ICDAM8: Rome, May 2012
Session C-5: Assessment of Sedentary Behaviors

Chair: Neville Owen

Neville Owen: Sedentary Behaviors

Josephine Chau (Sydney): Measuring Workers' Sitting Time by Domain: The Workforce Sitting Questionnaire (paper to be presented by Adrian Bauman)

Ilona Csizmadi (Calgary): Comprehensive Tool to Assess Sedentariness and Activity Energy Expenditure

Alex Hamilton (Oxford): Measuring Episodes of Sedentary Behaviour Using SENSECAM: A Pilot Study

Anna Timperio (Melbourne): Agreement Between ACTIVPAL and ACTIGRAPH for Assessing Children’s Sedentary Time
Sedentary Behaviors

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Sedentary Behaviours

• *Sedere* – “to sit”

• Different activities that involve sitting and low levels of energy expenditure (1.0-1.5 METS)

• Includes sitting during commuting, in the workplace, the domestic environment and during leisure time

“Sitting time” = what these sedentary behaviours primarily involve
Sedentary Behaviours

Physical Activity Guidelines: time spent in moderate-vigorous activity

Sitting Induces Muscular Inactivity

4 STEPS
GETTING OUT
OF A CHAIR
SITTING
STANDING


High television viewing time (2 to 4+ hrs/day) is detrimentally associated with biomarkers and health outcomes, independent of leisure-time physical activity

- Cardiovascular disease risk\(^1\)
- Overweight \(^2,3\)
- Diabetes\(^3\)
- Metabolic Syndrome\(^4,5\)
- Abnormal glucose metabolism\(^6\) and other biomarkers of cardio-metabolic health \(^7\)
- Cancer \(^8,9\)

\(^1\) Jakes et al., *E J Clin Nu* 2003; \(^2\) Ching et al., *AJPH* 1996; \(^3\) Hu et al., *JAMA* 2003 \(^4\) Dunstan et al., *Diabetologia* 2005; \(^5\) Bertrais et al., *Obesity Research* 2005; \(^6\) Dunstan et al., *Diabetes Care* 2004; \(^7\) Healy et al., *MSSE* 2008; \(^8\) Patel et al., *A J Epi* 2006; \(^9\) Howard et al., *Cancer Causes and Control* 2008
Prolonged TV time and microcirculation


Computerised assessment of Retinal Vascular Calibre

TV time and retinal venous calibre in men

*p = 0.006*

*adjusted for age, education, diet quality, smoking, waist circumference, systolic blood pressure, serum fasting glucose, serum 2h-post load glucose, serum fibrinogen levels, serum triglyceride levels, physical activity time
TV Time and Cardiovascular Mortality: AARP Cohort Findings

Television Viewing (hours/day)

- <1
- 1 to 2
- 3 to 4
- 5 to 6
- 7+

Hazard ratio

Reference

Moderate – vigorous physical activity (hours/week)

# Sitting time and mortality

<table>
<thead>
<tr>
<th>Study</th>
<th>N (person-yrs FU)</th>
<th>Age (years)</th>
<th>Mortality outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>All cause</td>
</tr>
<tr>
<td><strong>EPIC Norfolk</strong> (Wijndaele et al)</td>
<td>13,197 (124,902)</td>
<td>≥ 45</td>
<td>![Monitor]</td>
</tr>
<tr>
<td><strong>AusDiab</strong> (Dunstan et al)</td>
<td>8,800 (58,087)</td>
<td>≥ 25</td>
<td>![Monitor]</td>
</tr>
<tr>
<td><strong>Scottish HS</strong> (Stamatakis et al)</td>
<td>4,512 (19,364)</td>
<td>≥ 35</td>
<td>![Monitor]</td>
</tr>
<tr>
<td><strong>ACLS (men)</strong> (Warren et al)</td>
<td>7,744 (21 years FU)</td>
<td>≥ 20</td>
<td>![Monitor]</td>
</tr>
<tr>
<td><strong>JPHC</strong> (Inoue et al)</td>
<td>83,034 (725,071)</td>
<td>≥ 45</td>
<td>![Monitor]</td>
</tr>
<tr>
<td><strong>CFS</strong> (Katzmarzyk et al)</td>
<td>17,013 (204,732)</td>
<td>≥ 18</td>
<td>![Monitor]</td>
</tr>
<tr>
<td><strong>CPS2</strong> (Patel et al)</td>
<td>123,216 (1,610,728)</td>
<td>≥ 50</td>
<td>![Monitor]</td>
</tr>
</tbody>
</table>

Each of us should aim to participate in an appropriate level of physical activity for our age. Each of the life-course chapters provides an introduction, sets out the guidelines for that age group, summarises the evidence and discusses what the guidelines mean for people. We hope that this report will be read by policy makers, healthcare professionals and others working in health improvement. The guidelines are designed to help professionals to provide people with information on the type and amount of physical activity that they should undertake to benefit their health, in particular to prevent disease. The age groups covered in this report are:

- early years (under 5s)
- children and young people (5–18 years)
- adults (19–64 years)
- older adults (65+ years)

**EARLY YEARS (under 5s)**

1. Physical activity should be encouraged from birth, particularly through floor-based play and water-based activities in safe environments.

2. Children of pre-school age who are capable of walking unaided should be physically active daily for at least 180 minutes (3 hours), spread throughout the day.

3. All under 5s should minimise the amount of time spent being sedentary (sitting or sitting) for extended periods (except time spent sleeping).

**CHILDREN AND YOUNG PEOPLE (5–18 years)**

1. All children and young people should engage in moderate to vigorous intensity physical activity for at least 60 minutes and up to several hours every day.

2. Vigorous intensity activities, including those that strengthen muscle and bone, should be incorporated at least three days a week.

3. All children and young people should minimise the amount of time spent being sedentary (sitting) for extended periods.

**ADULTS (19–64 years)**

1. Adults should aim to be active daily. Over a week, activity should add up to at least 150 minutes (2½ hours) of moderate intensity activity in bouts of 10 minutes or more – one way to approach this is to do 30 minutes on at least 5 days a week.

2. Alternatively, comparable benefits can be achieved through 75 minutes of vigorous intensity activity spread across the week or a combination of moderate and vigorous intensity activity.

3. Adults should also undertake physical activity to improve muscle strength on at least two days a week.

4. All adults should minimise the amount of time spent being sedentary (sitting) for extended periods.

**OLDER ADULTS (65+ years)**

1. Older adults who participate in any amount of physical activity gain some health benefits, including maintenance of good physical and cognitive function. Some physical activity is better than none, and more physical activity provides greater health benefits.

2. Older adults should aim to be active daily. Over a week, activity should add up to at least 150 minutes (2½ hours) of moderate intensity activity in bouts of 10 minutes or more – one way to approach this is to do 30 minutes on at least 5 days a week.

3. For those who are already regularly active at moderate intensity, comparable benefits can be achieved through 75 minutes of vigorous intensity activity spread across the week or a combination of moderate and vigorous activity.

4. Older adults should also undertake physical activity to improve muscle strength on at least two days a week.

5. Older adults at risk of falls should incorporate physical activity to improve balance and co-ordination on at least two days a week.

6. All older adults should minimise the amount of time spent being sedentary (sitting) for extended periods.
Make Time + Break Time = Cancer Protection

Types of activity: Moderate / Vigorous  Break  Sedentary

Daily Activity

Cancer Risk Indicators

LOW  HIGH

Released: November 2011
Sitting less for adults

The arrival of the ‘electronic age’ has fundamentally changed how much time we spend sitting (also called being ‘sedentary’) at home, during travel and at work. This change has been directly linked to an increase in health problems, such as poor nutrition, obesity and insulin resistance, which can lead to diabetes. These health problems also increase your risk of developing coronary heart disease.

There are many ways in which adults can sit for long periods throughout the day. A typical day might include sitting:
- to eat breakfast
- to drive to work
- at your desk at work
- to drive home
- to eat dinner
- during the evening to do things such as watch television, use a computer and socialise.

It is very easy to sit too much – adults spend more than half of their waking hours sitting. Therefore, to reduce your risk of health problems, it is important to be aware of how much you sit and try to move more throughout the day.

Why is sitting less better for your health?

Adults who sit less throughout the day have a lower risk of early death – particularly from cardiovascular disease (CVD). Most research so far has been on how watching television affects health, because watching television is the most common leisure activity among adults. Adults who watch less than two hours of television a day are less likely to have type 2 diabetes or be obese, and have a lower risk of developing CVD. The reverse is also true – the more time an adult spends watching television, the higher their risk of health problems.

Adults who do regular planned exercise, such as going to the gym or running, can sit for long periods of time every day. Figure 1 (see page two) shows how easy it is for an adult to spend a large amount of time sitting during a typical working day. In this example, the adult gets 50 minutes of physical activity that day through a brisk walk in the morning and strength training in the evening. However, they also spend 15 hours (over 60% of total waking hours) sitting.

If an adult meets the Australian Government’s physical activity recommendations of 30 minutes or more moderate-intensity physical activity on most, if not all, days of the week, they are classified as ‘physically active’. However, adults may increase their health benefits if they also sit less during the day. In fact, new evidence suggests that, no matter what your total sitting time is, regular interruptions from sitting (even as little as standing up) may help to reduce your risk factors for developing coronary heart disease and diabetes.

Sitting less for children

The arrival of the ‘electronic age’ has fundamentally changed how much time we spend sitting (also called being ‘sedentary’) at home and in other places, such as at school and work. This change has been directly linked to an increase in health problems, such as poor nutrition, obesity and insulin resistance, which can lead to diabetes. These health problems increase your risk of developing coronary heart disease.

There are many opportunities for children and young people to sit for long periods of time. Even children and young people who play sport after school and meet the Physical Activity Recommendations for Children and Adolescents can still spend large amounts of the day sitting. See Figure 1 below for an example of what may be a typical child’s day.

Figure 1. Example of a child’s sitting time during one day (total sitting time 7.5 hours)

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 am</td>
<td>Watch TV (1 hour)</td>
</tr>
<tr>
<td></td>
<td>Travel by car from home to school (15 minutes)</td>
</tr>
<tr>
<td></td>
<td>Morning spent in classroom (2.5 hours)</td>
</tr>
<tr>
<td>8:30 am</td>
<td>Physical activity during recess and lunch (40 minutes)</td>
</tr>
<tr>
<td></td>
<td>Afternoon spent in classroom (2 hours)</td>
</tr>
<tr>
<td></td>
<td>Play computer gaming/watch TV (1 hour)</td>
</tr>
<tr>
<td></td>
<td>Homework (30 minutes)</td>
</tr>
<tr>
<td></td>
<td>Participation in organised sport (50 minutes)</td>
</tr>
<tr>
<td></td>
<td>Travel by car from school to home (15 minutes)</td>
</tr>
</tbody>
</table>

Because it is so easy for children and young people to sit too much, it is important for parents, carers, teachers and health care workers to encourage them to sit less and move more.

Why is sitting less better for children and young people?

Sitting less helps to reduce the risk of children and young people developing health and other problems in later life.

Watching television, using a computer and playing electronic games, which usually involve sitting for long periods of time, are a big part of children’s and young people’s leisure time. Therefore, children and young people who spend less time doing these things have better health than those who spend too much time doing these things.
rapidly-strengthening evidence base

modest evidence base

limited evidence base

i) Identifying relationships of sitting time with health outcomes

ii) measuring sitting time

iii) characterising prevalence and variations of sitting time in populations

iv) identifying the determinants of sitting time

v) developing and testing interventions to influence sitting time

vi) using the relevant evidence to inform public health guidelines and policy
Accelerometer measurement of sedentary time
You can be ‘active’, but mostly sit

The ‘Active’ Couch Potato

Mean mod-to-vigorous time = 31 mins/day
% Waking hours spent in Sedentary = 71%

<table>
<thead>
<tr>
<th>Time (minutes)</th>
<th>Activity Intensity</th>
<th>Energy Expenditure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Night</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Moderate/vigorous Very High
Light
Sedentary Very Low
Sedentary time

Moderate-vigorous activities

Light-intensity

Well-Understood, Powerful Biological Stimulus

BUT

Low Total Volume

Newly-Emerging, Unique Biological Stimulus?

AND

Very Large Total Volume

Differentiating the Domain of NEAT (James Levine)
The ‘breaks in sedentary time’ hypothesis

Breaking-up sedentary time (with frequent transitions from sitting to standing) has beneficial associations with markers (independent of total sedentary time)

Sedentary time & breaks in sedentary time
NHANES 2003-2006

- **Sedentary time:** detrimental
  HDL-C, triglycerides, insulin, HOMA-%B, HOMA-%S

- **Breaks:** beneficial
  Waist circumference, HDL-C, C-reactive protein

4.3cm difference

**Adjusted for age, sex, race/ethnicity, moderate-vigorous intensity activity + other potential confounders**

**Breaks in sedentary time additionally adjusted for total sedentary time**

Breaking Up Prolonged Sitting Reduces Postprandial Glucose and Insulin Responses

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Bronwyn A. Kingwell, PhD¹  
Robyn Larsen, PhD¹  
Genevieve N. Healy, PhD¹,³  
Ester Cerin, PhD⁶  
Marc T. Hamilton, PhD⁷  
Jonathan E. Shaw, MD¹,²  
David A. Bertovic, FRACP¹  
Paul Z. Zimmet, MD¹,²  
Jo Salmon, PhD⁴  
Neville Owen, PhD¹,³

E-pub 28th Feb, 2012
Study Protocol
**IDLE Breaks: Initial Findings**

**GLUCOSE**

![Graph showing glucose levels](image)

**INSULIN**

![Graph showing insulin levels](image)

Dunstan *et al.* (unpublished findings)

* p<0.001, # p<0.01
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Ecological Model of Four Domains of Sedentary Behavior

Behavior: Active Living Domains
- Negative perceptions of "active" environments: unsafe, uncomfortable, unattractive, inconvenient

Perceived Environment
- Comfort, convenience of labor saving devices, attractiveness of sedentary entertainment
- Social norms, Perceived crime
- Interpersonal modeling, social support, prompts to sit, awkwardness of standing
- Cues for sitting, purpose of furniture/desk
- Social climate, safety, crime, norms, culture

Transport
- Info promoting SB during transport
- Safety signage
- Radio ads & news
- Billboards

Workplace Environment
- Furniture designed for sitting
- Building design
- Stair design
- Ped/Bike Facilities

School Environment
- Neighborhood walkability
- Ped/bike facilities
- Facilities
- PE program
- Safe Routes to School

Household
- Demographics
- Biological
- Psychological
- Family Situation

- Home Environment
  - Electronic entertainment; passive/active
  - Remote controls
  - Furniture for sitting/reclining

- Recreation Environment
  - Seating in Parks
  - Park design to promote sitting
  - Screen-based entertainments: movies, game arcades, Sport spectatorship

- Leisure Time
  - Negative perceptions of "active" environments: unsafe, uncomfortable, unattractive, inconvenient
  - Concierge, convenience of labor saving devices, attractiveness of sedentary entertainment

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Sedentary behaviour measurement

How best to characterise sedentary time: total time; breaking-up, bouts of defined durations?

Making the best of both device-based and self-report measurement tools

Context-anchored measurement: identifying the volume and patterns of sitting time in key sedentary behaviour settings (workplace; domestic; transportation)

Capturing behavioural and contextual attributes concurrently
now for some good science!
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