Meeting 4

# 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 (1) type 2 diabetes, (2) weight status, (3) cardiovascular disease and (4) cancer?

5. Does the effect of moderate-to-vigorous physical activity on all-cause mortality vary by level of sedentary behavior?

# Question #2

- What is the relationship between sedentary behavior and mortality from cardiovascular disease?
  - 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, socio-economic status, or weight status?
  - c) Is the relationship independent of levels of light, moderate, or vigorous physical activity?
  - d) Is there any evidence that bouts or breaks in sedentary behavior are important factors?
- Source of evidence to answer question:
  - – Combination of SR/MA/Existing report and de novo systematic review of original articles

# 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 participate in varying levels and types of sedentary behavior

**Exposure**

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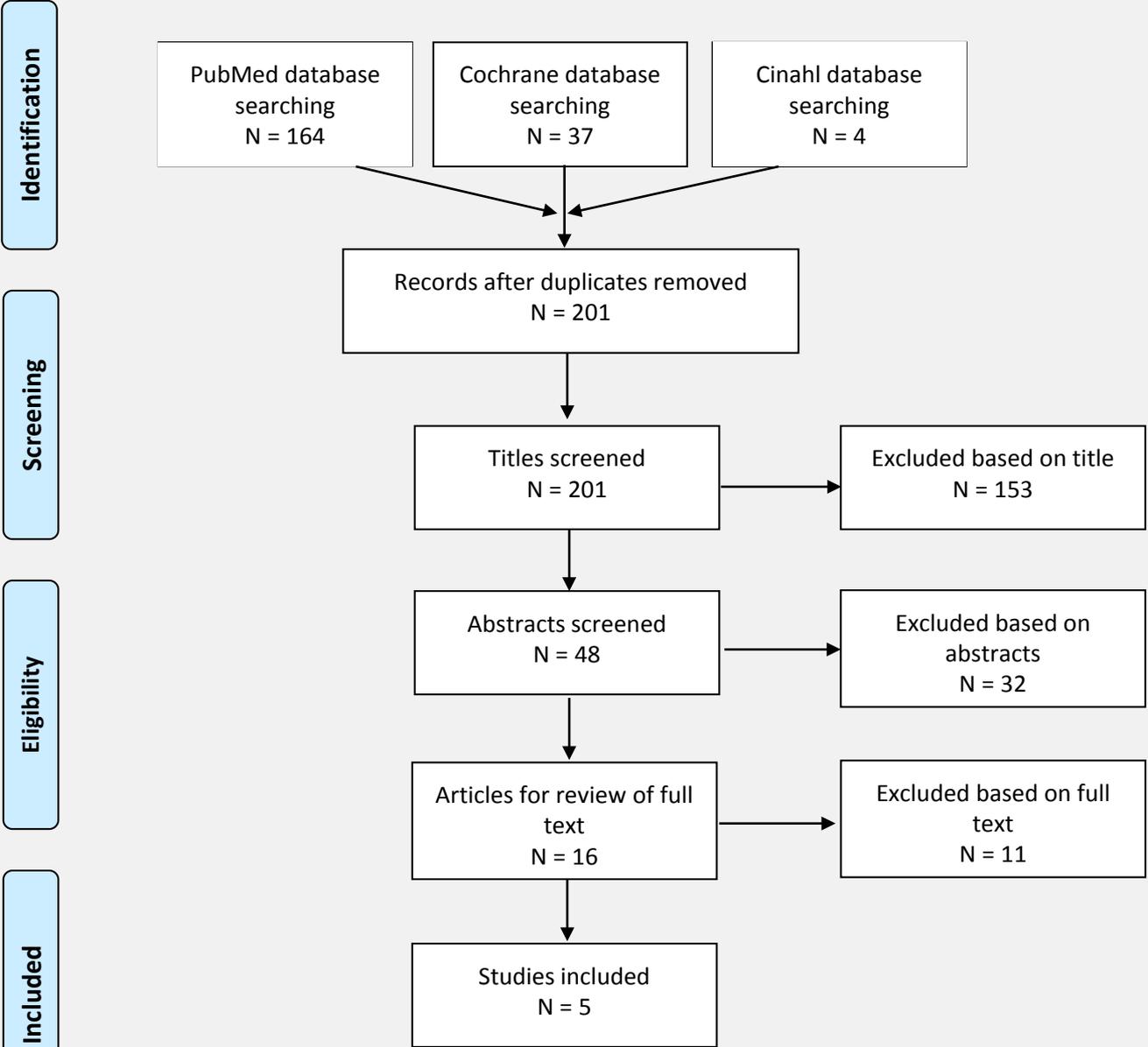- Occupational sitting time
- Objective measures of sedentary time

**Key Definitions**

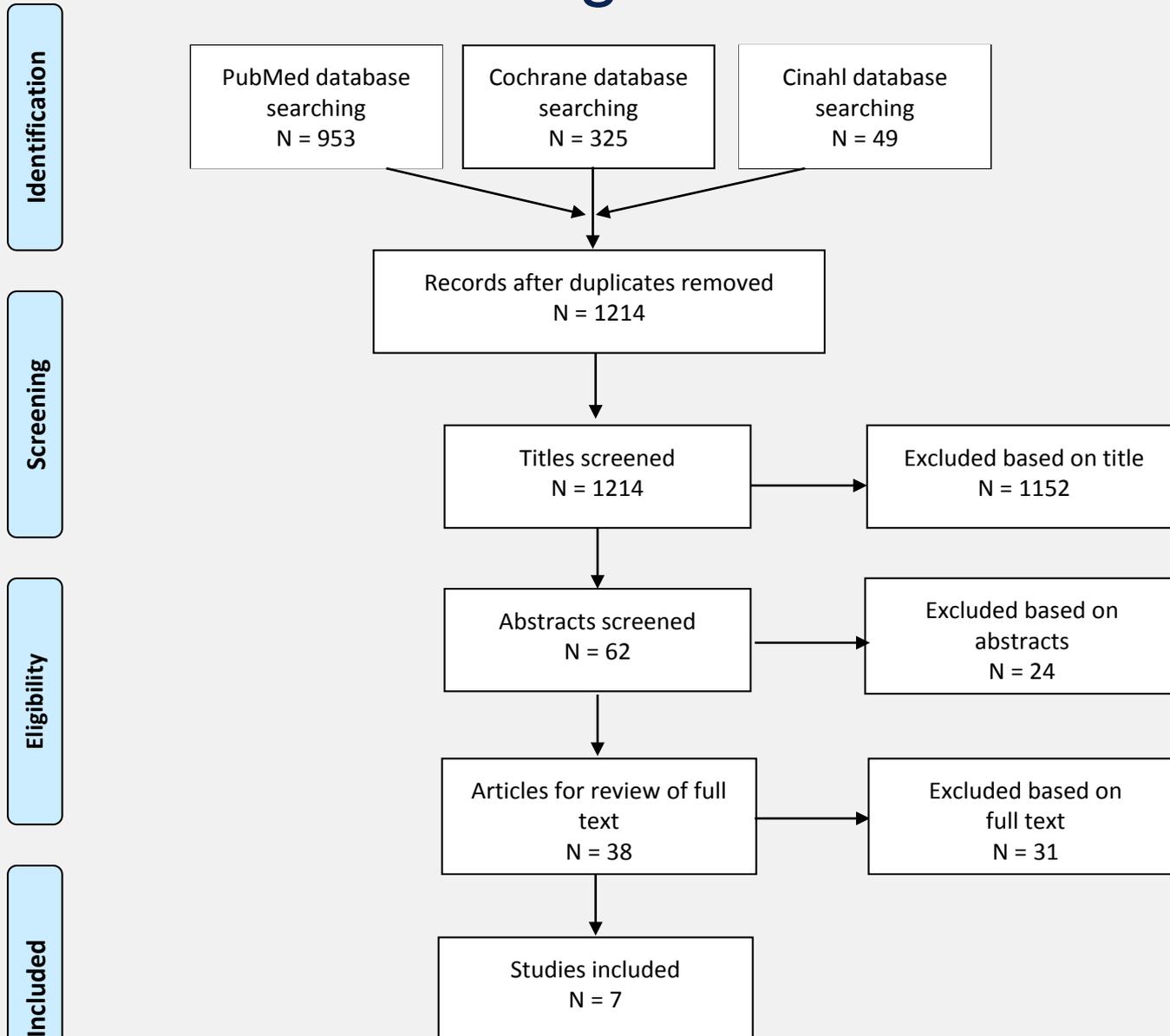Sedentary Behavior: In general any waking behavior characterized by an energy expenditure ≤1.5 METs while in a sitting or reclining posture (Sedentary Behaviour Research Network. Standardized use of the terms "sedentary" and "sedentary behaviours". *Appl Physiol Nutr Metab* 2012;37:540-542).

**Endpoint Health Outcomes**

Incidence of:
- All-cause mortality
- Cardiovascular disease mortality
- Cancer mortality

# Search Results Q2: High-Quality Reviews[1]



**Identification**

| PubMed database searching N = 164 | Cochrane database searching N = 37 | Cinahl database searching N = 4 |

Records after duplicates removed
N = 201

**Screening**

Titles screened
N = 201 → Excluded based on title
N = 153

**Eligibility**

Abstracts screened
N = 48 → Excluded based on abstracts
N = 32

Articles for review of full text
N = 16 → Excluded based on full text
N = 11

**Included**

Studies included
N = 5

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

# Search Results Q2: Original Research[1]



**Identification**

| PubMed database searching N = 953 | Cochrane database searching N = 325 | Cinahl database searching N = 49 |

Records after duplicates removed
N = 1214

**Screening**

Titles screened
N = 1214 → Excluded based on title
N = 1152

**Eligibility**

Abstracts screened
N = 62 → Excluded based on abstracts
N = 24

Articles for review of full text
N = 38 → Excluded based on full text
N = 31

**Included**

Studies included
N = 7

[1] Supplemental search with inclusion January 1, 2014- January 30, 2017

# Description of the Evidence

## Sources of Evidence Included:

1.  Systematic reviews and meta-analyses published from 2000 to December 5, 2016 databases (n=5)

2.  Relevant original research articles cited by the systematic reviews and meta-analyses, and (n=11)

3.  Recent original research articles published between January 2014 and January 30, 2017 (n=7)

# *Draft* Key Findings

## Overall Association

- 5 SRs/MAs that reviewed 11 original studies have addressed the relationship between sedentary behavior and CVD mortality, and they provide strong evidence demonstrating a significant relationship between sedentary behavior and CVD mortality.

- Biswas et al. [2015] analyzed 7 cohort studies and reported a HR of **1.15 (95% CI: 1.11-1.20).**

- Wilmot et al.[2012] analyzed 8 cohort studies and reported a HR of **1.90 (95% CI: 1.36-2.66).**

# *Draft* Key Findings

<u>Dose-Response</u>

- The results of a pooled analysis of 11 prospective cohort studies by Ekelund et al. [2016] demonstrated that the associations among sedentary behavior, moderate-to-vigorous physical activity and CVD mortality were similar to those observed for all-cause mortality.

**Figure 3. Relationship between sitting and CVD mortality, stratified by levels of MVPA**
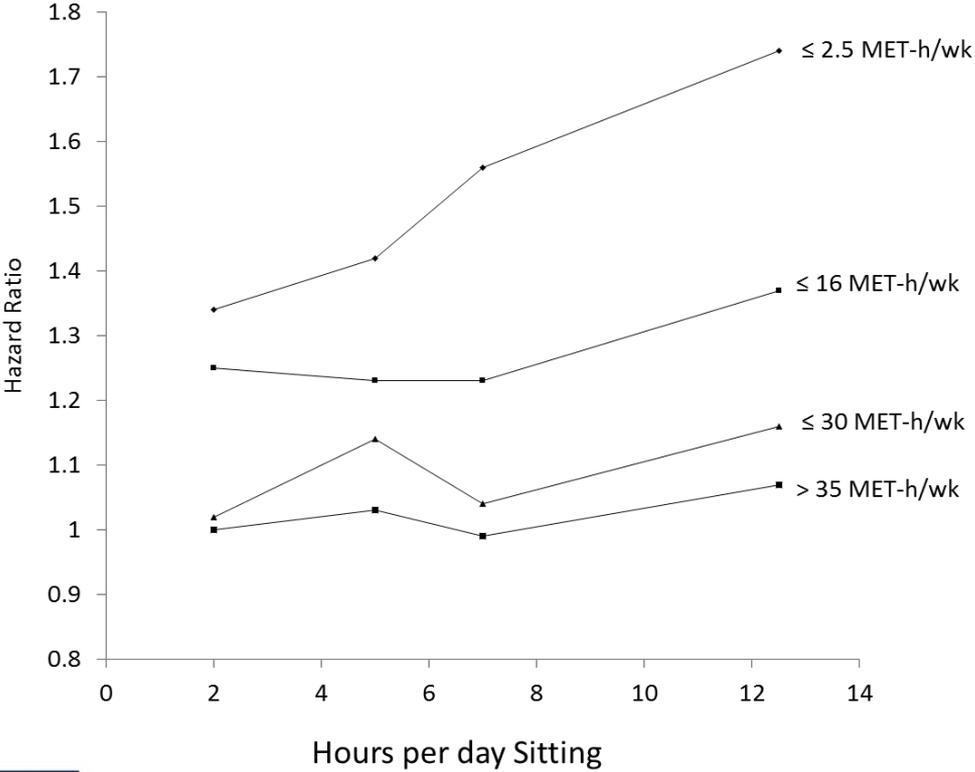
# *Draft* Conclusion Statement

- Strong evidence demonstrates a significant relationship between greater time spent in sedentary behavior and higher mortality rates from CVD. **PAGAC Grade: Strong**

- Strong evidence demonstrates the existence of a direct, positive dose-response relationship between sedentary behavior and mortality from CVD. **PAGAC Grade: Strong**

- Limited evidence suggests that the relationship between sedentary behavior and CVD mortality does not vary by age, sex, race/ethnicity, or weight status. **PAGAC Grade: Limited.** Available evidence is insufficient to determine whether the relationship between sedentary behavior and mortality from CVD varies by socio-economic status. **PAGAC Grade: Grade not assignable**

- Moderate evidence indicates that the relationship between sedentary behavior and mortality from CVD varies by levels of moderate-to-vigorous physical activity. **PAGAC Grade: Moderate**

- Insufficient evidence is available that bouts or breaks in sedentary behavior are important factors in the relationship between sedentary behavior and mortality from CVD. **PAGAC Grade: Grade not assignable**
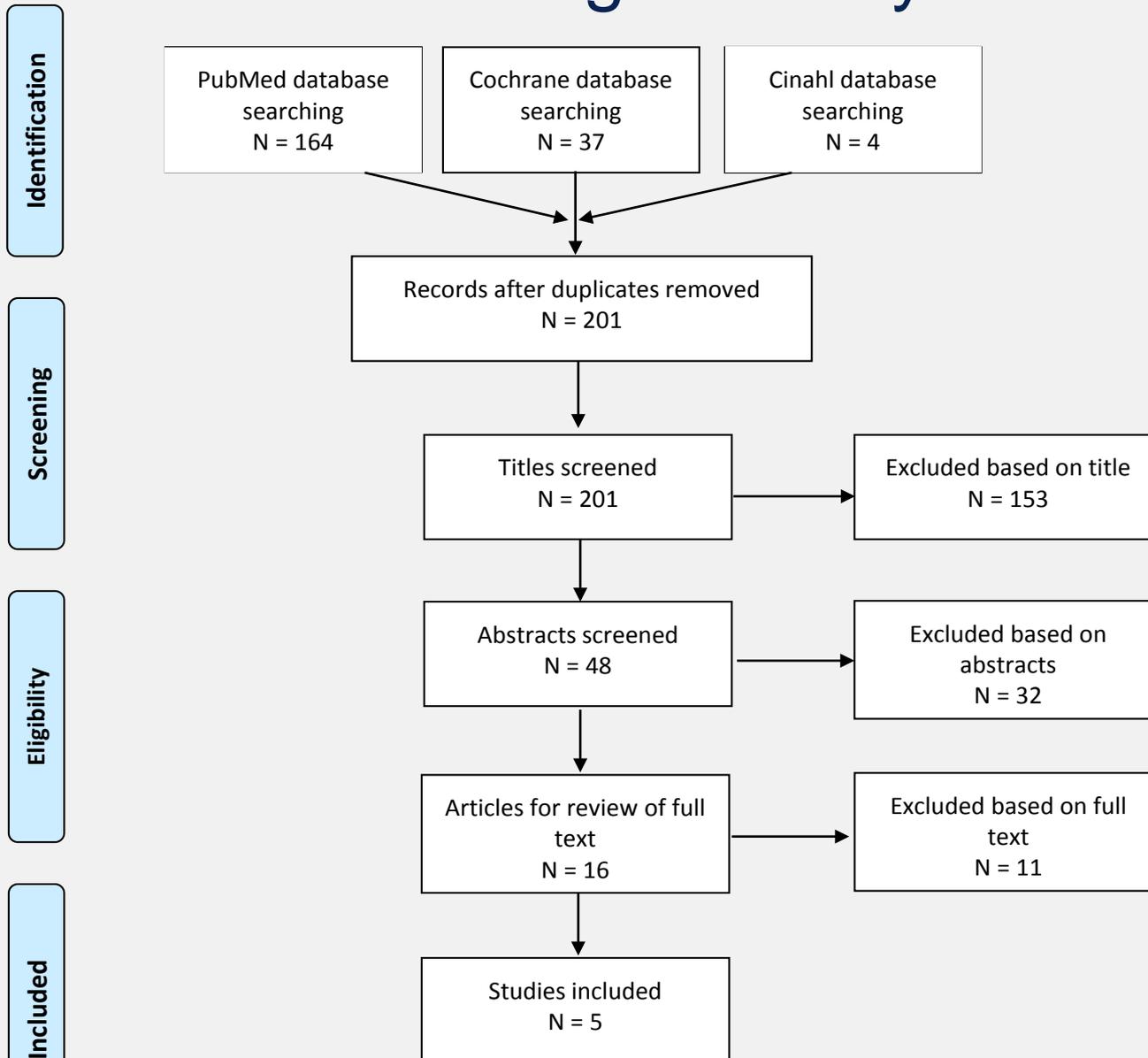
# Committee Discussion Q#2

- What is the relationship between sedentary behavior and mortality from cardiovascular disease?
  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, socio-economic status, or weight status?
  c) Is the relationship independent of levels of light, moderate, or vigorous physical activity?
  d) Is there any evidence that bouts or breaks in sedentary behavior are important factors?
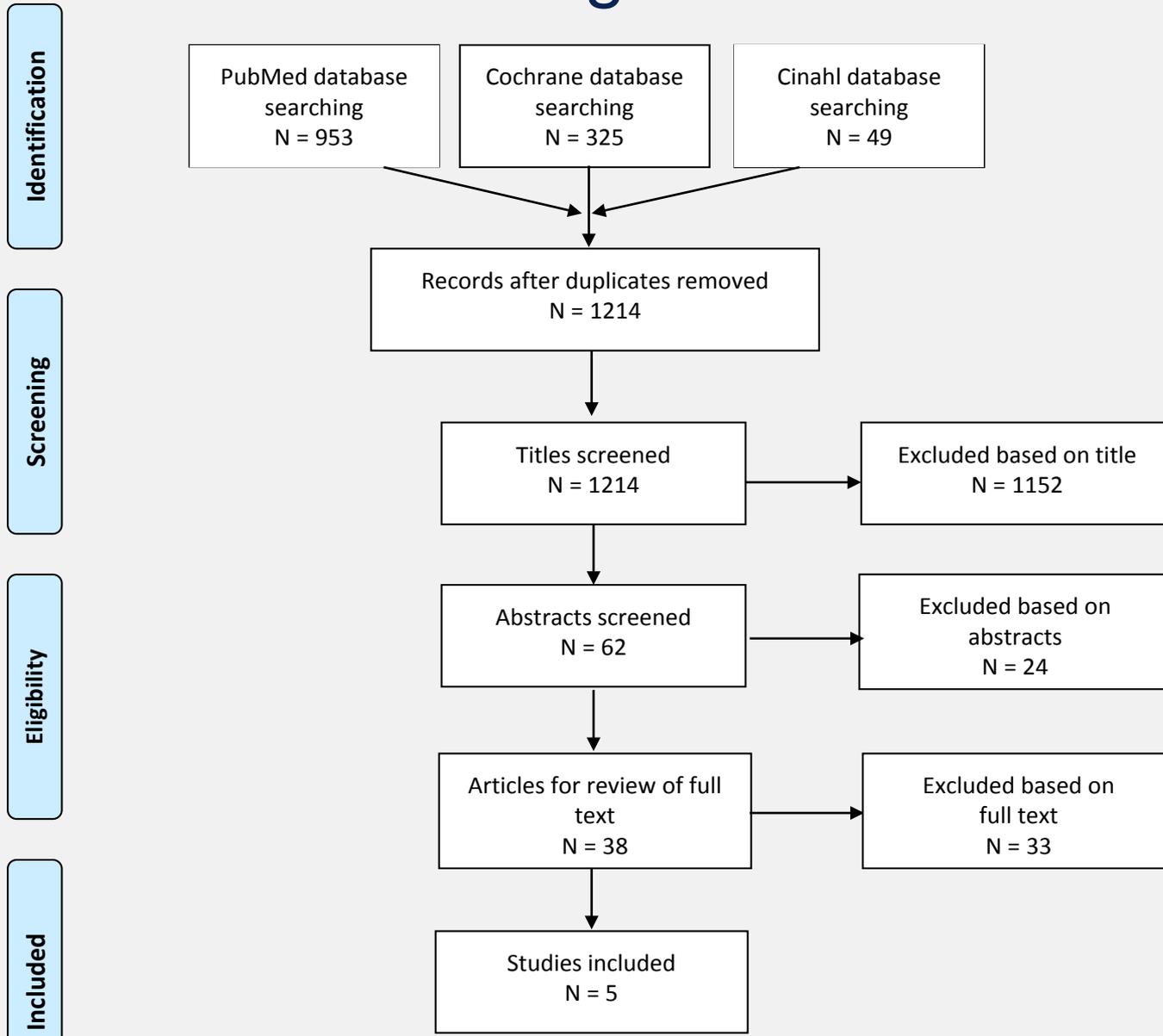
# Question #3

- What is the relationship between sedentary behavior and mortality from cancer?

  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, socio-economic status, or weight status?

  c) Is the relationship independent of levels of light, moderate, or vigorous physical activity?

  d) Is there any evidence that bouts or breaks in sedentary behavior are important factors?

- Source of evidence to answer question:
  – Combination of SR/MA/Existing report and de novo systematic review of original articles

# Search Results Q3: High-Quality Reviews[1]

**Identification**

| PubMed database searching N = 164 | Cochrane database searching N = 37 | Cinahl database searching N = 4 |

Records after duplicates removed
N = 201

**Screening**

Titles screened
N = 201

Excluded based on title
N = 153

Abstracts screened
N = 48

Excluded based on abstracts
N = 32

**Eligibility**

Articles for review of full text
N = 16

Excluded based on full text
N = 11

**Included**

Studies included
N = 5

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

# Search Results Q3: Original Research[1]

**Identification**

| PubMed database searching N = 953 | Cochrane database searching N = 325 | Cinahl database searching N = 49 |

Records after duplicates removed
N = 1214

**Screening**

Titles screened
N = 1214 → Excluded based on title N = 1152

**Eligibility**

Abstracts screened
N = 62 → Excluded based on abstracts N = 24

Articles for review of full text
N = 38 → Excluded based on full text N = 33

**Included**

Studies included
N = 5

[1] Supplemental search with inclusion January 1, 2014- January 30, 2017

# Description of the Evidence

## Sources of Evidence Included:

1. Systematic reviews and meta-analyses published from 2000 to December 5, 2016 databases (n=5)

2. Relevant original research articles cited by the systematic reviews and meta-analyses (n=8)

3. Recent original research articles published between January 2014 and January 30, 2017 (n=5)

# *Draft* Key Findings

Overall Association

- 5 SRs/MAs suggest a weak association between sedentary behavior and all-cancer mortality.
- A meta-analysis of 8 studies by Biswas et al. [2015] reported a summary HR of **1.13 (1.05-1.21).**
- 13 original research studies were identified that addressed the association between sedentary behavior and cancer mortality:
  - 5 of the 13 studies reported a significant association and the results were not always consistent (1 in women only; 1 for TV viewing but not sitting; 1 in current smokers only).

Cancer is a heterogeneous disease, and the major risk factors differ by cancer site. Further, associations between specific risk factors and cancer mortality are affected by cancer screening and treatment availability and efficacy. A limitation of most studies of sedentary behavior and cancer mortality is a failure to take these factors into account.

# *Draft* Key Findings

## Dose-Response

- Limited evidence suggests the existence of a dose-response association between sedentary behavior and cancer mortality.
- 13 original research studies tested for the existence of a dose-response association, and 5 reported a significant dose-response association in the total sample or in one or more subgroups.

# *Draft* Conclusion Statement

- Limited evidence demonstrates a direct relationship between greater time spent in sedentary behavior and higher mortality rates from cancer. **PAGAC Grade: Limited**

- Limited evidence demonstrates the existence of a direct, positive dose-response relationship between sedentary behavior and mortality from cancer. **PAGAC Grade: Limited**

- Insufficient evidence suggests that the relationship between sedentary behavior and cancer mortality does not vary by age, sex, race/ethnicity or weight status. **PAGAC Grade: Grade not assignable.** There is insufficient evidence available to determine if the relationship between sedentary behavior and mortality from cancer varies by socio-economic status. **PAGAC Grade: Grade not assignable**

- Insufficient evidence demonstrates that the relationship between sedentary behavior and mortality from cancer varies by levels of moderate-to-vigorous physical activity. **PAGAC Grade: Grade not assignable**

- There is insufficient evidence available that bouts or breaks in sedentary behavior are important factors in the relationship between sedentary behavior and mortality from cancer. **PAGAC Grade: Grade not assignable**

# Committee Discussion Q#3

- What is the relationship between sedentary behavior and mortality from cancer?

  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, socio-economic status, or weight status?

  c) Is the relationship independent of levels of light, moderate, or vigorous physical activity?

  d) Is there any evidence that bouts or breaks in sedentary behavior are important factors?

# Question #4

- What is the relationship between sedentary behavior and (1) type 2 diabetes, (2) weight status, (3) cardiovascular disease and (4) cancer?

  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, socio-economic status, or weight status?

  c) Is the relationship independent of levels of light, moderate, or vigorous physical activity?

  d) Is there any evidence that bouts or breaks in sedentary behavior are important factors?

- Source of evidence to answer question

  – Combination of SR/MA/Existing report and de novo systematic review of original articles

# Analytical Framework (Q4)

**Systematic Review Question #4**

What is the relationship between sedentary behavior and (1) type 2 diabetes, (2) weight status, (3) cardiovascular disease and (4) cancer?

**Target Population**

Adults, 18 years and older

**Comparison**

Adults who participate 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**
- Diabetes
- Weight Status
- Cardiovascular disease
- Cancer

**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).

# Common Inclusion/Exclusion Criteria

- Language
  - Exclude: Studies that do not have full text in English

- Publication Status
  - Include: Studies published in peer-reviewed journals, PAGAC-approved reports
  - Exclude: Grey literature

- Study Subjects
  - Exclude: Studies of animals only

# Inclusion/Exclusion Criteria

- **Date of Publication**
  - Original Research: Include 2014 - Present
  - SR/MA: Include 2000 - Present
- **Study Subjects**
  - Include: Adults ages 18 and older
- **Study Design**
  - Include: Prospective cohort studies, Systematic reviews, Meta-analyses, PAGAC-Approved reports
  - Exclude: Randomized controlled trials, Non-randomized controlled trials, Retrospective cohort studies, Case-control studies, Cross-sectional studies, Before-and-after studies, Narrative reviews, Commentaries, Editorials
- **Exposure/Intervention**
  - Include: All types of sedentary behavior
  - Exclude: Studies that use sedentary behavior solely as confounding variable
- **Outcome**
  - Include: Diabetes, Weight Status, Cardiovascular disease, Cancer

# Search Terms

- ## Sedentary Terms

  Physical* Inactiv*, Inactivity, Sedentarism, Sedentary, Sedentari*, Sitting, Screen time, Television, TV, Video game, Video gaming, Computer use, Computer time

- ## Incidence Terms

  Risk, Risks, Incidence, Incident, Incidents

# Search Terms (2)

- ## Outcome Terms

### CVD

Arteriosclerosis, Death sudden cardiac, Heart failure, Myocardial ischemia, Myocardial infarction, Stroke, Subarachnoid hemorrhage, Aortic Aneurysm, Thoracic, intracranial hemorrhages, Arteriosclero*, Atherosclero, Cerebral infarction, Cerebrovascular diseases, Cerebrovascular disease, Coronary heart disease, Intracerebral Hemorrhage, Intracerebral Hemorrhages, Intracranial hemorrhage, Ischemic subarachnoid hemorrhages

### Diabetes

Diabetes, Insulin resistance, Diabetes Mellitus, Type 2, Hyperglycemia, Glycemic Index, Blood glucose

- ## Outcome Terms Continued
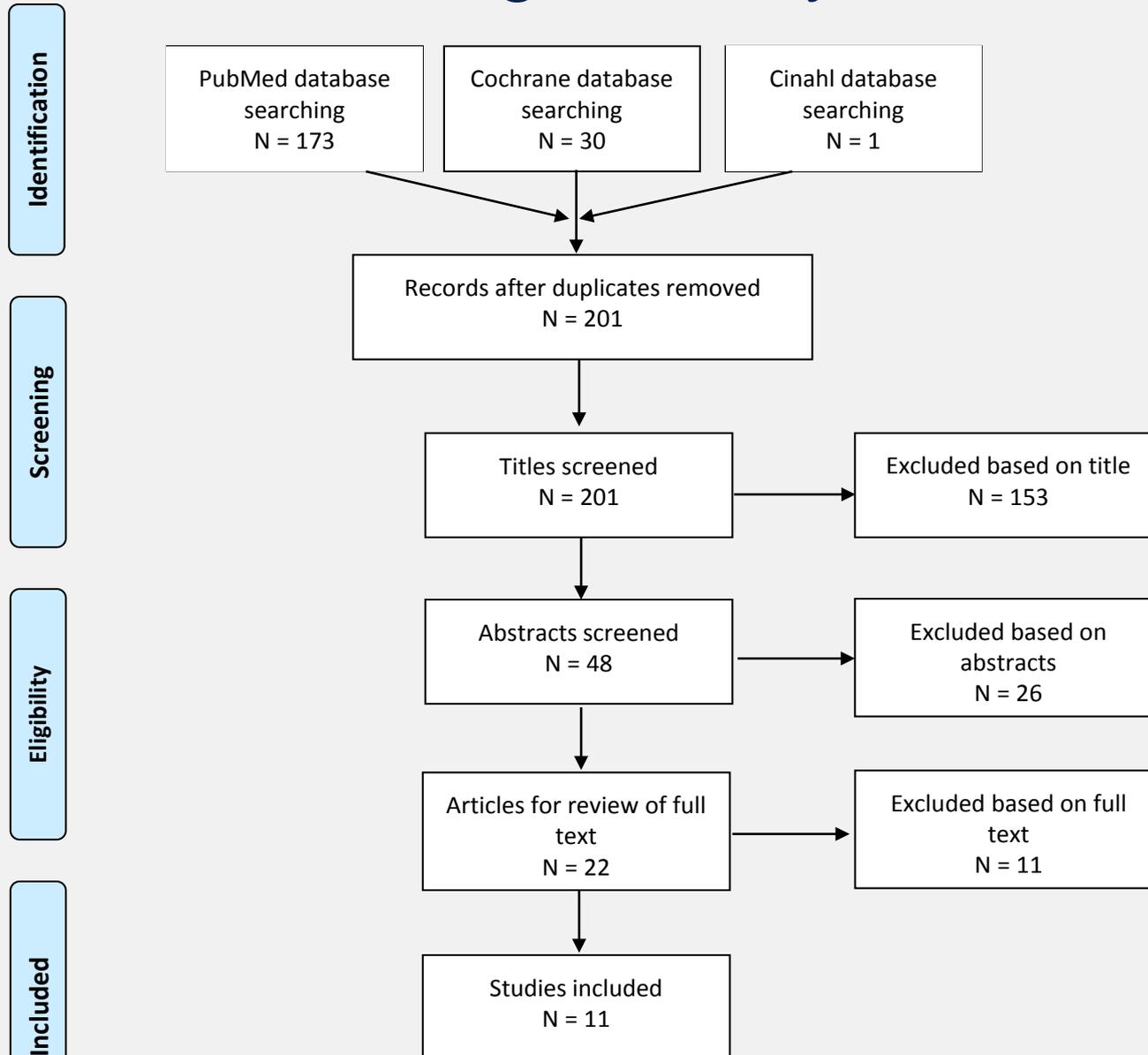
Weight Status

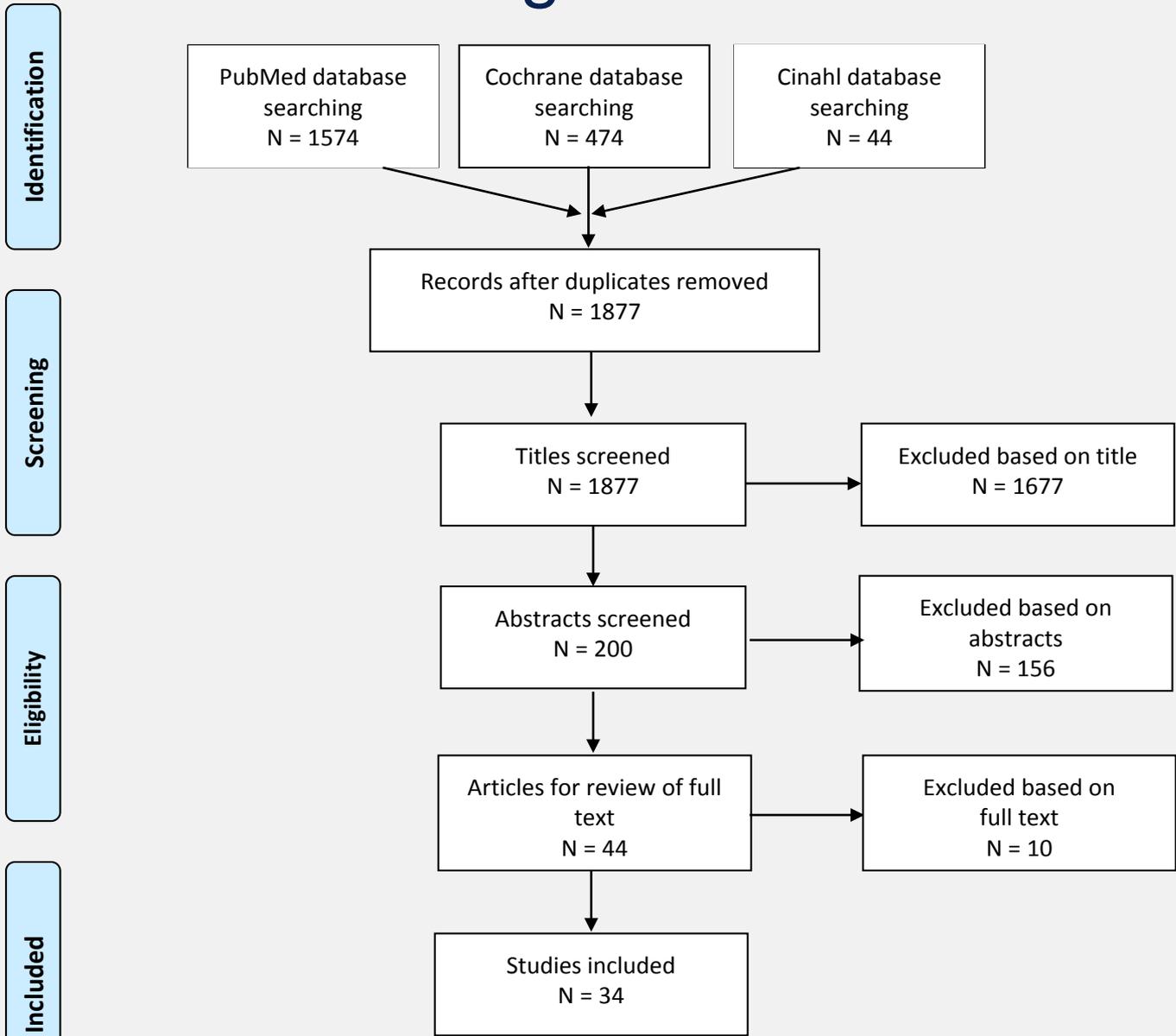Adiposity, Body composition, Body Mass Index, Overweight, Fatness, BMI, Obese, Obesity

Cancer

Cancer, Neoplasms, Neoplasm, Tumor, Carcinogenesis, Leukemia, Lymphoma, Malignancy, Blastoma, Tumour, Melanoma, Myeloma, Carcinoma, Neoplasia, Sarcoma, Tumors, Tumours, Adenosarcoma, Angiosarcoma, Astrocytoma, Cholangiocarcinoma, Chondrosarcoma, Craniopharyngioma, Ependymoma, Fibrosarcoma, Glioma, Langerhans Cell Histiocytosis, Hodgkin's Disease, Leiomyosarcoma, Medulloblastoma, Mesothelioma, Neuroblastoma, Rhabdomyosarcoma, Osteosarcoma

# Search Results Q4: High-Quality Reviews[1]



**Identification**

| PubMed database searching N = 173 | Cochrane database searching N = 30 | Cinahl database searching N = 1 |

Records after duplicates removed
N = 201

**Screening**

Titles screened
N = 201 → Excluded based on title N = 153

**Eligibility**

Abstracts screened
N = 48 → Excluded based on abstracts N = 26

Articles for review of full text
N = 22 → Excluded based on full text N = 11

**Included**

Studies included
N = 11

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

# Search Results Q4: Original Research[1]



**Identification**

| PubMed database searching N = 1574 | Cochrane database searching N = 474 | Cinahl database searching N = 44 |

Records after duplicates removed
N = 1877

**Screening**

Titles screened
N = 1877 → Excluded based on title
N = 1677

**Eligibility**

Abstracts screened
N = 200 → Excluded based on abstracts
N = 156

Articles for review of full text
N = 44 → Excluded based on full text
N = 10

**Included**

Studies included
N = 34

[1] Supplemental search with inclusion January 1, 2014- April 25, 2017

# Description of the Evidence

## Sources of Evidence Included:

1. Systematic reviews and meta-analyses published from 2000 to February 21, 2017 databases (n=11; 5 for type 2 diabetes, 2 for weight status, 5 for cardiovascular disease, and 8 for cancer)

2. Recent original research articles published between January 2014 and April 25, 2017 (n=34)

# *Draft* Key Findings

Type 2 Diabetes

- Two SRs and 3 MAs addressed the association between sedentary behavior and type 2 diabetes. All 3 MAs reported significant risk estimates:
  - RR per 2 hours of TV viewing per day was **1.20 (1.14-1.27)** from 4 original papers [Grontved & Hu, 2011];
  - RR from 5 cross-sectional and 5 prospective studies was **2.12 (1.61-2.78)** for highest vs lowest sedentary time [Wilmot et al. 2012]
  - HR was **1.91 (1.64-2.22)** from 5 prospective studies [Biswas et al. 2015].

- There is limited evidence of a graded, positive **dose-response association** between sedentary behavior and type 2 diabetes. Grontved & Hu [2011] reported a significant, positive linear dose-response association between TV viewing and type 2 diabetes. Two of four original research studies that tested for linear dose-response associations reported a significant finding.

# *Draft* Conclusion Statement

<u>Type 2 Diabetes</u>

- Strong evidence demonstrates a significant relationship between greater time spent in sedentary behavior and higher risk of type 2 diabetes. **PAGAC Grade: Strong.**

- Limited evidence suggests the existence of a direct, graded dose-response relationship between sedentary behavior and risk of type 2 diabetes. **PAGAC Grade: Limited.**

- Insufficient evidence is available to determine whether the relationship between sedentary behavior and type 2 diabetes varies by age, sex/ethnicity, socio-economic status, or weight status.  **PAGAC Grade: Grade not assignable.**

- Insufficient evidence is available to determine whether the relationship between sedentary behavior and type 2 diabetes varies by level of moderate-to-vigorous physical activity. **PAGAC Grade: Grade not assignable.**

- There is insufficient evidence available that bouts or breaks in sedentary behavior are important factors in the relationship between sedentary behavior and incidence of type 2 diabetes. **PAGAC Grade: Grade not assignable.**

# *Draft* Key Findings

<u>Weight Status</u>

- Two systematic reviews [Thorp et al. 2011; Proper et al. 2011] each reviewed 10 original research studies and concluded that there was **insufficient or limited evidence**, respectively, that sedentary behavior was related to changes in body weight or other indicators of weight status.

- **Eleven of fourteen newer original studies reported a significant positive association** between at least one sedentary behavior and at least one indicator of adiposity or weight status. However, there was considerable heterogeneity in the relationships observed among the studies that reported significant effects.

- A statistically significant **linear dose-response association** was observed in nine of the twelve studies for at least one sub-group of for one of the weight-related outcomes.

# *Draft* Conclusion Statement

## Weight Status

- Limited evidence suggests a positive relationship between greater time spent in sedentary behavior and higher levels of adiposity and indicators of weight status. **PAGAC Grade: Limited.**

- Limited evidence suggests the existence of a direct, graded dose-response relationship between greater sedentary behavior and higher levels of adiposity and indicators of weight status. **PAGAC Grade: Limited.**

- Insufficient evidence is available to determine whether the relationship between sedentary behavior and weight status varies by age, sex/ethnicity, socio-economic status, or weight status. **PAGAC Grade: Grade not assignable.**

- Insufficient evidence is available to determine whether the relationship between sedentary behavior and weight status varies by level of moderate-to-vigorous physical activity. **PAGAC Grade: Grade not assignable.**

- Insufficient evidence is available to determine whether bouts or breaks in sedentary behavior are important factors in the relationship between sedentary behavior and weight status. **PAGAC Grade: Grade not assignable.**

# *Draft* Key Findings

Cardiovascular Disease (CVD)

- One SR and 4 MAs addressed the association between sedentary behavior and CVD. All 4 MAs reported a statistically significant estimate of risk:

  - Grontved & Hu [2011] reported a pooled RR of **1.15 (1.06-1.23)** per 2 hours of TV viewing per day;

  - Biswas et al. [2015] and Pandey et al. [2016] reported summary HRs of **1.14 (1.00-1.30)** and **1.14 (1.09-1.19),** respectively, for high versus low sedentary behavior;

  - Wilmot et al. [2012] reported a significant summary RR of **2.47 (1.44-4.24).**

- Grontved & Hu [2011] reported a significant linear **dose-response association** between TV viewing and incident CVD, and Pandey et al. [2016] reported a significant, curvilinear dose-response association with increasing slope of risk at increasingly higher levels of sedentary time. Three recent research studies published between 2014 and 2017 reported significant linear dose-response associations between sedentary behavior and incident CVD.

# *Draft* Conclusion Statement

Cardiovascular Disease

- Strong evidence demonstrates a significant relationship between greater time spent in sedentary behavior and higher risk of incident cardiovascular disease. **PAGAC Grade: Strong.**

- Strong evidence demonstrates the existence of a direct, graded dose-response relationship between sedentary behavior and risk of cardiovascular disease. **PAGAC Grade: Strong.**

- Insufficient evidence is available to determine whether the relationship between sedentary behavior and incident cardiovascular disease varies by age, sex/ethnicity, socio-economic status, or weight status. **PAGAC Grade: Grade not assignable.**

- Insufficient evidence is available to determine whether the relationship between sedentary behavior and incident cardiovascular disease varies by level of moderate-to-vigorous physical activity. **PAGAC Grade: Grade not assignable.**

- There is insufficient evidence available that bouts or breaks in sedentary behavior are important factors in the relationship between sedentary behavior and incidence of cardiovascular disease. **PAGAC Grade: Grade not assignable.**

# *Draft* Key Findings

Total Cancer Incidence

- Two MAs examined the association between sedentary behavior and total cancer incidence:
    - Shen et al. [2014] reported a summary RR of **1.20 [1.12-1.28];**
    - Biswas et al. [2015] reported a summary HR of **1.13 [1.05-1.21]** for highest versus lowest sedentary behavior.
    - A more recent large study (American Cancer Prevention Study II Nutrition Cohort) reported a significant association between leisure-time sitting and total cancer incidence in women but not in men [Patel et al. 2015].

# *Draft* Key Findings

Breast Cancer Incidence

- Three MAs examined the association of sedentary behavior with breast cancer:
    - Zhou et al. [2015] reported non-significant associations for sitting time (**OR = 1.05; 0.99-1.11**) and TV viewing (**OR = 1.07; 0.96-1.20**).
    - Schmid & Leitzmann [2014] reported a non-significant association (**RR = 1.03; 0.95-1.12**).
    - Shen et al. [2014] reported a significant association between sedentary behavior and breast cancer (**RR = 1.17; 1.03-1.33**).
- Shen et al. [2014] used three prospective cohort studies in their analysis, whereas Schmid & Leitzmann [2014] relied on 13 case-control and prospective studies, and Zhou et al. [2015] used both case-control and prospective studies (9 studies for sitting and 6 studies for TV viewing).

- Of the two newer original research studies, one reported a significant association with breast cancer and the other did not.

# *Draft* Key Findings

Endometrial Cancer Incidence

- Two MAs examined the association between sedentary behavior (highest versus lowest levels) and endometrial cancer:
    - Schmid & Leitzmann [2014] reported a summary RR of **1.36 [1.15-1.60];**
    - Shen et al. [2014] reported a summary RR of **1.28 [1.08-1.53].**

# *Draft* Key Findings

Colorectal Cancer Incidence

- Two MAs examined the association between sedentary behavior (highest versus lowest levels) and colorectal cancer:
  - Shen et al. [2014] reported a significant association between sedentary behavior and combined colorectal cancer (**RR = 1.30; 1.12-1.49**);
  - Schmid & Leitzmann [2014] reported a significant association for colon cancer (**RR = 1.28; 1.13-1.45**] but not for rectal cancer (**RR = 1.03; 0.89-1.19**).

# *Draft* Key Findings

<u>Lung Cancer Incidence</u>

- Two MAs examined the association between sedentary behavior (comparing highest versus lowest levels) and lung cancer:
    - Schmid and Leitzmann [2014] reported a summary RR of **1.21 [1.03-1.43]**;
    - Shen et al. [2014] reported a summary RR of **1.27 [1.06-1.52]**.

# *Draft* Key Findings

Other Cancers

- Two MAs examined site-specific cancers [Schmid & Leitzmann, 2014; Shen et al. 2014] and **did not** find significant associations between sedentary behavior and risk of ovarian cancer, prostate cancer, stomach cancer, testicular cancer, renal cell carcinoma or non-Hodgkin lymphoid neoplasms.

# *Draft* Key Findings

## Dose-Response

- One MA examined dose-response associations between sedentary behavior and cancer risk by modelling the association according to 2-hour increments per day of time spent sedentary [Schmid & Leitzmann, 2014]:
    - Each 2-hour per day of sitting time was related to significantly increased risk of risk of colon cancer (**RR = 1.08; 1.04-1.11**), endometrial cancer (**RR = 1.10; 1.05-1.15**), and a borderline statistically increased risk of lung cancer (**RR = 1.06; 1.00-1.11**).

# *Draft* Conclusion Statement

<u>Cancer</u>

- Moderate evidence indicates a significant relationship between greater time spent in sedentary behavior and higher risk of incident cancer, particularly for endometrial, colon and lung cancer. **PAGAC Grade: Moderate.**

- Limited evidence suggests the existence of a direct dose-response relationship between sedentary behavior and risk of endometrial, colon and lung cancers. **PAGAC Grade: Limited.**

- Insufficient evidence is available to determine whether the relationship between sedentary behavior and cancer varies by age, sex/ethnicity, socio-economic status, or weight status.  **PAGAC Grade: Grade not assignable.**

- Insufficient evidence is available to determine whether the relationship between sedentary behavior and cancer varies by level of moderate-to-vigorous physical activity. **PAGAC Grade: Grade not assignable.**

- There is insufficient evidence available that bouts or breaks in sedentary behavior are important factors in the relationship between sedentary behavior and cancer. **PAGAC Grade: Grade not assignable.**

# Committee Discussion Q#4

- What is the relationship between sedentary behavior and incidence of (1) type 2 diabetes, (2) weight status, (3) cardiovascular disease and (4) cancer?

  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, socio-economic status, or weight status?

  c) Is the relationship independent of levels of light, moderate, or vigorous physical activity?

  d) Is there any evidence that bouts or breaks in sedentary behavior are important factors?

# Question #5

- Does the effect of moderate-to-vigorous physical activity on all-cause mortality vary by level of sedentary behavior?

- Source of evidence to answer question
  – Combination of SR/MA/Existing report and de novo systematic review of original articles

# Analytical Framework (Q5)

**Systematic Review Questions**

Does the relationship between moderate-to-vigorous physical activity and all-cause mortality vary by level of sedentary behavior?

**Target Population**

Adults, 18 years and older

**Comparison**

Adults who participate 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

**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).

**Endpoint Health Outcomes**

Incidence of:
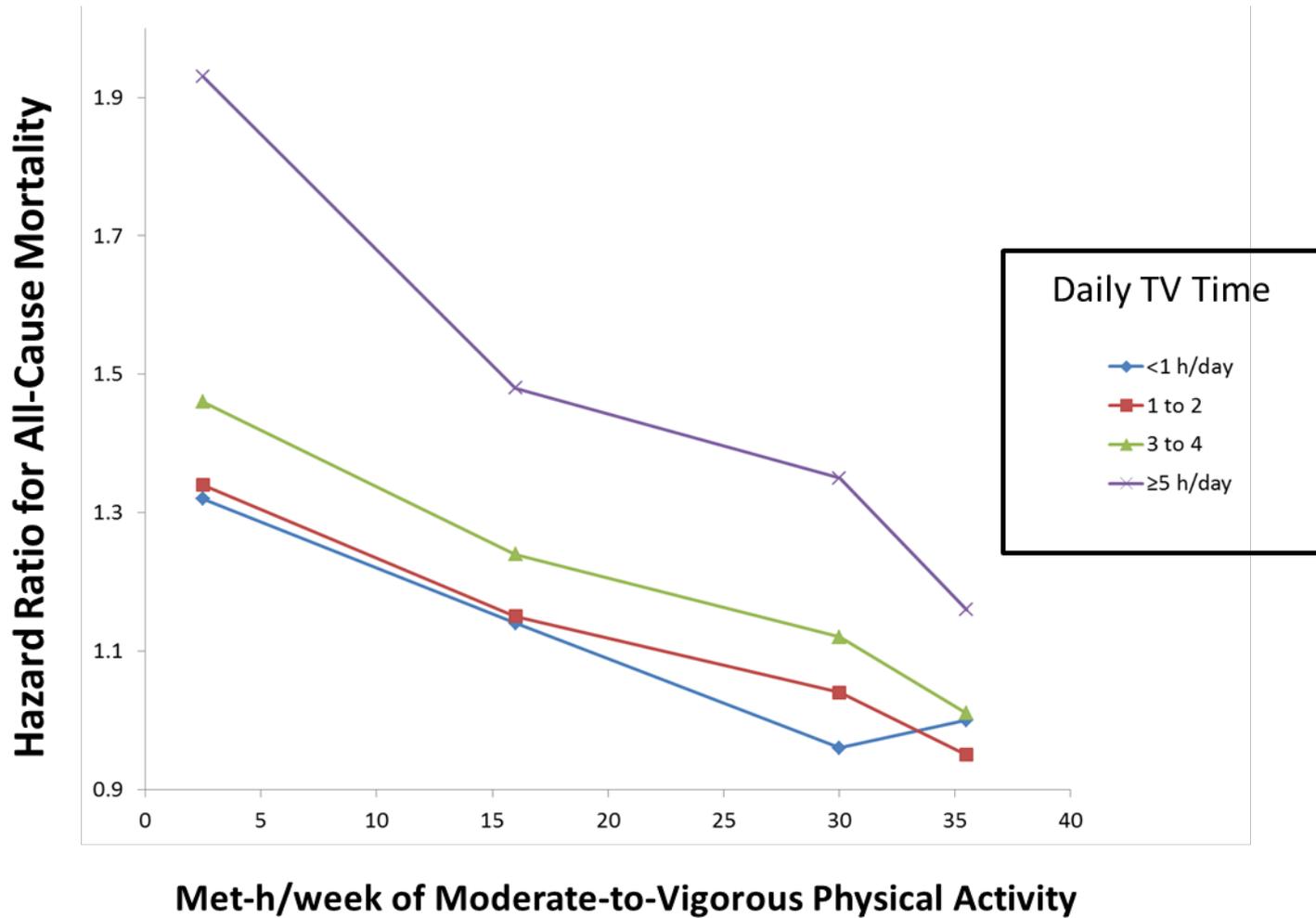- All-cause mortality

# Description of the Evidence

## Sources of Evidence Included:

1. The evidence used to address Question 5 was obtained from the evidence base compiled for Question 1.

2. Cohort studies that included multiple levels of moderate-to-vigorous physical activity as the exposure, in addition to at least two levels of sedentary time, were included in the evidence base.

   - Systematic reviews and meta-analyses published from 2000 to December 5, 2016 databases (n=1)
   - Relevant original research articles cited by the systematic reviews and meta-analyses, and (n=2)
   - Recent original research articles published between January 2014 and January 30, 2017 (n=1)

# *Draft* Key Findings

Ekelund et al. *Lancet* 2016

# *Draft* Key Findings

Ekelund et al. *Lancet* 2016
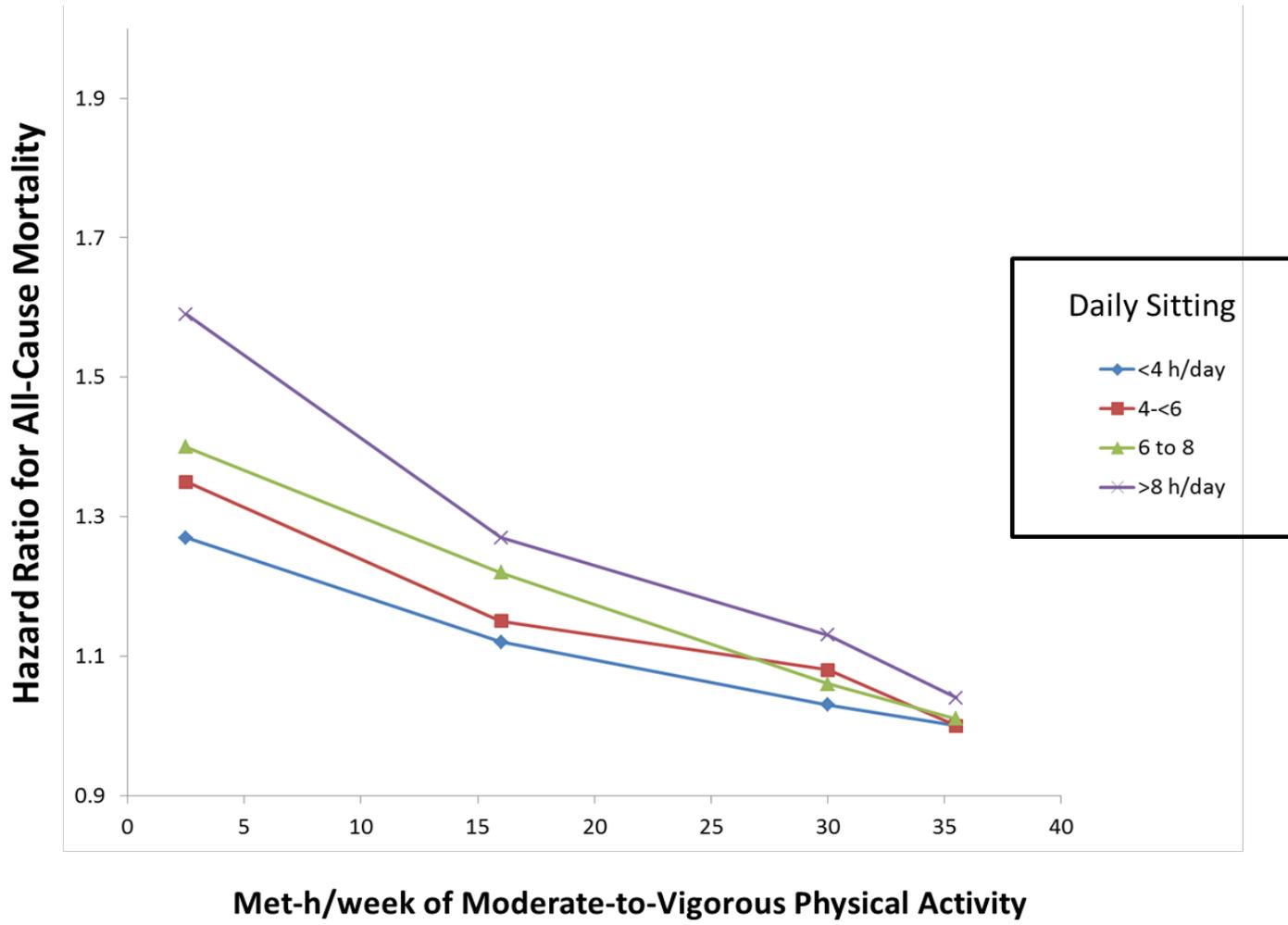
# *Draft* Conclusion Statement

Moderate evidence indicates that the effect of moderate-to-vigorous physical activity on all-cause mortality varies by level of sedentary behavior. **PAGAC Grade: Moderate.**

# Committee Discussion Q#5

- Does the effect of moderate-to-vigorous physical activity on all-cause mortality vary by level of sedentary behavior?

# *Draft* Research Recommendations

**1.** Conduct research using prospective cohorts on the interactive effects of physical activity and sedentary behavior on all-cause, CVD and cancer mortality, especially on the role of light activity on attenuating the relationship between sitting and all-cause mortality.

**2.** Conduct research using prospective cohorts on the role of bouts and breaks in sedentary behavior in relation to all-cause, CVD and cancer mortality.

**3.** Conduct research on how factors such as sex, age, race/ethnicity, socioeconomic status and weight status, as well as shape of the dose-response association, relate to the association between sedentary behavior and CVD mortality.

**4.** Conduct research on the strength of the association between sedentary behavior and cancer mortality (all-cancer mortality and site-specific cancer mortality) in addition to research that will address all sub-questions related to sedentary behavior and cancer mortality.

**5.** Conduct research to disentangle the independent effects of sedentary behavior and adiposity on risk of type 2 diabetes.

# Next Steps

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