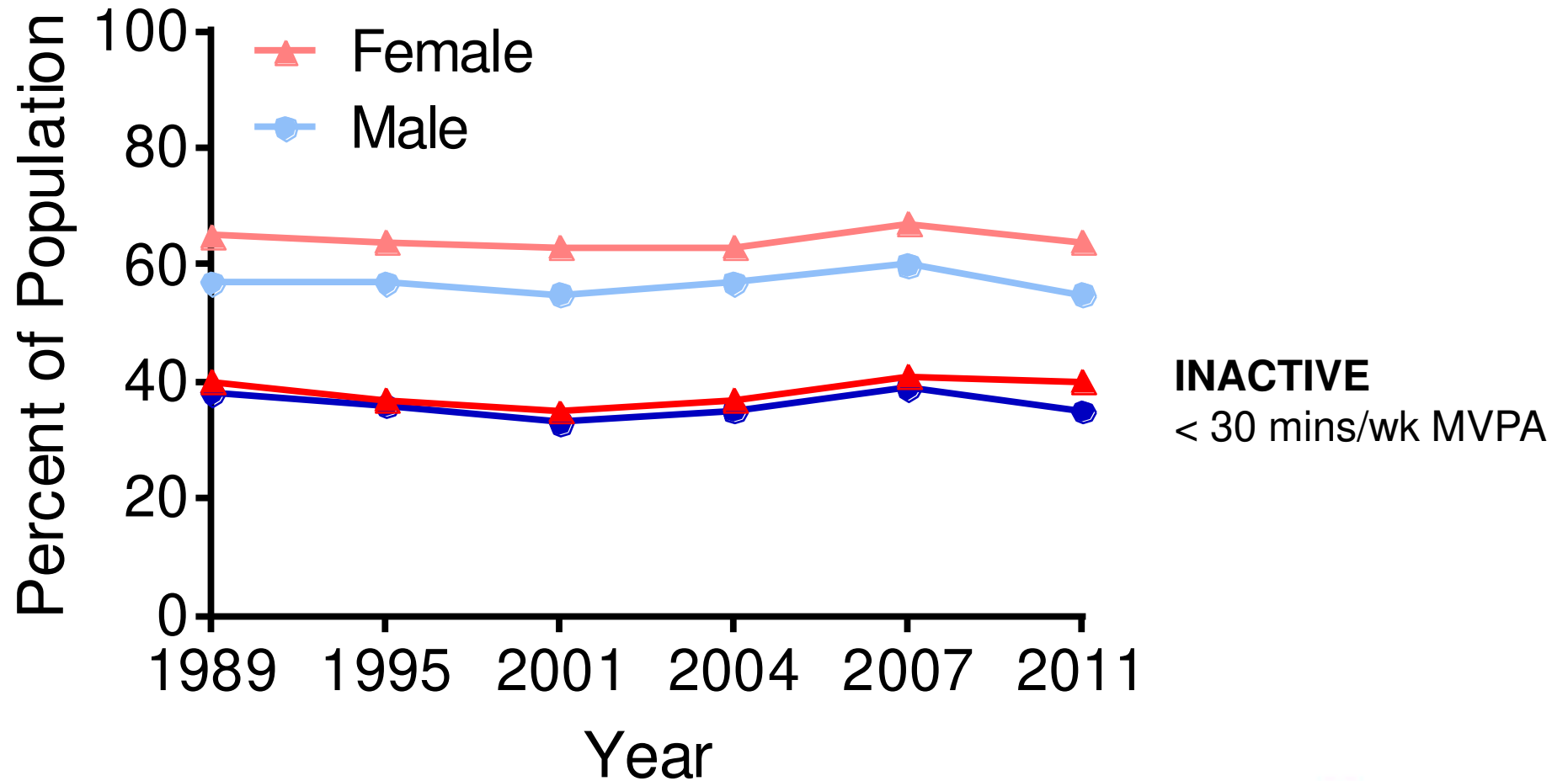
< 150 min/week moderate/vigorous PA = **INSUFFICIENTLY ACTIVE**

BUT.... population participation levels are low and have been unchanged in 22 yrs!



Insufficiently Active
< 150 mins/wk MVPA

WORSE STILL.... ~2/5^{ths} of Australian adults are INACTIVE



Source: Chau et al. Aust NZ J Public Health 2017 12699

Chronic Disease: Australia's Biggest Health Challenge

- * Arthritis
- * Asthma
- * Back pain and problems
- * Cancer
- * Cardiovascular disease (CVD)
- * Chronic obstructive pulmonary disease
- * Diabetes
- * Mental health conditions

Source: AIHW: Australia's Health 2016 Fact Sheet

Quick facts

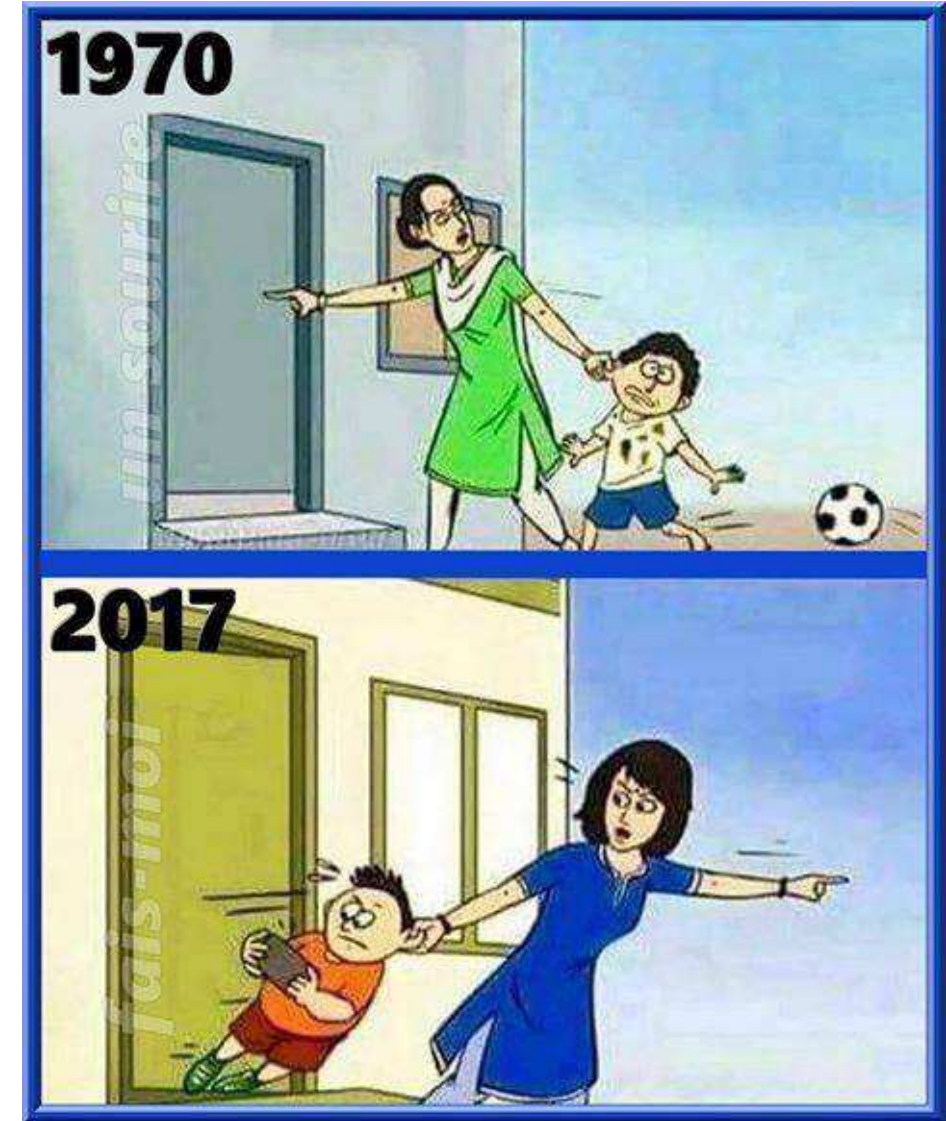
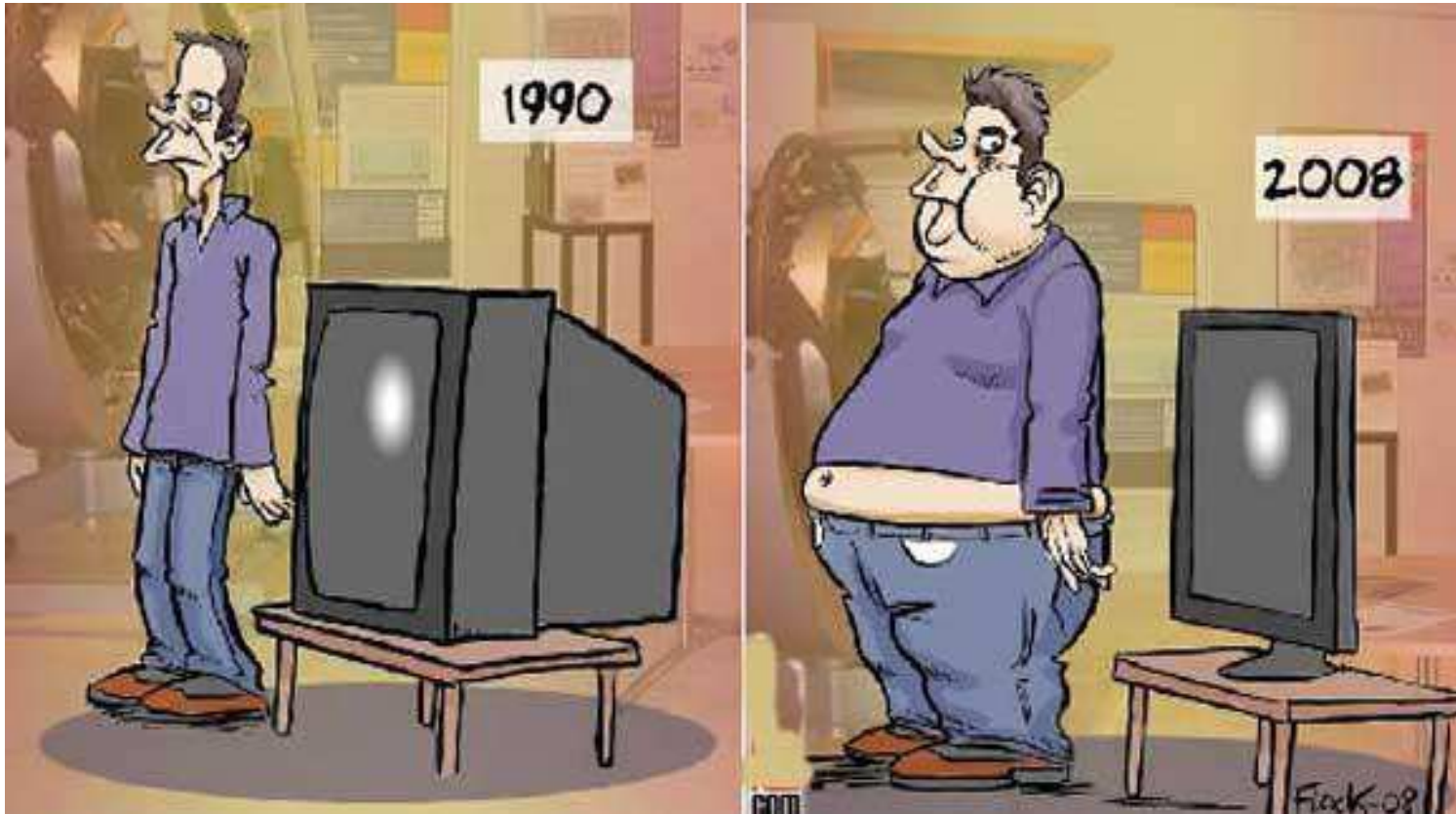
In 2014–15, more than **11 million** Australians had at least one of eight selected chronic diseases.

Chronic diseases are associated with:

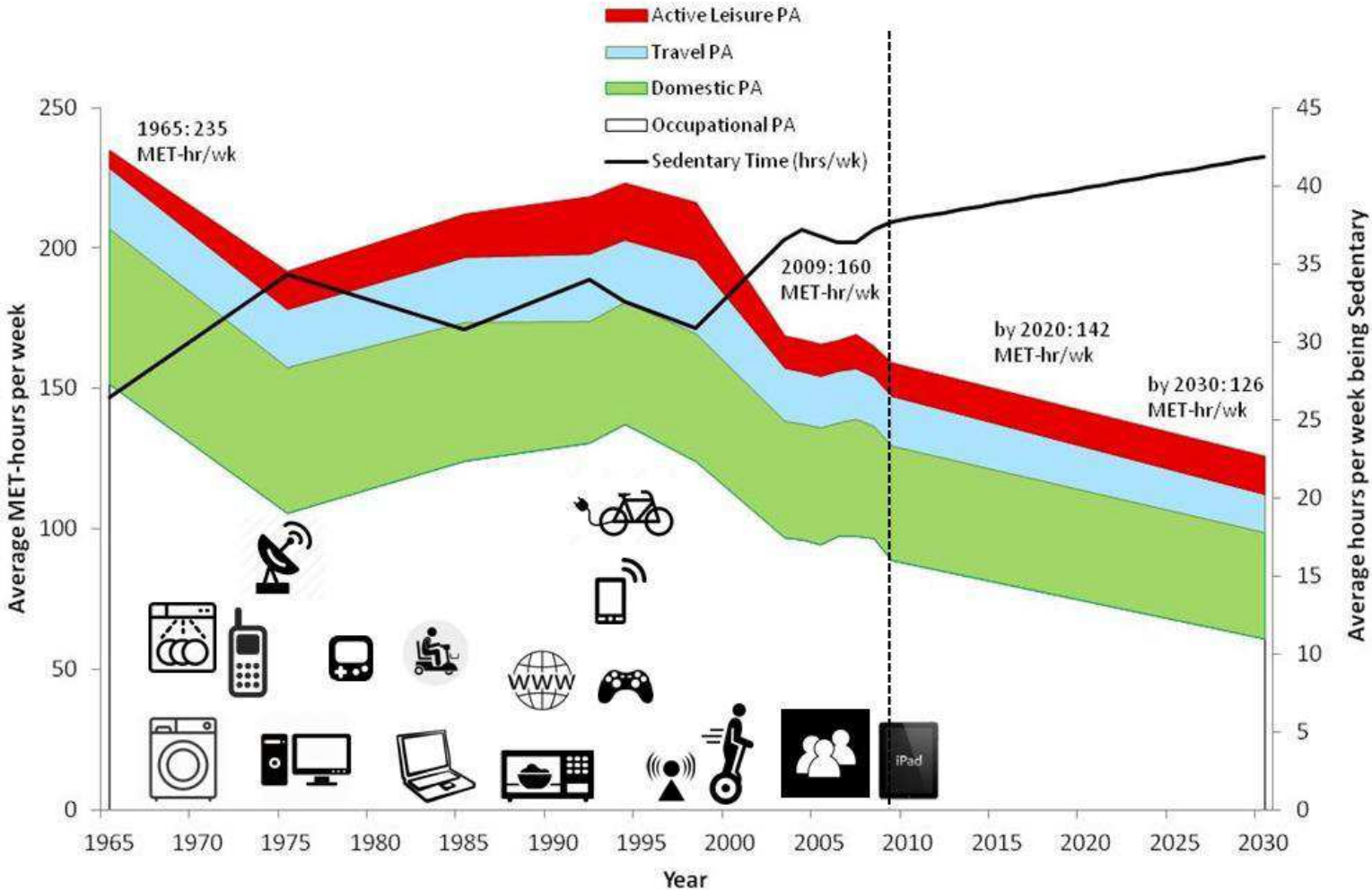
- more than **7 in 10** deaths
- around **1 in 3** problems managed in general practice
- more than **1 in 3** potentially preventable hospitalisations.

Almost **1 in 3** (29%) people aged 65 and over report having three or more chronic diseases, compared with 2.4% of people aged under 45.

Our Changing World



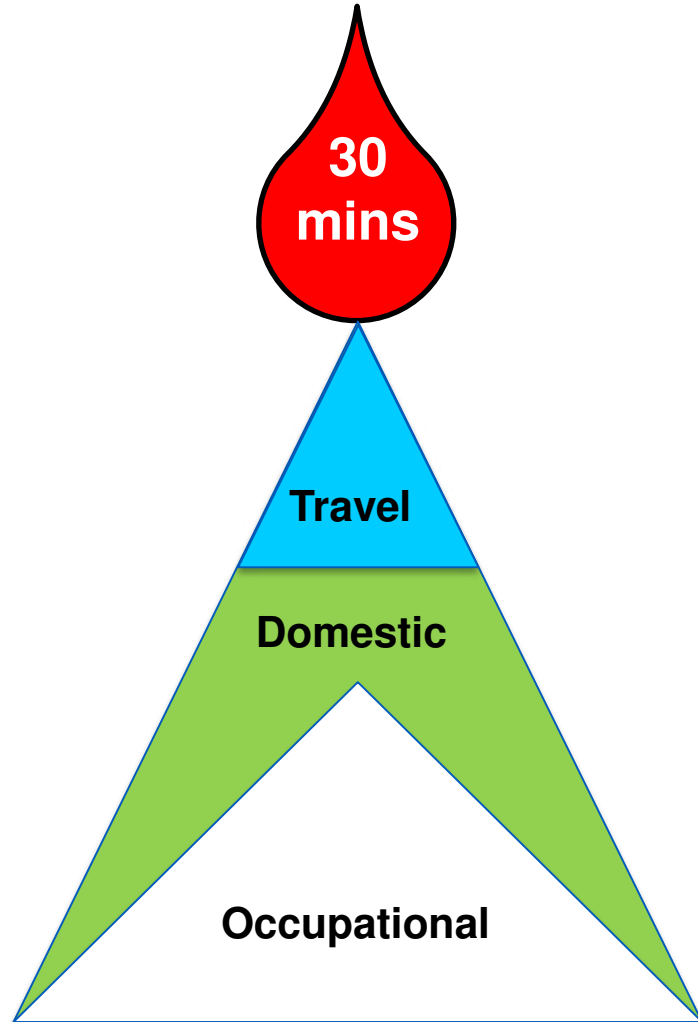
Overall physical activity levels are rapidly declining



Source: Ng & Popkin (2012) *Obesity Rev*: 13: 659-680

Is the 30 minutes/moderate-to-vigorous intensity recommendation sufficient, given the diminishing background of activity?

1989



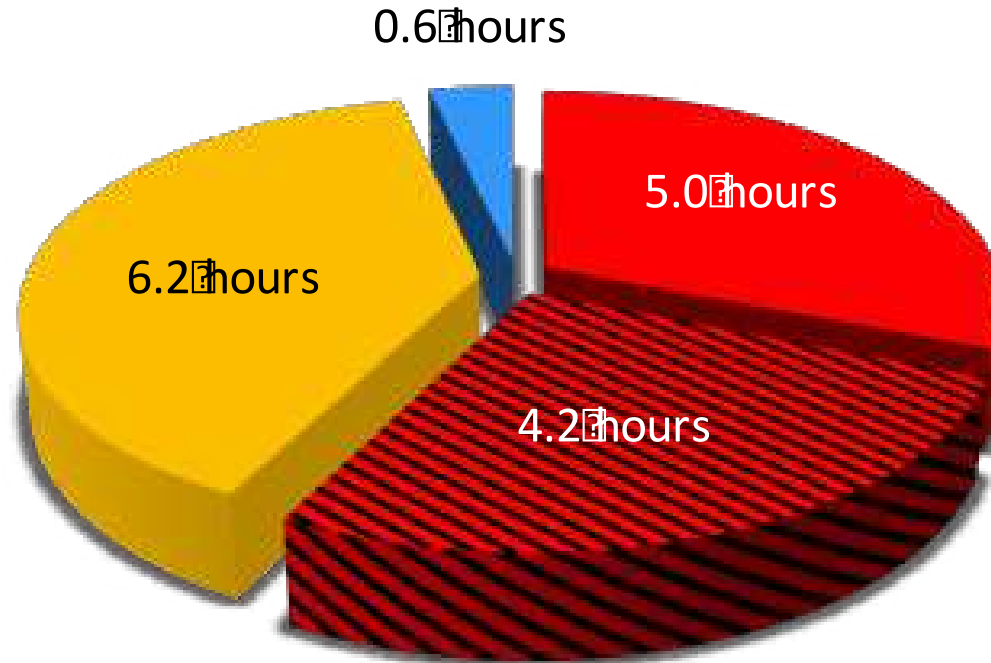
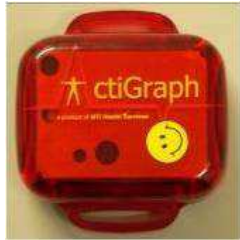
2017





A poster for the "NATIONAL PHYSICAL ACTIVITY GUIDELINES FOR AUSTRALIANS". The poster features a large red teardrop shape with "30 mins" written inside, overlaid on a blue triangle. To the right of the teardrop is a list of four numbered points:

1. think of movement as an opportunity, not an inconvenience.
2. be active every day in as many ways as you can.
3. put together at least 30 minutes of moderate-intensity physical activity on most, preferably all, days.
4. if you can, also enjoy some regular, vigorous exercise for extra health and fitness.

The poster also includes images of people walking, pushing a stroller, and a person on a bicycle. The Australian Government logo is visible in the bottom left corner, and the Department of Health and Aged Care logo is in the bottom right corner.

Sitting is now the predominant waking behaviour (AusDiab)



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

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

Source: Healy *et al.* 2015 *Eur Heart J* 36 (39) 2643-9

HIGH SITTING IS ASSOCIATED WITH INCREASED CVD RISK



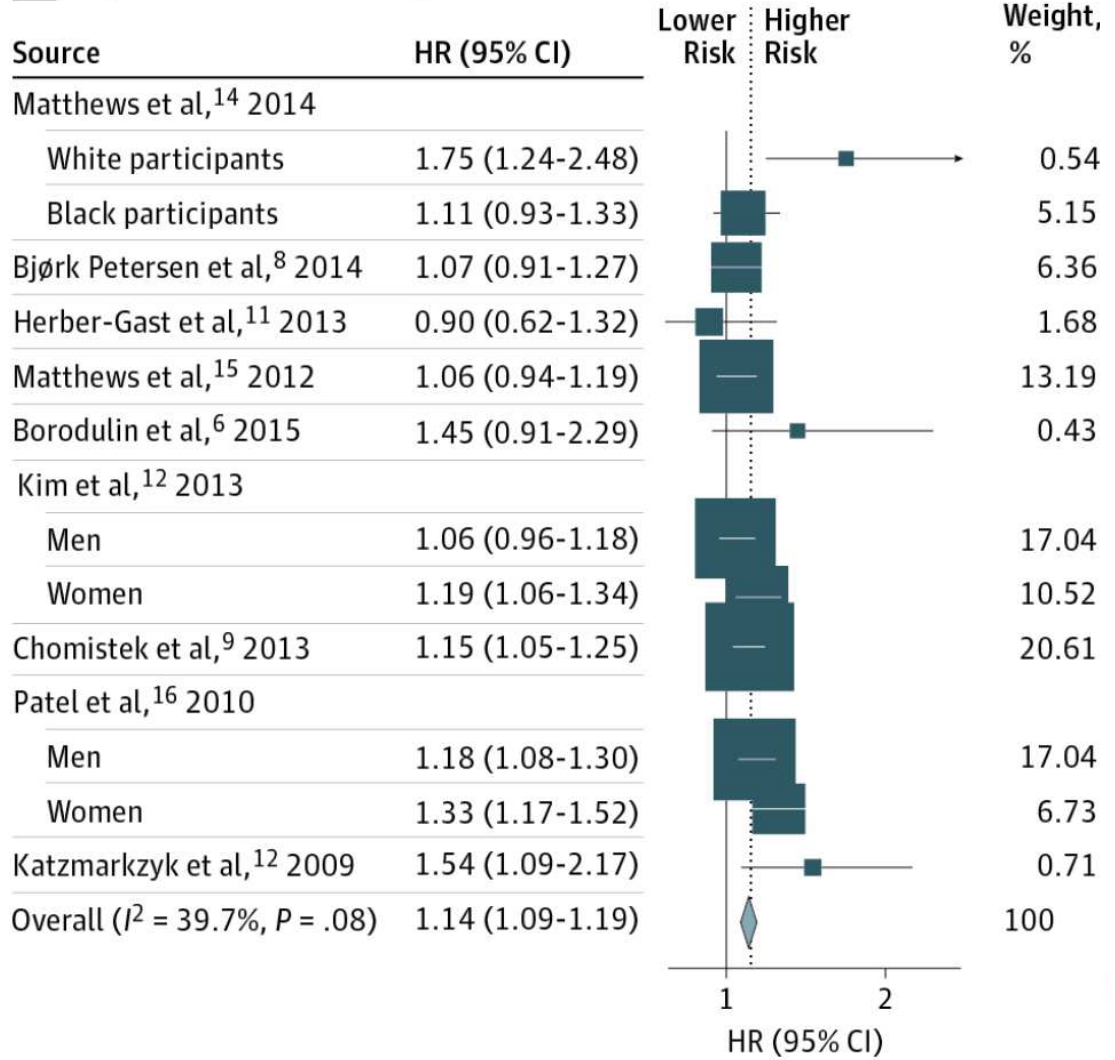
HIGH sitters
Sitting: 12.5 h/day

V'S



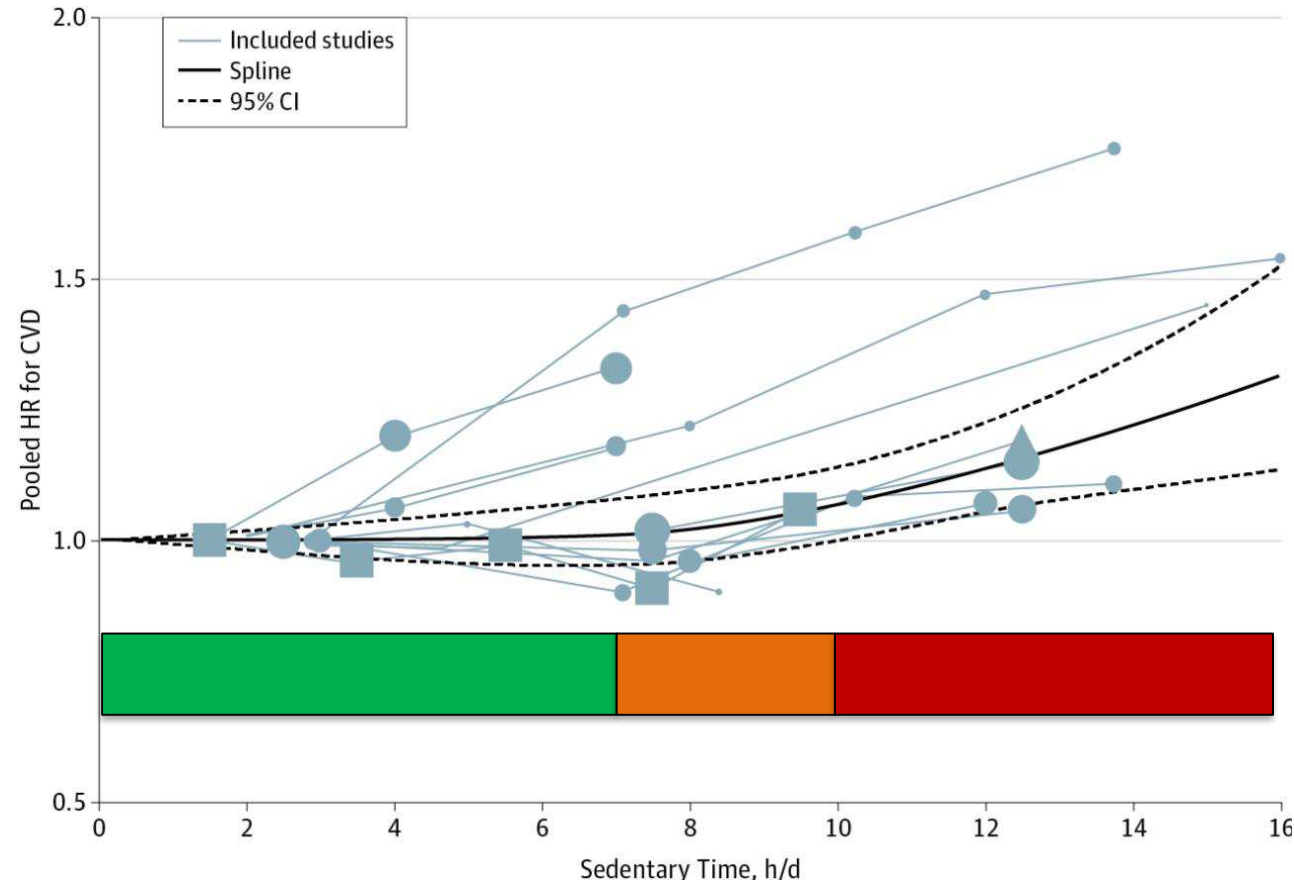
LOW sitters
Sitting: 2.5 h/day

A Highest vs lowest sedentary duration



Source:
Pandey A et al. JAMA Cardiology 2016; 1(5) 575-583

> 10 hrs/d = DANGER ZONE for CVD Risk



Source:
Pandey A *et al.* *JAMA Cardiology*
2016; 1(5) 575-583

Dose-Response Association Between Sedentary Time Duration and Risk for Cardiovascular Disease (CVD).

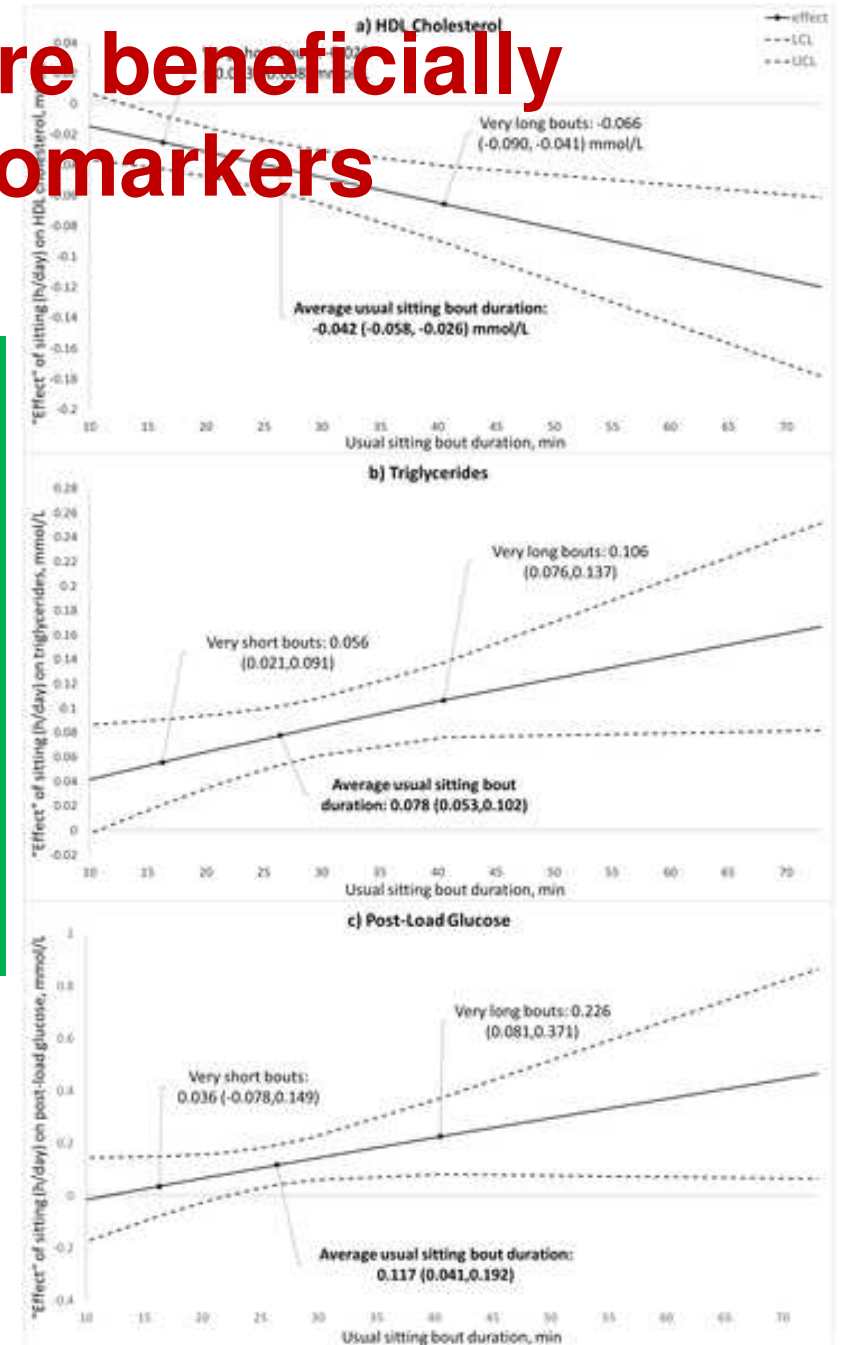
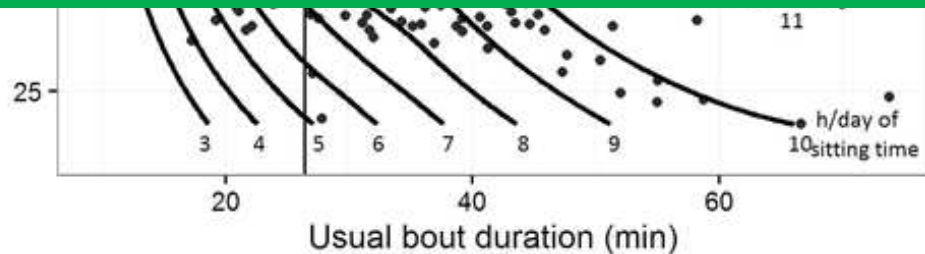
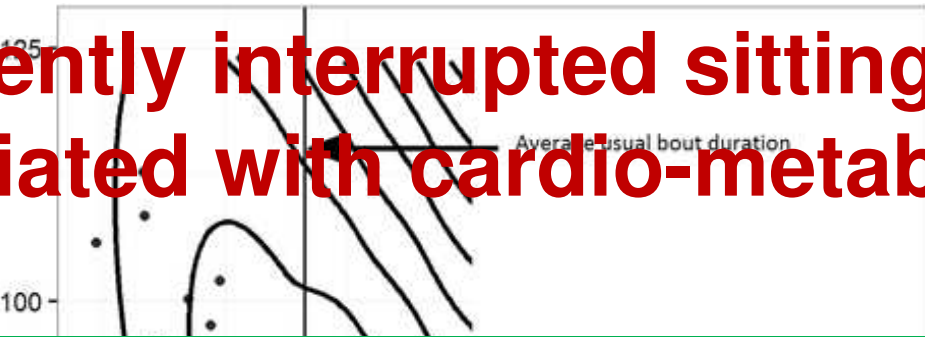
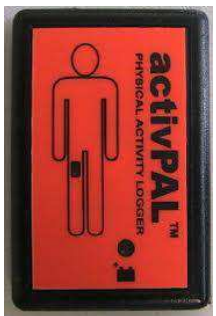
Dose-response associations are reported in the included studies and observed on pooled analysis. The pooled analysis estimates are shown by spline (smoothed fit) and 95% CIs of the pooled hazard ratio (HR) for adverse cardiovascular events by duration of sedentary time. The size of each data marker indicates study size.

Frequently interrupted sitting patterns are beneficially associated with cardio-metabolic risk biomarkers

Interrupted Patterns Vs Prolonged Sitting Patterns

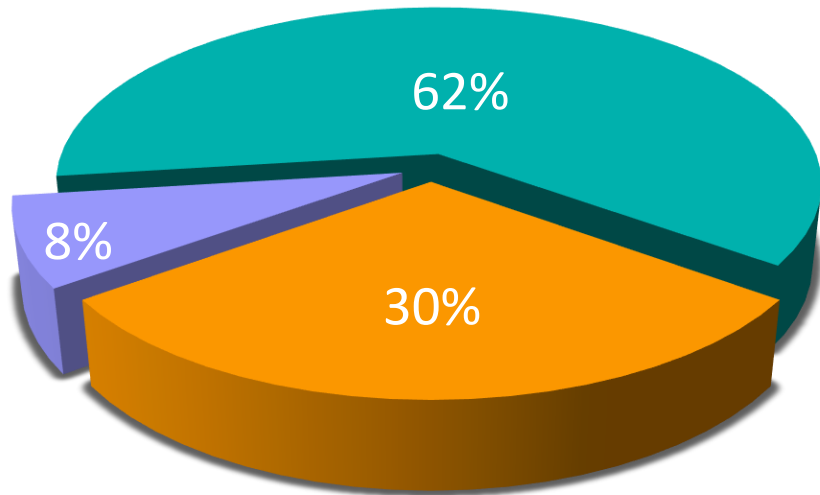
Beneficial associations for:

- ✓ BMI
- ✓ Waist circumference
- ✓ Triglycerides
- ✓ Fasting glucose
- ✓ 2hr post-load glucose






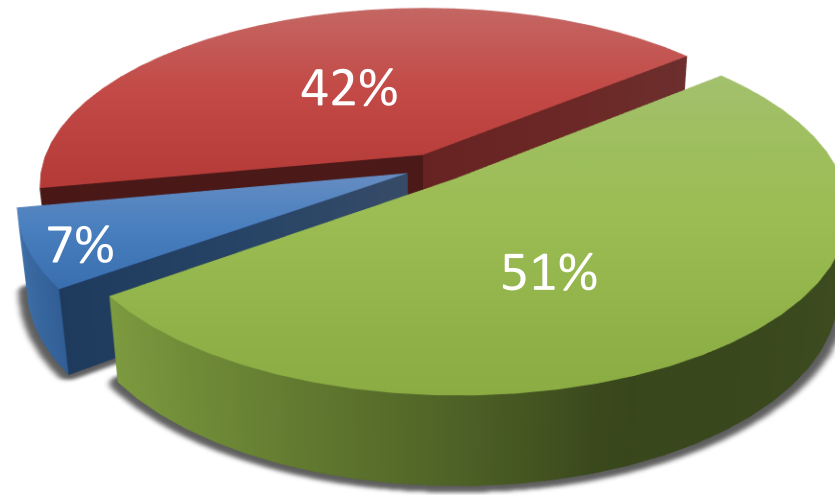
Bellettiere J, Winkler EAH, Chastin SFM, Kerr J, Owen N, et al. (2017) Associations of sitting accumulation patterns with cardio-metabolic risk biomarkers in Australian adults. PLOS ONE 12(6): e0180119

Total Sitting Time & Prolonged Sitting






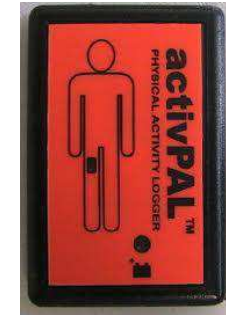
Proportion of population total sitting for:

-  <7 h/d
-  7-10 h/d
-  >10 h/d



Proportion of population accumulating prolonged sitting in ≥ 30 min bouts totalling:

-  <2 h/d
-  2-4 h/d
-  >4 h/d



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

DEFINING ATTRIBUTES OF SITTING

POSTURE (GRAVITY)

↓ ENERGY EXPENDITURE

↓ BLOOD FLOW

↓ MUSCLE ACTIVITY

↑ CLOTTING FACTORS

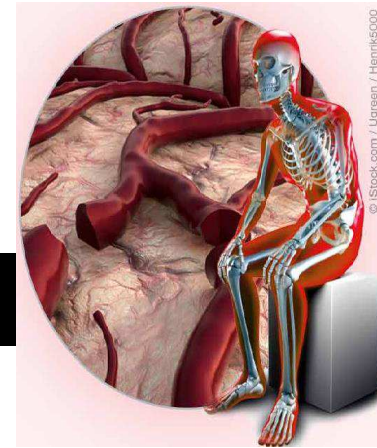
↓ ENDOTHELIAL FUNCTION

↓ GLUCOSE UPTAKE

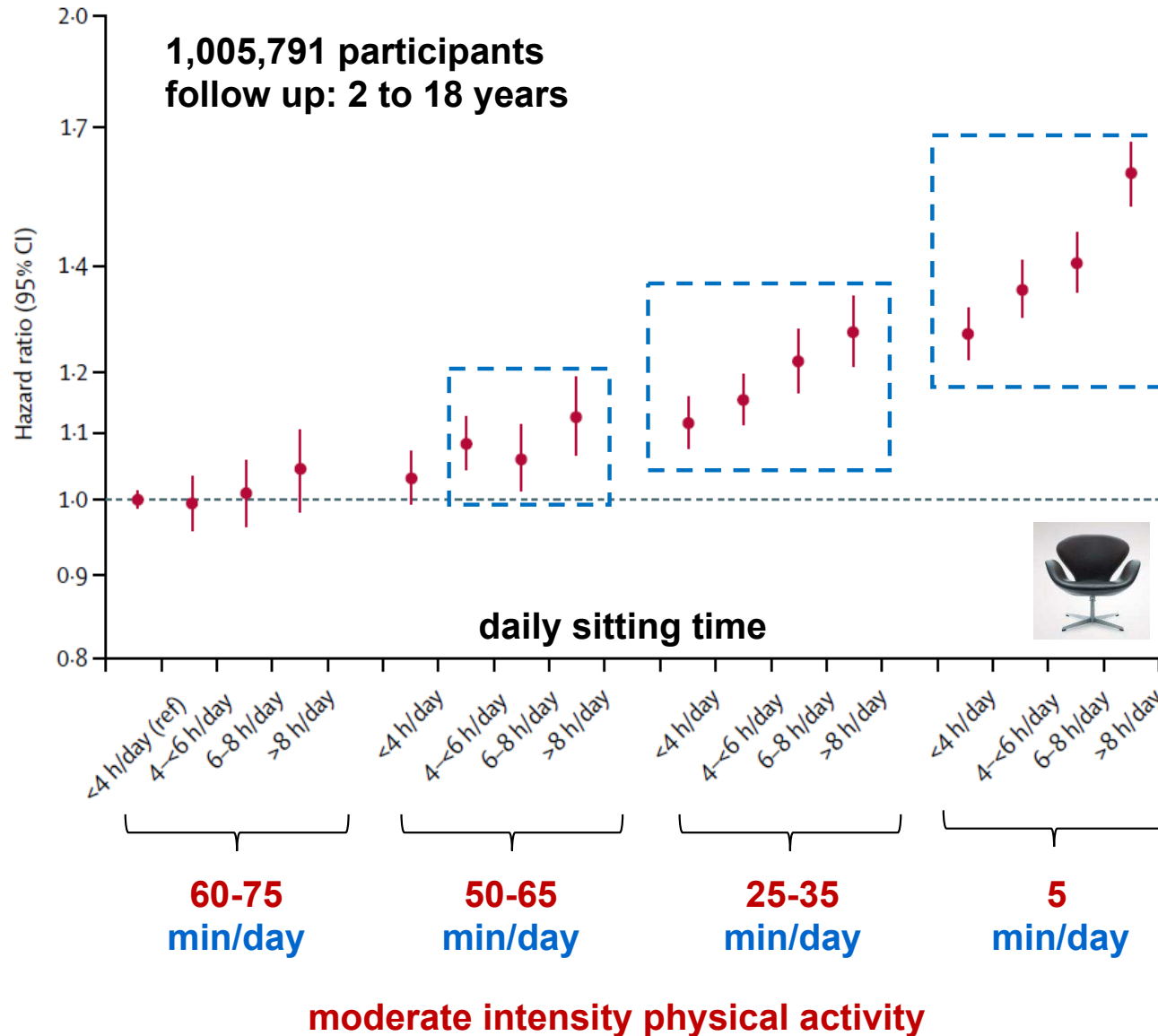
↓ LIPID METABOLISM

VASCULAR

METABOLISM



Only very high volumes of MVPA provide protection

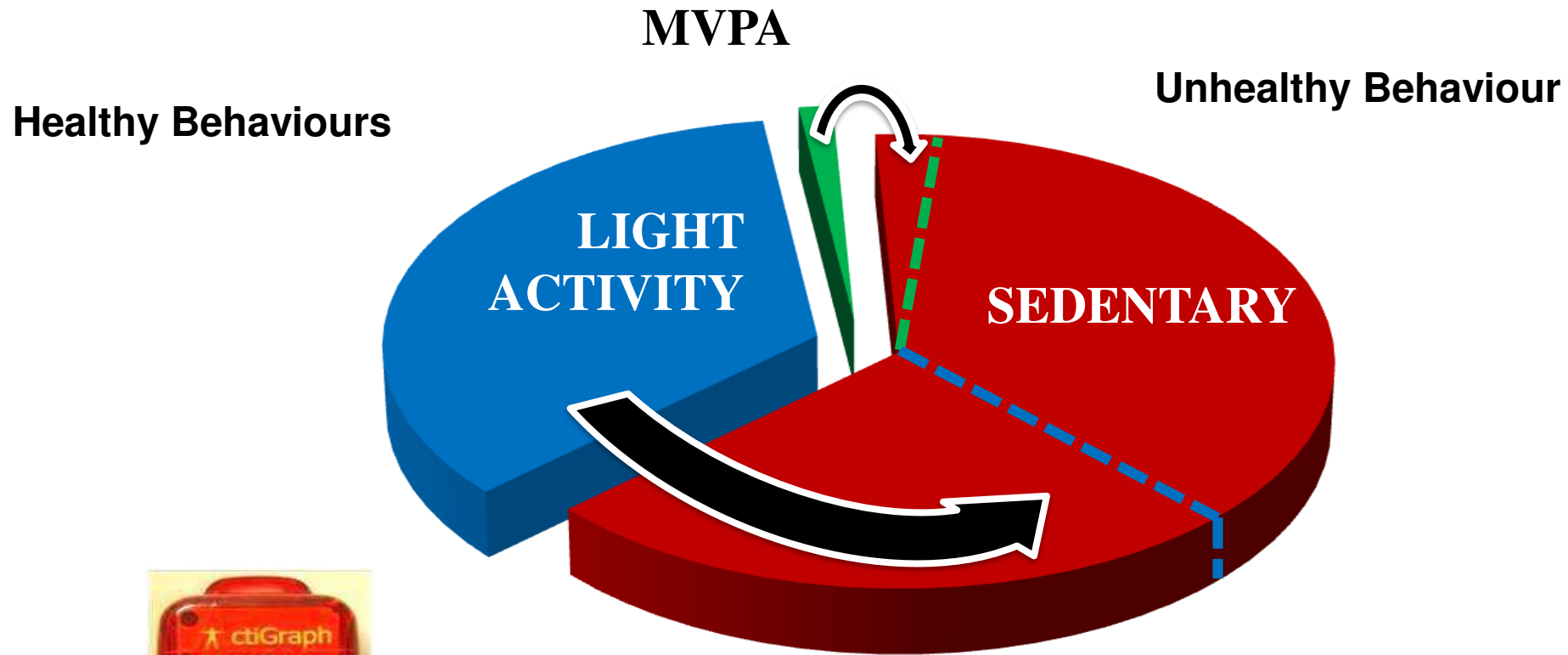


Does physical activity attenuate, or even eliminate, the detrimental association of sitting time with mortality?
A harmonised meta-analysis of data from more than 1 million men and women

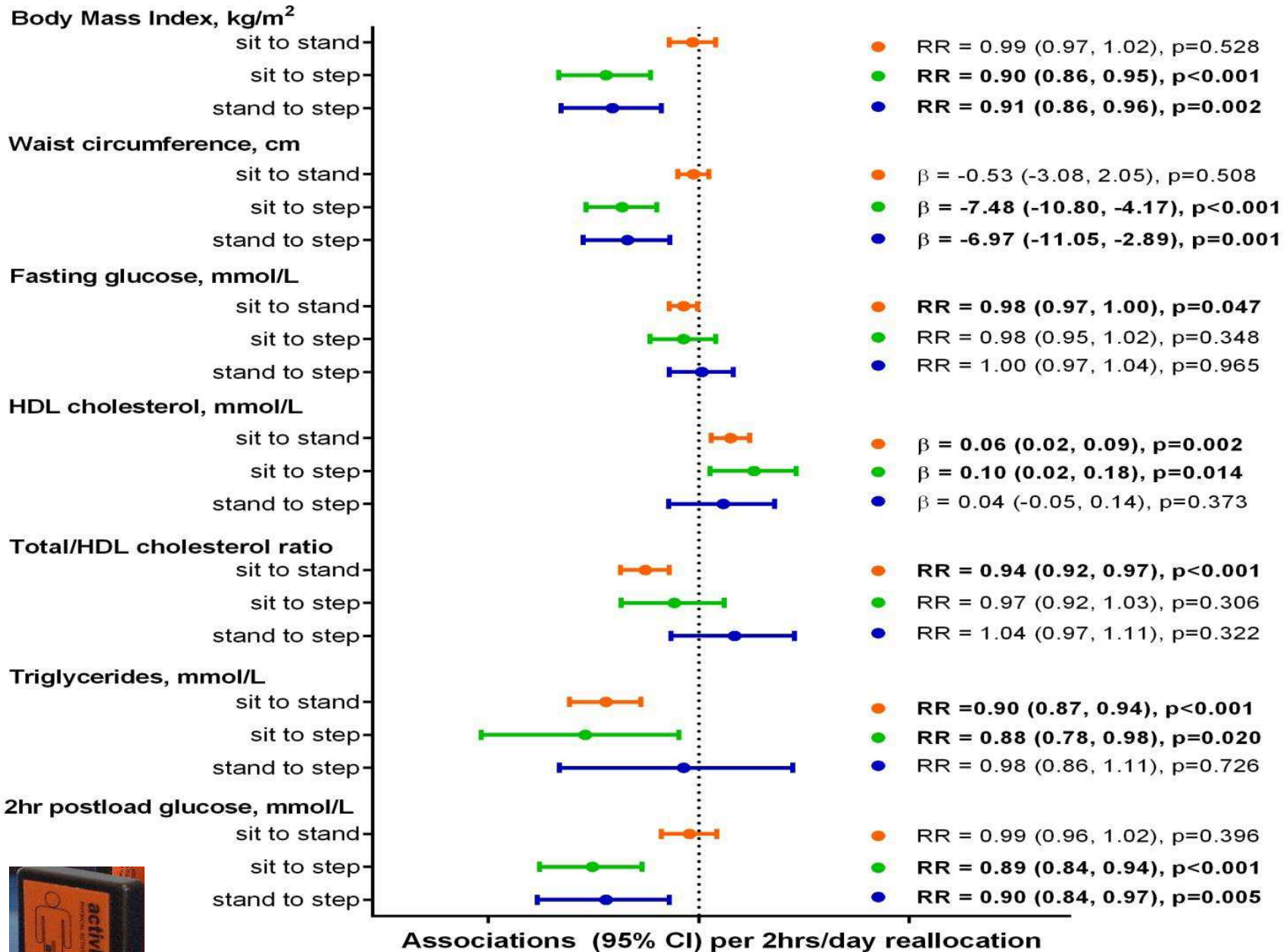
Ulf Ekelund, Jostein Steene-Johannessen, Wendy J Brown, Morten Wang Fagerland, Neville Owen, Kenneth E Powell, Adrian Bauman, I-Min Lee, for the Lancet Physical Activity Series 2 Executive Committee* and the Lancet Sedentary Behaviour Working Group*

Ekelund *et al.* 2016 *The Lancet* 388: 1302-10

Increasing Daily Overall PA: A 'whole of day' approach 'Sitting Less AND Moving More'



Source: Dempsey *et al.* *Curr Diab Rep* 2014 14: 522



Associations (95% CI) per 2hrs/day reallocation

Source: Healy *et al. Eur Heart J* 2015 36: 2643-2649

If not sitting – then what?

Sitting to standing – benefits for fasting glucose, HDL-C, triglycerides

Sitting to stepping – benefits for BMI, waist circumference, triglycerides, 2hr glucose



What are the feasible 'counter-measures'?

Don't just sit there!

We know sitting too much is bad, and most of us intuitively feel a little guilty after a long TV binge. But what exactly goes wrong in our bodies when we park ourselves for nearly eight hours per day, the average for a U.S. adult? Many things, say four experts, who detailed a chain of problems from head to toe.

ORGAN DAMAGE

Heart disease
Muscles burn fat and boost from more sluggish during a long sit, allowing fatty acids to more easily clog the heart. Prolonged sitting has been linked to high blood pressure and elevated cholesterol, and people with the most sedentary lives are more than twice as likely to have cardiovascular disease than those with the least.

Overproductive pancreas
The pancreas produces insulin, a hormone that carries glucose to cells for energy. But cells in sedentary folks don't respond as readily to insulin, so the pancreas produces more and more, which can lead to diabetes and other diseases. A 2011 study found a decline in insulin response after just one day of prolonged sitting.

Colon cancer
Studies have linked sitting to a greater risk for colon, breast and endometrial cancers. The reason is unclear, but one theory is that excess insulin encourages cell growth. Another is that regular movement boosts natural anticancer cells that kill pre-cancerous — and potentially cancer-causing — free radicals.

TROUBLE AT THE TOP

Foggy brain
Making muscles pump fresh blood and oxygen through the brain and trigger the release of all sorts of brain and mood-regulating chemicals. When we are sedentary for a long time, everything slows, including brain function.

Strained necks
If most of your sitting occurs at a desk at work, craning your neck forward to look at a keyboard or lifting your head to stare at a phone while typing can strain the cervical vertebrae and lead to permanent imbalances.

Sore shoulders and back
The neck doesn't wash alone. Slumping forward overexerts the shoulder and back muscles as well, particularly the trapezius, which connects the neck and shoulders.

BAD BACK

Inflexible spine
Spines that don't move become inflexible and susceptible to damage in routine activities, such as when you reach for a coffee cup or bend to tie a shoe. When we move around, soft disks between vertebrae expand and contract like sponges, soaking up fresh blood and nutrients. When we sit for long times, disks are squashed unevenly and lose springiness. Collapsing tendons around supporting tendons and ligaments.

Disk damage
People who sit more are at greater risk for narrowed lumbar disks. A muscle called the psoas travels through the abdominal cavity and, when it tightens, pulls the upper lumbar spine forward. Excess body weight puts extra on the lumbar tubular body (lower) instead of being distributed along the rest of the spine.

MUSCLE DEGENERATION

Musky bits
When you stand, reach or even sit upright, abdominal muscles tighten. But when you're sitting, they go uncranked. Tight back muscles and wimpy abs form a posture-working alliance that can magnify the spinal strain with a condition called hyperlordosis, or swayback.

Tight hips
Flexion helps keep you balanced, but muscles often go uncranked when you sit. Tight muscles in the hip flexors lead to a greater range of motion and stiffer legs. Studies have found that decreased hip mobility is a main reason elderly people tend to fall.

Limp glutes
Sitting requires your glutes to do absolutely nothing, and they get used to it. Tight glutes hurt your mobility, your ability to push off and your ability to maintain a powerful stride.

LEG DISORDERS

Poor circulation in legs
Sitting for long periods of time slows blood circulation, which causes fluid to pool in the legs. Problems range from swollen ankles and varicose veins to deep-vein thrombosis (DVT).

Soft bones
Weight-bearing activities such as walking and running stimulate the hip and greater risk of injury than those who watch less than one hour per day. Scientists partially attribute the recent surge in cases of osteoporosis to lack of activity.

So what can we do? The experts recommend ...

Sitting on something wobbly such as an exercise ball or even a hula hoop to force you to use muscles to keep your core steady to work. Sit up straight and keep your feet flat on the floor in front of you so they support about a quarter of your weight.

Stretching the hip flexors for three minutes for one side once a day, like this:

Walking during commercials when you're watching TV. Even a 1-inch step of 1 mph would burn twice the calories of sitting, and more vigorous exercise would be even better.

Alternating between sitting and standing at your work station. For each 30 min, stand up every half hour or so and walk.

Trying yoga poses — the cow pose and the cat — to improve endurance and flexion in your back.

The experts
Scientists interviewed for this report:

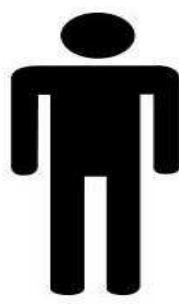
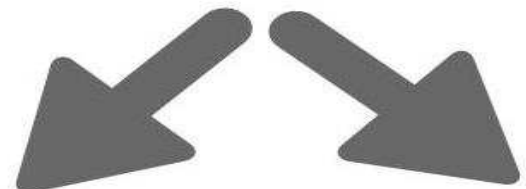
James A. Levine, director of the Institute for Health and Behavior at Boston Children's Hospital and Boston University.

Charles E. Matthews, National Cancer Institute investigator and author of several books on sedentary behavior.

Ray DeCherney, director of the Utah Center for Health, Prevention, and Wellness at the University of Utah.

Tal Avramy, associate professor of Barry Goldwater Department of Sport and Exercise Sciences.

Inactive (sitting)




Active (reduced or non-sitting)

Solutions



Experimentally Interrupting Sitting Time



 = Brief (~3-5 min) 'breaks' from sitting



Benefits for Type 2 Diabetes of Interrupting Prolonged Sitting with Brief Bouts of Light Walking or Simple Resistance Activities

PC Dempsey, RN Larsen, P Sethi, JW Sacre, NE Straznicky, ND Cohen, E Cerin, GW Lambert, N Owen, BA Kingwell, DW Dunstan

Diabetes Care (2016) 39: 964-72



Randomised, three-condition, cross-over trial

- 24 men/women with type 2 diabetes (diet/metformin treated)

Light intensity walking

– LW:

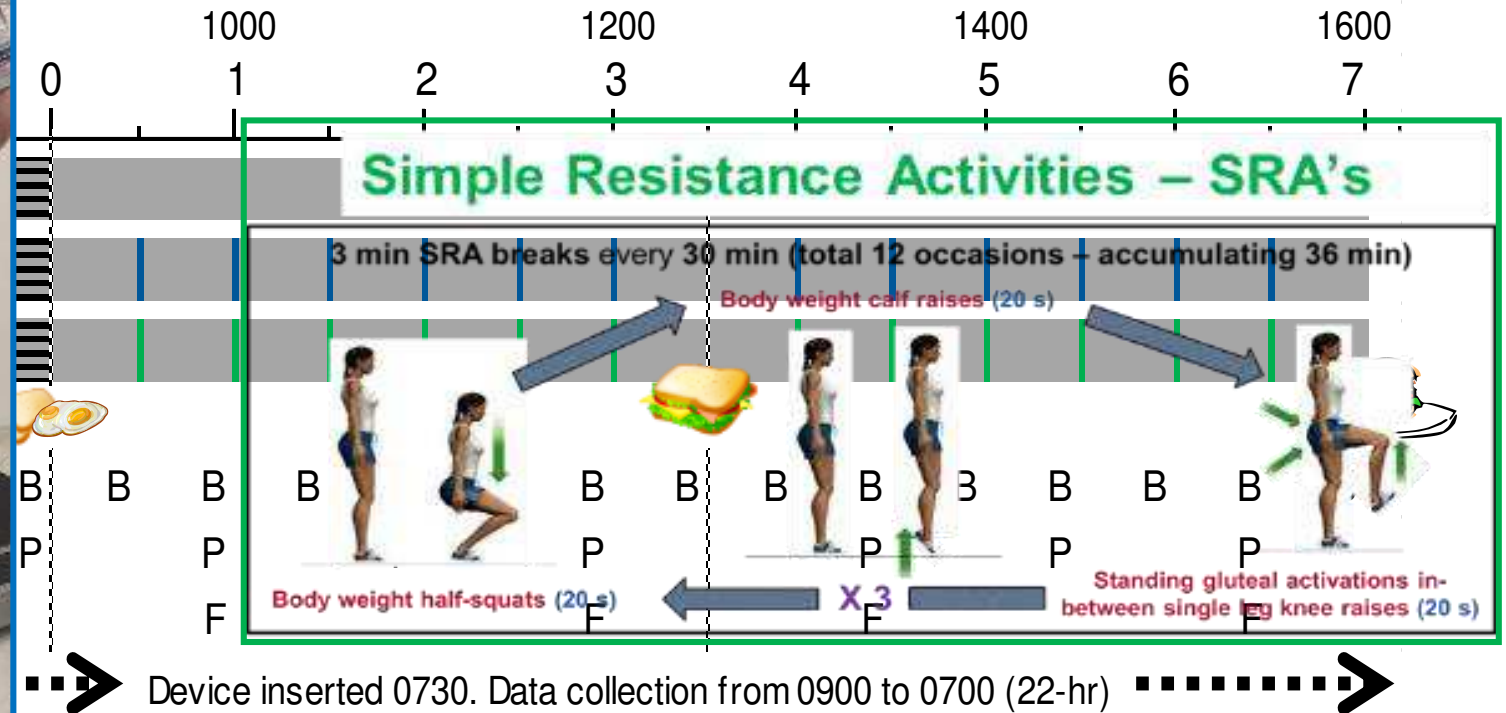
3 min @ 3.2km/h every

30 min



between conditions

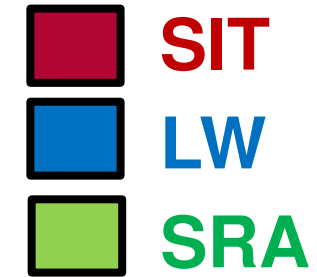
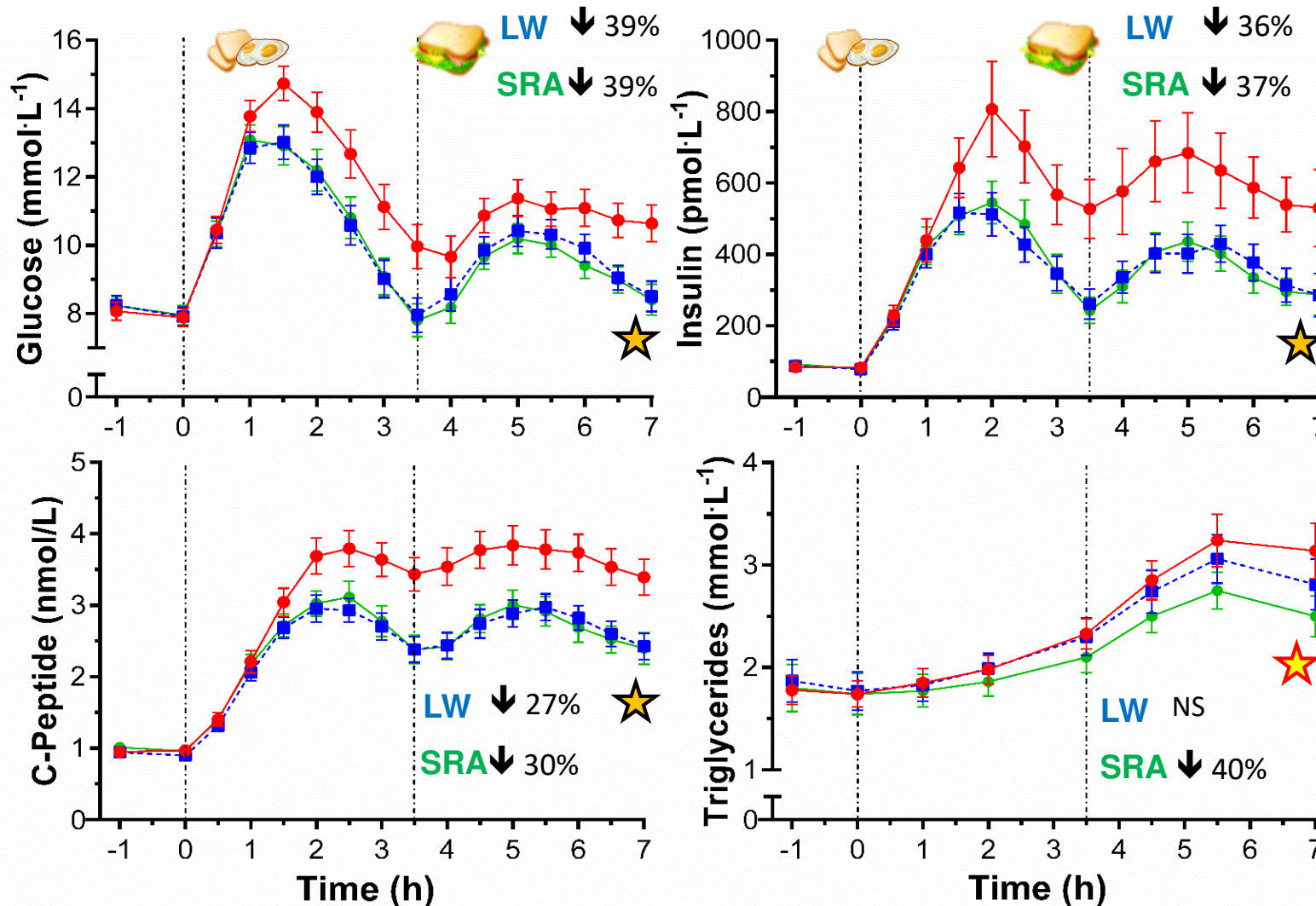
activity & medications strictly controlled



Device inserted 0730. Data collection from 0900 to 0700 (22-hr)

|| = Interruptions from sitting

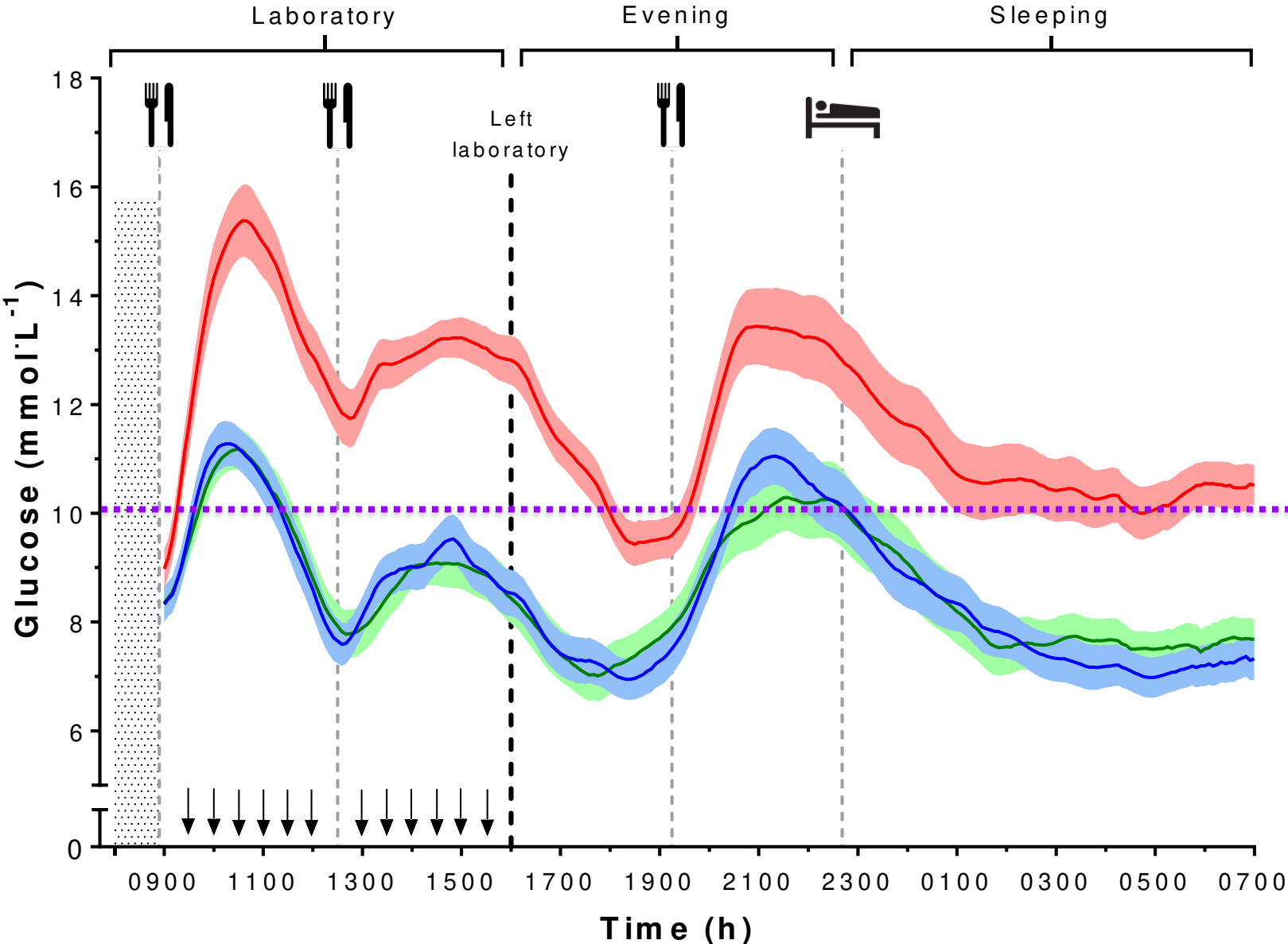
Results: ↓ postprandial responses



★ = LW / SRA vs SIT ($P < 0.001$)

★ = SRA vs SIT / LW ($P < 0.001$)

Results: ↓ hyperglycemia (CGM)

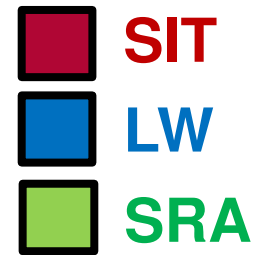
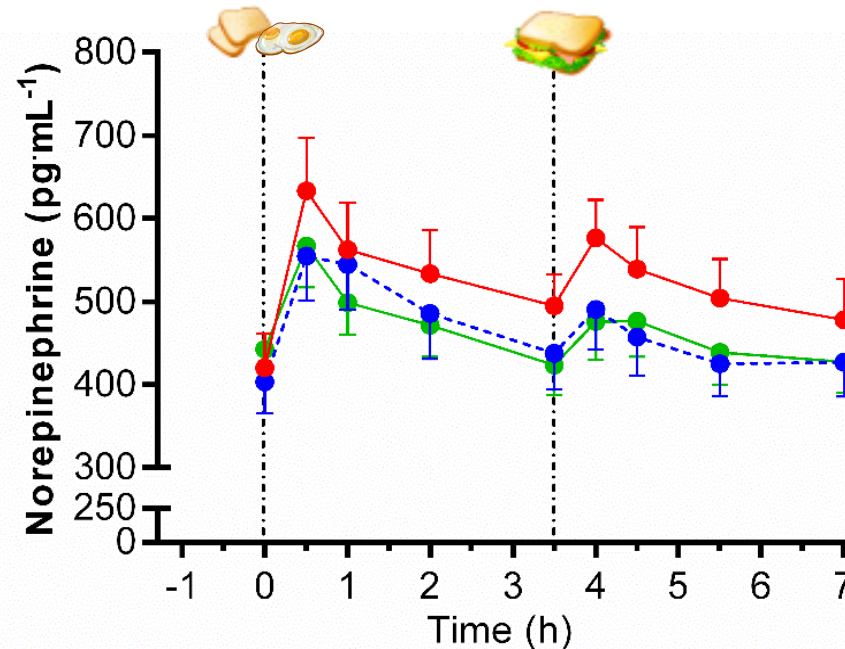
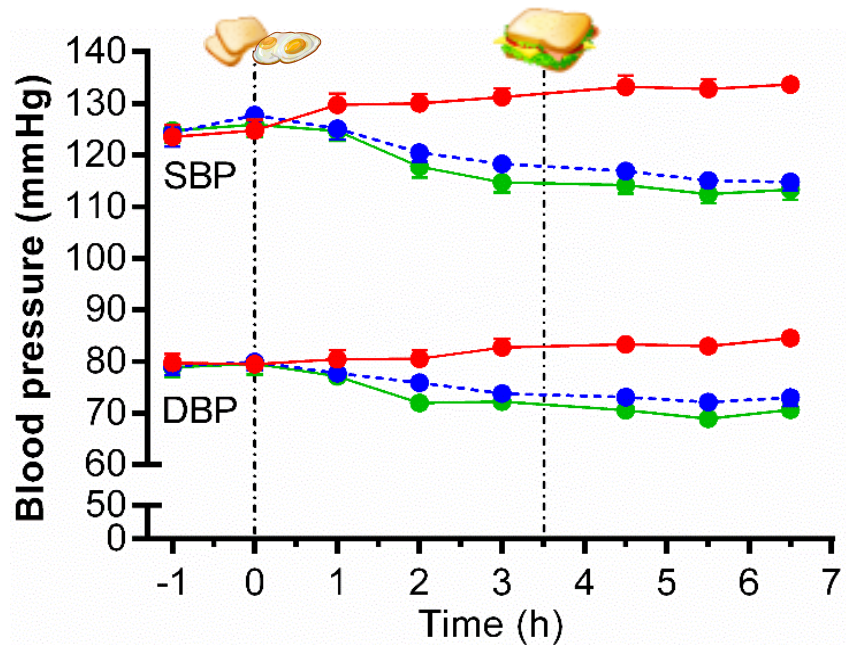


- SIT
- LW
- SRA

≥ 10 mmol = hyperglycemia

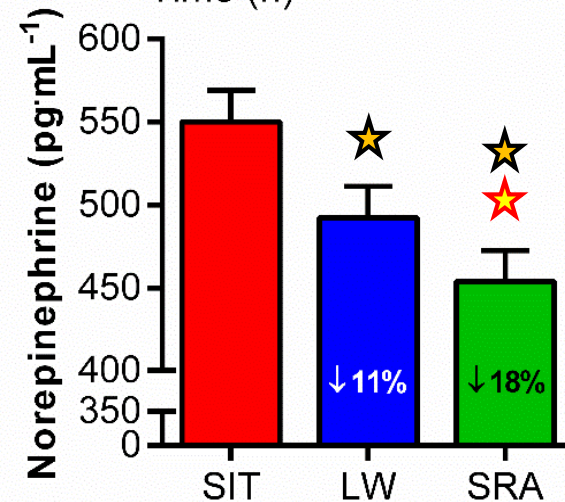
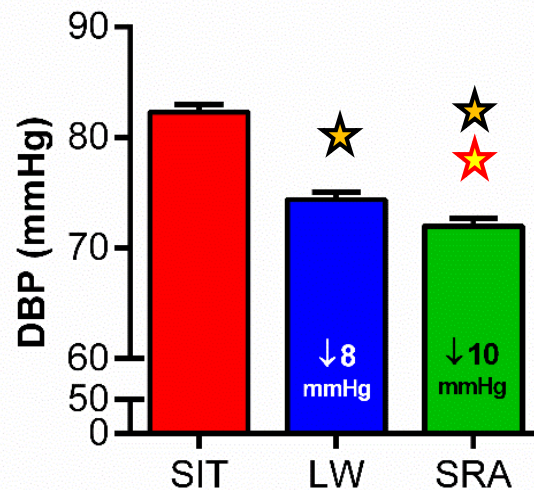
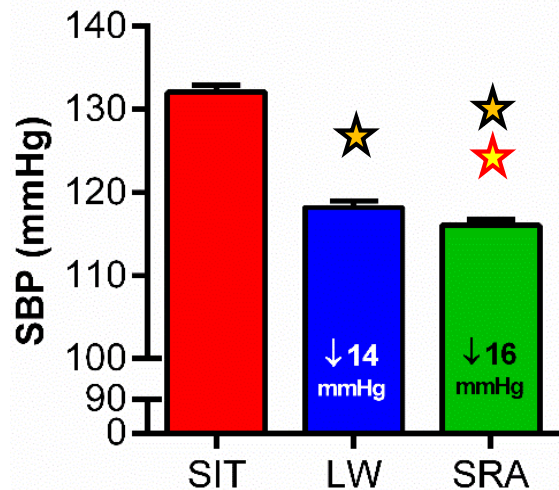
Dempsey *et al.*
Diabetologia 2017

Results: ↓ BP & plasma NE



★ = LW / SRA
VS SIT ($P < 0.05$)

★ = SRA VS
LW ($P < 0.05$)



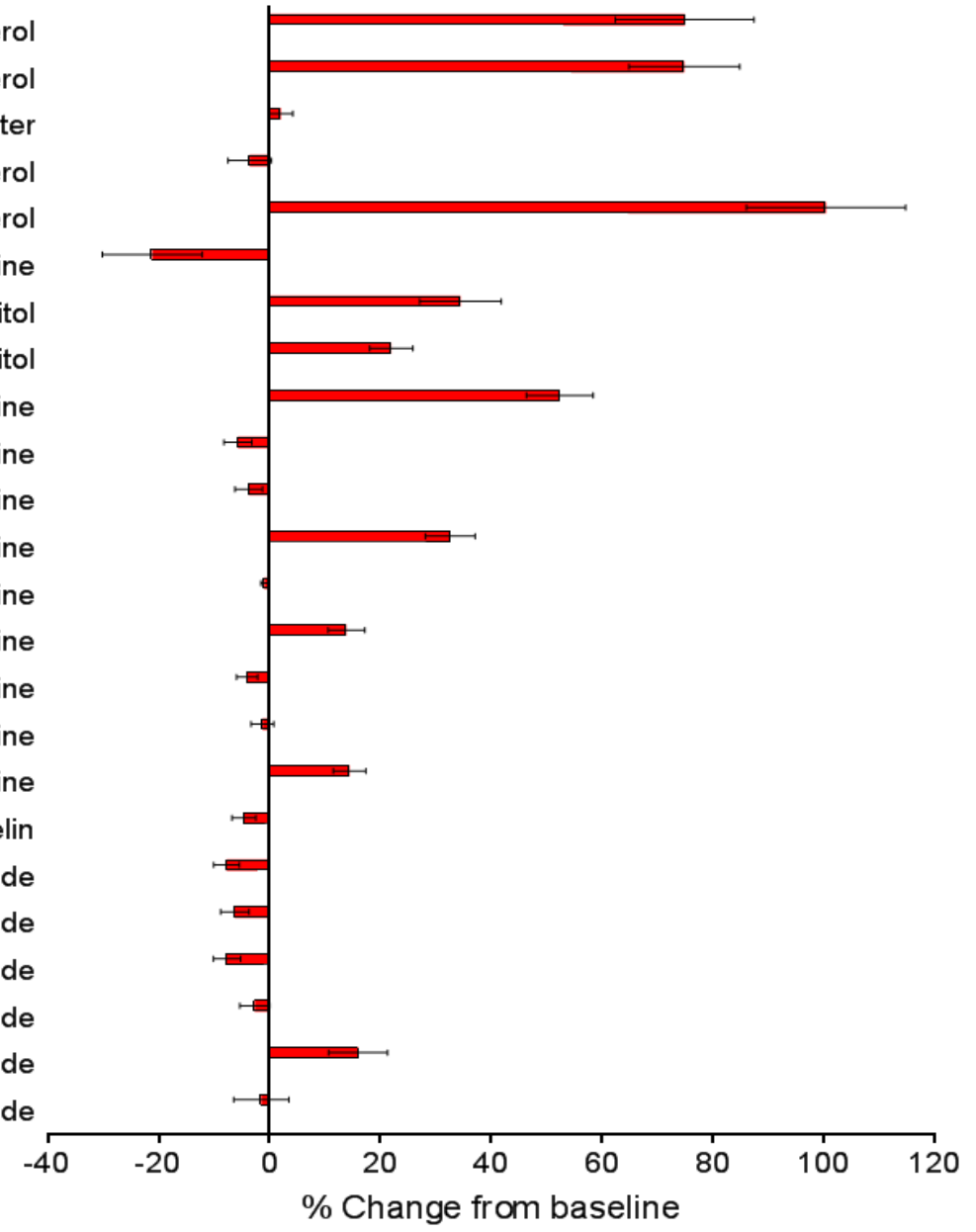
Results: Lipidomics

Lipid Class or Subclass

- Triacylglycerol
- Diacylglycerol
- Cholesteryl ester
- Cholesterol
- Phosphatidylglycerol
- Phosphatidylserine
- Lysophosphatidylinositol
- Phosphatidylinositol
- Lysophosphatidylethanolamine
- Alkenylphosphatidylethanolamine
- Alkylphosphatidylethanolamine
- Phosphatidylethanolamine
- Lysoalkylphosphatidylcholine
- Lysophosphatidylcholine
- Alkenylphosphatidylcholine
- Alkylphosphatidylcholine
- Phosphatidylcholine
- Sphingomyelin
- GM3 ganglioside
- Trihexosylceramide
- Dihexosylceramide
- Monohexosylceramide
- Ceramide
- Dihydroceramide

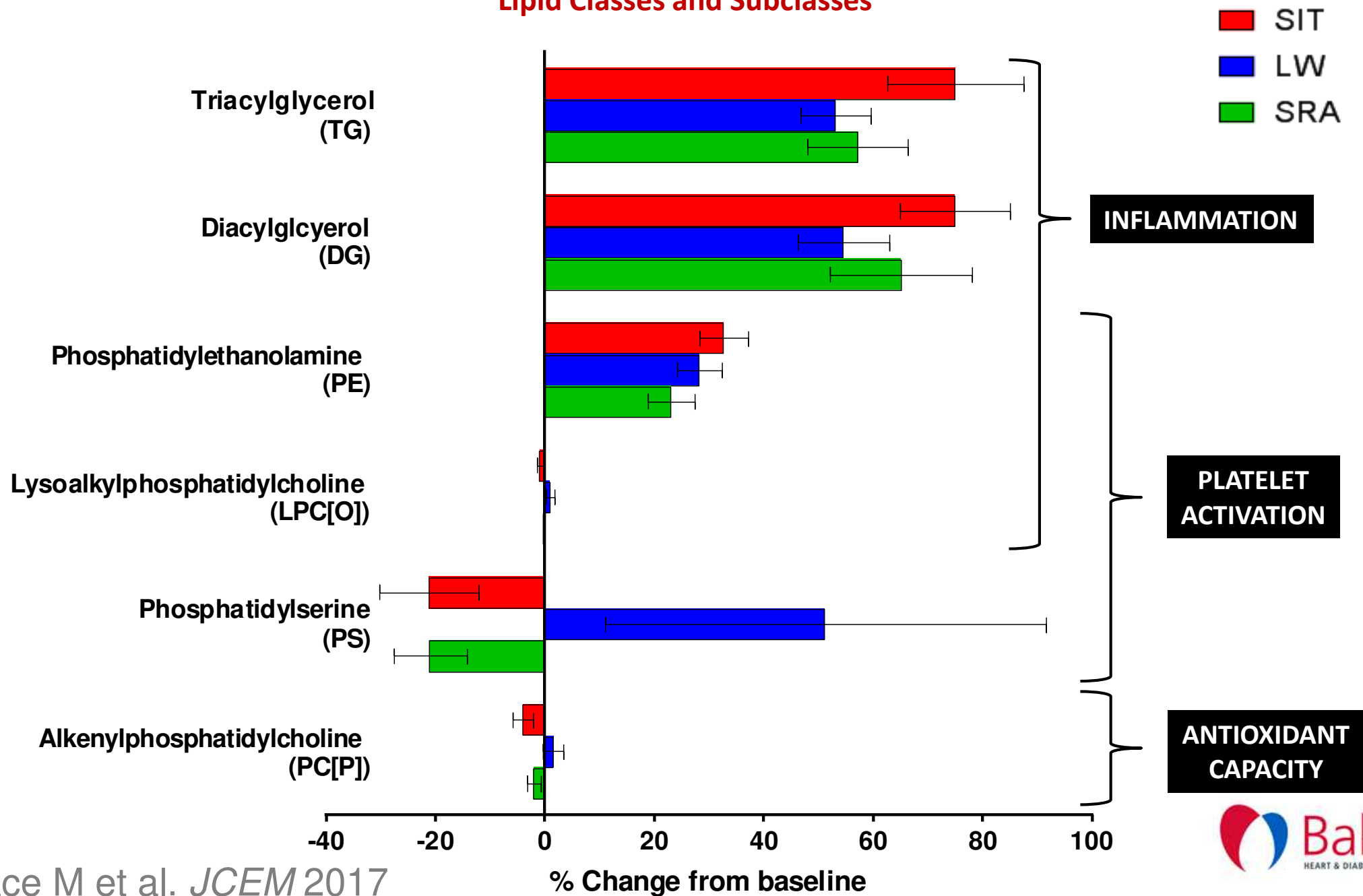
Lipid Classes and Subclasses

- SIT
- LW
- SRA



Grace M et al. *JCEM* 2017

Lipid Classes and Subclasses



Results: Subjective Fatigue

Visit Date: / / PP ID: Condition: SED WALK SRA
 Time: 0h 2h 4h 5.5h 7.5h

We are trying to find out about your level of vitality (energy and level of fatigue) throughout the testing day. There are 18 items we would like you to respond to. This should take 1 minute of your time. Thanks!

DIRECTIONS: You are asked to mark with a single vertical dash on (and within) each of the following horizontal lines to indicate how you are feeling **RIGHT NOW**.

For example, suppose you have not eaten since yesterday. Where would you mark the line below?

not at all hungry ————— extremely hungry

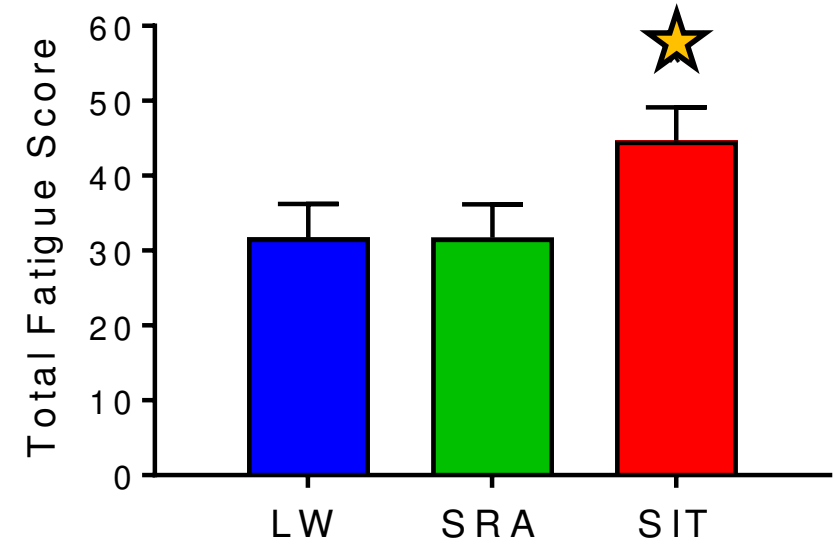
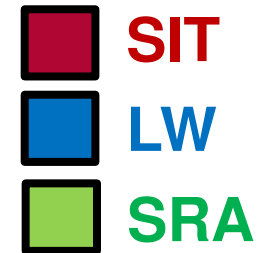
You would probably mark the line closer to the "extremely hungry" end of the line. This is where I put it:

not at all hungry ————— | ————— extremely hungry

NOW PLEASE COMPLETE THE FOLLOWING ITEMS:

1. not at all tired ————— extremely tired
2. not at all sleepy ————— extremely sleepy
3. not at all drowsy ————— extremely drowsy
4. not at all fatigued ————— extremely fatigued
5. not at all worn out ————— extremely worn out

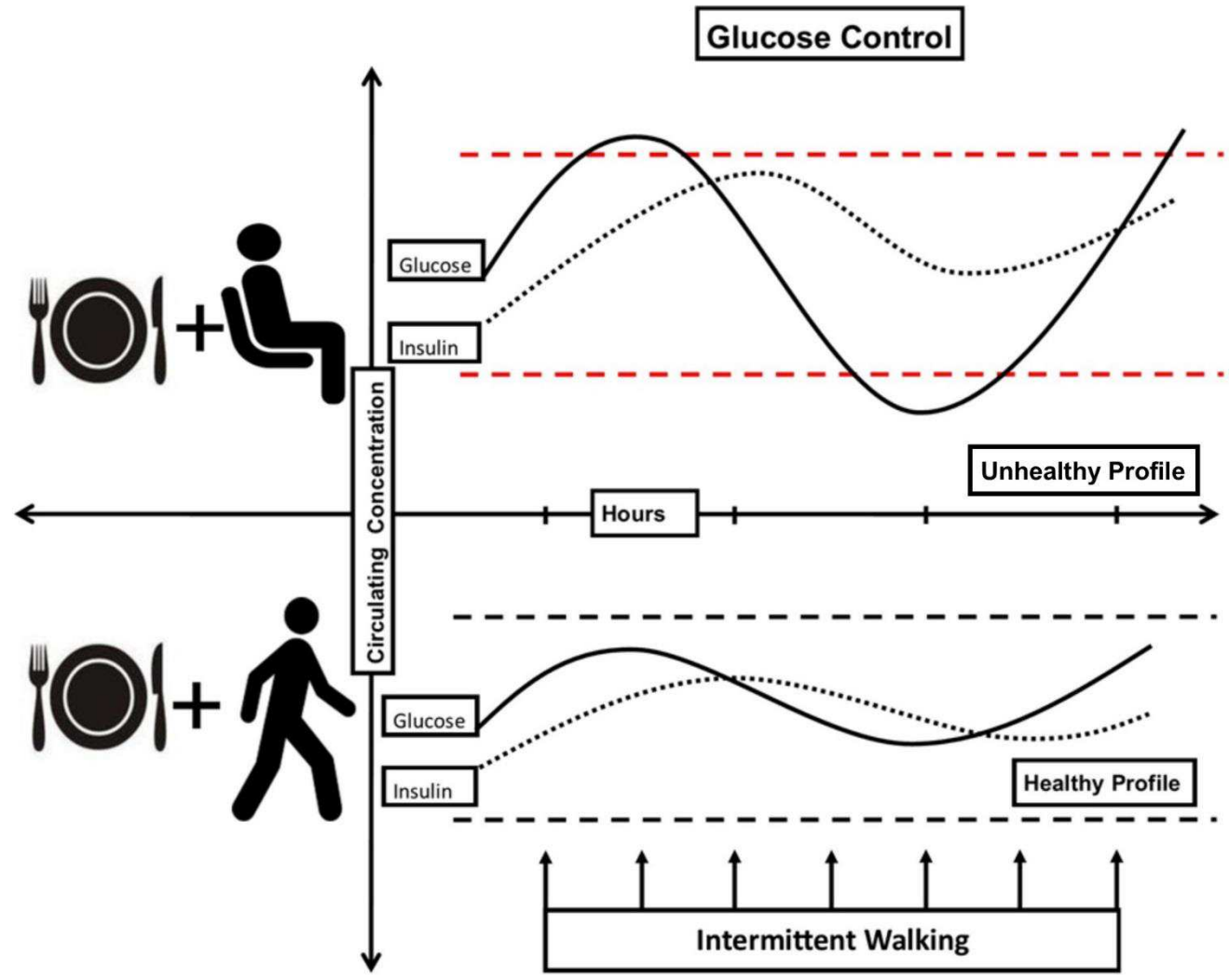
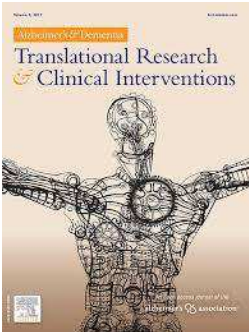
Total Fatigue Score



★ = SIT vs LW / SRA ($P < 0.05$)

7

Could prolonged sitting be bad for brain health'?



Michael Wheeler



THE UNIVERSITY OF WESTERN AUSTRALIA



Wheeler M et al. *Alzheimer's & Dementia Trans Res Clin Int* 2017; 3: 291-300
See also: Article in The Conversation

RISE & RECHARGE – THE APP

rise & recharge

Brought to you by

Baker IDI
HEART & DIABETES INSTITUTE

Proudly supported by

Vodafone
Foundation



Activity Tracker



www.riserecharge.com

Take Home Messages

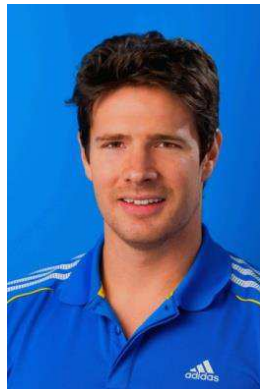
- Excessive sitting is highly prevalent across society
- There is strong evidence linking excessive sitting to CVD risk
- Solutions need to be sought to overcome the ‘normal’ state of prolonged sitting in various contexts – particularly workplace/schools
- **The Key Message:** In addition to engaging in health-enhancing exercise, people should be encouraged to minimise the time spent in prolonged sitting and break up long periods of sitting as often as possible

“Sit Less, Move More, More Often”

Acknowledgements



Michael Wheeler
PhD Student



Dr Paddy Dempsey



Prof Neville Owen



Dr Megan Grace



Dr Robyn Larsen



Dr Genevieve Healy
Uni of Queensland



Thank You For Listening



**Physical Activity Laboratory
Baker Heart & Diabetes Institute
david.dunstan@baker.edu.au**

Spare Slides



MOVE MORE SIT LESS!



Educating companies on the productivity, engagement and reduced absenteeism benefits of Active Working.



A campaign to grow awareness and education of the dangers of sedentary working and sitting more than 4 hours a day.



An event run in conjunction with the British Heart Foundation, to draw awareness to dangers of the sedentary office. April 24th 2015

Why not become an "Official Supporter" or "Official Partner" and contact us: partnerships@activeworking.org.uk

ON YOUR FEET
Baker 101

QUIT THE SIT

AND TAKE A STAND FOR BETTER HEALTH

THURSDAY 11 JUNE 2015

#QuitTheSit
@QuitTheSit

REGISTER AT
WWW.ONYOURFEET.ORG.AU

Partnership logos: schiavello, humanix, fitbit, ANYTIME FITNESS



Move. Each week, Apple Watch suggests a new Move goal for how many active calories to burn per day, based on your recent history. Adjust it up or down until it feels just right. You close the Move ring when you meet your personal active calorie burn goal for the day.



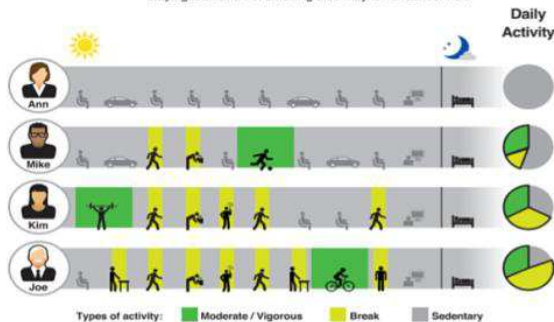
Exercise. Any activity performed at the level of a brisk walk or above is considered exercise. And Apple Watch keeps track of how much you do each day, even when it's not in the context of a dedicated workout. You close the Exercise ring when you reach the globally recommended 30 minutes of exercise a day.



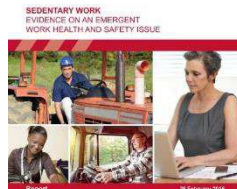
Stand. Apple Watch senses when you stand up and gives you credit when you do. So you can minimize your sedentary time throughout the day. If you've been sitting too long, it reminds you to get up. You close the Stand ring when you've stood for at least one minute in 12 different hours during the day.

Make Time for Break Time

This graphic illustrates how different amounts of activity influence certain much-studied indicators of cancer risk. Other factors like eating smart, staying lean and not smoking also may lower cancer risk.



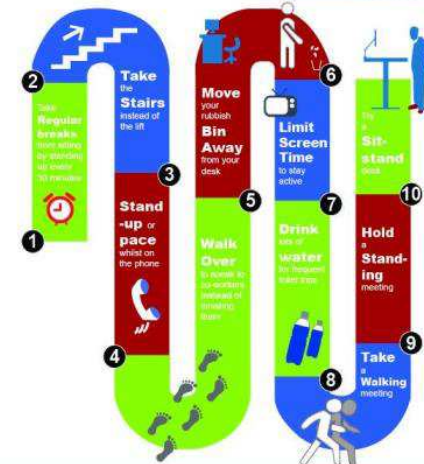
AMERICAN INSTITUTE OF CANCER RESEARCH



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10 Ways to Sit Less At Work



For more info:
www.onyourfeet.org.uk
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NATIONAL GET FIT DON'T SIT DAY

GET UP & MOVE!

MAY 6, 2015

American Diabetes Association

Sedentary Behavior and Cardiovascular Morbidity and Mortality

A Science Advisory From the American Heart Association

Endorsed by The Obesity Society

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On behalf of the Physical Activity Committee of the Council on Lifestyle and Cardiometabolic Health; Council on Clinical Cardiology; Council on Epidemiology and Prevention; Council on Functional Genomics and Translational Biology; and Stroke Council

CONCLUSIONS

The evidence to date is suggestive, but not conclusive, that sedentary behavior contributes to CVD and diabetes mellitus risk. Nonetheless, there is evidence to suggest that sedentary behavior could contribute to excess morbidity and mortality. However, there currently is insufficient evidence on which to base specific public health recommendations regarding the appropriate limit to the amount of sedentary behavior required to maximize CVD health benefits. Given the current state of the science on sedentary behavior and in the absence of sufficient data to recommend quantitative guidelines, it is appropriate to promote the advisory, "Sit less, move more."

Physical Activity/Exercise and Diabetes: A Position Statement of the American Diabetes Association

Diabetes Care 2016;39:2065–2079 | DOI: 10.2337/dc16-1728

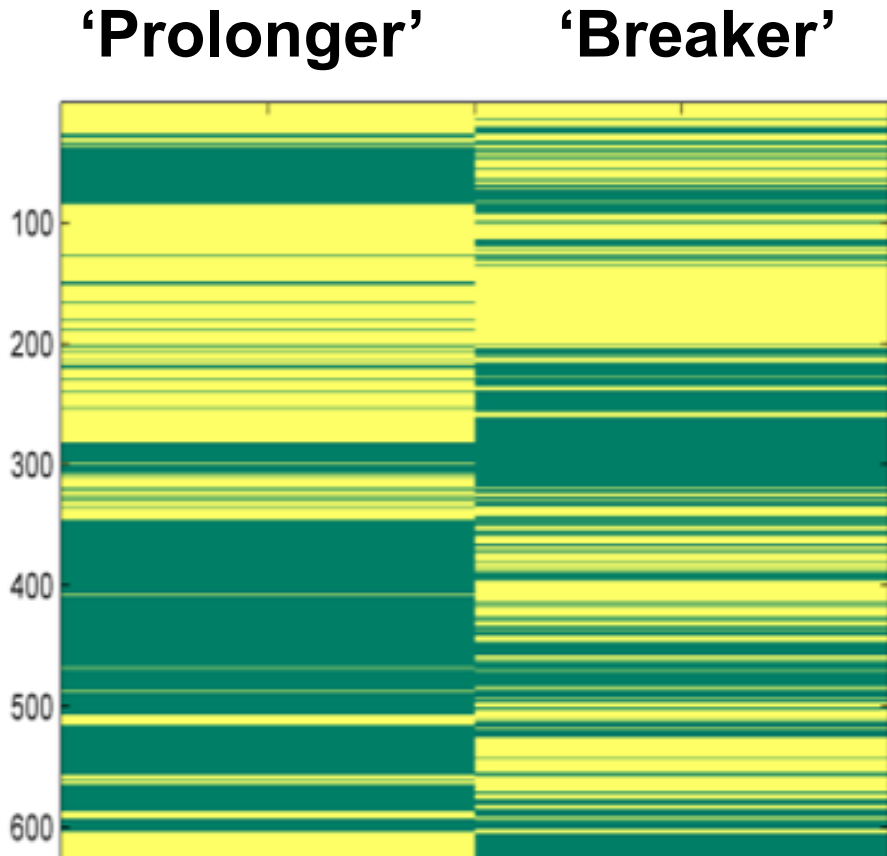
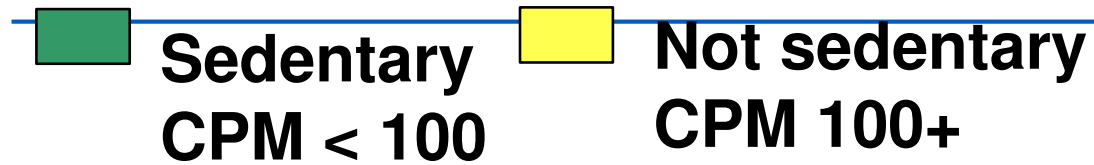
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BENEFITS OF AND RECOMMENDATIONS FOR REDUCED SEDENTARY TIME

Recommendations

- All adults, and particularly those with type 2 diabetes, should decrease the amount of time spent in daily sedentary behavior. **B**
- Prolonged sitting should be interrupted with bouts of light activity every 30 min for blood glucose benefits, at least in adults with type 2 diabetes. **C**
- The above two recommendations are additional to, and not a replacement for, increased structured exercise and incidental movement. **C**

Prolonged Sitting – Particularly Hazardous

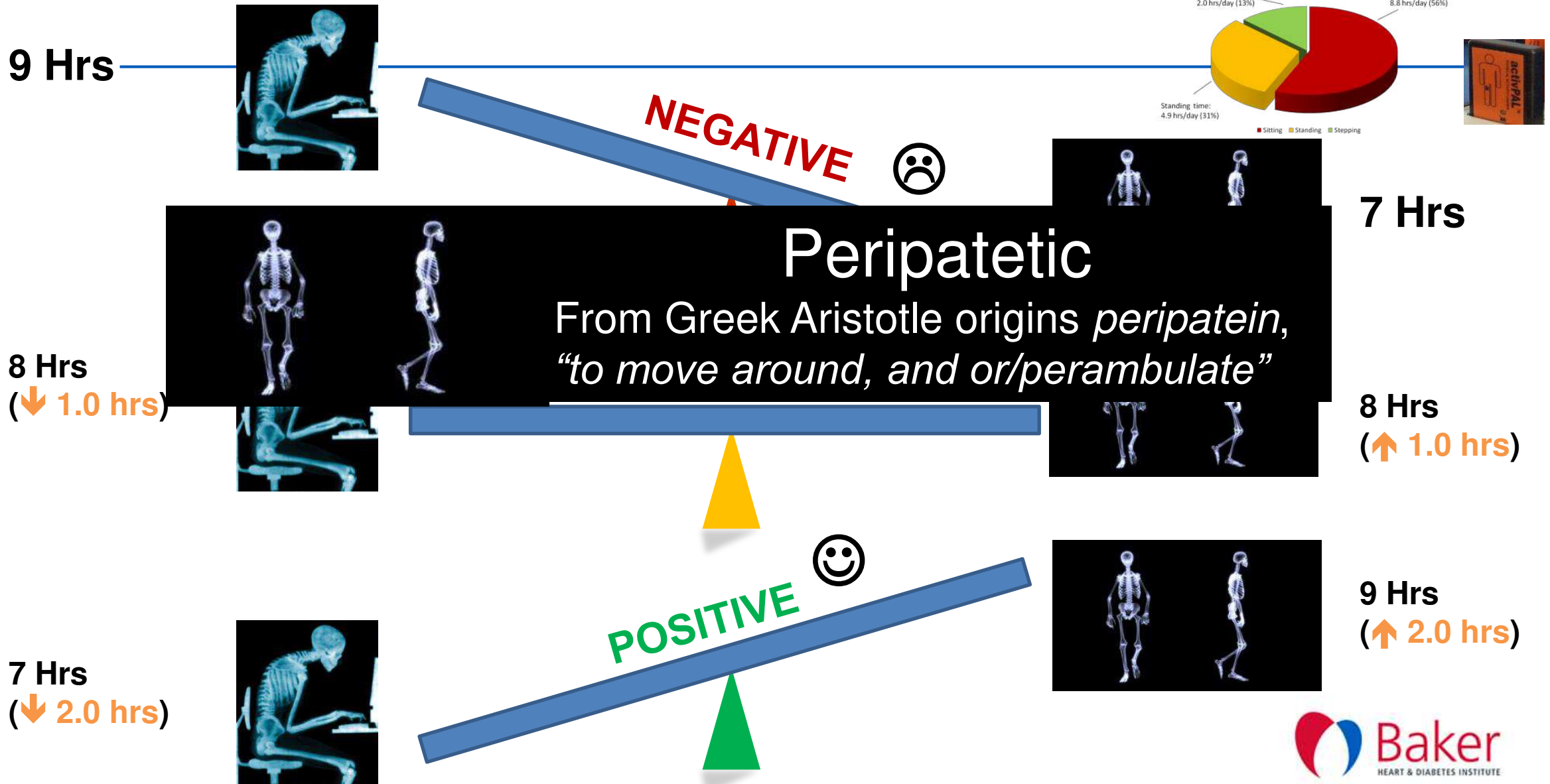


These two people have exactly the same sedentary time

More breaks from sitting time associated with lower average waist circumference, BMI, triglycerides, and 2-hr plasma glucose

Healy, G.N., Dunstan, D.W., Salmon, J., Cerin, E., Shaw, J.E., Zimmet, P.Z. and Owen, N. (2008). Breaks in sedentary time: Beneficial associations with metabolic risk. *Diabetes Care*, 31, 661-666.

The Concept of 'Peripatetic Balance'





Australian Government
Department of Health

More than half of all
Australian adults are not
active enough



Make *your* move – Sit less
Be active for life!



Australia's Physical Activity and Sedentary Behaviour Guidelines for Adults (18–64 years)

PHYSICAL ACTIVITY

- Doing any physical activity is better than doing none. If you currently do no physical activity, start by doing some, and gradually build up to the recommended amount.
- Be active on most, preferably all, days every week.
- Accumulate 150 to 300 minutes (2 ½ to 5 hours) of moderate intensity physical activity or 75 to 150 minutes (1 ¼ to 2 ½ hours) of vigorous intensity physical activity, or an equivalent combination of both moderate and vigorous activities, each week.
- Do muscle strengthening activities on at least 2 days each week.

SEDENTARY BEHAVIOUR

- Minimise the amount of time spent in prolonged sitting.
- Break up long periods of sitting as often as possible.

Breaking sitting with light activities vs structured exercise: a randomised crossover study demonstrating benefits for glycaemic control and insulin sensitivity in type 2 diabetes

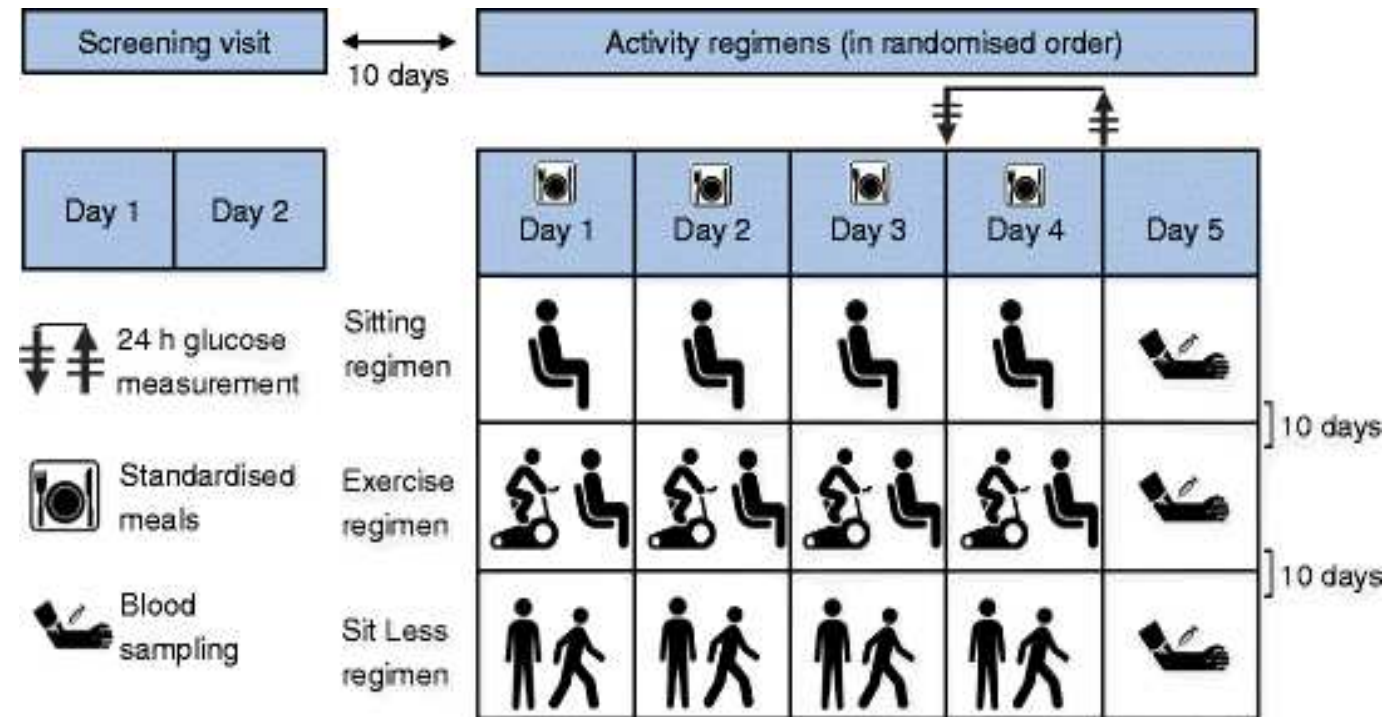
BMFM Duvivier *et al. Diabetologia* (2017) 60: 490-98

- * 19 adults with T2D (Age: 63+/- 9 yrs)
- * Not taking insulin & HbA1c < 10%
- * Physically inactive (< 2.5 hr/wk)

SITTING - 14 hrs/day

EXERCISE - 1.1 h/day of sitting replaced by mod/vig cycling

SIT LESS - 4.7 hr/d of sitting replaced by 2.5 hr standing and 2.2 hr light intensity walking



Breaking up sitting time with standing and light walking has beneficial effects on insulin resistance and glucose metabolism

