Meta-analysis made (somewhat) painless

Marissa A. Bowman, MS

Graduate Student, Clinical-Health Psychology

Mechanisms and Moderators of Sleep Health Laboratory

University of Pittsburgh

mabowman5@pitt.edu , @PittSleepGirl

Sleep T32
Pittsburgh, PA
September 27, 2019

UNIVERSITY OF PITTSBURGH
Center for
Sleep and
Circadian
Science

But first, Twitter...

- Follow our Twitter & tweet at @PittSleep
  - Send me your articles to share!

But first, Twitter...

- Tweeted about sjPlot package in R and I have 120+ likes on it!

Predictors	Unadjusted model				Interaction				Adjusted model			
	Estimates	SE	95% CI	p	Estimates	SE	95% CI	p	Estimates	SE	95% CI	p
(Intercept)	11.77	1.05	9.70 – 13.83	**<0.001**	11.50	1.18	9.19 – 13.80	**<0.001**	22.17	8.34	5.89 – 38.46	**0.008**
Time	-0.20	0.06	-0.32 – -0.08	**0.001**	-0.29	0.18	-0.65 – 0.07	0.112	0.03	0.17	-0.30 – 0.36	0.869
Sleep health	-1.34	0.26	-1.86 – -0.83	**<0.001**	-1.27	0.30	-1.86 – -0.69	**<0.001**	-1.11	0.29	-1.67 – -0.55	**<0.001**
Sleep health x Time					-0.02	0.05	-0.11 – 0.07	0.602				

Outline

- What is a meta-analysis?

- Why conduct a meta-analysis?

- How do you do one in seven "easy" steps?

What is a meta-analysis?

- Meta-analysis is a quantitative method to aggregate findings from many published articles to more precisely estimate the observed effect size between two variables of interest
  - allows you to weight high-quality studies (based on their sample size or rigor) more than lower quality studies.
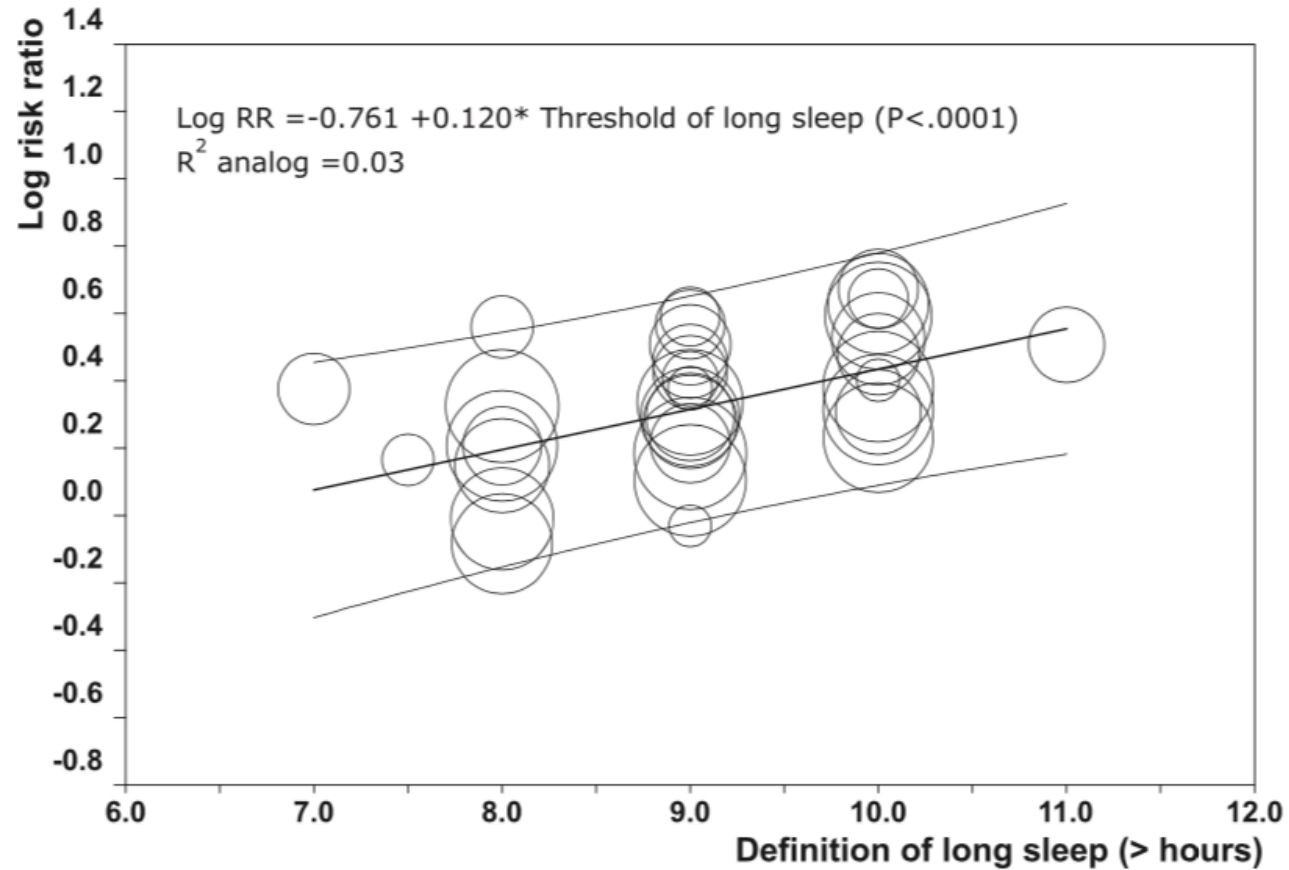
Weighting

Fig. 5. Meta-regression for specific values of long sleep duration in mortality.

Jike…Buysse,& Kaneita (2018).. *Sleep Med Rev*

Why a meta-analysis?

| Intuition behind vote counting	Intuition behind meta-analysis
How many studies found a significant effect? ✓✓✓✗✗✗ 3 out of 6 studies Overreliance on p-values	What was the studies' average effect size? 0.51, 0.13, 062, 0.30, -0.05, 0.19 $M = 0.28$

Seven "easy" steps

1. Identify your question
2. Develop your search terms
3. Pre-register your meta-analysis on PROSPERO
4. Organize your screening flow
5. Recruit colleagues to serve as independent raters
6. Perform your pre-designed screen
7. Conduct your meta-analysis!

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1. Identify your question

- Is your research question best answered by a meta-analysis?
  - Good question: What is the overall effect of insomnia on risk for incident major depressive disorder?
  - Bad questions (for a meta): Interest in integrating disparate literatures; areas with few articles

Integration of disparate literatures

- Only ONE study tested the full model statistically – one wanted to, but couldn't because race was unrelated to nocturnal blood pressure non-dipping

- Goal of our review became showing how strong each individual literature is, and where future directions might be

Black compared to White

ssure non-dipping

Bowman, Buysse,…& Hall. (in press) Curr Hypertens Rep.
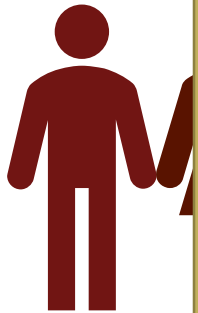
Insufficient # of studies

Sleep and Telomeres		
Category	Sample Size	Total studies
Duration	245	
Duration	434	
Duration	154	
Duration	283	
Duration	497	5 adults studies
Duration - Children	1567	1 child study
Quality	245	
Quality	954	
Quality	154	
Quality	283	
Quality	87	
Quality	239	6 adults studies
Latency	245	1 adults study
Insomnia	497	
	236	
	140	3 adults studies
Shift work	4117	
	619	
	150	3 adults studies

Sleep across the lifespan

Current project

Key question: Is there an association between age and sleep in healthy individuals (i.e. no medical, psychiatric, sleep disorder comorbidities)?

Previous meta analysis (2004): Includes 65 polysomnography and actigraphy studies, and suggests that the answer is yes!

Current meta-analysis: Extends this study by using actigraphy-assessed sleep duration, efficiency, AND timing and regularity

Ohayon et al (2004) SLEEP..

1. Identify your question

- Once you think you have a good question, search carefully to ensure it has not been published (on PubMed) or is not in-preparation elsewhere (PROSPERO; https://www.crd.york.ac.uk/prospero/)

Searching PROSPERO

42 records found for **sleep and aging**

|	Registered	Title	Type	Review status
☐	06/08/2019	A meta-analysis of actigraphy-assessed sleep characteristics across the lifespan [CRD42019137424]	👤	Review Ongoing
☐	29/03/2019	A systematic review and meta analysis on the effect of multidomain interventions to improve cognition in older adults [CRD42019126899]	👤	Review Ongoing
☐	30/03/2017	A systematic review on the relationship between telomere length and sleep [CRD42017058472]	👤	Review Ongoing
☐	20/05/2019	Aging fingerprints on cognitive control, attention and working memory related brain oscillatory activity [CRD42019121575]	👤	Review Ongoing
☐	17/07/2019	Association of vitamin D with the quality of sleep in older adults: a meta-analysis [CRD42019132111]	👤	Review Ongoing
☐	03/05/2016	Clinical and economic outcomes reported within interventions to reduce antipsychotic and benzodiazepine use within nursing homes: a systematic review [CRD42016038601]	👤	Review Completed published

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2. Develop your search terms

- Think of what happens when you type something into Google…
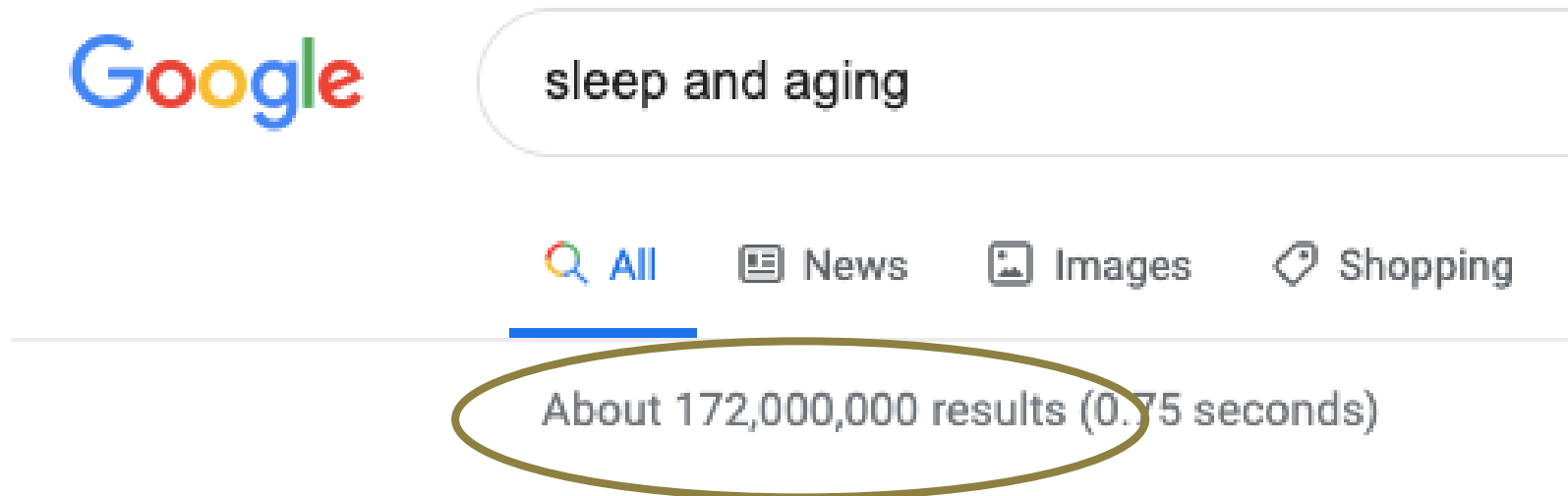
2. Develop your search terms

- Collaborate with an expert librarian!
- Our PubMed search terms

(((("Humans"[Mesh]) AND (((sleep*[text word] OR parasomnia*[text word] OR dyssomnia*[text word] OR circadian rhythm*[text word] OR dyssomnia[MeSH Terms] OR circadian rhythm[MeSH Terms] OR sleep[MeSH Terms])) AND (actiwatch[text word] OR actillume[text word] OR actigraph*[text word] OR acceleromet*[text word] OR activity sleep monitor*[text word] OR accelerometry[MeSH Terms])))) OR (((((sleep*[text word] OR parasomnia*[text word] OR dyssomnia*[text word] OR circadian rhythm*[text word] OR dyssomnia[MeSH Terms] OR circadian rhythm[MeSH Terms] OR sleep[MeSH Terms])) AND (actiwatch[text word] OR actillume[text word] OR actigraph*[text word] OR acceleromet*[text word] OR activity sleep monitor*[text word] OR accelerometry[MeSH Terms]))) NOT (("Animals"[Mesh] OR mice[tiab] OR mouse[tiab] OR gerbils[tiab]))

- She then did the same process for Cochrane Central, PsycINFO, and EMBASE
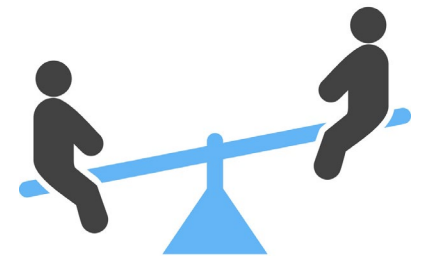
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3. Pre-register your meta-analysis on PROSPERO

Why pre-register?
- Increases transparency
- Maybe will help prevent "scooping"?
- Practically, you have to complete a form with 30 questions about the meta, and it is helpful to think through these in advance

Takes 2 months + to be reviewed, then you might have to make revisions, so recommend that you do this ASAP

3. Pre-register your meta-analysis on PROSPERO

NIHR | National Institute for Health Research

PROSPERO
International prospective register of systematic reviews

🖨 Print | 📄 PDF

A meta-analysis of actigraphy-assessed sleep characteristics across the lifespan

Marissa Bowman, Martica Hall, Daniel Buysse, Anna Marsland, Aidan Wright, Jill Foust

Citation

Marissa Bowman, Martica Hall, Daniel Buysse, Anna Marsland, Aidan Wright, Jill Foust. A meta-analysis of actigraphy-assessed sleep characteristics across the lifespan. PROSPERO 2019 CRD42019137424 Available from: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42019137424

Review question

Do actigraphy-assessed sleep measures change across the lifespan?

Searches

The search will be completed in the following electronic databases: PubMed, EMBASE, Cochrane Central Register of Controlled Trials (CENTRAL), and PsycINFO. There is no date restriction or language restriction.

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PRISMA WITH DETAILS
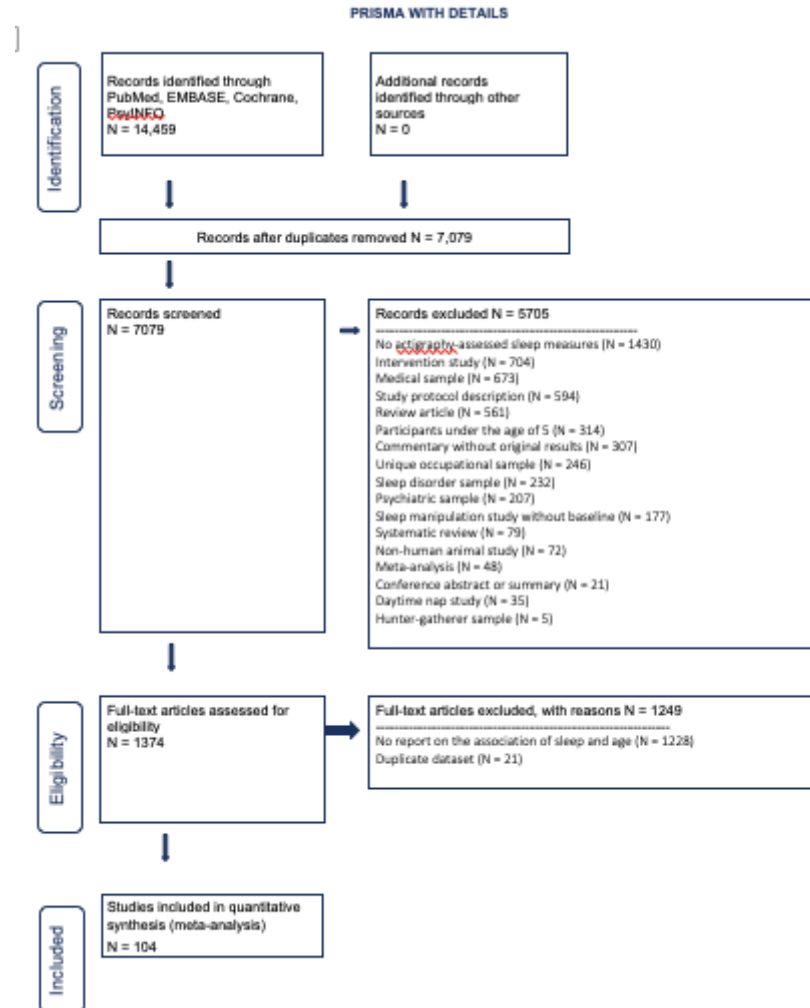
4. Organize your study flow

Distiller SR

My Tasks | Project Progress | DistillerAI

Welcome to Sleep Health Across the Lifespan !

mabowman5@pitt.edu, there are references assigned to you. Please click "Unreviewed" below to start reviewing.

👉 Title/abstract Screening - Title and Abstract Screening

✏ 0 Unreviewed   ✔ 7079 Reviewed by you   ⚡ 0 My Conflicts

👉 Full text screening - Full Text Screening

✏ 20 Unreviewed   ✔ 1375 Reviewed by you   ⚡ 0 My Conflicts

👉 Data extraction - Data extraction

✏ 101 Unreviewed   ✔ 1 Reviewed by you   ⚡ 0 My Conflicts

4. Organize your study flow

cycle are potential modifiable risk factors for cardiometabolic disease. The aim of this study was to evaluate the relationship between objective measures of sleep-wake timing and stability with cardiometabolic disease risk.

METHODS: In this multicenter, cross-sectional, population-based study, actigraphy data were obtained from the 2,156 adults, aged 18 to 64 years, recruited from the Sueno ancillary study of the Hispanic Community Health Study/Study of Latinos (2010-2013). These data were correlated with measures of cardiometabolic disease risk, including systolic and diastolic BPs, homeostatic assessment of insulin resistance, glycosylated hemoglobin, BMI, and hypertension and diabetes status.

RESULTS: Each 10% decrease in interdaily stability was associated with a 3.0% absolute increase in the prevalence of hypertension (95% CI, 0.6-5.3; P < .05), an increase in systolic BP by 0.78 mm Hg (95% CI, 0.12-1.45; P < .05) and an increase in diastolic BP by 0.80 mm Hg (95% CI, 0.28-1.32; P < .05). In addition, delaying the midpoint of sleep by 1 h was associated with an increase in systolic BP by 0.73 mm Hg (95% CI, 0.30-1.16; P < .01) and diastolic BP by 0.53 mm Hg (95% CI, 0.17-0.90; P < .01). These associations were not significant after

Full Text Screening

1. Does this study report the association between age and at least one of the sleep outcomes as a main effect?

   ○ Yes ○ Yes, but don't report test statistic or p-value ○ No, but adjust for age on sleep
   ● No, but adjust for age on different outcome ○ No Clear Response

2. Is the mean and standard deviation of at least one outcome of interest reported? (If no, study will still be included but authors will be contacted)

   ○ Yes ○ Yes, the mean is weighted ○ Yes, the mean is stratified by a variable
   ○ No, the mean and standard deviation are not reported ○ No, the mean is age-standardized ○ No Clear Response

3. Does this study need to be excluded because the same dataset has already been used in another study? (Exclude the study with smaller sample size or less complete data reported in-text)

   ○ Yes (exclude)

   ○ No

   Clear Response

4. Organize your study flow

- Alternatives to Distiller SR
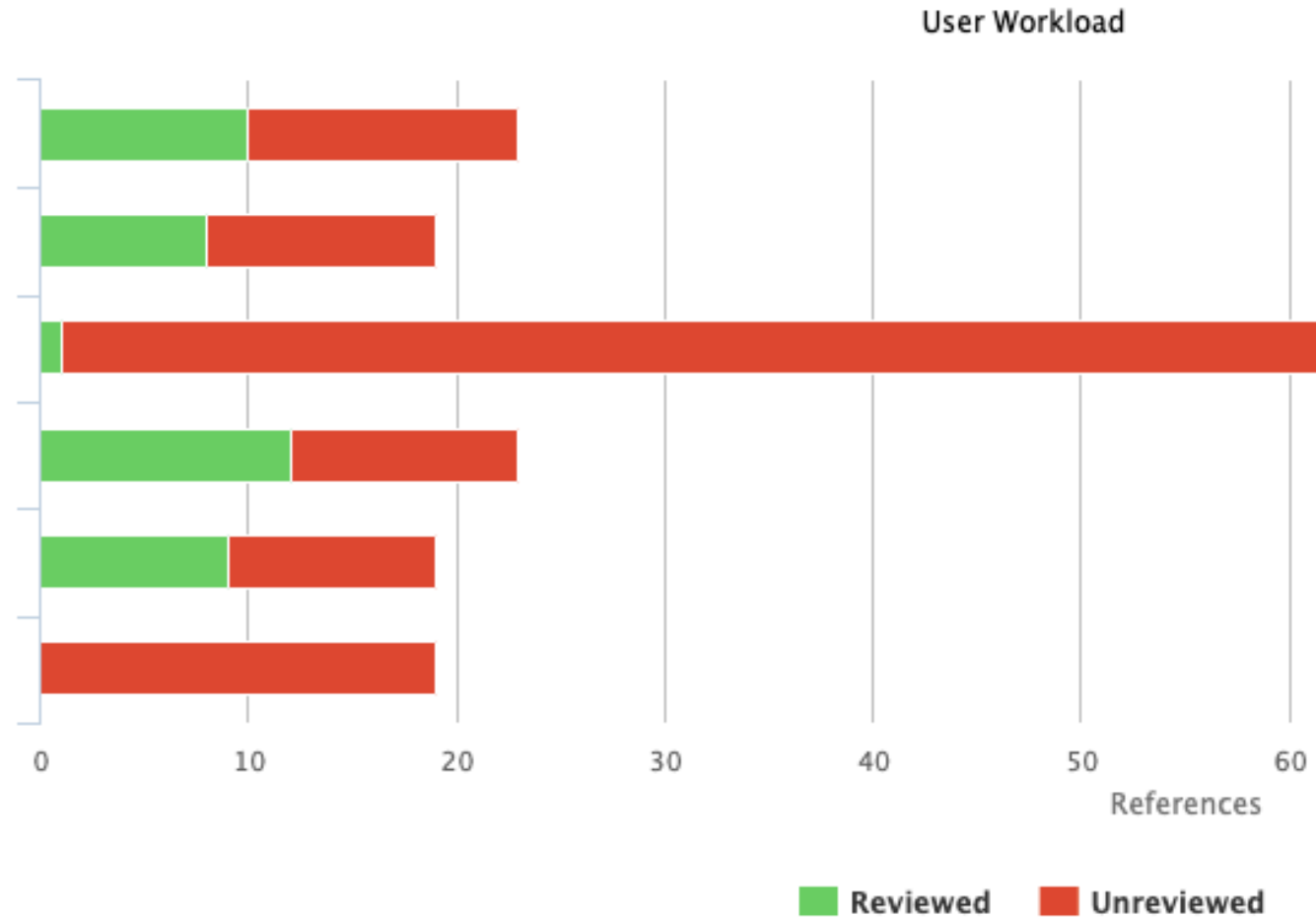 - Covidence – mobile app
  - Rayyan – free but clunky

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5. Recruit independent raters

- Independent raters are recommended at title/abstract screening and data extraction stage to reduce risk of bias
  - With 7,000+ tiab, I absolutely noticed that some days I was more inclusive than other days..
  - For data entry, other people interpret manuscript wording differently..
- I would recommend a very specific SOP for your raters, in-person training, and checking the first ~10 articles they do
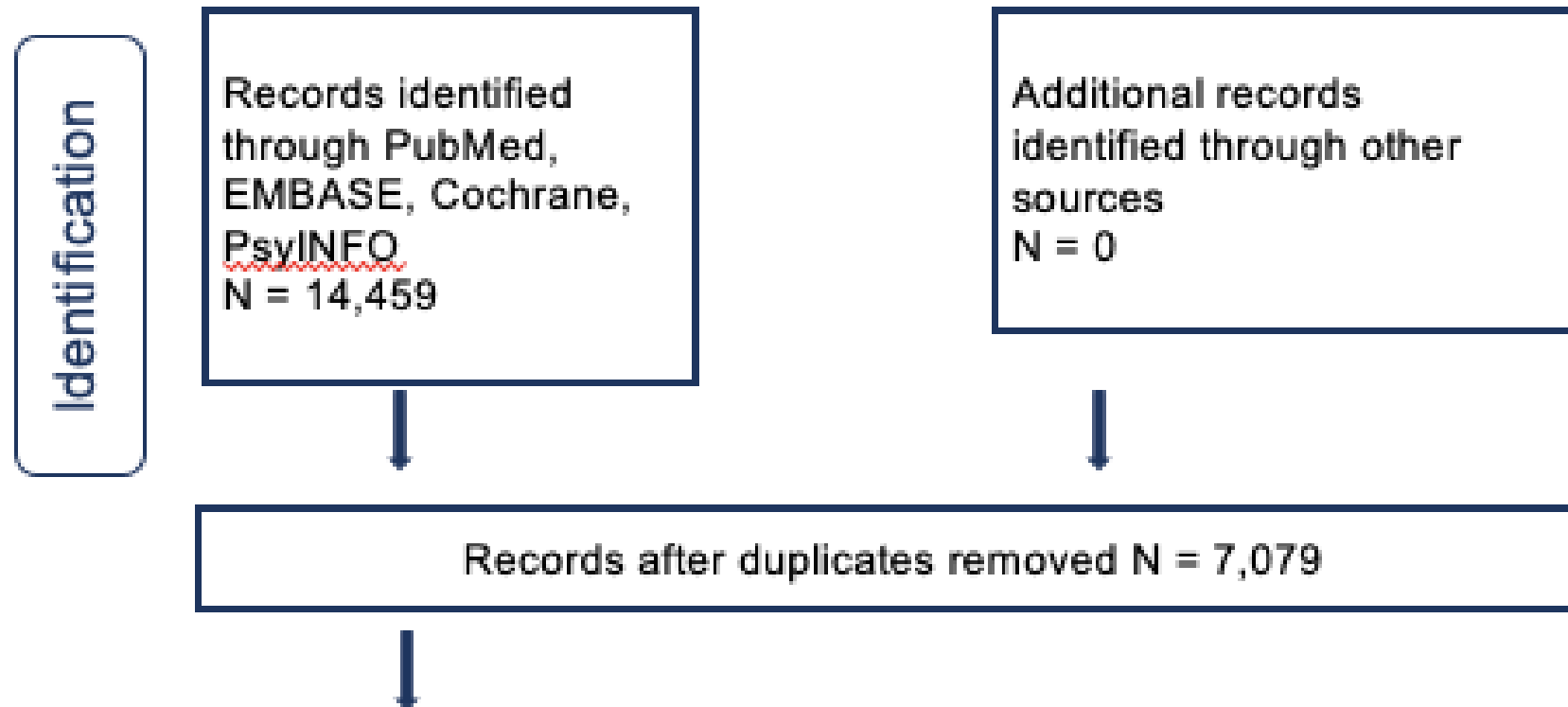
5. Recruit independent raters

6. Perform your pre-designed screen
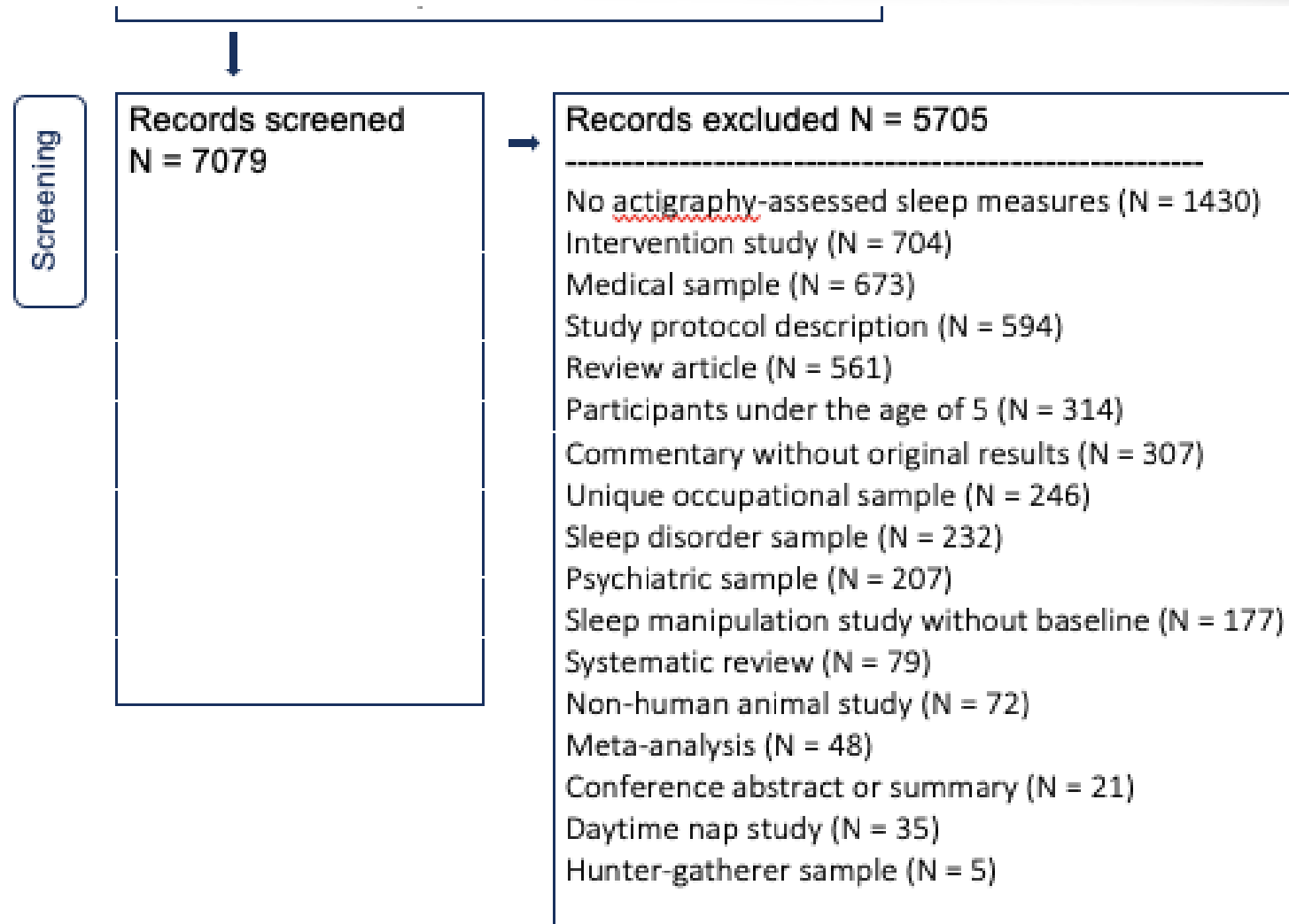
- This is the majority of your time!
  1. Title/abstract screening (7,079)
  2. Download all PDFs that are eligible for full-text (1,374)
  3. Full-text screening (1,374)
  4. Data extraction (104)

Identification

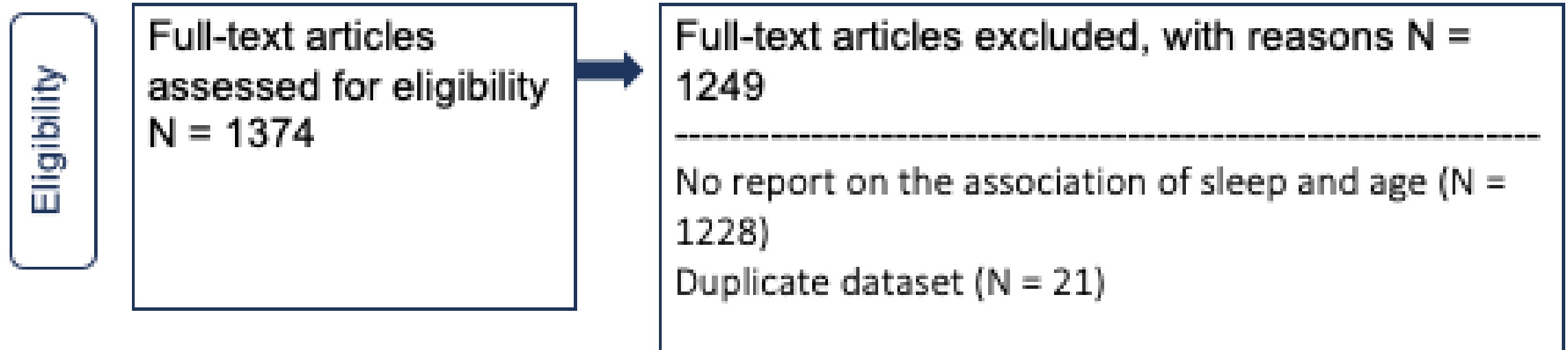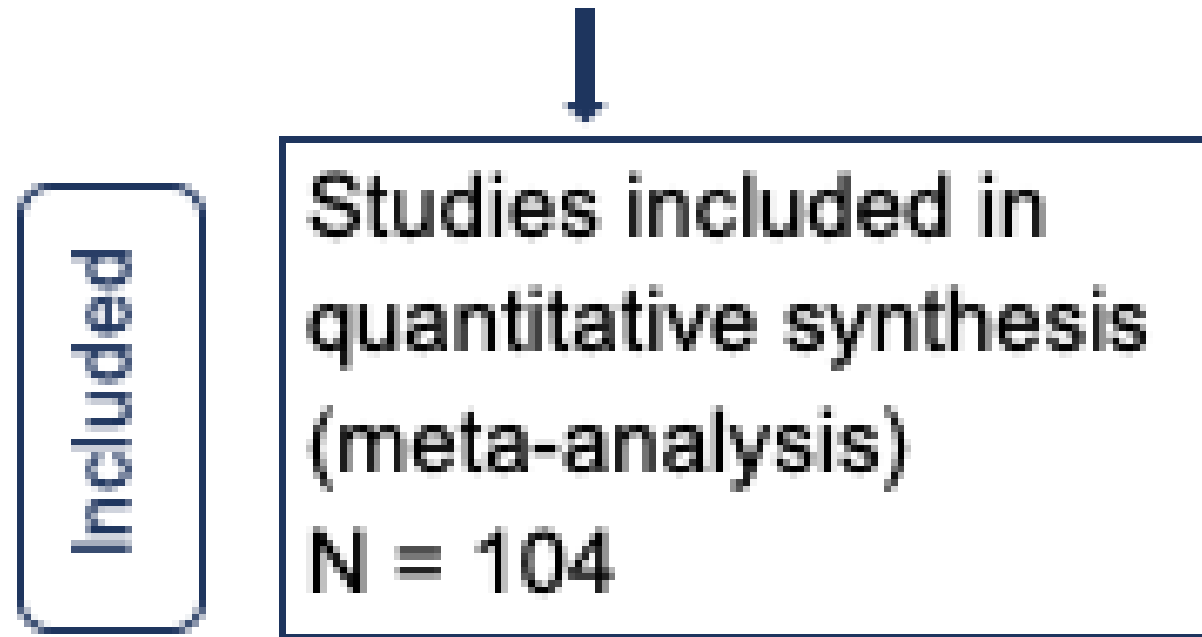Records identified through PubMed, EMBASE, Cochrane, PsyINFO
N = 14,459

Additional records identified through other sources
N = 0

Records after duplicates removed N = 7,079

Screening

Records screened N = 7079	Records excluded N = 5705

	No actigraphy-assessed sleep measures (N = 1430)
	Intervention study (N = 704)
	Medical sample (N = 673)
	Study protocol description (N = 594)
	Review article (N = 561)
	Participants under the age of 5 (N = 314)
	Commentary without original results (N = 307)
	Unique occupational sample (N = 246)
	Sleep disorder sample (N = 232)
	Psychiatric sample (N = 207)
	Sleep manipulation study without baseline (N = 177)
	Systematic review (N = 79)
	Non-human animal study (N = 72)
	Meta-analysis (N = 48)
	Conference abstract or summary (N = 21)
	Daytime nap study (N = 35)
	Hunter-gatherer sample (N = 5)

6. Perform your pre-designed screen

Eligibility

Full-text articles assessed for eligibility N = 1374

Full-text articles excluded, with reasons N = 1249

No report on the association of sleep and age (N = 1228)

Duplicate dataset (N = 21)

6. Perform your pre-designed screen

Included

Studies included in
quantitative synthesis
(meta-analysis)
N = 104

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- Packages designed for the purpose:
  - Comprehensive Meta-Analysis (CMA) and RevMan
- Syntax available online for more general-purpose statistical packages
  - SPSS, Stata, and R

7. Conduct your meta-analysis!

Comprehensive Meta-Analysis software

Thank you

- What questions do you have?