Sedentary Behaviour: Definitions and Distinctions for Cancer-Prevention Research

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Awake 7 am

Breakfast 15 mins

Transport to work 45 mins

Work on computer 3.5 hrs

Lunch 30 mins

Work on computer 4 hrs

Transport From work 45 mins

Evening meal 30 mins

Watch TV 4 hrs

Exercise – 30 min

Sleep 11 pm

Sitting Opportunities 15.5 hrs
Sedentary behaviour

Public Health Physical Activity Guidelines: time spent in moderate-vigorous activity

<table>
<thead>
<tr>
<th>Activity</th>
<th>METs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sitting quietly (watching TV)</td>
<td>1.0</td>
</tr>
<tr>
<td>Sitting (talking)</td>
<td>1.5</td>
</tr>
<tr>
<td>Sitting (desk work)</td>
<td>1.8</td>
</tr>
<tr>
<td>Sleeping</td>
<td>0.9</td>
</tr>
<tr>
<td>Standing</td>
<td>2.0</td>
</tr>
<tr>
<td>Slow walking</td>
<td>2.5</td>
</tr>
<tr>
<td>Brisk walking</td>
<td>3.8</td>
</tr>
</tbody>
</table>

Sitting induces muscular inactivity

4 STEPS

GETTING OUT OF A CHAIR

SITTING

STANDING

Sedentary behaviour and health: a traffic-light system for the status of the science

1. Identifying relationships of sitting time with health outcomes

2. measuring sitting time

3. characterising prevalence and variations of sitting time in populations

4. identifying the determinants of sitting time

5. developing and testing interventions to influence sitting time

6. using the relevant evidence to inform programs and policy

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Australian Diabetes, Obesity & Lifestyle Study *

AusDiab1, AusDiab2 (AusDiab3, 2011-12)

population-based observational and cohort study 1999/2000 (n=11,247) and 2004/2005 (n=9,303)

aim to estimate national prevalence of diabetes and its precursors in Australian adults ≥ 25 years

* www.bakeridi.edu.au/ausdiab
AusDiab1 - TV time: summary of cross-sectional findings

TV time in AusDiab1 associated with:

- Abnormal glucose metabolism \(^1\)
- Metabolic syndrome \(^2\)
- Elevated 2-h plasma glucose \(^3,4\) and other glycaemic measures \(^3\)
- Associations independent of leisure-time physical activity
- Associations generally stronger for women than for men

\(^1\) Dunstan et al., Diabetes Care 2004; \(^2\) Dunstan et al., Diabetologia 2005; \(^3\) Dunstan et al., Diabetes Care 2007; \(^4\) Healy et al., Diabetes Care 2007
AusDiab2: overall sitting time and biomarkers

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Device-based measurement of movement and posture

Accelerometer

The ‘market dominator’ from whose output (counts of less than 100 pm) we infer ‘sedentary’ time

Inclinometer

From whose output we can derive posture-based indices of ‘sitting’ time
You can be ‘active’, but mostly sit

The ‘Active’ Couch Potato

<table>
<thead>
<tr>
<th>Time (minutes)</th>
<th>Morning</th>
<th>Night</th>
<th>Activity Intensity</th>
<th>Energy Expenditure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sedentary</td>
<td></td>
<td></td>
<td>Very Low</td>
<td>Very Low</td>
</tr>
<tr>
<td>Light</td>
<td></td>
<td></td>
<td>Very High</td>
<td>Very High</td>
</tr>
<tr>
<td>Moderate/vigorous</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Mean mod-to-vigorous time = 31 mins/day
% Waking hours spent in Sedentary = 71%
How adults’ overall daily movement patterns are distributed over physically-active and sedentary time

- Sedentary time: 9.3 hrs/day (60%)
- Light-intensity: 6.5 hrs/day (35%)
- Moderate-vigorous activities: 0.7 hrs/day (5%)

The ‘breaks in sedentary time’ hypothesis

Breaking-up sedentary time (with frequent transitions from sitting to standing) has beneficial associations biomarkers (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

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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*

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The range of variation in adults’ sedentary time

Quartiles of sedentary time. Based on 1 week of accelerometer data in 1712 adults, these stacked column graphs show the allocation of waking hours spent sedentary, in light activity, and in exercise, from the lower to the upper quartile of overall sedentary time; data from the National Health and Nutrition Examination Survey.

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Multiple dimensions of influence on behaviour

Behaviour-specific models are needed

Environments can directly influence behaviour

**Behavior settings** – ‘restrict the range of behaviors, by promoting and sometimes demanding certain actions and by discouraging or prohibiting others...’

Thinking about multiple influences on physically-active and sedentary time

- Intraperisonal
  - Biological
  - Psychological
- Interpersonal
- Physical Environment
- Policy Context

our conventional ‘comfort zone’ for causation and explanation
Unstandardised regression coefficients (and 95% confidence intervals); differences in TV viewing time (min/day) compared to the reference category (low walkability)

Sedentary time and neighborhood walkability; an emerging scientific puzzle

**Australia (Adelaide):** TV time significantly lower among women in high-walkable neighbourhoods

**USA (Baltimore and Seattle):** Overall sedentary time (accelerometer assessed), TV time and time sitting in cars significantly lower for men and women high-walkable neighbourhoods

**Belgium (Ghent):** Overall sedentary time (accelerometer assessed) significantly higher for men and women high-walkable neighbourhoods

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Understanding the **acute** metabolic effects of prolonged sitting in adults

**The IDLE Breaks study**
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SITTING INCREASES RISK OF DEATH UP TO 40%

Sitting 6+ hours per day makes you up to 40% likelier to die within 15 years than someone who sits less than 3. Even if you exercise.

Average Physical Activity (Waking Hours):

- Sedentary
- Low-Intensity Physical Activity (Walking, Standing)
- Medium-Vigorous Physical Activity (Running, Sports)

Studies show that reducing sitting time helps. It's clear that sitting is killing us: but how?

Graphic thanks to Medical Billing & Coding http://www.medicalbillingandcoding.org/sitting-kills/
Heart Foundation

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’s 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’s 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 sedentary 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 still sit for long periods of time every day. Figure 1 (see page 2) 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 60 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) play a role in reducing your risk factors for developing coronary heart disease and diabetes."

http://www.heartfoundation.org.au/Healthy_Living/Physical_Activity/Pages/default.aspx
Quantity and Quality of Exercise for Developing and Maintaining Cardiorespiratory, Musculoskeletal, and Neuromotor Fitness in Apparently Healthy Adults: Guidance for Prescribing Exercise

This pronouncement was written for the American College of Sports Medicine by Carol Ewing Garber, Ph.D., FACSM, (Chair); Bryan Blissmer, Ph.D.; Michael R. Deschenes, Ph.D., FACSM; Barry A. Franklin, Ph.D., FACSM; Michael J. Lamonte, Ph.D., FACSM; I-Ming D., Sc.D., FACSM; David C. Nieman, Ph.D., FACSM; and I. Swain, Ph.D., FACSM.

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ACSM Position Stand: Guidance for Prescribing Exercise (2011) – Sedentary Behaviour

1. Sitting = television watching, computer use, and sitting in a car or at a desk.

2. Spending long periods of sitting =
   - CHD mortality, depression, increased waist circumference, elevated blood pressure, worsened chronic disease biomarkers such as blood glucose, insulin, and lipoproteins

3. Sitting is detrimental even among individuals who meet current physical activity recommendations

4. “health and fitness professionals should be concerned about the amount of time clients spend in activities such as television watching and sitting at a desk”
Sedentary behavior and cancer: research opportunities

Re-analyses of prospective epidemiological data sets, treating sitting time as distinct exposure variable?

Valid and reliable self-report AND device-based measures for epidemiological, genetic and behavioral studies

Characterizing sedentary behavior variables: total time; breaks; prolonged bouts; sedentary/light balance; sedentary/moderate balance; time-of-day variations
Sedentary behavior/microcirculation relationships (e.g., kidneys; retina) as potential markers of inflammation

What amounts and intensities of moderate and/or vigorous activity might be protective, in the presence of prolonged sitting time?

Identifying potential pathways through gene-expression studies.

Genetic variations that may underlie predispositions to sit, and/or greater risk susceptibility
Sedentary behavior and cancer: research opportunities

Feasibility of reducing and/or breaking up prolonged sitting, for different groups (younger, older, cancer-type survivors) in different settings (workplace, domestic, transit)?

If intervention trials find significant changes in sitting time indices, are there improvements in relevant biomarkers?

Mortality outcomes require considerable patience and are solid and categorical: but, device-based data with biomarker and gene-expression changes allow *acute and medium-term intervention impacts on pathways* to be examined.
Sedentary behavior and cancer: research opportunities

Sedentary time indices in built-environment/physical activity studies (IPEN 11-country study; the ‘Belgian paradox’)

Evidence on behavioural, adiposity and biomarker changes from ‘natural experiments’ (height-adjustable workstations; community infrastructure initiatives)

Strong behavioral criteria to guide environmental, organizational and policy initiatives on ‘too much sitting’ (dose-response data from device-based measurement, with biomarker and mortality outcomes)
THANK YOU FOR YOUR INTEREST