Exercise for Health: What's New in 2022

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Disclosures

- No relevant disclosures to report

Outline

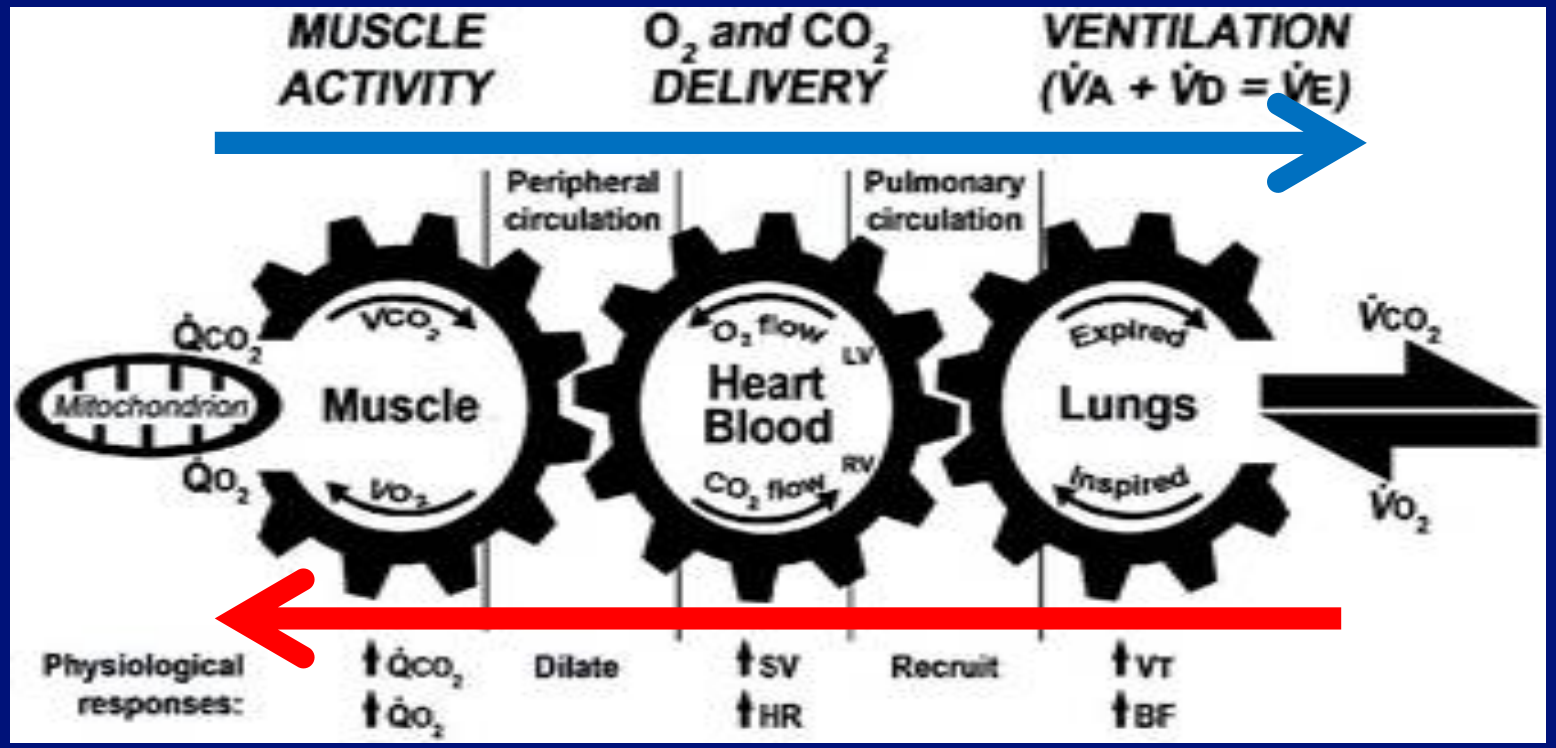
- Basic Exercise Physiology & Terminology
- Exercise Benefits: Data behind the Dose
  - 2018 HHS Guidelines, 2019 AHA/ACC Prevention Guidelines, 2020 WHO Guidelines
- Hot Topics
  - Exercise vs. Steps vs. Sitting
  - Exercise & COVID-19

Physical Activity vs. Exercise: Definitions

- **Physical Activity:** Any bodily movement resulting from contraction of skeletal muscle that increases energy expenditure above the basal level
  - Exercise
  - Occupational
  - Commuting

- **Exercise:** form of PA, planned and structured action with the objective of improving or maintaining physical fitness or health
  - **Dose = Duration x Frequency x Intensity**

Overview: Basic Exercise Physiology



Stringer et al., J Appl Physiol, 1998

Activity Specific Physiology

- **Endurance / Isotonic / Dynamic / "Aerobic" Activities:**
- Sustained increase in metabolic demand
  - ↑ CO (5x rest)
  - ↑ HR and SV
  - Peripheral vasodilation

- **Strength / Isometric / Static Activities:**
- Repetitive, intense skeletal muscle contraction
  - Concomitant ↑ SBP (> 200mmHg)
  - Peripheral vasoconstriction

Physical Activity Research

- Randomized controlled trials are hard to perform
  - Most often examine intermediate outcomes over short time: Lipids, BP, Weight

- Most of the information that we have regarding beneficial effects of exercise are from observational epidemiological studies
  - Subject to unmeasured bias and confounding
  - Cannot determine causality
  - Rely on self-reported physical activity habits, recently have used accelerometers
  - Contain few subjects performing high doses of exercise, limiting conclusions in this group

BJSM Online First, published on March 15, 2018 as 10.1136/bjsports-2017-098639

Review

Is physical activity a cause of longevity? It is not as straightforward as some would believe. A critical analysis

Urho M Kujala

BJSM Online First, published on March 15, 2018 as 10.1136/bjsports-2018-099185

Editorial

Can we proceed with physical activity recommendations if (almost) no clinical trial data exist on mortality?

Eric J Shiroma,[1] I-Min Lee[2,3]

Additionally, physical activity is a multidimensional concept, made up of dose (total volume), frequency, duration, intensity and activity type. While physical activity guidelines specify a minimum volume of at least 150 min/week of moderate-to-vigorous physical activity, there is little consensus on the optimum frequency, duration or type.[7]

In an attempt to answer some of the

New Guidelines: 2018 & 2019 & 2020

779 pages

2018 Physical Activity Guidelines Advisory Committee Scientific Report

To the Secretary of Health and Human Services

98 pages

Arnett et al.
2019 ACC/AHA Guideline on the Primary Prevention of Cardiovascular Disease

2019 ACC/AHA Guideline on the Primary Prevention of Cardiovascular Disease

A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines

Endorsed by the American Association of Cardiovascular and Pulmonary Rehabilitation, the American Geriatrics Society, the American Society of Preventive Cardiology, and the Preventive Cardiovascular Nurses Association

118 pages

Physical Activity Guidelines for Americans
2nd edition

104 pages

WHO GUIDELINES ON
PHYSICAL ACTIVITY AND SEDENTARY BEHAVIOUR

2019 ACC/AHA Guideline on the Primary Prevention of Cardiovascular Disease

A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines

Endorsed by the American Association of Cardiovascular and Pulmonary Rehabilitation, the American Geriatrics Society, the American Society of Preventive Cardiology, and the Preventive Cardiovascular Nurses Association

3.2. Exercise and Physical Activity

Table 4. Definitions and Examples of Different Intensities of Physical Activity

Intensity	METs	Examples
Sedentary behavior*	1–1.5	Sitting, reclining, or lying; watching television
Light	1.6–2.9	Walking slowly, cooking, light housework
Moderate	3.0 –5.9	Brisk walking (2.4–4 mph), biking (5–9 mph), ballroom dancing, active yoga, recreational swimming
Vigorous	≥6	Jogging/running, biking (≥10 mph), singles tennis, swimming laps

		6).
IIb	C-LD	4. Decreasing sedentary behavior in adults may be reasonable to reduce ASCVD risk (S3.2-3, S3.2-9–S3.2-11).

2018 Physical Activity Guidelines Advisory Committee Scientific Report

- Physical activity reduces:
  - Weight gain in adults, children, pregnant women
  - Dementia
  - Depression, anxiety
  - Falls
  - Breast and colon cancer
  - Risk of developing a new “chronic condition” (ex. osteoarthritis, HTN, DMII)

- Physical activity improves:
  - Sleep quality
  - Cognitive function
  - Daily physical function

2018 Physical Activity Guidelines Advisory Committee Scientific Report

- **"Aerobic Exercise" Dose:**
  - **THE SAME: 150–300 minutes per week of moderate intensity "aerobic" physical activity**
  - **Half if "vigorous" physical activity**
  - **Accrued in "bouts" of ANY duration**
- Improving from sedentary counts
- Reducing sitting time and increasing light physical activity *may* count
- We need to know more about:
  - Step Counts – what number?
  - HIIT – though it seems to have comparable benefit
- **Resistance training, twice weekly**

You know you need physical activity to stay healthy.
But did you know it can help you feel better right away?

Boost your mood | Sharpen your focus | Reduce your stress | Improve your sleep

So get more active — and start feeling better today.

How much activity do I need?

Moderate-intensity aerobic activity
Anything that gets your heart beating faster counts.

at least **150** minutes a week

AND

Muscle-strengthening activity
Do activities that make your muscles work harder than usual.

at least **2** days a week

Tight on time this week? **Start with just 5 minutes.** It all adds up!

Or get the same benefits in half the time. If you step it up to **vigorous-intensity** aerobic activity, aim for at least **75 minutes** a week.

Is it moderate or vigorous? Use the "talk test" to find out.

When you're being active, just try talking:

- If you're breathing hard but can still have a conversation easily, it's **moderate-intensity activity**
- If you can only say a few words before you have to take a breath, it's **vigorous-intensity activity**

What counts?

Whatever gets you moving!

Even things you have to do anyway

Even things that don't feel like exercise

You can get more active.

No matter who you are, where you live, on your own, or together.
You can find a way that works for you.




And over time, physical activity can help you live a longer, healthier life.

- ✓ Lower your risk of diseases like type 2 diabetes and some cancers
- ✓ Control your blood pressure
- ✓ Stay at a healthy weight

So take the first step. Get a little more active each day. **Move your way.**

Find tips to get moving and build a weekly activity plan.
health.gov/MoveYourWay/Activity-Planner

Exercise and CVD Risk Factors

EXERCISE AND LIPOPROTEINS

EFFECTS OF THE AMOUNT AND INTENSITY OF EXERCISE ON PLASMA LIPOPROTEINS

WILLIAM E. KRAUS, M.D., JOSEPH A. HOUMARD, PH.D., BRIAN D. DUSCHA, M.S., KENNETH J. KNETZGER, M.S., MICHELLE B. WHARTON, M.A., JENNIFER S. MCCARTNEY, M.A., CONNIE W. BALES, PH.D., R.D., SARAH HENES, R.D., GREGORY P. SAMSA, PH.D., JAMES D. OTVOS, PH.D., KRISHNAJI R. KULKARNI, PH.D., AND CRIS A. SLENTZ, PH.D.

- **Studies of Targeted Risk Reduction Interventions through Defined Exercise (STRRIDE)**
- 111 sedentary, overweight individuals with dyslipidemia
- For ***eight months***, randomized to:
  1) Usual activity patterns, "controls"
  2) Low amount, moderate intensity (walking ~ 11 miles/week)
  3) Low amount, high intensity (jogging ~11 miles/week)
  4) High amount, high intensity (jogging ~17 miles/week)
- Minimal weight change

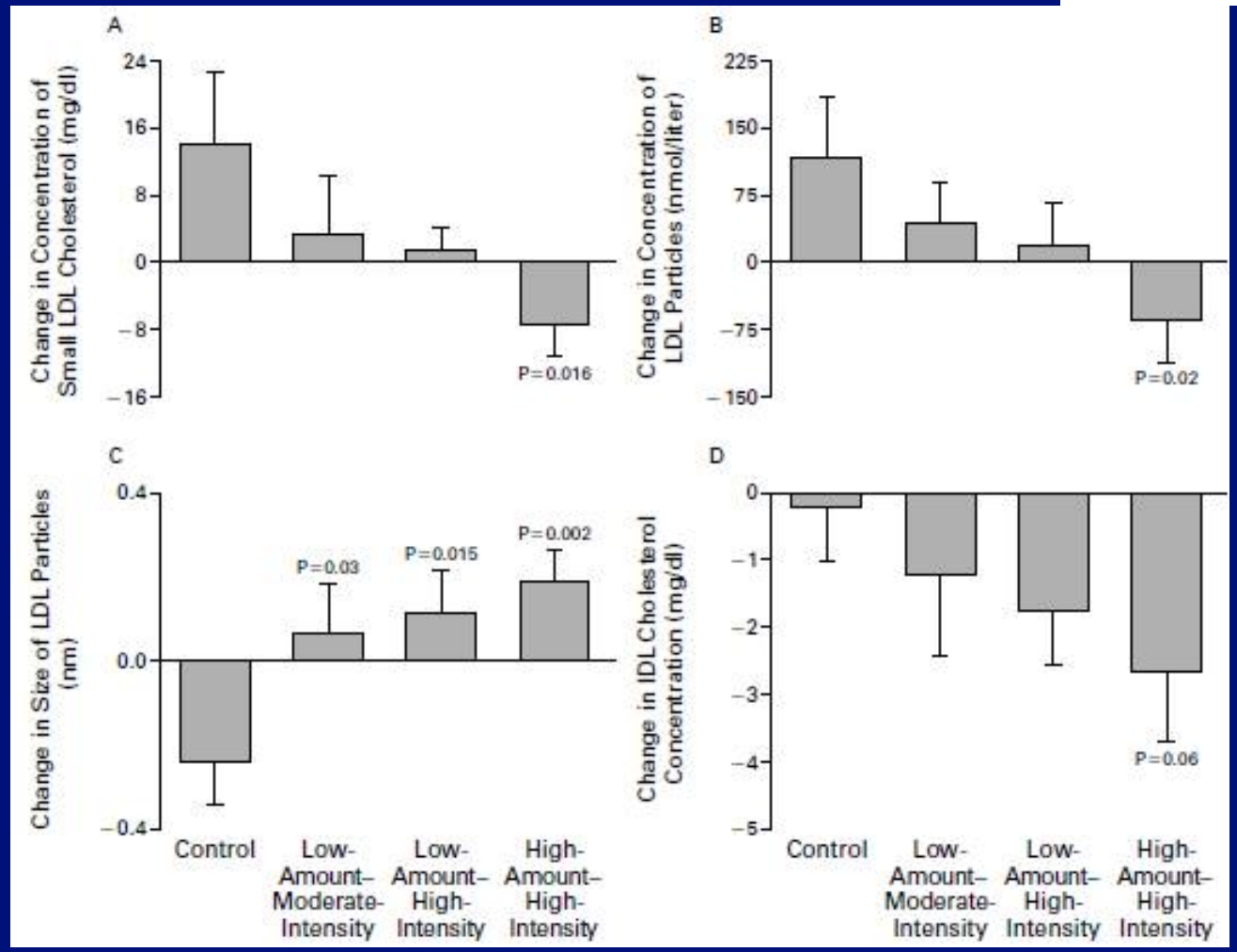
Kraus et al, NEJM 2002

Exercise and Lipids

EXERCISE AND LIPOPROTEINS

EFFECTS OF THE AMOUNT AND INTENSITY OF EXERCISE ON PLASMA LIPOPROTEINS

William E. Kraus, M.D., Joseph A. Houmard, Ph.D., Brian D. Duscha, M.S., Kenneth J. Knetzger, M.S., Michelle B. Wharton, M.A., Jennifer S. McCartney, M.A., Connie W. Bales, Ph.D., R.D., Sarah Henes, R.D., Gregory P. Samsa, Ph.D., James D. Otvos, Ph.D., Krishnaji R. Kulkarni, Ph.D., and Cris A. Slentz, Ph.D.



- TG ↓, HDL↑, LDL subfractions: improved more in high amount than low amount groups
- No impact of exercise intensity

Kraus et al, NEJM 2002

Exercise and Lipids

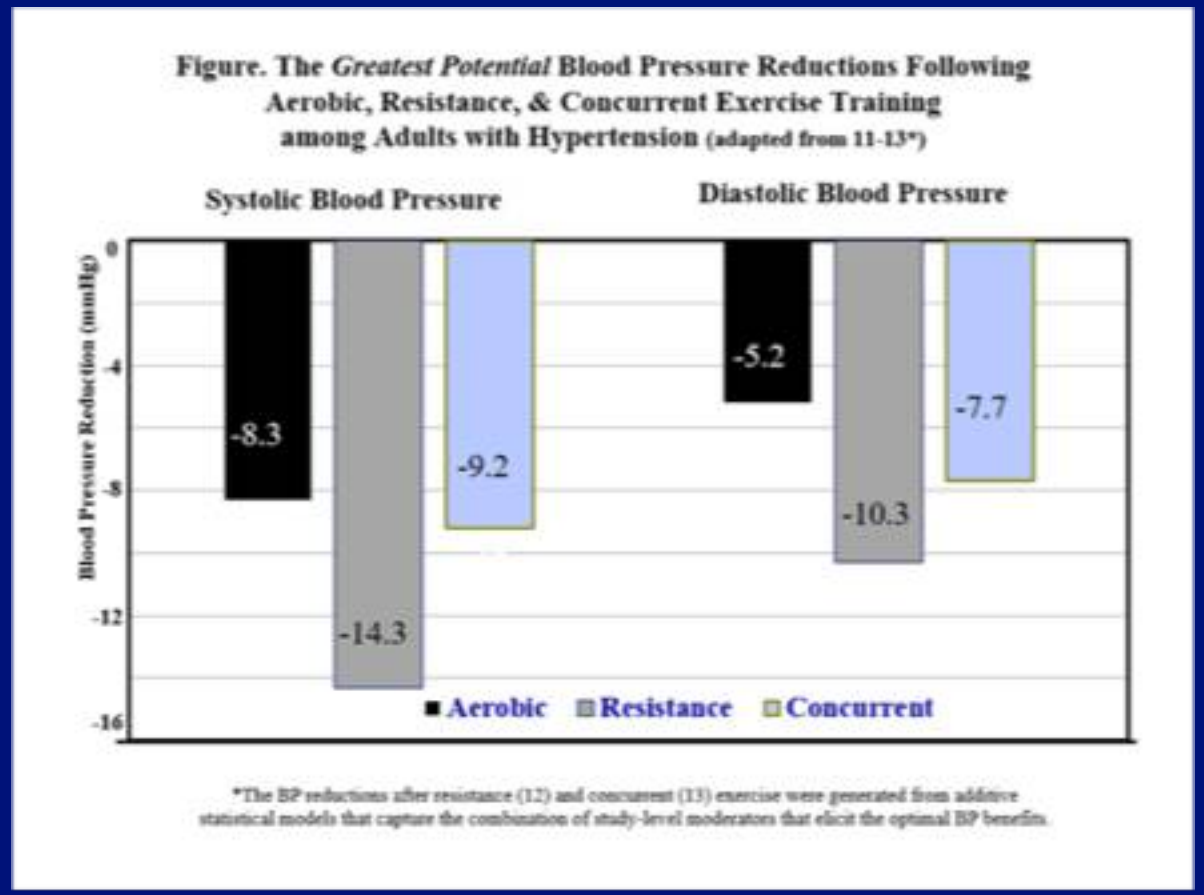
- Other studies also suggest small (4-8%) beneficial change in lipids, most consistently HDL, with exercise in range of recommended activity levels

- Though changes are small, potentially much larger impact in reduction of CVD events
  - Exercise may also help with weight loss in real life, compounding effect
  - As little as 10% reduction of TC through dietary or pharmacologic intervention results in 27% reduction in incident CVD
  - No similar study for impact of exercise on lipids

Wasfy et al, Circulation 2016;
Law et al, BMJ 1994

Exercise and Blood Pressure

- Exercise training reduces BP modestly
  - **SBP: ↓ 5-15 mmHg if hypertensive**
  - **DBP: ↓ 5-10 mmHg if hypertensive**
    - **Less if normotensive or pre-hypertensive**
  - No clear "dose response"
  - Intensity data are conflicting
  - Resistance or combined training may work just as well



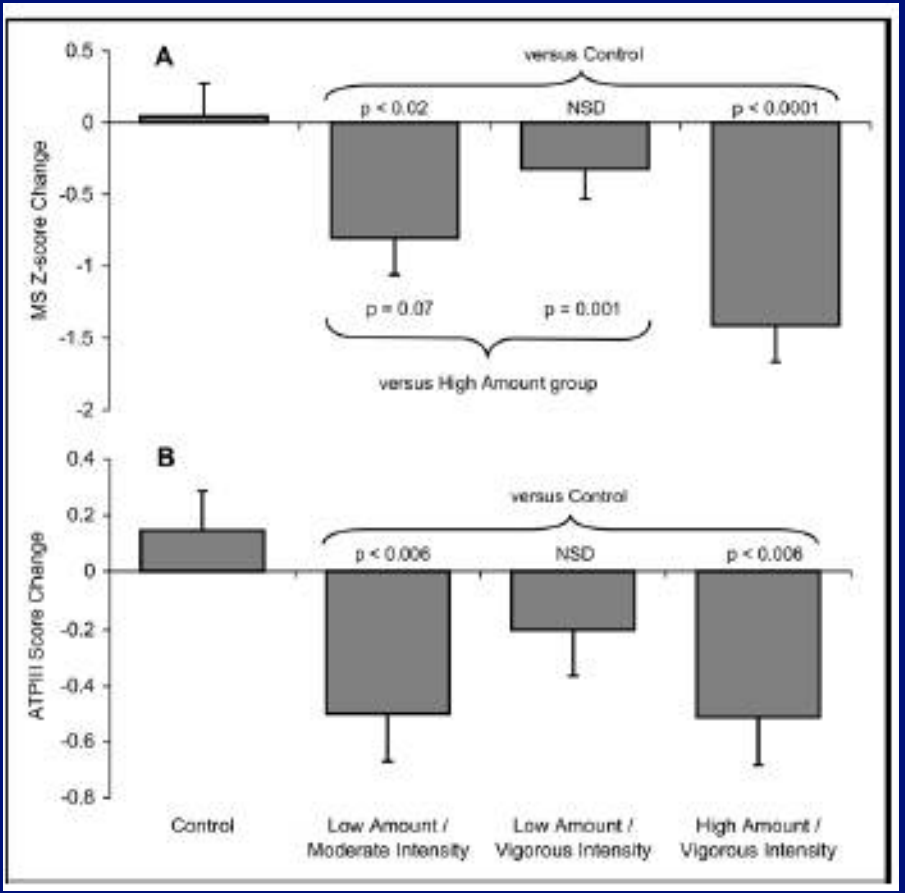
Wasfy et al, Circulation 2016; Hagberg et al, AJC, 1989; Molmen-Hansen Eur J Prev Card, 2014; Pescatello LS et al, MSSE 2019

Exercise and Diabetes Risk

- Exercise training increases insulin sensitivity and non-insulin dependent skeletal muscle glucose metabolism

- Most studies have employed exercise as part of comprehensive lifestyle modification in people at risk of DM
  - US Diabetes Prevention Study
  → weight loss was the primary driver of reduced risk

- STRRIDE Analysis (n=171)
  - High amount of exercise → most benefit in reducing metabolic syndrome



Exercise and Weight

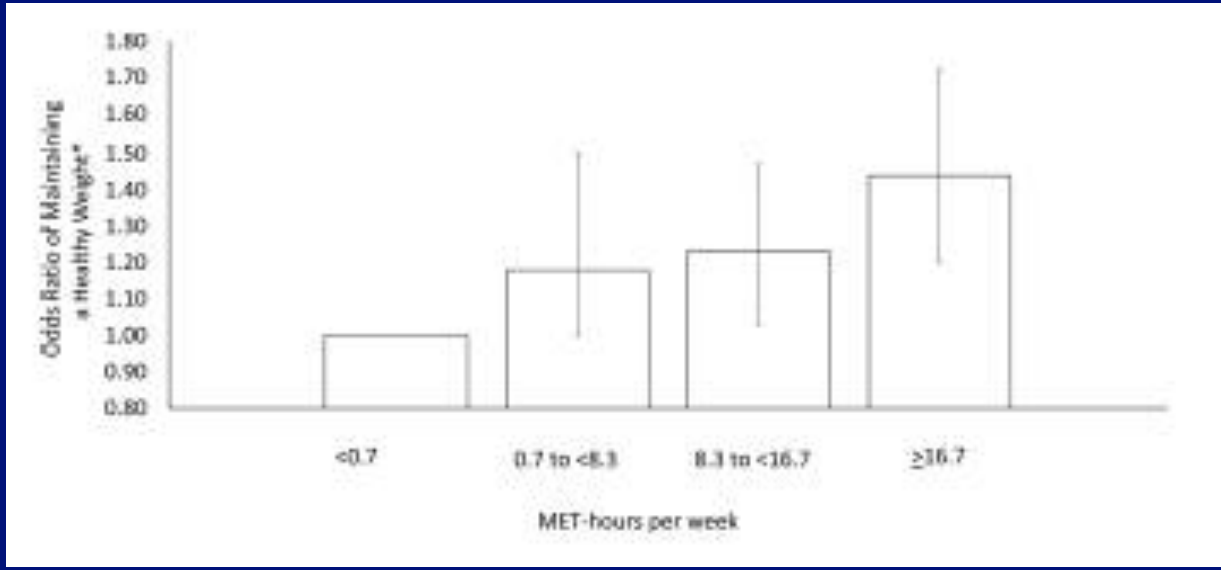
- Weight loss is one of most common reasons people exercise → Changes in body mass are driven by change in net energy balance!

- Specific guidelines for obesity treatment / prevention suggest about **double** "recommended" exercise dose (i.e. ***200-300 minutes/week of moderate intensity*** exercise) for weight loss and prevention of weight regain
  - Largely based on cross sectional data describing the activity levels associated with normal BMI

Jensen MD, et al.
2013 AHA/ACC/TOS Obesity Guideline

2013 AHA/ACC/TOS Guideline for the Management of Overweight and Obesity in Adults

A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and The Obesity Society



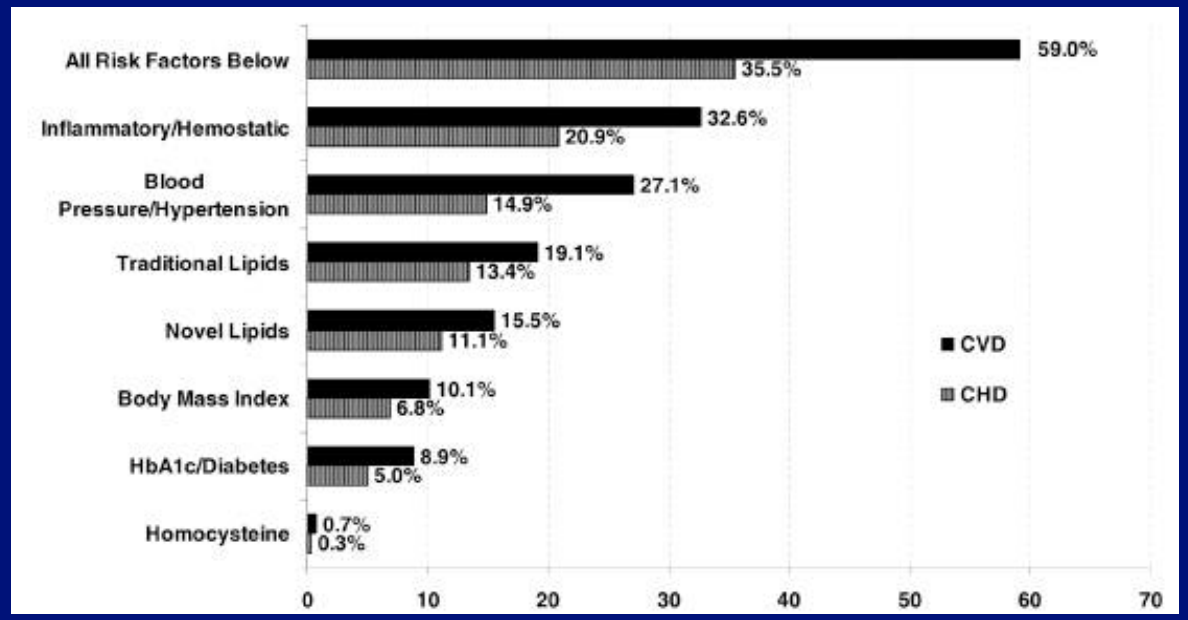
Exercise and Weight

- RCTs have confirmed higher amounts of exercise do result in more weight loss
  - Even in the context of RCTs in which subjects instructed not to change diet, the math does not add up….
  - ***Most data support approximately double the recommended amount of activity (ex. 60 minutes of walking most days per week) +/- dietary intervention is required for weight loss and maintenance***

Adding it all up…

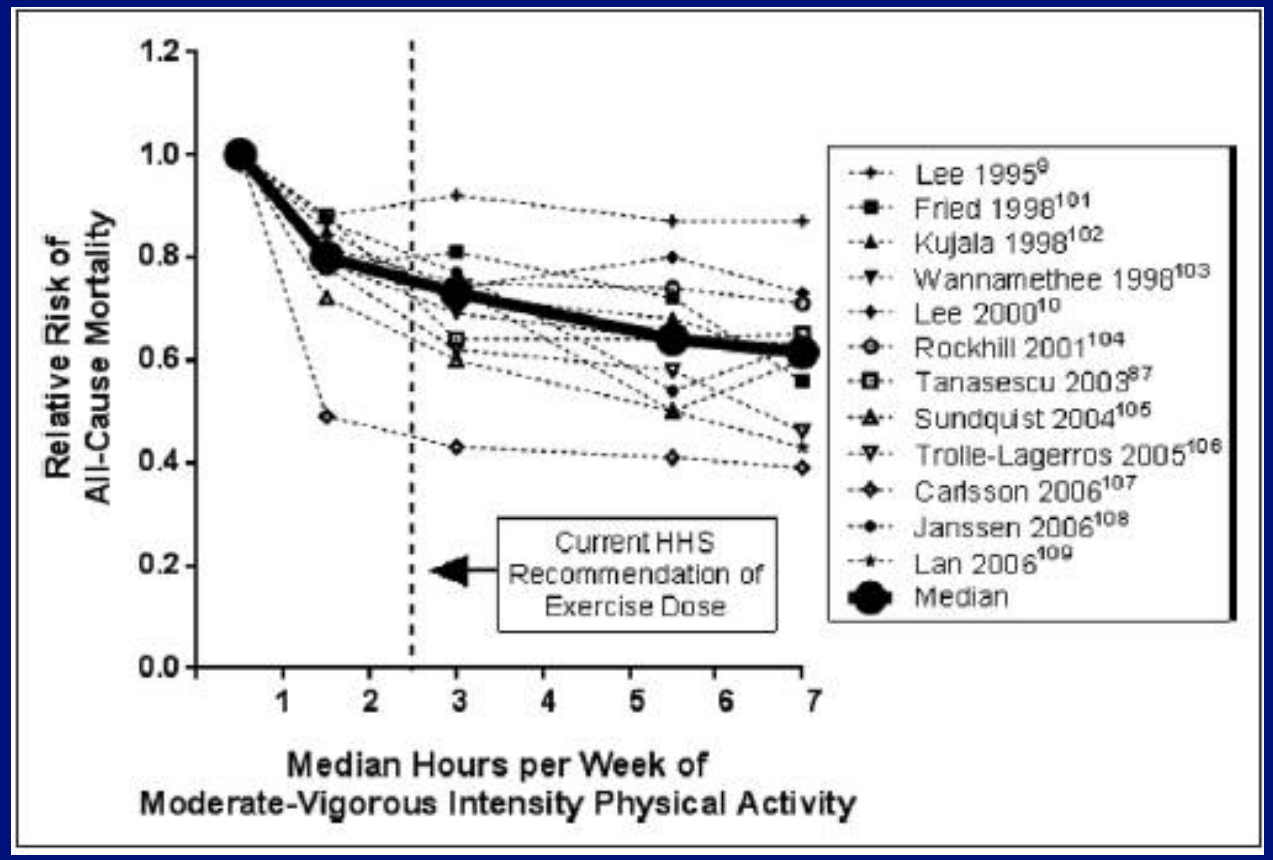
- Exercise has modest effects on measurable CVD risk factors

- **We only understand about half of the impact of exercise on CVD risk!**
- In the Women's Health Study (n=27k), physical activity and CVD events were inversely correlated
  - The most active women had 41% lower CVD risk than sedentary
  - Differences in known risk factors (especially inflammatory markers, BP, and lipids) explained only 59% of the inverse association



Mora Circulation 2007

Mortality: Data behind the Dose

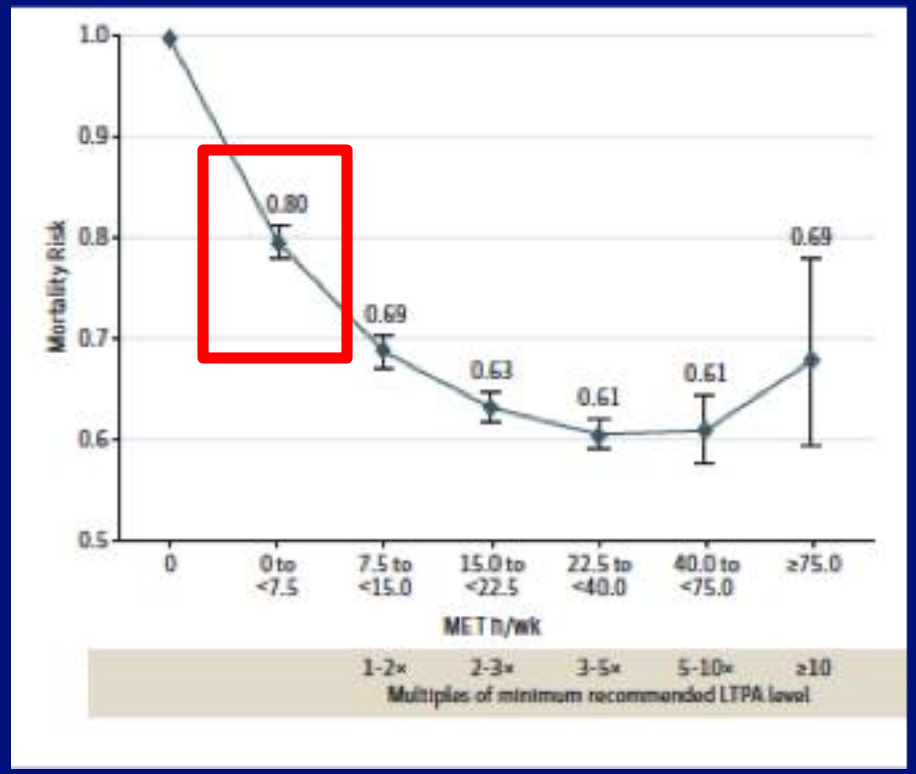


- 1 million subjects, ~140k deaths over median f/up of 12 years
- 1.5 hours/week → 20% risk reduction
- 5.5 hours/week → 40% risk reduction

Wasfy & Baggish, Circulation 2016

Low Dose: "Some Better than None?"

- Pooled data from 6 studies, 600k subjects over median 14 years
- Small amount of exercise → 20% mortality risk reduction
- Similar trend in other contemporary studies



Arem et al, JAMA Int Med 2015; Wen et al, Lancet 2011

Low Intensity: Not as Clear

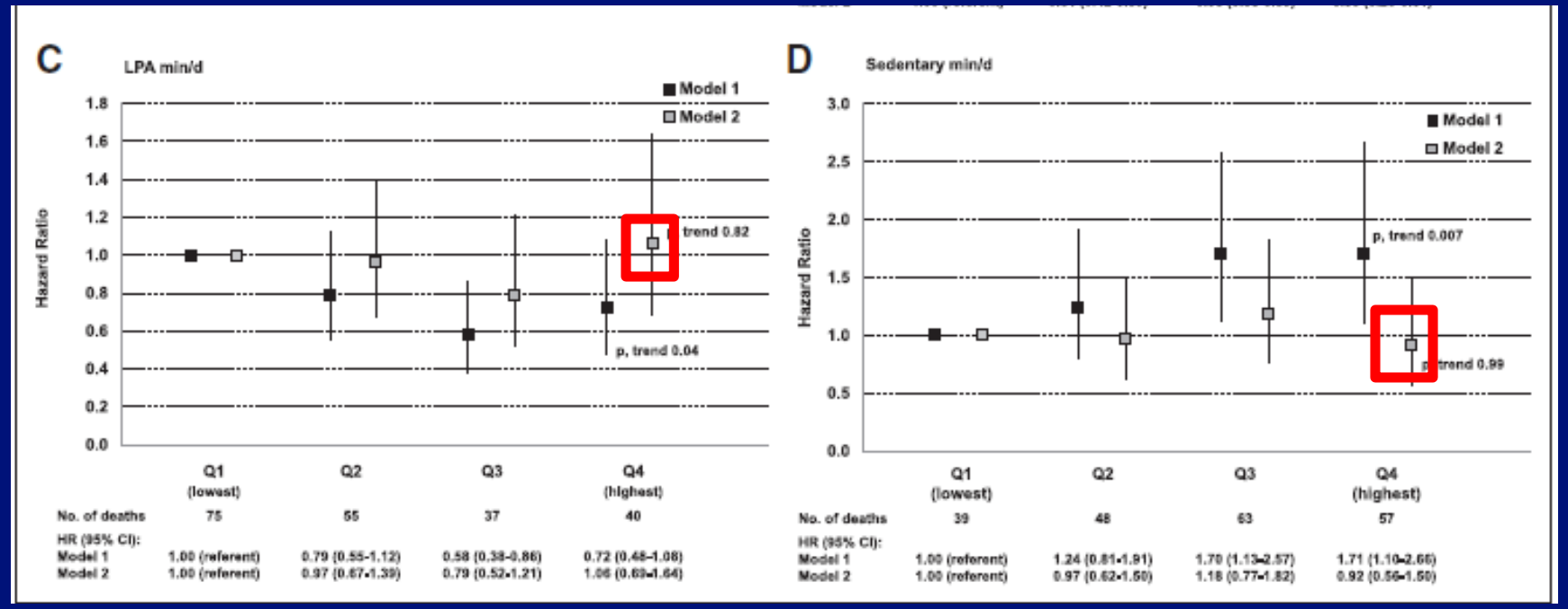
RESEARCH LETTER

Accelerometer-Measured Physical Activity and Sedentary Behavior in Relation to All-Cause Mortality

The Women's Health Study

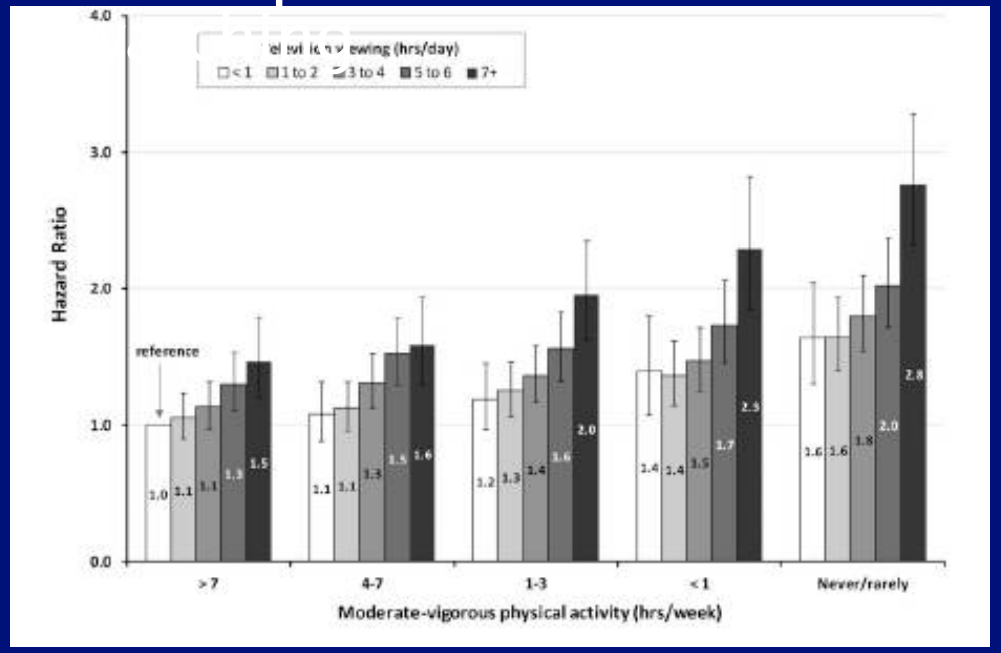
Lee et al, Circulation 2018

- **Light activity & sedentary time** were **not** associated with mortality once adjusted for **mod–vig PA!**

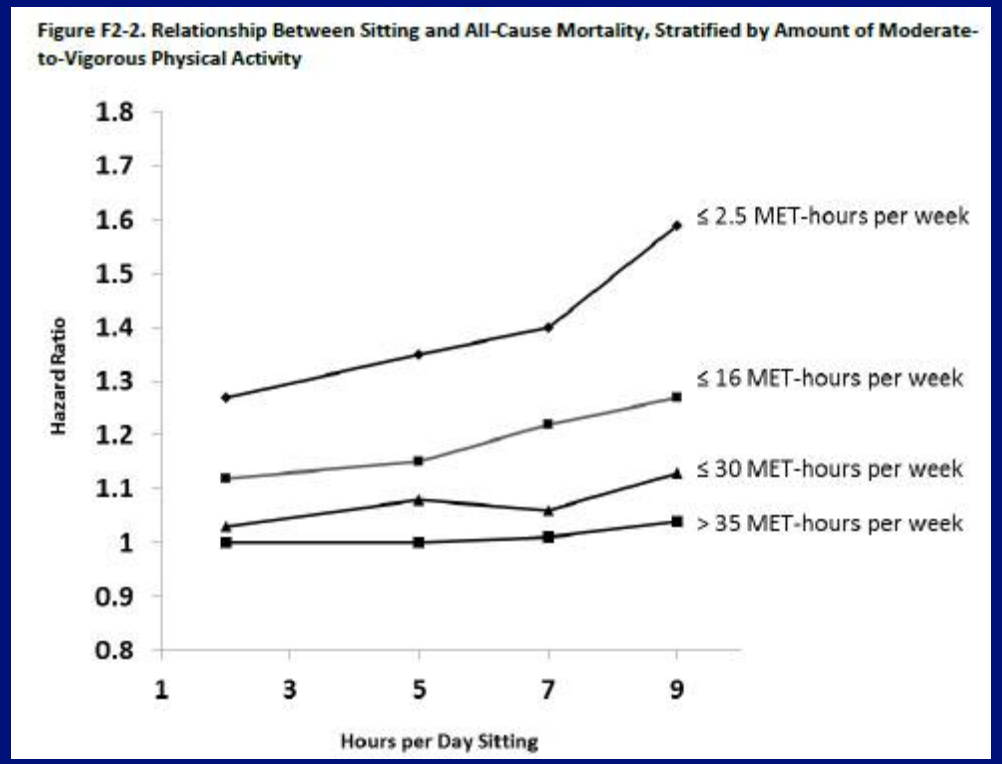


Is Sedentary Behavior Bad?

Self reported TV



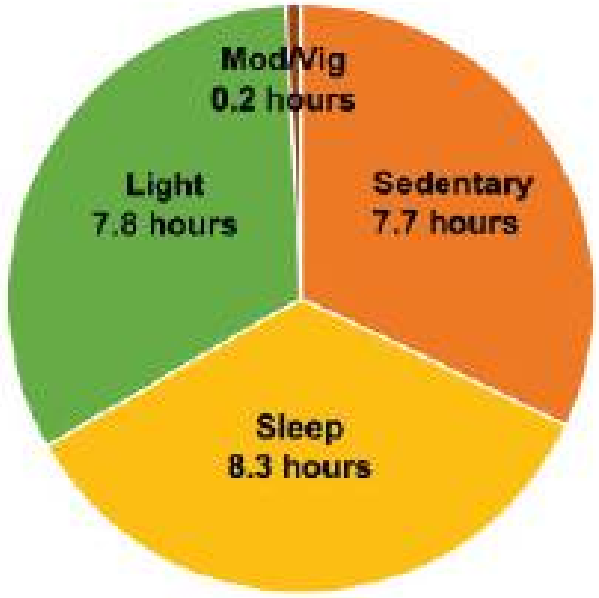
Emerging data suggest sedentary behavior is bad but perhaps most because the company it keeps (i.e. low levels of physical activity)



Matthews et al, Am J Clin Nutr, 2012;
Elkund Lancet 2016

Is Sedentary Behavior Bad?

IIb	C-LD	4. Decreasing sedentary behavior in adults may be reasonable to reduce ASCVD risk (S3.2-3, S3.2-9–S3.2-11).



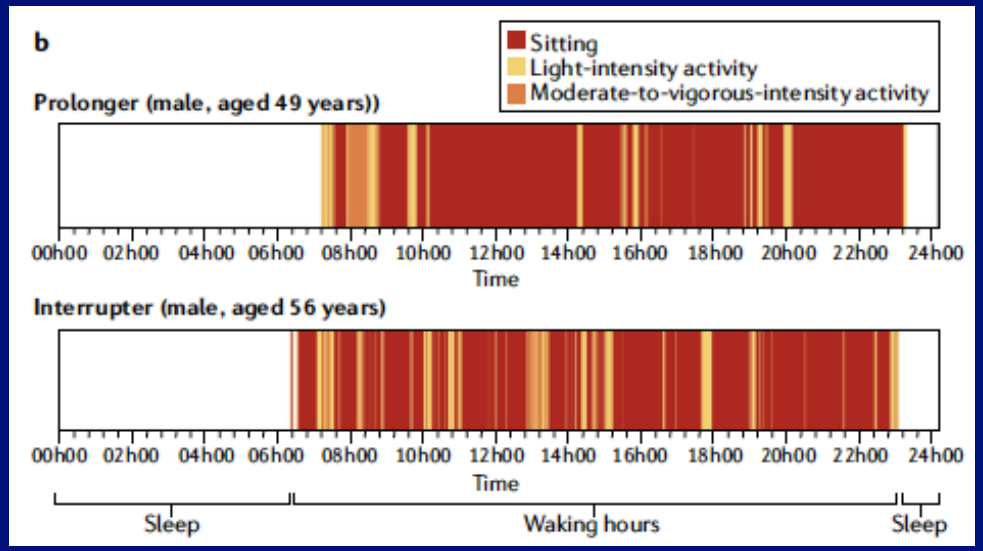
"High volumes of moderate to vigorous PA appear to remove the risk of all-cause mortality associated with high volumes of sitting.
Very low time spent sitting reduces but does not eliminate the risk of no moderate to vigorous physical activity"

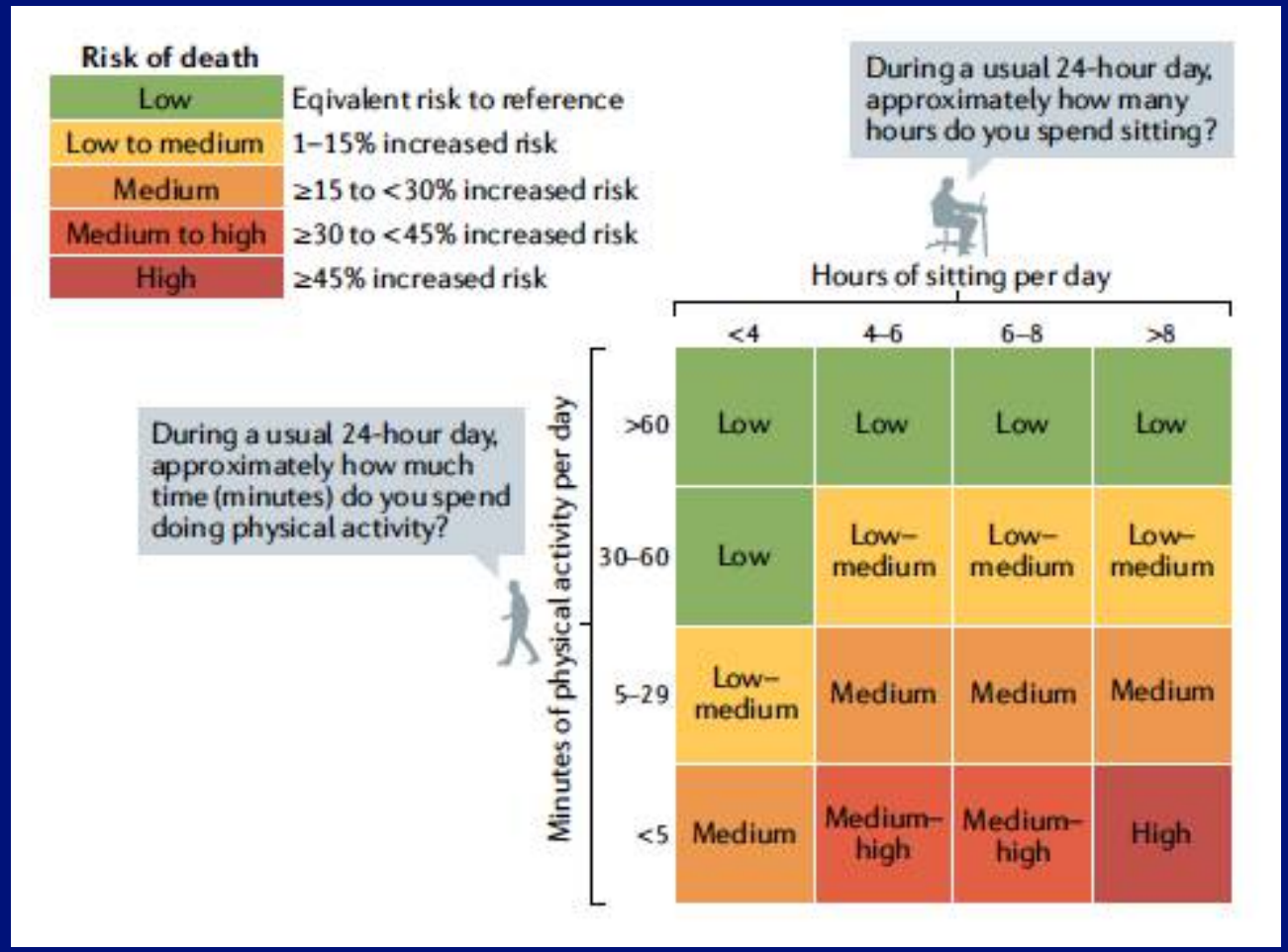
Arnett et al, Circulation 2019

Is Sedentary Behavior Bad?

Sit less and move more for cardiovascular health: emerging insights and opportunities

David W. Dunstan[1,2], Shilpa Dogra[3], Sophie E. Carter[4] and Neville Owen[5,6]





Putting It Together: PA vs. Sedentary vs. Sleep

- 6 studies
- 130k individuals

What are the findings?

- In this study, sleep time was not associated with all-cause mortality.
- Wrist and hip accelerometer data when processed using threshold classification methods lead to different results.
- Several different combinations of time spent in physical activities, sedentary behaviours and sleep are associated with a similar lower mortality risk.
- Replacing sedentary time with light physical activity provides health benefits but increasing moderate to vigorous physical activity requires less time for similar benefits.

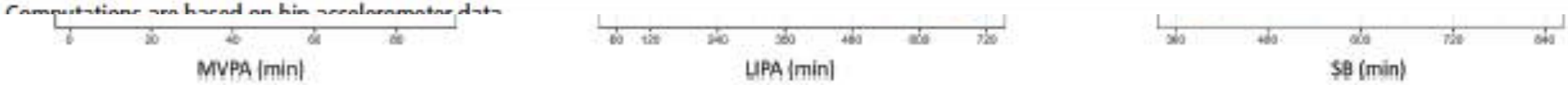
Joint association between accelerometry-measured daily combination of time spent in physical activity, sedentary behaviour and sleep and all-cause mortality: a pooled analysis of six prospective cohorts using compositional analysis

Sebastien Chastin [1,2] Duncan McGregor,[1,3] Javier Palarea-Albaladejo,[3] Keith M Diaz,[4] Maria Hagströmer,[5,6,7] Pedro Curi Hallal,[8] Vincent T van Hees,[9] Steven Hooker,[10] Virginia J Howard,[11] I-Min Lee [12] Philip von Rosen,[5] Séverine Sabia,[13,14] Eric J Shiroma,[15] Manasa S Yerramalla,[13] Philippa Dall[1]

Table 4 Estimated time difference in waking day composition associated with a risk reduction of 10% in all-cause mortality (HR=0.90) with respect to the reference composition

Reference composition	MVPA=2 min/day LIPA=358 min/day SB=10 hours/day	MVPA=10 min/day LIPA=350 min/day SB=10 hours/day	MVPA=30 min/day LIPA=330 min/day SB=10 hours/day
Composition difference			
More MVPA and less SB (LIPA is fixed)	8 min (95% CI 3 to 91)	29 min (95% CI 13 to 95)	52 min (95% CI 31 to 98)
More LIPA and less SB (MVPA is fixed)	51 min (95% CI 39 to 79)	50 min (95% CI 39 to 72)	49 min (95% CI 37 to 70)

Computations are based on hip accelerometer data

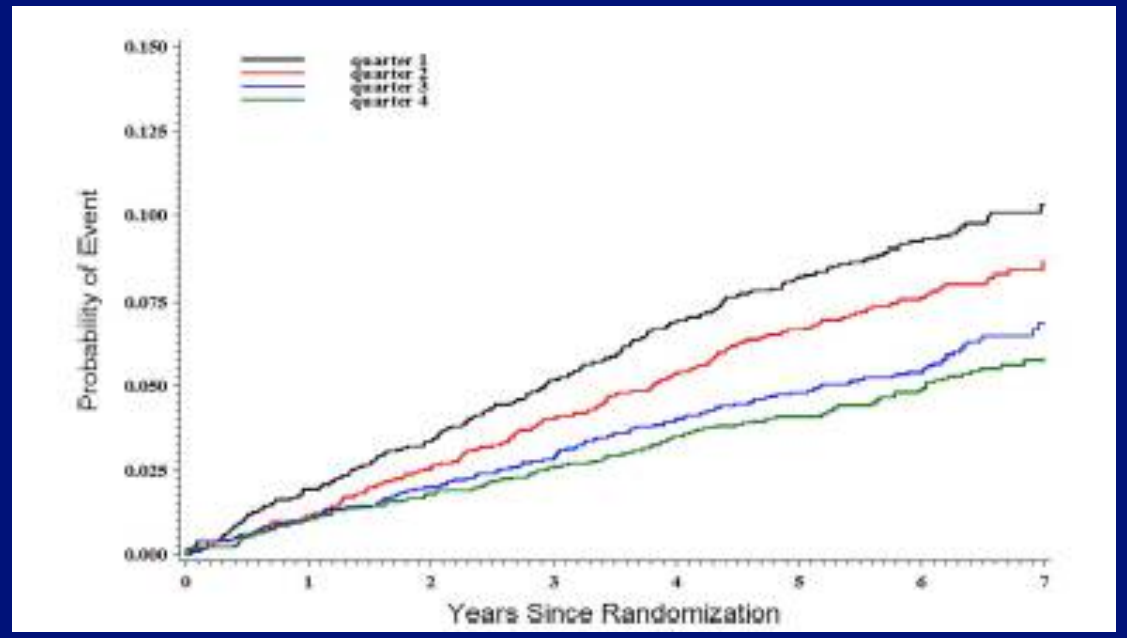


10,000 Steps?

- 1975: Japanese company developed a pedometer named and marketed as "manpo-kei" – 10,000 steps meter

- Steps are a measurement of total physical activity

- Emerging data suggest physical activity dose in this range associated with health benefits, but need to understand this better – not in PA guidelines



Yates et al, Lancet, 2014

10k is not a magic number

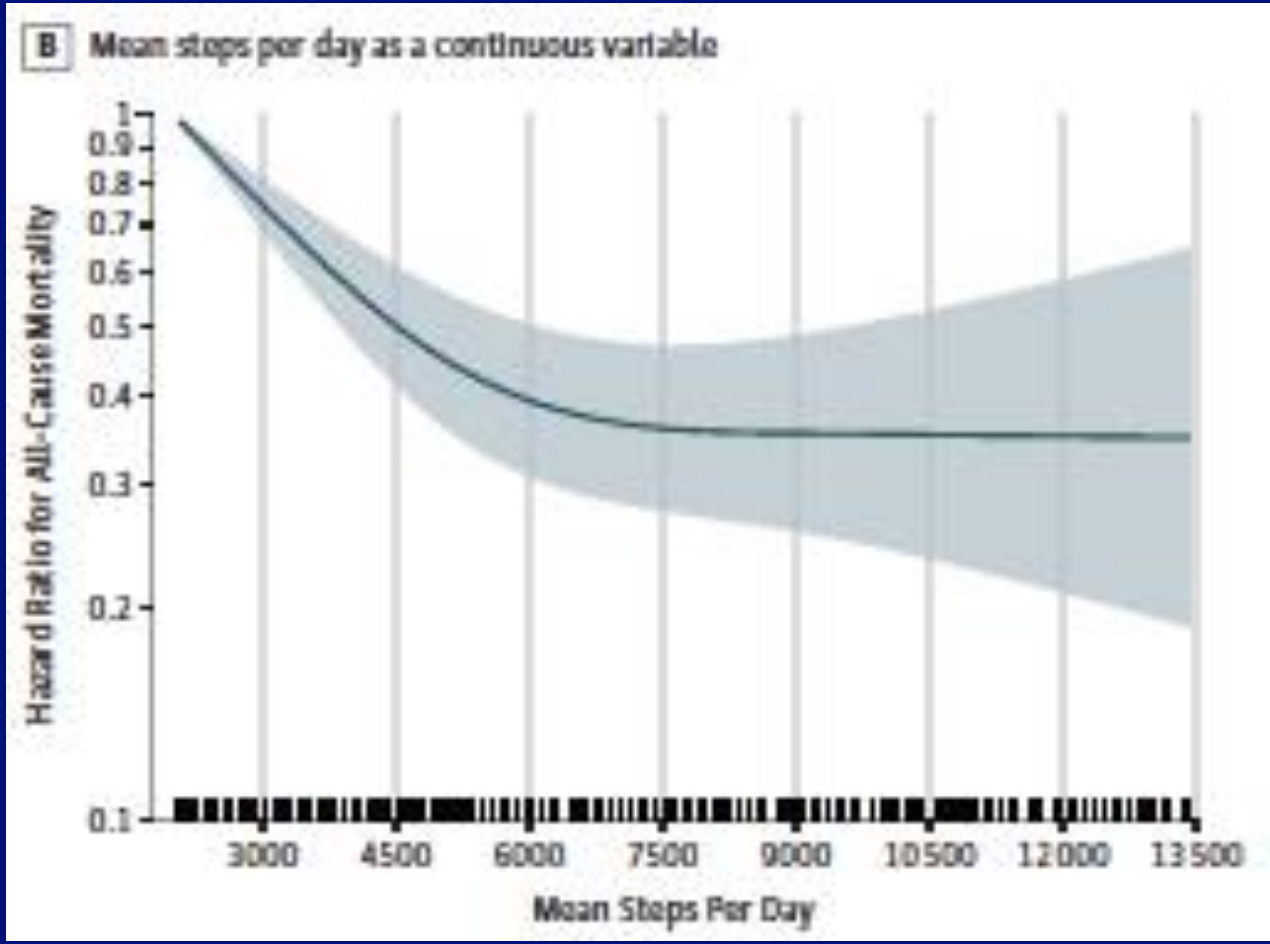
JAMA Internal Medicine | Original Investigation

Association of Step Volume and Intensity With All-Cause Mortality in Older Women

I-Min Lee, MBBS, ScD; Eric J. Shiroma, ScD; Masamitsu Kamada, PhD; David R. Bassett, PhD; Charles E. Matthews, PhD; Julie E. Buring, ScD

Women's Health Study:
~72 yo average age

Reduction in mortality at 4700k
Levels off at 7500k steps

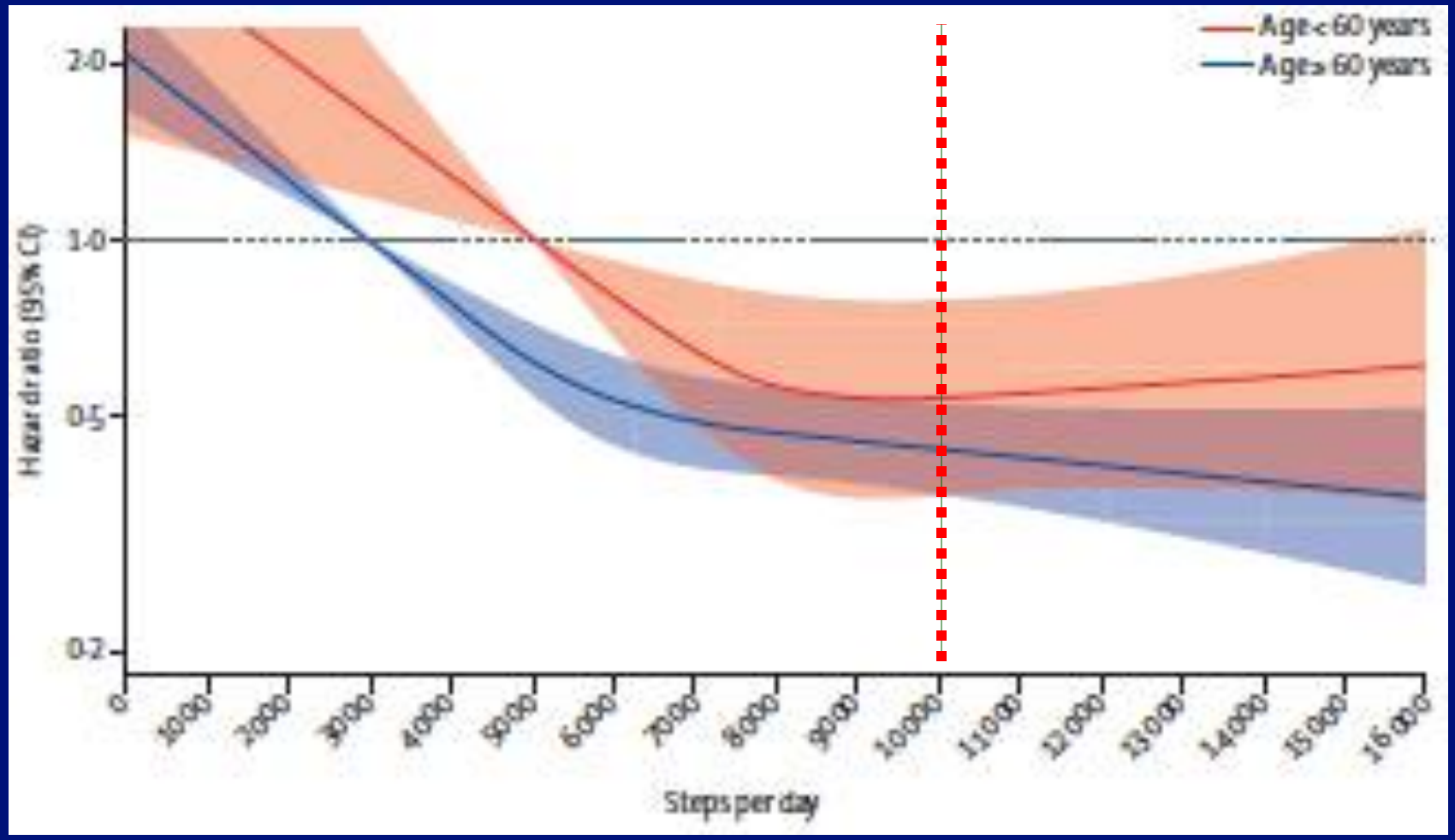


10k is not a magic number

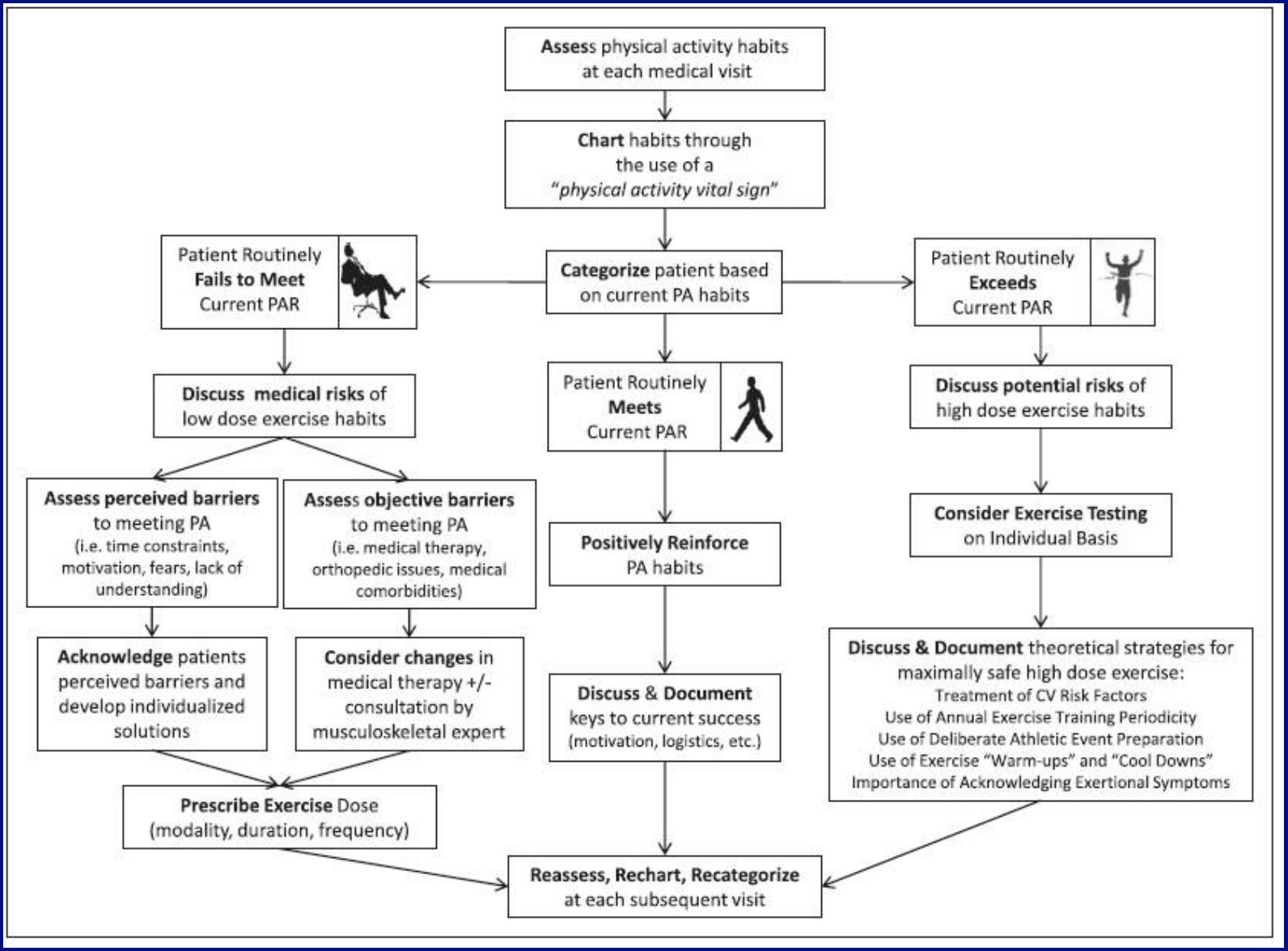
15 Studies
47k adults, f/up 7.1 years

Daily steps and all-cause mortality: a meta-analysis of 15 international cohorts

Amanda E Paluch, Shivangi Bajpai, David R Bassett, Mercedes R Carnethon, Ulf Ekelund, Kelly R Evenson, Deborah A Galuska, Barbara J Jefferis, William E Kraus, I-Min Lee, Charles E Matthews, John D Omura, Alpa V Patel, Carl F Pieper, Erika Rees-Punia, Dhayana Dallmeier, Jochen Klenk, Peter H Whincup, Erin E Dooley, Kelley Pettee Gabriel, Priya Palta, Lisa A Pompeii, Ariel Chernofsky, Martin G Larson, Ramachandran S Vasan, Nicole Spartano, Marcel Ballin, Peter Nordström, Anna Nordström, Sigmund A Anderssen, Bjørge H Hansen, Jennifer A Cochrane, Terence Dwyer, Jing Wang, Luigi Ferrucci, Fangyu Liu, Jennifer Schrack, Jacek Urbanek, Pedro F Saint-Maurice, Naofumi Yamamoto, Yutaka Yoshitake, Robert L Newton Jr, Shengping Yang, Eric J Shiroma, Janet E Fulton, on behalf of The Steps for Health Collaborative



Assessing Physical Activity



Exercise in the COVID-19 Era: Risk of Infection?

CDC Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™

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EMERGING INFECTIOUS DISEASES®

ISSN: 1080-6059

EID Journal > Volume 26 > Early Release > Main Article

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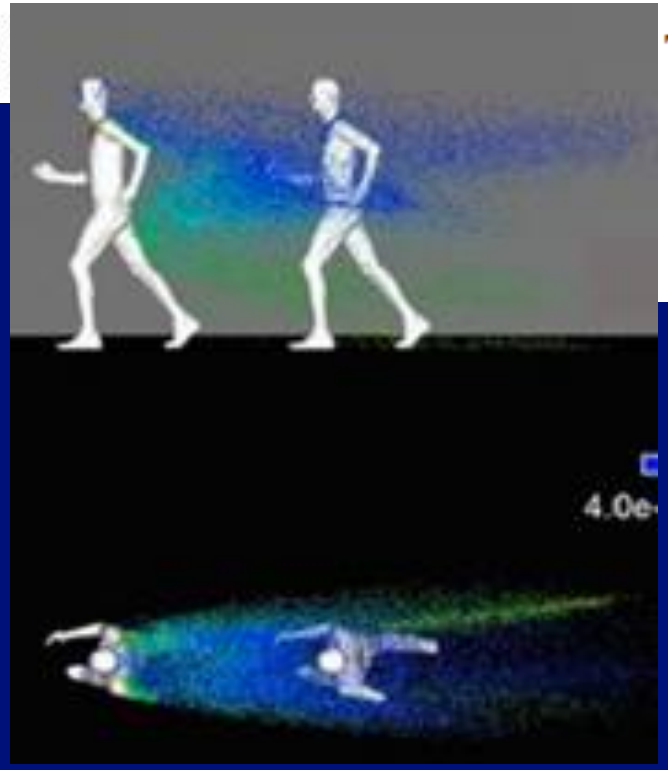
Volume 26, Number 8—August 2020

Research Letter



Preprint

YET UNPUBLISHED

Towards aerodynamically equivalent COVID-19 1.5 m social distancing for walking and running

B. Blocken [1,2], F. Malizia [2], T. van Druenen [1], T. Marchal [3,4]

Indoor transmission of SARS-CoV-2

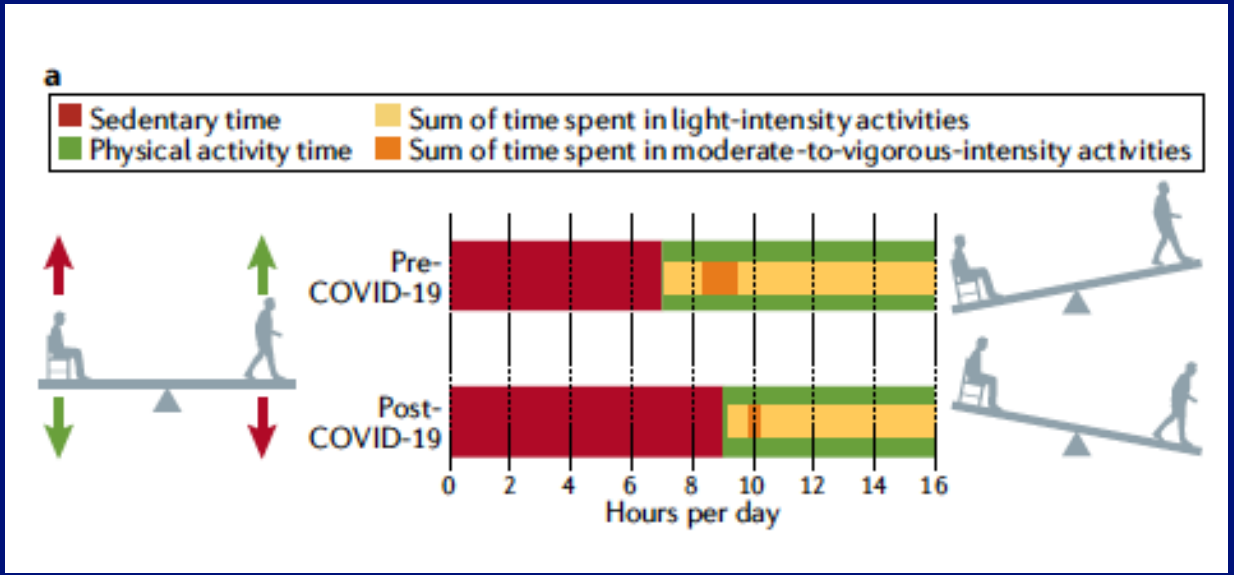
Hua QIAN[1,*], Te MIAO[2,*], Li LIU[3], Xiaohong ZHENG[1], Danting LUO[1], and Yuguo Li[2,4,

1/1245 cases due to outdoor transmission

A LOT HAS BEEN LEARNED!

Exercise in the COVID-19 Era: Risk of Inactivity?

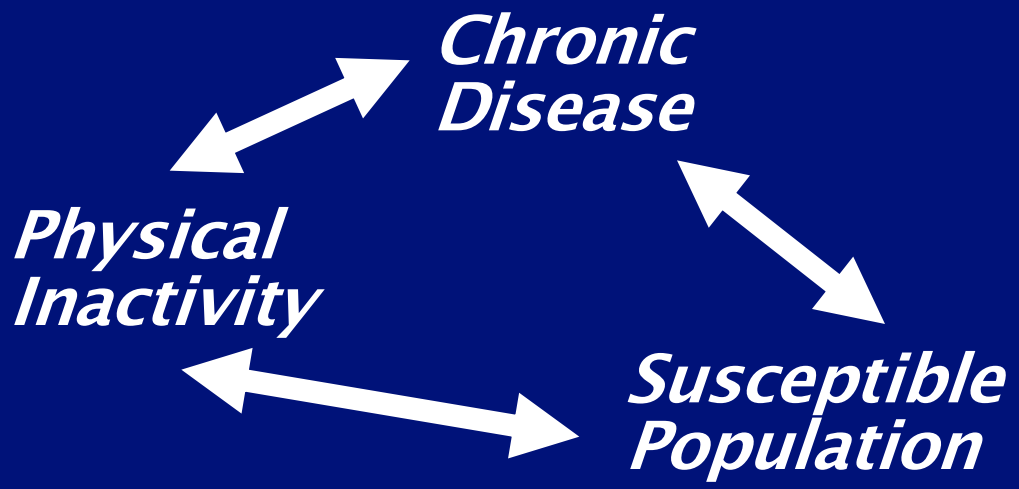
Intermediate Term:



Long Term:

Commentary

A tale of two pandemics: How will COVID-19 and global trends in physical inactivity and sedentary behavior affect one another?



Pecanha et al, AJP Heart, 2020; Hall et al, Prog CV Disease, 2020; Dunstan et al, Nat Reviews, 2021

Practical Advice for Patients

Staying Active During the Coronavirus Pandemic

Exercise is Medicine | AMERICAN COLLEGE of SPORTS MEDICINE

Stay positive. Stay active. **Be smart and safe.**

https://www.exerciseismedicine.org/

Thank You !

MGH 1811

Cardiovascular Performance Program