



Meeting 3

Brain Health

Chair: Kirk Erickson

Members: Chuck Hillman, Rich Macko, David Marquez, Ken Powell

Experts and Consultants



- Invited experts: None
- Consultants:
 - David Conroy, PhD (Q2: Quality of Life)
 - The Pennsylvania State University

Subcommittee Questions



1. What is the relationship between physical activity and cognition?
2. What is the relationship between physical activity and well-being and quality-of-life?
3. What is the relationship between physical activity and (1) affect and (2) anxiety?
4. What is the relationship between physical activity and sleep and circadian rhythms?

Question 1

1. What is the relationship between physical activity and cognition?
 - a) Does the relationship exist across the lifespan?
 - b) Does the relationship vary for individuals with normal to impaired cognitive function (i.e., dementia)?
 - c) What is the relationship between physical activity and biomarkers of brain health?
 - d) Is there a dose-response relationship? If yes, what is the shape of the relationship?
 - e) Does the relationship vary by age, sex, race/ethnicity or socio-economic status?
- Source of evidence to answer question
 - Systematic Reviews, Meta-Analyses

Analytical Framework

Systematic Review Question

What is the relationship between physical activity and cognition?

Target Population

People of all ages

Comparison

People who participate in varying levels of physical activity

Intervention/Exposure

All types and intensities of physical activity, including free-living activities, play, and physical fitness

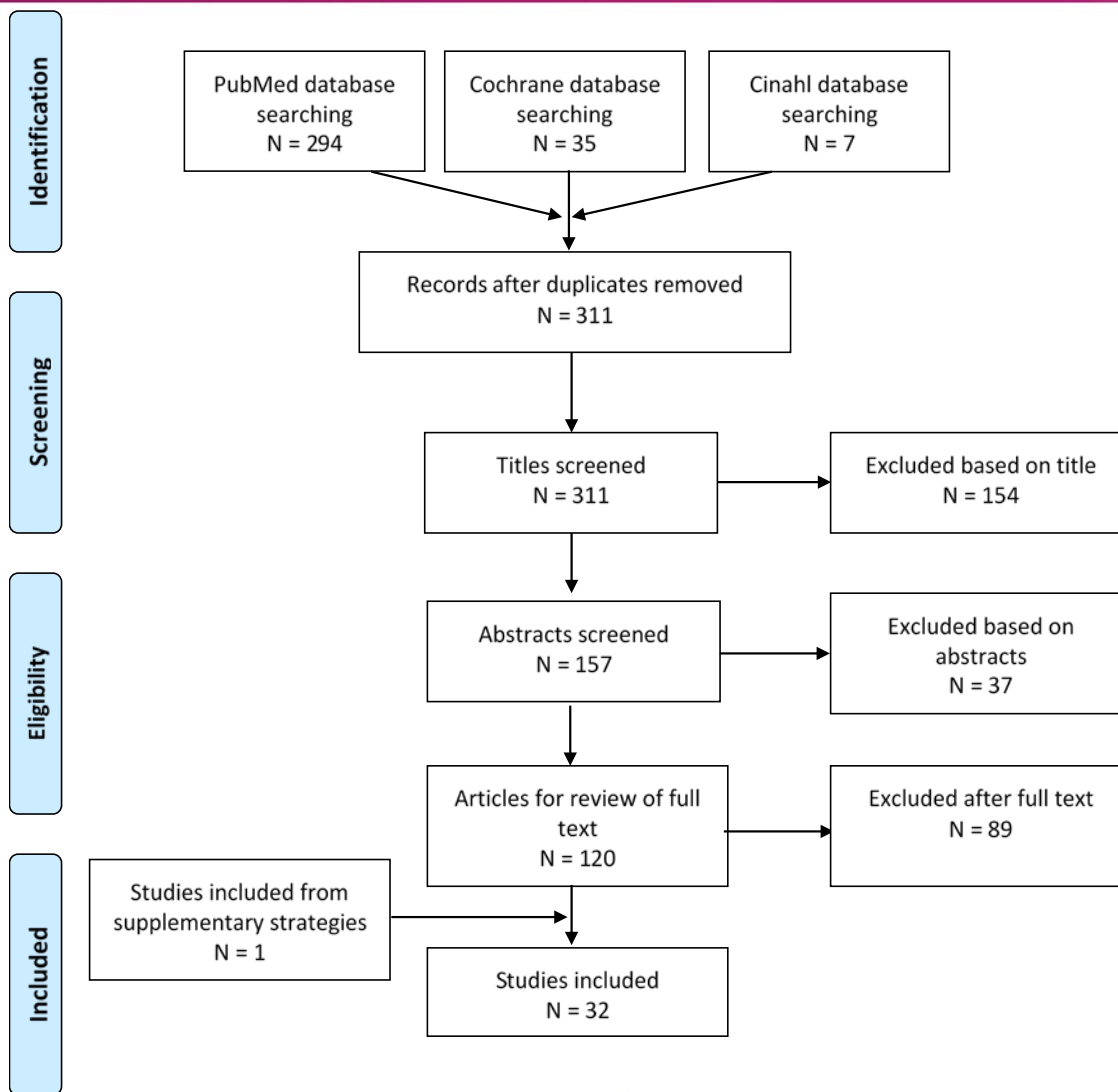
Endpoint Health Outcomes

- Academic achievement
- ADHD
- Alzheimer's disease
- Cognitive decline
- Cognition
- Cognitive function
- Cognitive processing / cognitive processes
- Cognitive impairment
- Cognitive motor / motor cognition
- Dementia
- Impaired cognitive function
- Impaired memory
- Independence / Instrumental ADL / Basic ADL
- Intelligence
- Memory
- Mild cognitive impairment

Key Definitions

- Cognition: The set of mental processes that contribute to perception, memory, intellect, and action. Cognitive function can be assessed using a variety of techniques including paper-pencil based tests, neuropsychological testing, and computerized testing methods. Cognitive functions are largely divided into different domains that capture both the type of process as well as the brain areas and circuits that support those functions. Working memory, visual attention, and long-term memory are all examples of different cognitive domains that are thought to be dependent on overlapping but yet largely separate neural systems.

Search Results: High-Quality Reviews¹



Description of the Evidence



- Massive literature covering many different populations, study designs, and cognitive outcomes.
- Children, Aging, Dementia – largest categories
- 13 ‘categories’ of papers were selected (32 papers):
 - Acute exercise (4 meta-analyses)
 - ADHD (2 meta-analyses; 1 systematic review)
 - Adolescents (1 meta-analysis; 1 systematic review)
 - Adult Lifespan (3 meta-analyses)
 - Aging (3 meta-analyses)
 - Children (4 systematic reviews)
 - Dementia (4 meta-analyses)
 - Mechanisms (1 meta-analysis; 3 systematic reviews)
 - Multiple Sclerosis (1 systematic review)
 - Parkinson’s disease (1 systematic review)
 - Schizophrenia (1 meta-analysis)
 - Sedentary behavior (1 systematic review)
 - Stroke (1 systematic review)

Description of the Evidence



- Number of studies and estimated sample sizes included in MA and SRs:
 - Acute (79+ studies; N=1000+)
 - ADHD (20+ studies; N=500+)
 - Adolescents (34+ studies; N=1400+)
 - Adult Lifespan (40+ studies; N=2000+)
 - Aging (25+ studies; N=2000+)
 - Children (64+ studies; N=1000+)
 - Dementia (20+ studies; N=33,000+)
 - Mechanisms (14+ studies; N=600+)
 - Multiple sclerosis (19 studies; N=1000+)
 - Parkinson's disease (8 studies; N=100)
 - Schizophrenia (10 studies; N=350+)
 - Sedentary behavior (7 studies; N=1000+)
 - Stroke (10 studies; N=400)
- Most papers summarized RCTs and a few (e.g., dementia) focused on prospective observational studies.

Draft Key Findings

- Despite significant heterogeneity in (1) populations, (2) outcomes, (3) exposures, the effect sizes reported were highly consistent:
 - Effects were of small-moderate size (Hedge's $g=0.1-0.5$).
 - Smaller effect sizes for acute exercise and generally larger effect sizes for studies of longer duration.
 - Some evidence for effect moderation by sex
- Effects were also consistent in impaired populations.
 - E.g., Schizophrenia effects sizes were similar to dementia and ADHD (~ 0.3)

Draft Conclusion Statement

- Conclusion Statement:
 - There is a significant body of research on the effects of physical activity on cognitive and brain outcomes.
 - This research spreads across many different cognitive disorders which demands different types of interventions and different outcomes (e.g., academic achievement to dementia diagnoses).
 - We are working from a ‘bottom-up’ perspective by first examining the evidence in each category and then will try to make a summary statement across populations.
 - Physical activity appears to have a consistent positive effect on cognitive function across the lifespan and levels of impairment.
 - Evidence for some effect moderators: dose (duration, intensity), sex. Little evidence for SES or race/ethnicity effects.
- Grade:
 - We have yet to establish the overall grade, but probably MODERATE

Draft Implications



- There is sufficient evidence to address the question.
- Physical activity has a small-moderate effect on cognitive outcomes across many different populations.

Draft Research Recommendations

- Conduct research with larger sample sizes, multiple doses, and with more comprehensive cognitive assessments.
- Utilize more cutting edge neuroimaging techniques and statistical approaches to better understand mechanisms and moderators.

Committee Discussion



1. What is the relationship between physical activity and cognition?
 - a) Does the relationship exist across the lifespan?
 - b) Does the relationship vary for individuals with normal to impaired cognitive function (i.e., dementia)?
 - c) What is the relationship between physical activity and biomarkers of brain health?
 - d) Is there a dose-response relationship? If yes, what is the shape of the relationship?
 - e) Does the relationship vary by age, sex, race/ethnicity or socio-economic status?

Question 2

1. What is the relationship between physical activity and quality-of-life?
 - 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?
- Source of evidence to answer question:
 - TBD

Analytical Framework

Systematic Review Question

What is the relationship between physical activity and quality-of-life?

Target Population

People of all ages without chronic conditions

Comparison

People who participate in varying levels of physical activity

Intervention/Exposure

All types and intensities of physical activity, including free-living activities, and play

Endpoint Health Outcomes

- Quality of Life
- Life Satisfaction
- Health-Related Quality of Life
- Social Quality of Life

Key Definitions

- Quality of Life: “Quality of life, rather than being a description of patients’ health status, is a reflection of the way that patients perceive and react to their health status and to other, nonmedical aspects of their lives” (Source: Gill TM, Feinstein AR. A critical appraisal of the quality of quality-of-life measurements. *JAMA*. 1994;272:619-626.)

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

Draft Search Terms: Physical Activity



- Aerobic activity(ies)
- Aerobic endurance
- Balance training
- Cardiovascular activity(ies)
- Chi kung
- Computer time
- Computer use
- Endurance activity(ies)
- Endurance training
- Exercise
- Free living activity(ies)
- Functional training
- Inactivity
- Lifestyle activity(ies)
- Motor performance
- Motor skill(s)
- Physical activity(ies)
- Physical conditioning
- Physical education
- Physical education and training
- Physically inactive
- Qi gong
- (Recess AND (Child OR Youth))
- Recreational activity(ies)
- Resistance training
- Screen time
- Sedentarism
- Sedentary lifestyle
- Sedentary
- Sitting
- Strength training
- Stretching
- Tai chi
- Tai ji
- Television
- TV viewing
- TV watching
- Video game(ing)
- Walk(ing)
- Yoga

Committee Discussion



2. What is the relationship between physical activity and well-being and quality-of-life?
 - 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?

Additional Prioritized Questions



3. What is the relationship between physical activity and (1) affect and (2) anxiety?
 - Across the spectrum from normal mood patterns to dysfunctional mood (i.e., depression)

4. What is the relationship between physical activity and sleep and circadian rhythms?
 - Sleep disturbances are ubiquitous, functionally impairing throughout the lifespan, and linked to many other conditions and physiological issues.