



Meeting 3

Sedentary Behavior

Chair: Peter Katzmarzyk

Members: John Jakicic, Ken Powell

Experts and Consultants



- Invited experts: None
- Consultants: None

Subcommittee Questions

1. What is the relationship between sedentary behavior and all-cause mortality?
2. What is the relationship between sedentary behavior and mortality from cardiovascular disease?
3. What is the relationship between sedentary behavior and mortality from cancer?
4. What is the relationship between sedentary behavior and incidence of (1) diabetes, (2) obesity, (3) cardiovascular disease and (4) cancer?
5. Is there a level of physical activity which negates the negative health effects of sedentary behavior?

Question 1

1. What is the relationship between sedentary behavior and all-cause mortality?
 - a) Is there a dose-response relationship? If yes, what is the shape of the relationship?
 - b) Does the relationship vary by age, sex, race/ethnicity, or socio-economic status?
 - c) Is the relationship independent of levels of light, moderate, or vigorous physical activity?
 - d) Is there evidence that bouts or breaks in sedentary behavior are important factors?
- Source of evidence to answer question
 - Systematic Reviews, Meta-Analyses, Original Research

Analytical Framework (Q1-3)

Systematic Review Questions

- Q1. What is the relationship between sedentary behavior and all-cause mortality?
- Q2. What is the relationship between sedentary behavior and mortality from cardiovascular disease?
- Q3. What is the relationship between sedentary behavior and mortality from cancer?

Target Population

Adults, 18 years and older

Comparison

Adults who participant in varying levels and types of sedentary behavior

Exposure

Sedentary behavior

- Total sitting time
- Screen time
- Leisure-time sitting
- Occupational sitting time
- Objective measures of sedentary time

Endpoint Health Outcomes

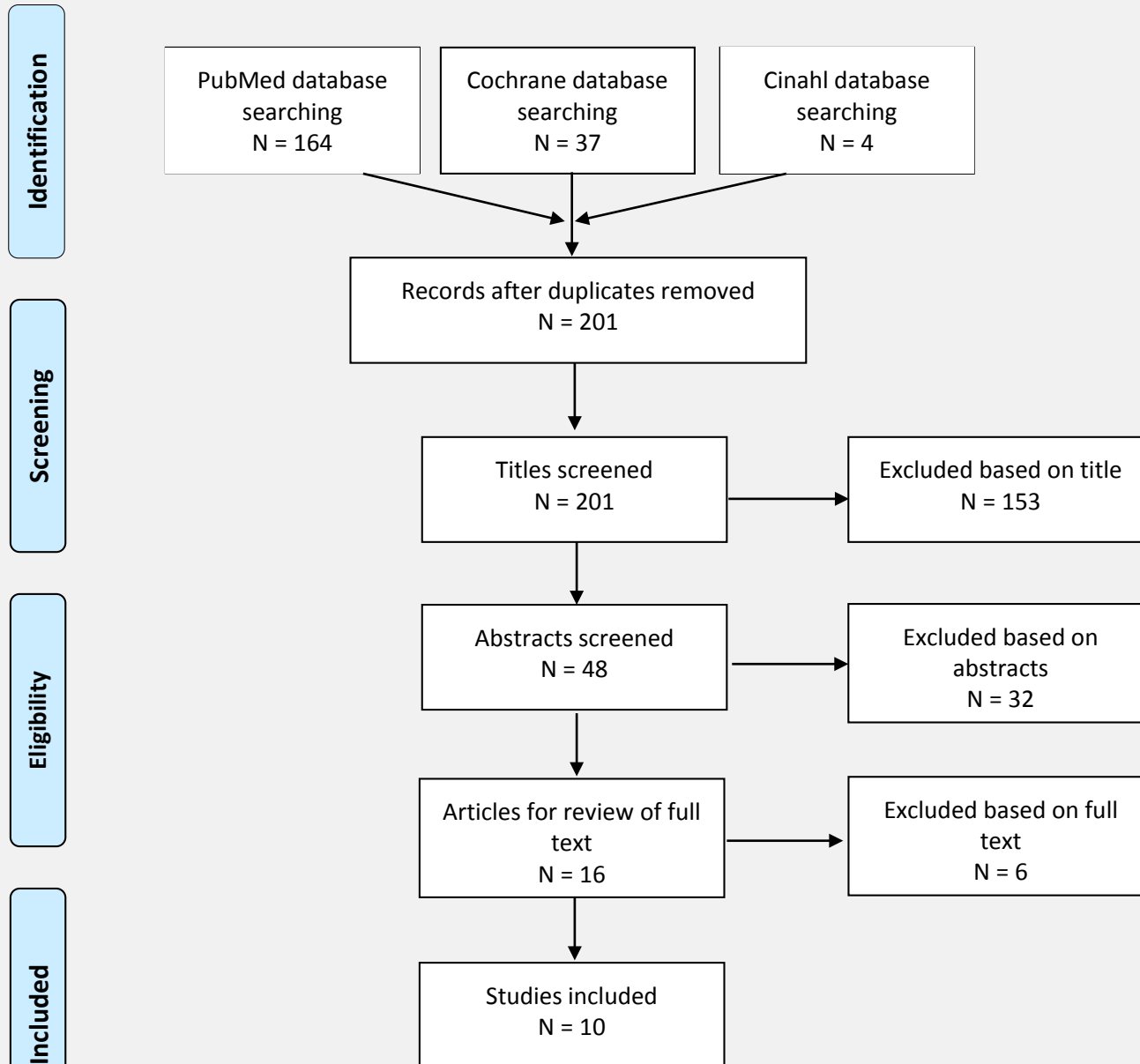
Incidence of:

- All-cause mortality
- Cardiovascular disease mortality
- Cancer mortality

Key Definitions

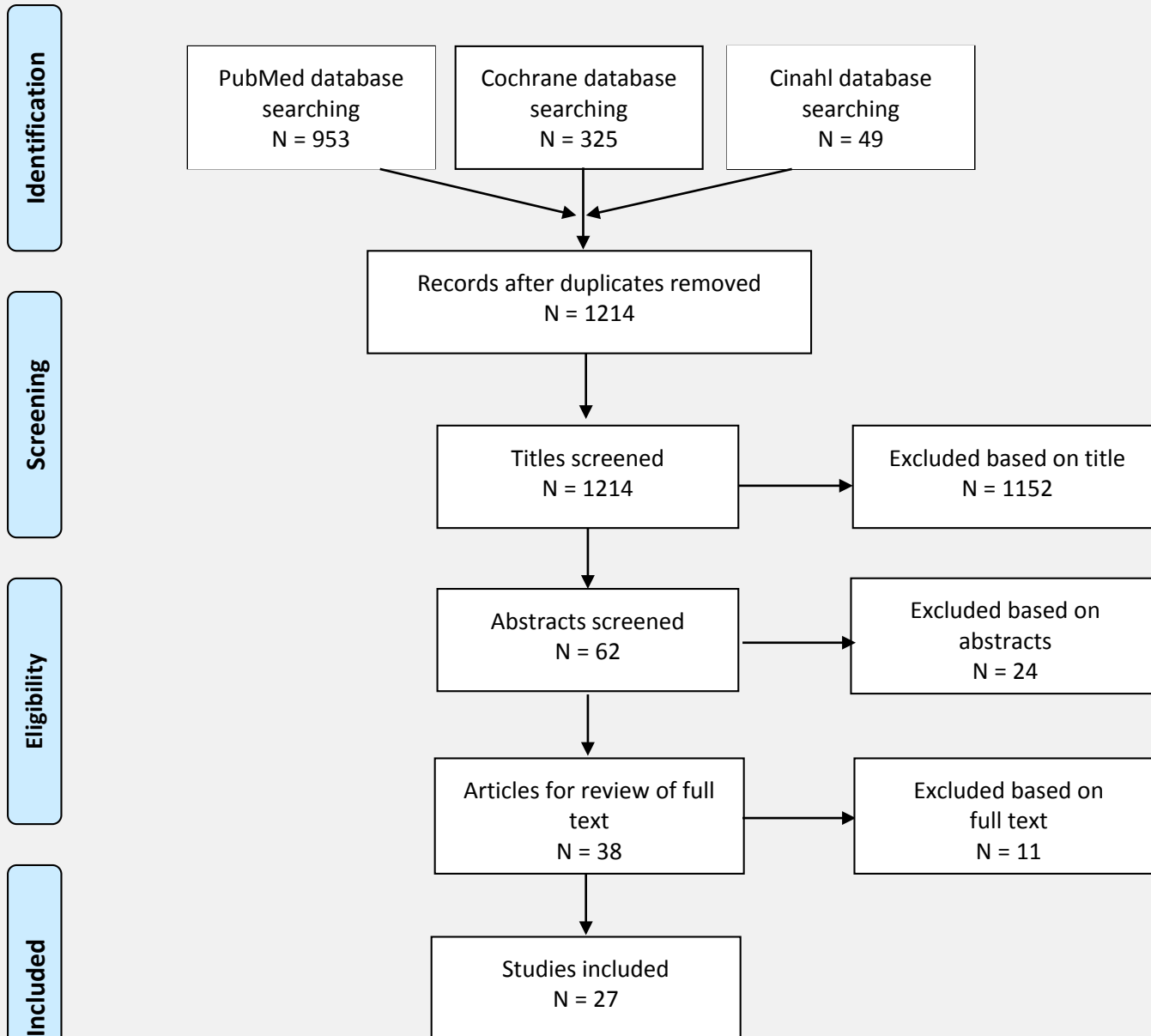
Sedentary Behavior: In general any waking behavior characterized by an energy expenditure ≤ 1.5 METs while in a sitting or reclining posture (Sedentary Behaviour Research Network. Standardized use of the terms "sedentary" and "sedentary behaviours". *Appl Physiol Nutr Metab* 2012;37:540-542).

Search Results Q1: High-Quality Reviews¹



¹ Reviews include systematic reviews, meta-analyses, and pooled analyses.

Search Results Q1: Original Research¹



¹ Supplemental search with inclusion January 2014- January 2017

Description of the Evidence



Sources of Evidence Included:

- 1) Systematic reviews and meta-analyses published from the inception dates of the PubMed, Cochrane and Cinahl databases to December 5, 2016 (n = 10)
- 2) Relevant original research articles cited by the systematic reviews and meta-analyses, and (n = 20)
- 3) Recent original research articles published between January 2014 and January 30, 2017 (n = 27).

Draft Key Findings

Evidence for a Relationship

A meta-analysis of 14 prospective cohort studies reported a HR of **1.22 (95% CI: 1.09-1.41)** for the relationship between sedentary behavior and all-cause mortality.*

Evidence for a Dose-Response Relationship

A meta-analysis of daily sitting time and all-cause mortality reported a spline model of best fit had HRs of 1.00 (95% CI: 0.98-1.03), 1.02 (95% CI: 0.99-1.05) and 1.05 (95% CI: 1.02-1.08) for every 1-hour increase in daily sitting time in intervals between 0-3, >3-7 and >7 h/day total sitting, respectively.**

A meta-analysis of TV viewing and all-cause mortality reported a statistically significantly relationship with all-cause mortality risk in a curvilinear fashion ($P_{\text{nonlinearity}} = 0.001$).***

*Biswas et al. *Arch Intern Med.* 2015;162:123-32; ** Chau et al. *PLOS One* 2013;8:e80000; ***Sun et al. *Am J Epidemiol* 2015;182:908-16.

Draft Key Findings

Does the Relationship Vary by Age, Sex, Race/Ethnicity, or Socio-economic Status?

- The available evidence suggests that the observed relationship between sedentary behavior and all-cause mortality applies broadly to the general adult population of the United States.
- In general, studies reported no significant effect modification by age, sex or race/ethnicity, and age- sex-, and race/ethnicity-stratified analyses were generally significant in all strata.

Draft Key Findings

Is the Relationship Independent of Levels of Light, Moderate, or Vigorous Physical Activity?

A meta-analysis of 6 prospective cohort studies* reported differential risk associated with sedentary behavior across levels of physical activity:

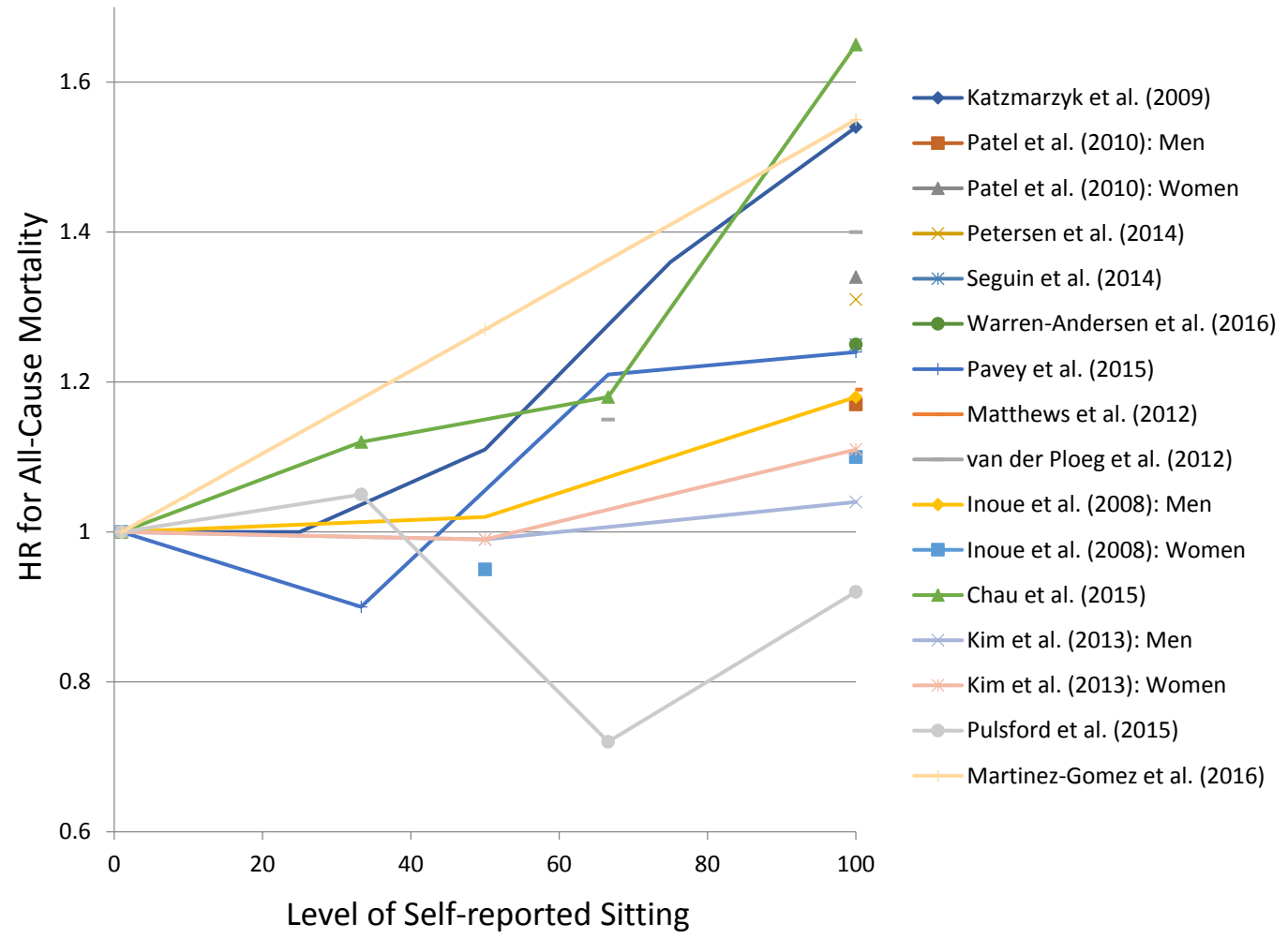
- Low Activity Level, High Sedentary Time: HR = 1.46 (95% C.I.:1.22-1.75)
- High Activity Level, High Sedentary Time: HR = 1.16 (95% C.I.: 0.84-1.56)

A meta-analysis of 13 prospective cohort studies and over 1 million adults** examined the joint associations between sedentary time, physical activity and all-cause mortality:

- High levels of moderate intensity physical activity (i.e., about 60–75 min per day) eliminated the increased risk of death associated with high sitting time.
- This high activity level attenuates, but does not eliminate the increased risk associated with high TV-viewing time.

*Biswas et al. *Arch Intern Med.* 2015;162:123-32; **Ekelund et al. *Lancet* 2016;388:1302-10.

Draft Key Findings



Draft Key Findings

Role of Bouts or Breaks in Sedentary Behavior

Only one study was identified that included bouts of sedentary behavior in their definition of the exposure*:

- Using accelerometry data from NHANES, sedentary bouts were defined as ≥ 30 minutes with at least 80% of the minutes < 100 counts/min minute, allowing for < 5 consecutive minutes above the threshold.
- Based on latent class analysis, the class with the highest percentage of the day in sedentary bouts had a higher risk of all-cause mortality compared to the class with the fewer sedentary bouts (HR = 2.10; 95 % C.I.: 1.11-3.97).

*Evenson et al. *Am J Prev Med* 2017;52:135-43.

Draft Conclusion Statement

- a) Strong evidence demonstrates a significant relationship between greater time spent in sedentary behavior and higher all-cause mortality rates. **PAGAC Grade: Strong.**
- b) Strong evidence demonstrates the existence of a direct, curvilinear dose-response relationship between sedentary behavior and all-cause mortality with an increasing slope at higher levels of sedentary behavior. **PAGAC Grade: Strong.**
- c) Limited evidence suggests that the relationship between sedentary behavior and all-cause mortality does not vary by age, sex or ethnicity. **PAGAC Grade: Limited.** There is insufficient evidence available to determine if the relationship between sedentary behavior and all-cause mortality varies by socio-economic status. **PAGAC Grade: Grade not assignable.**
- d) Strong evidence demonstrates that the relationship between sedentary behavior and all-cause mortality varies by levels of moderate-to-vigorous physical activity. **PAGAC Grade: Strong.**
- e) There is insufficient evidence available that bouts or breaks in sedentary behavior are important factors in the relationship between sedentary behavior and all-cause mortality. **PAGAC Grade: Grade not assignable.**

Draft Implications

- The evidence suggests that the risk of all-cause mortality increases with the hours spent in sedentary behavior.
- Thus, it is prudent to limit excessive time spent sitting.
- Further, it appears as though the elevated risk associated with sedentary behavior can be offset by higher levels of moderate-to-vigorous physical activity.
- Therefore, moderate-to-vigorous physical activity as part of every adult's lifestyle is beneficial, especially for those who sit for large portions of the day.

Draft Research Recommendations

- Given the lack of information on the role of bouts and breaks in sedentary behavior in relation to all-cause mortality, there is a great need for rigorously designed research on this topic.
- There is also a need for further research on the interactive effects of physical activity and sedentary behavior on all-cause mortality, especially on the role of light activity on attenuating the relationship between sitting and all-cause mortality.

Committee Discussion



1. What is the relationship between sedentary behavior and all-cause mortality?