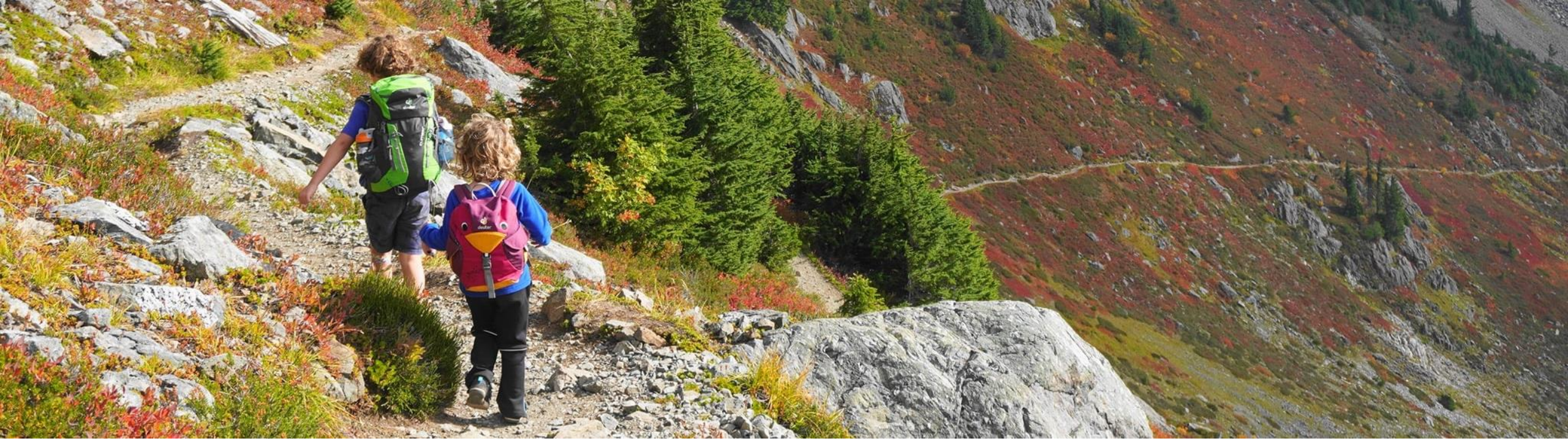




The Effect of Sedentary Behavior on Health and Wellness

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Disclosures

Jessie Fudge, MD

No Relationships to Disclose

Objectives

Define Non-Communicable Diseases (NCD)

Brief Review Physical Activity Guidelines

Review Benefits of Physical Activity

Compare Insufficient Physical Activity and Sedentary Behavior

Review of the literature

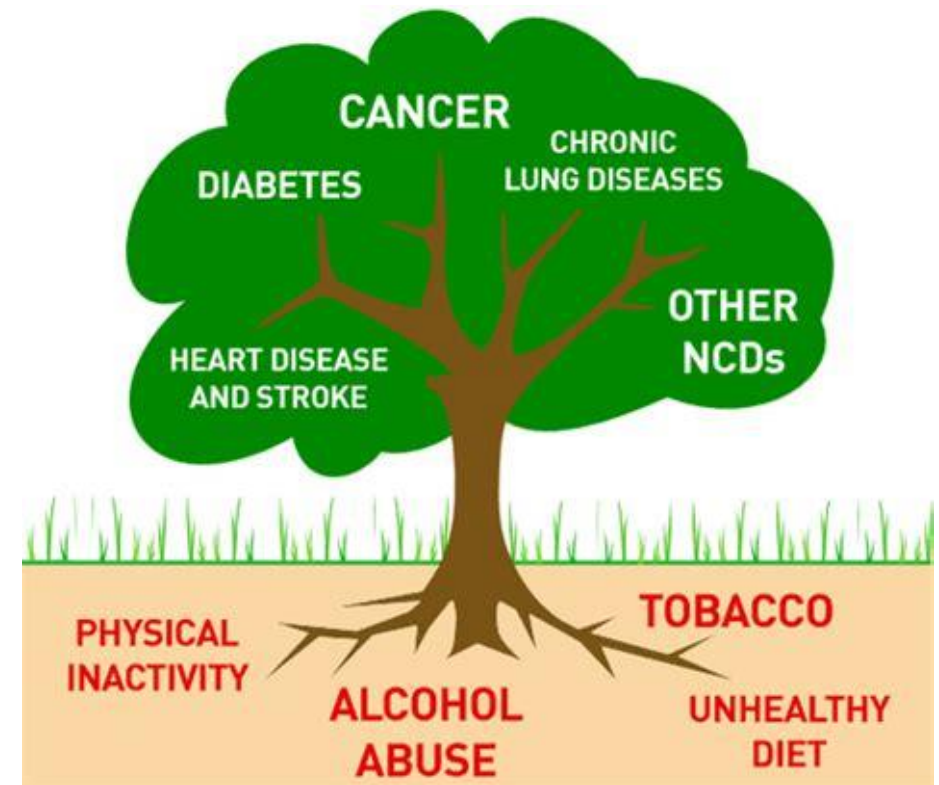
Non-Communicable Diseases

Definition

- Medical conditions that are not infectious and cannot be transmitted from one person or animal to another.
- Result of a combination of genetic, physiological, environmental and behavioral factors
- Disproportionately affect people in low- and middle-income countries

Non-Communicable Diseases

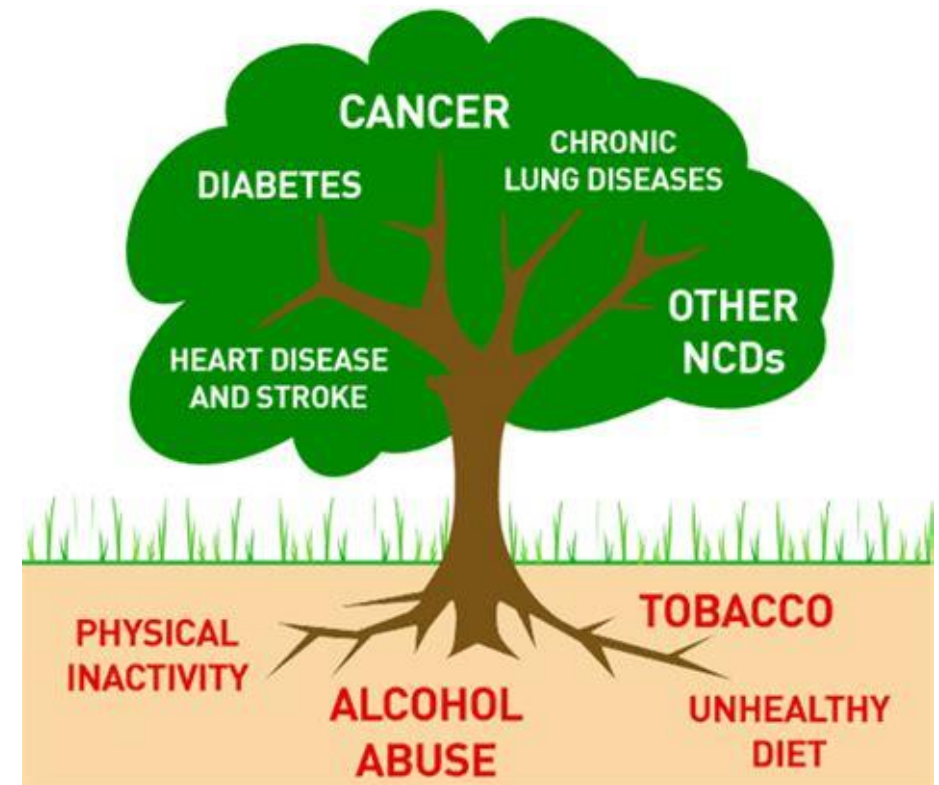
- 75% of non-pandemic related global deaths were due to NCDs in 2021 (43 million people)
 - Cardiovascular Disease (44% of NCD deaths)
 - Cancers (23% of NCD deaths)
 - Chronic Respiratory Disease (9%)
 - Diabetes (5% of NCD deaths)



WHO Global NCD Action Plan 2013-2020

Non-Communicable Diseases

- Behavioral Risk Factors
 - Tobacco Use (including exposure to second hand smoke)
 - Unhealthy Diet
 - Physical Inactivity/Sedentary Behavior
 - Harmful Use of Alcohol
- Metabolic Risk Factors
 - Elevated blood pressure
 - Overweight/Obesity
 - High blood sugar (including diabetes)
 - Elevated Cholesterol



WHO Global NCD Action Plan 2013-2020

Physical Activity

Definition

- WHO defines physical activity as any bodily movement produced by skeletal muscles that requires energy expenditure – including activities undertaken while working, playing, carrying out household chores, traveling, and engaging in recreational pursuits.

Physical Activity Recommendations

- Children/Adolescents (5-17yo)

- 60 minutes vigorous exercise DAILY
- Additional health benefits with free play >60 minutes
- Strengthening activities at least 3 days per week

Moderate: brisk walk, dancing, gardening

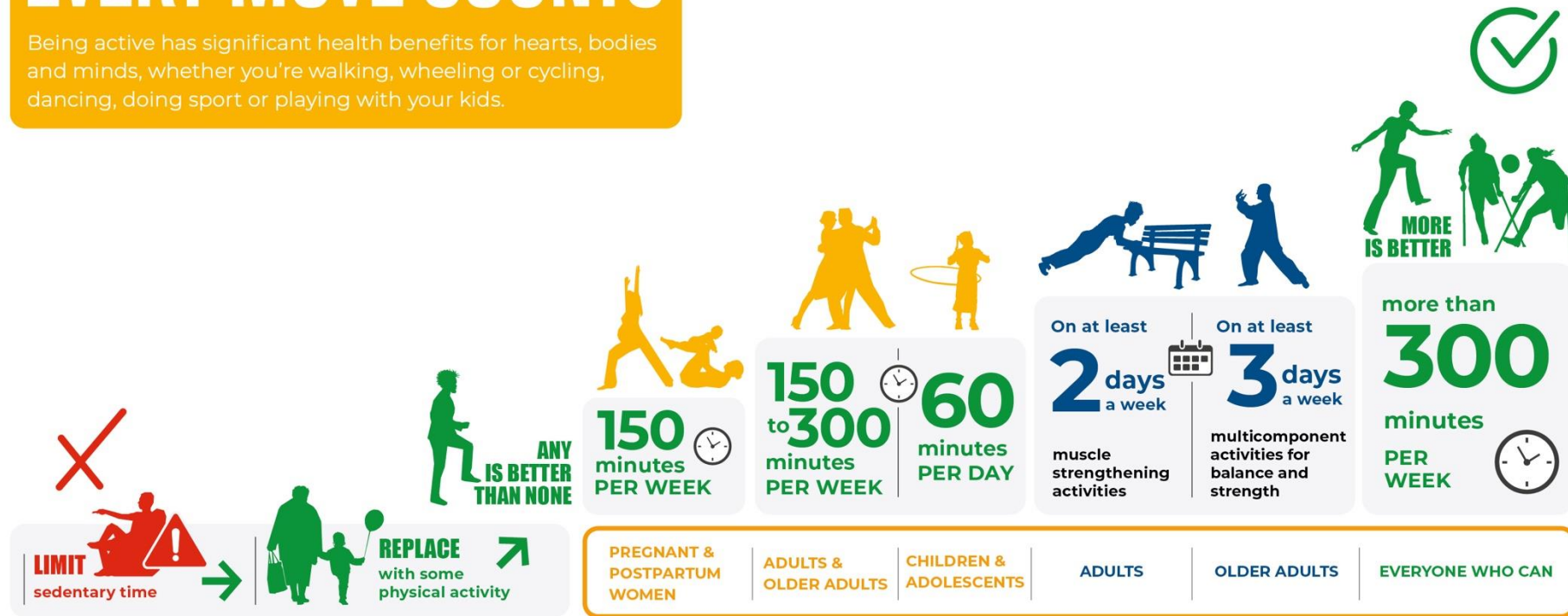
Vigorous: running, fast cycling, fast swimming, heavy lifting

- Adults

- 150 minutes moderate intensity exercise over the course of a WEEK (average 30 minutes 5 days per week)
 - Additional health benefits at 300 minutes per week
- OR 70 minutes vigorous intensity exercise over the week
- Time can be split up throughout the day
- Muscle strengthening activities at least 2 days per week

EVERY MOVE COUNTS

Being active has significant health benefits for hearts, bodies and minds, whether you're walking, wheeling or cycling, dancing, doing sport or playing with your kids.



WHO guidelines on physical activity and sedentary behaviour (2020).

For more information, visit: www.who.int/health-topics/physical-activity

LET'S
Be active
Everyone
Everywhere
Everyday



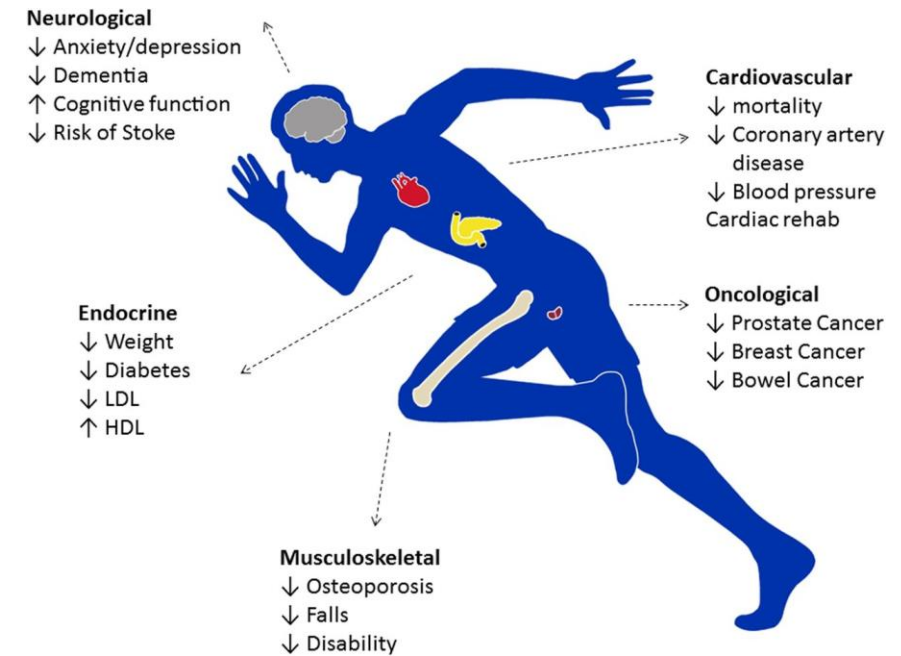
Benefits to Physical Activity

■ Children/Adolescents (5-17yo)

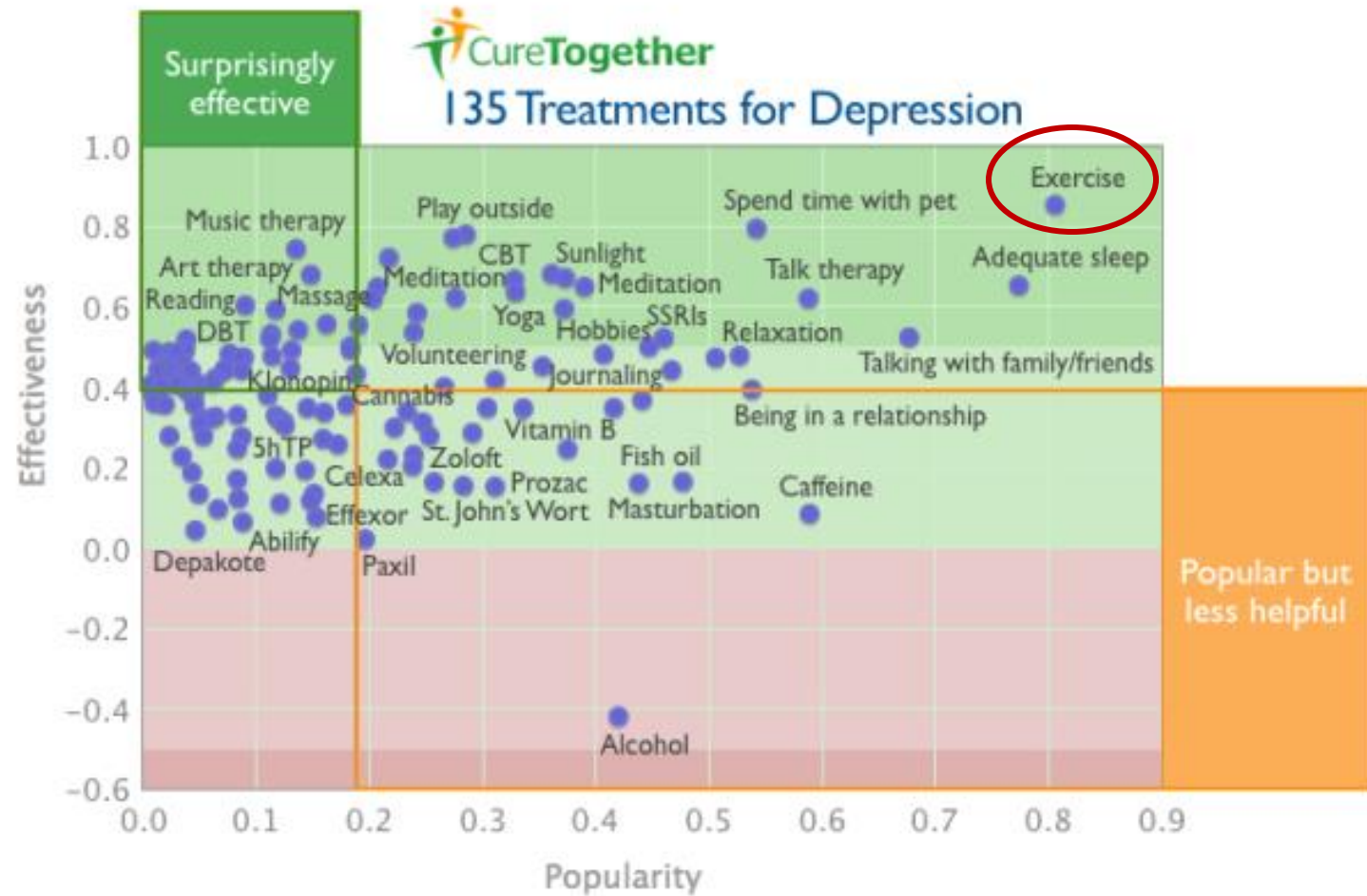
- Improved physical fitness
- Improved cardiometabolic health, bone health
- Improvements in mental health and cognitive outcomes
- Reduced Body Fat

■ Adults

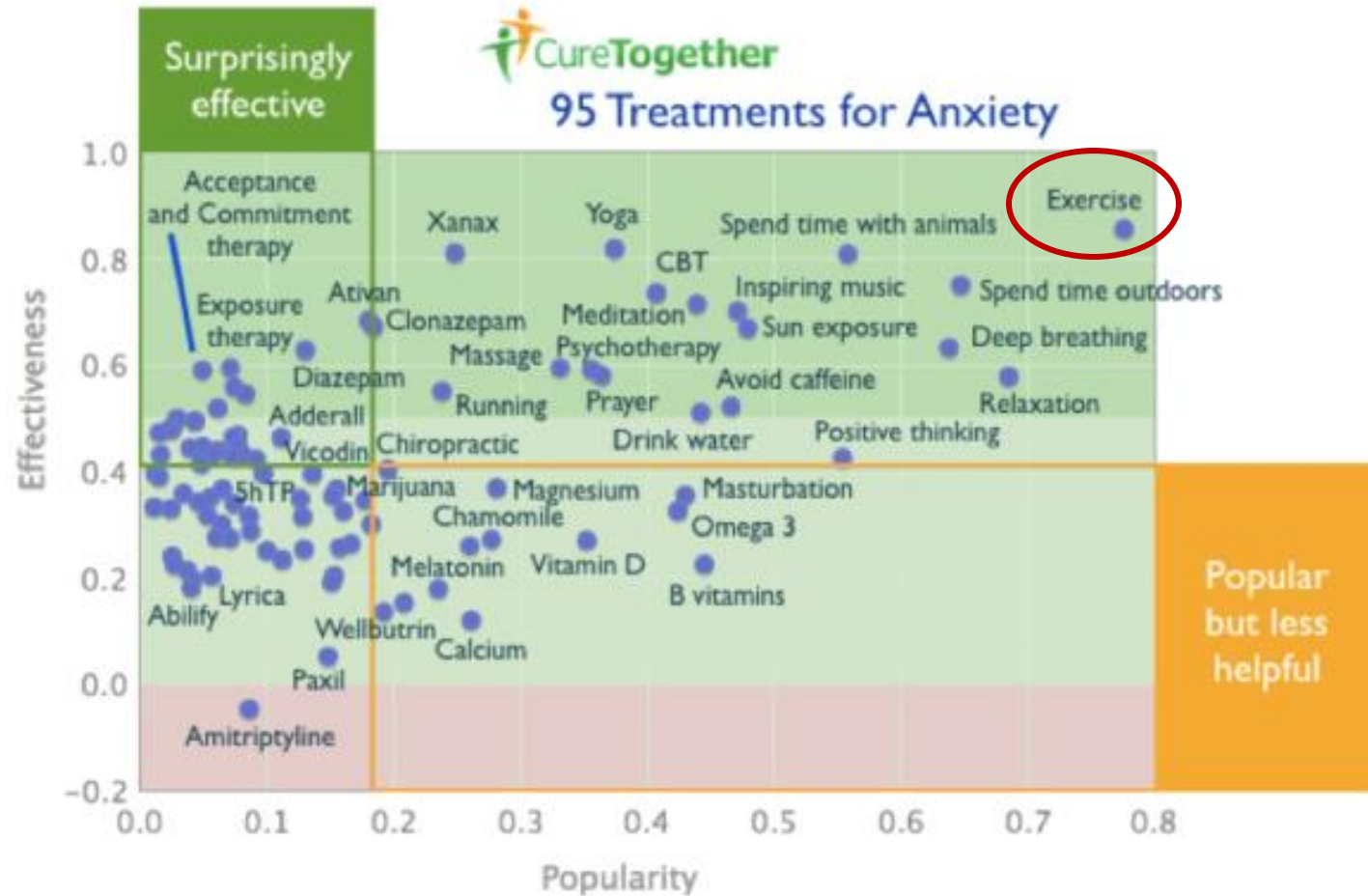
- Achieve and maintain a healthy weight
- Reduces feeling of stress, anxiety and depression
- Boosts energy, improves sleep and productivity
- Reduce risk of:
 - Dying from heart disease or stroke
 - Developing high blood pressure, high cholesterol, diabetes, and some cancer (breast cancer, colon cancer)
 - Falls



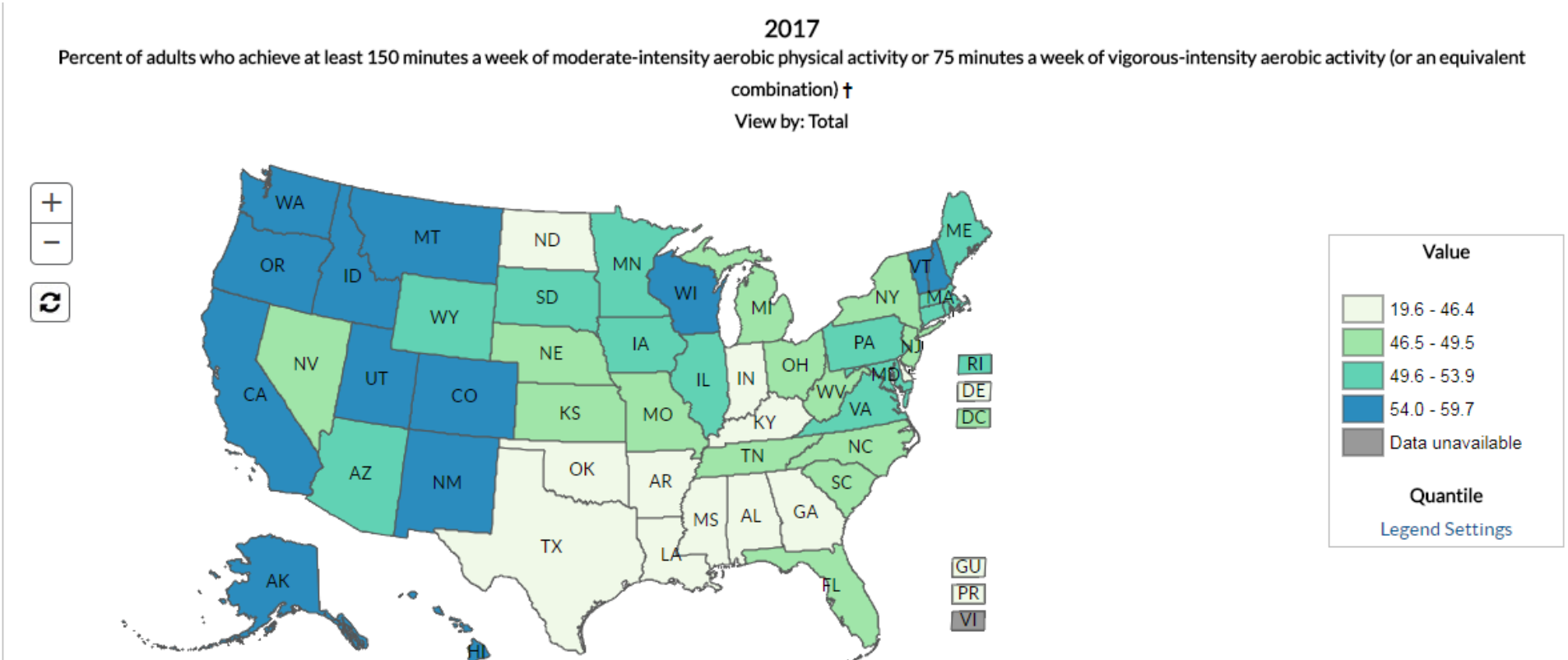
Mental Health Benefits



Mental Health Benefits



USA Physical Activity Levels

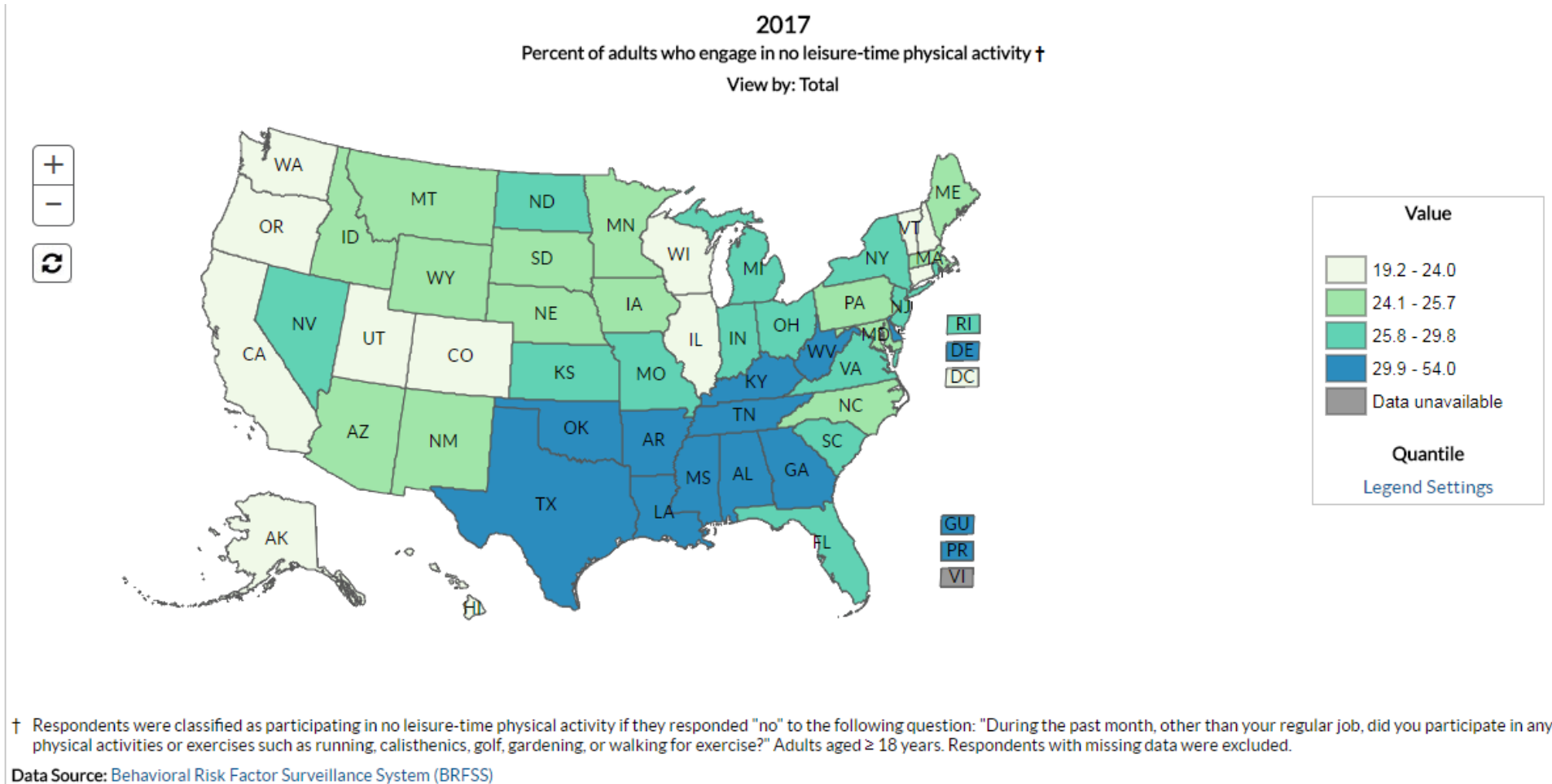


† Respondents were classified as active if they reported at least 150 minutes per week of moderate-intensity activity, or at least 75 minutes per week of vigorous-intensity activity, or a combination of moderate-intensity and vigorous-intensity activity (multiplied by two) totaling at least 150 minutes per week. Adults aged ≥ 18 years. Respondents whose physical activity level could not be categorized due to missing physical activity data were excluded.

Data Source: [Behavioral Risk Factor Surveillance System \(BRFSS\)](#)

<https://www.cdc.gov/nccdphp/dnpao/data-trends-maps/index.html>

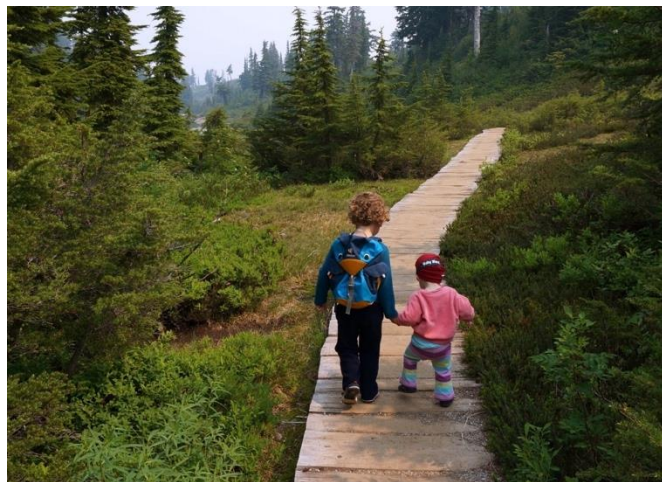
USA Physical Activity Levels



Insufficient Physical Activity

People who are insufficiently active have a 20% to 30% increased risk of death compared to people who are sufficiently active

- One of the leading risk factors for death worldwide
- 31% of the world's adult population are physically inactive
 - increase in 5% between 2010 and 2022
- 81% of the world's adolescents are not active enough



Risk Factors for Insufficient Physical Activity

- Low or decreasing levels of physical activity correspond with high-income countries or increasing GNP
 - Inactivity during leisure time
 - Sedentary behavior on the job and at home
 - Increase Passive modes of transportation
- Environmental Factors
 - Fear of violence or crime
 - High density traffic
 - Low air quality/pollution
 - Lack of parks, sidewalks, sports/recreation facilities



Sedentary Behavior

Definition

- Defined as any waking behavior such as sitting or lying with minimal energy expenditure (<1.5 metabolic equivalent task (MET))
- Occupies a large proportion of waking hours across multi environments
- Usually quantified as total daily sitting time
- Independent predictor of metabolic risk (even in those meeting Activity Guidelines)

Sedentary Behavior

- US Adults report an average of 9.5 hours per day sedentary
 - Previous day recalls (October and November 2019)
 - Age 20-75, mean age 45.39 (n=2640)
- 82% of leisure time was spent sedentary
 - Watching television/movies
 - Internet/Computer Use



Sedentary Behavior vs Physical Inactivity

Sedentary Behavior

Time in very low energy expenditure state

Physical Inactivity

Performing insufficient amounts of moderate to vigorous-intensity activity (not meeting physical activity guidelines for age)

Someone can be physically inactive (not meet physical activity guidelines) and not be sedentary

Similarly, someone who spends the majority of their time in sedentary activities may meet recommended levels of physical activity and be considered physically active

Sitting Time, Leisure-Time Physical Activity, and Risk of Mortality Among US Stroke Survivors: A Prospective Cohort Study From the NHANES 2007 to 2018

Chuanchuan Yu¹, MSc¹; Yalin Cao, MD²; Qifang Liu³, MD; Hongwen Tan, MD; Guiling Xia, MD; Baolin Chen, MD; Fawang Du⁴, MD; Kui Lu, PhD; Gustavo Saposnik⁵, MD, MPH, PhD

Sufficiently active stroke survivors had a lower risk of all-cause, CVD, and non-CVD mortality compared with insufficiently active stroke survivors.

Sitting at least 8 h/d was associated with higher risks of all-cause and non-CVD mortality compared with sitting <6 h/d.

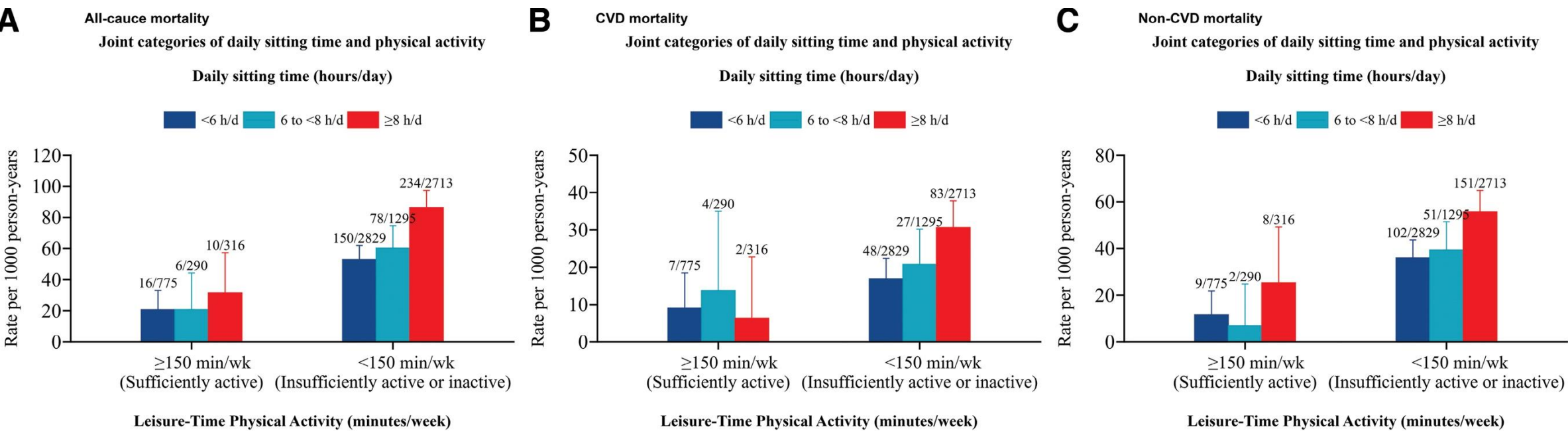


Figure 2. Mortality rates per 1000 person-years (95% CI) stratified by joint variables of leisure-time physical activity and daily sitting time. A, All-cause; (B) CVD; (C) non-CVD. Sufficiently active: ≥150 min/wk; insufficiently active or inactive: <150 min/wk.

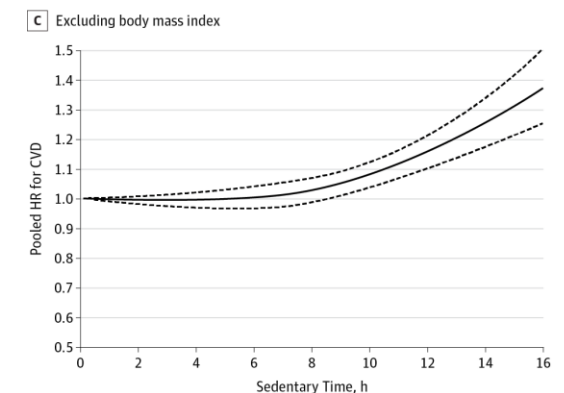
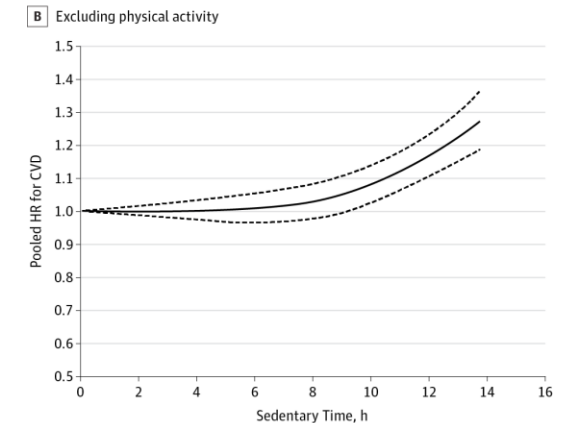
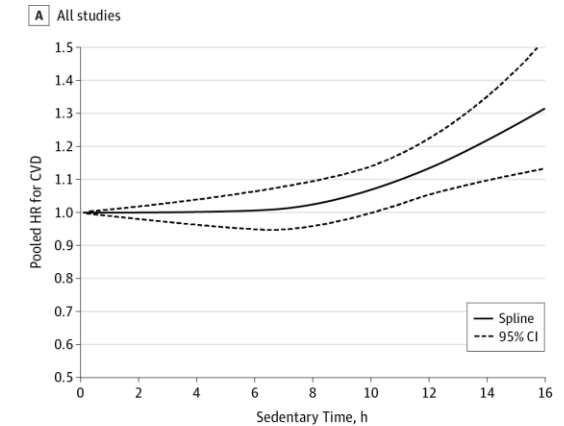
From: Continuous Dose-Response Association Between Sedentary Time and Risk for Cardiovascular Disease: A Meta-analysis

JAMA Cardiol. 2016;1(5):575-583. doi:10.1001/jamacardio.2016.1567

Continuous dose-response association between total sedentary duration and risk for CVD after adjustment for all potential confounders including physical activity (9 studies); after adjustment for potential confounders excluding physical activity (4 studies); and after adjustment for potential confounders excluding body mass index (5 studies). Spline (smoothed fit) and 95% CI of pooled hazard ratio (HR) for CVD incidence by sedentary hours are shown.

■ Cardiovascular Risk

- Nonlinear association between total sedentary time and cardiovascular risk.
- Increase risk > 10 hours spent sedentary

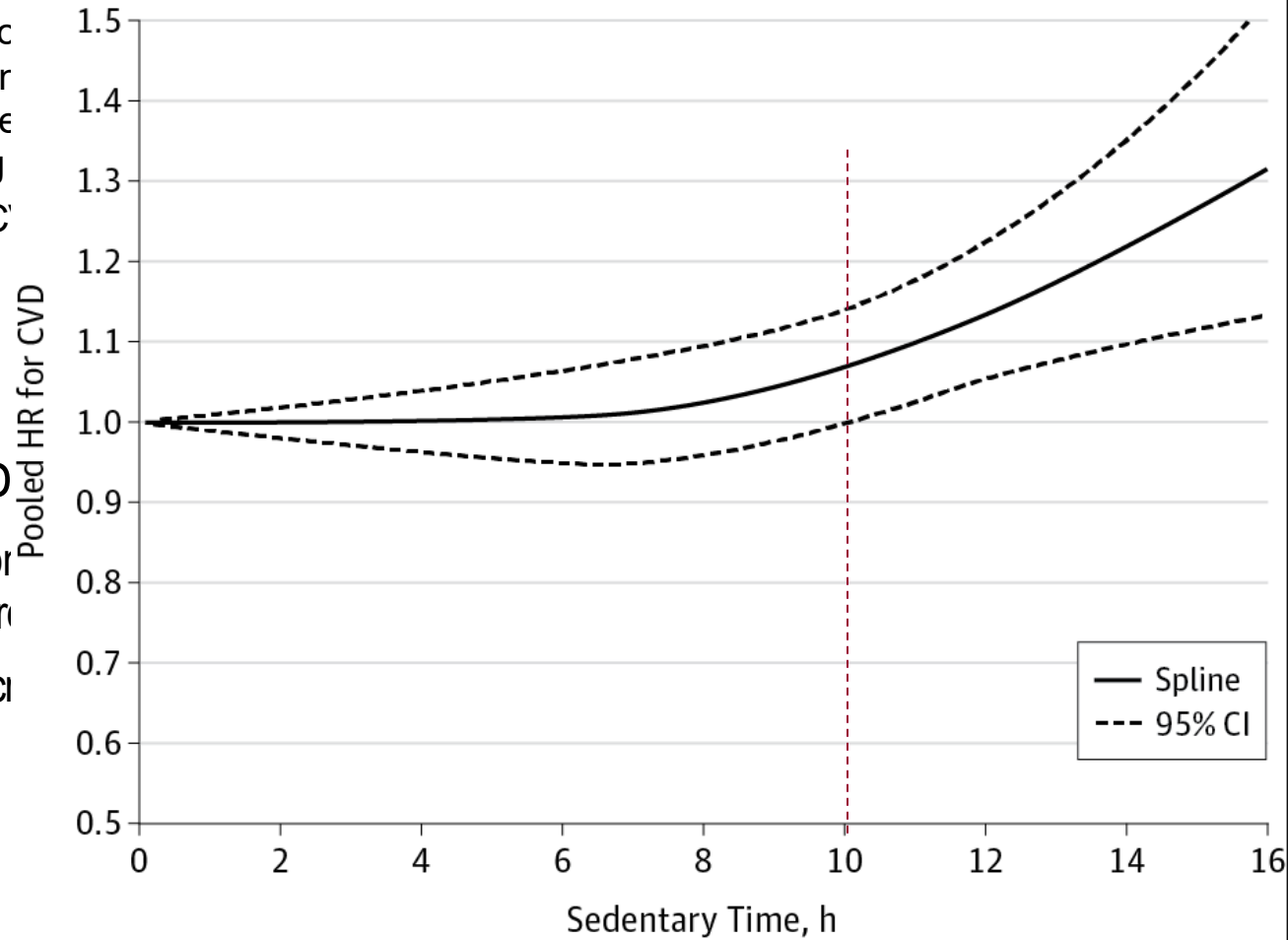


From: Continuous Dose-Response Association Between Sedentary Time and Risk for Cardiovascular Disease: A Meta-analysis

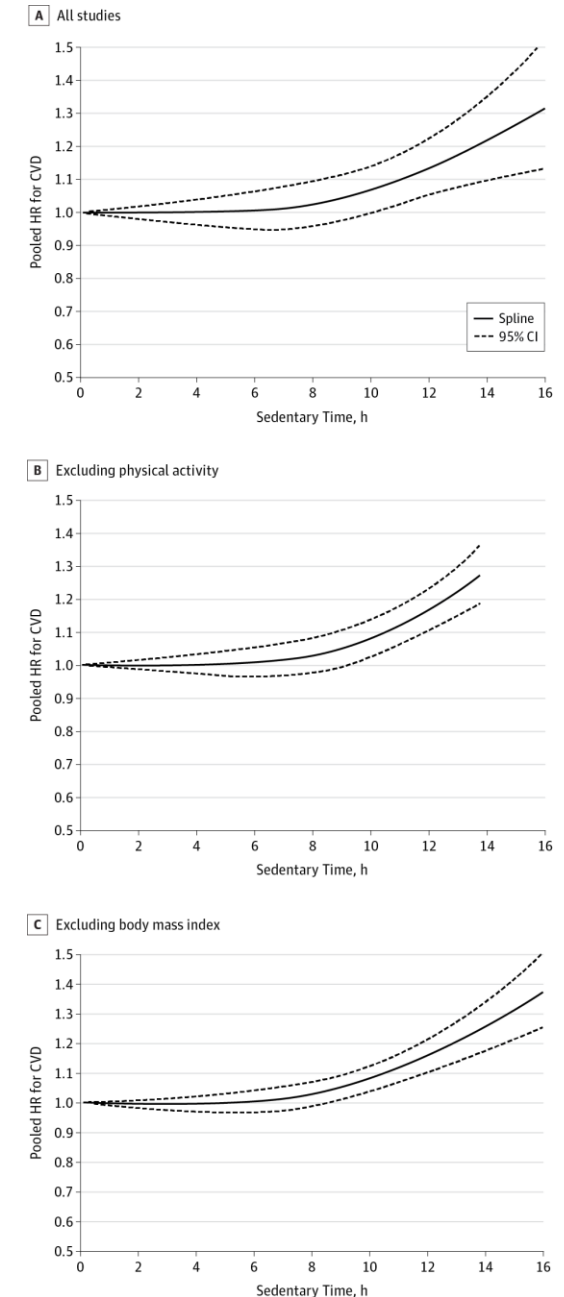
JAMA Cardiol. 2016;1(5):583-591

Continuous dose-response adjustment for all potential confounders excepting cardiovascular disease hazard ratio (HR) for CVD

- Cardio
- Nor
- Incl

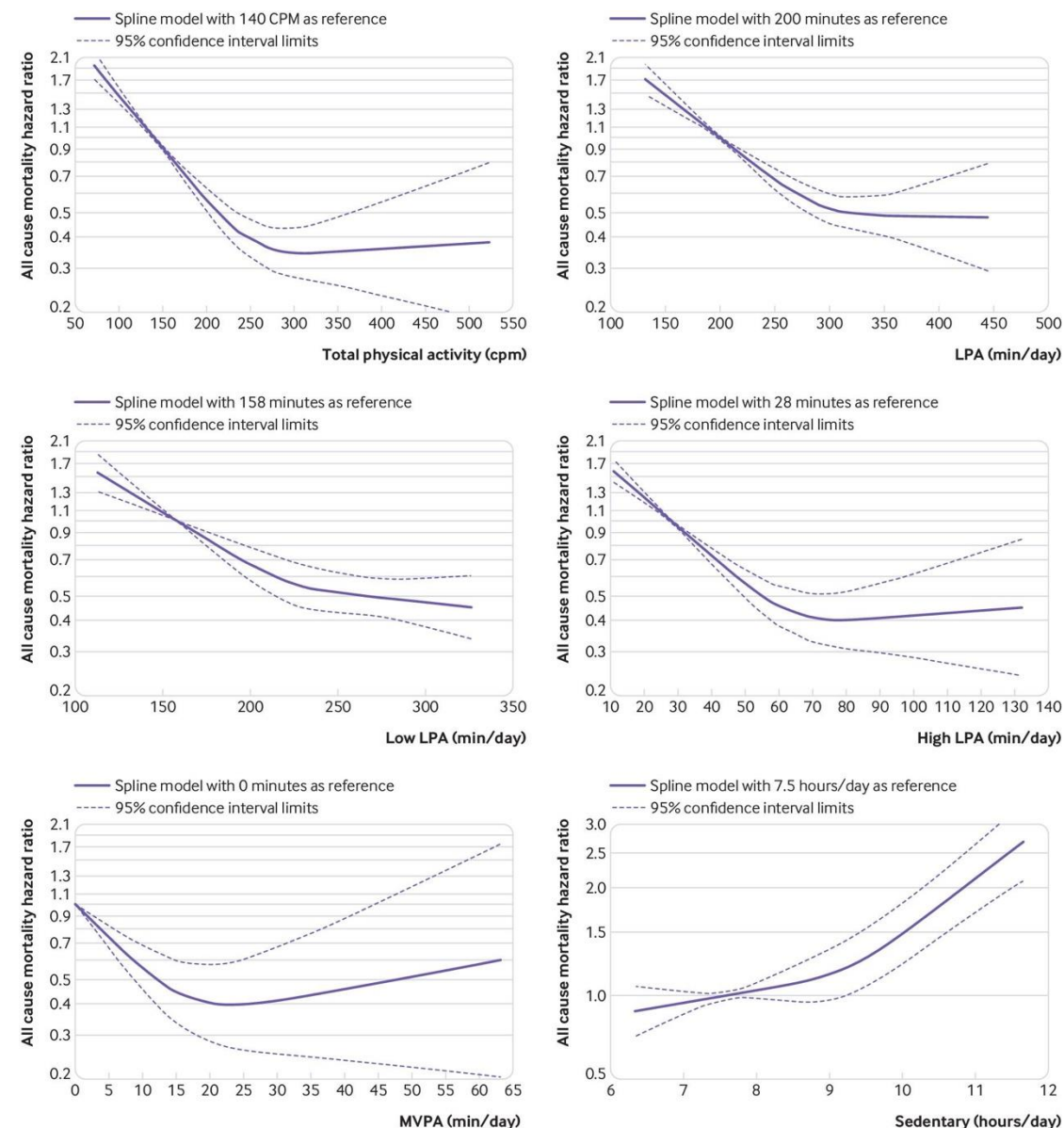


Ambarish Pandey, MD et al. Continuous Dose-Response Association Between Sedentary Time and Risk for Cardiovascular Disease: A Meta-analysis. JAMA Cardio. 2016; 1(5): 575-583



Dose-response associations between accelerometry measured physical activity and sedentary time and all cause mortality: systematic review and harmonised meta-analysis

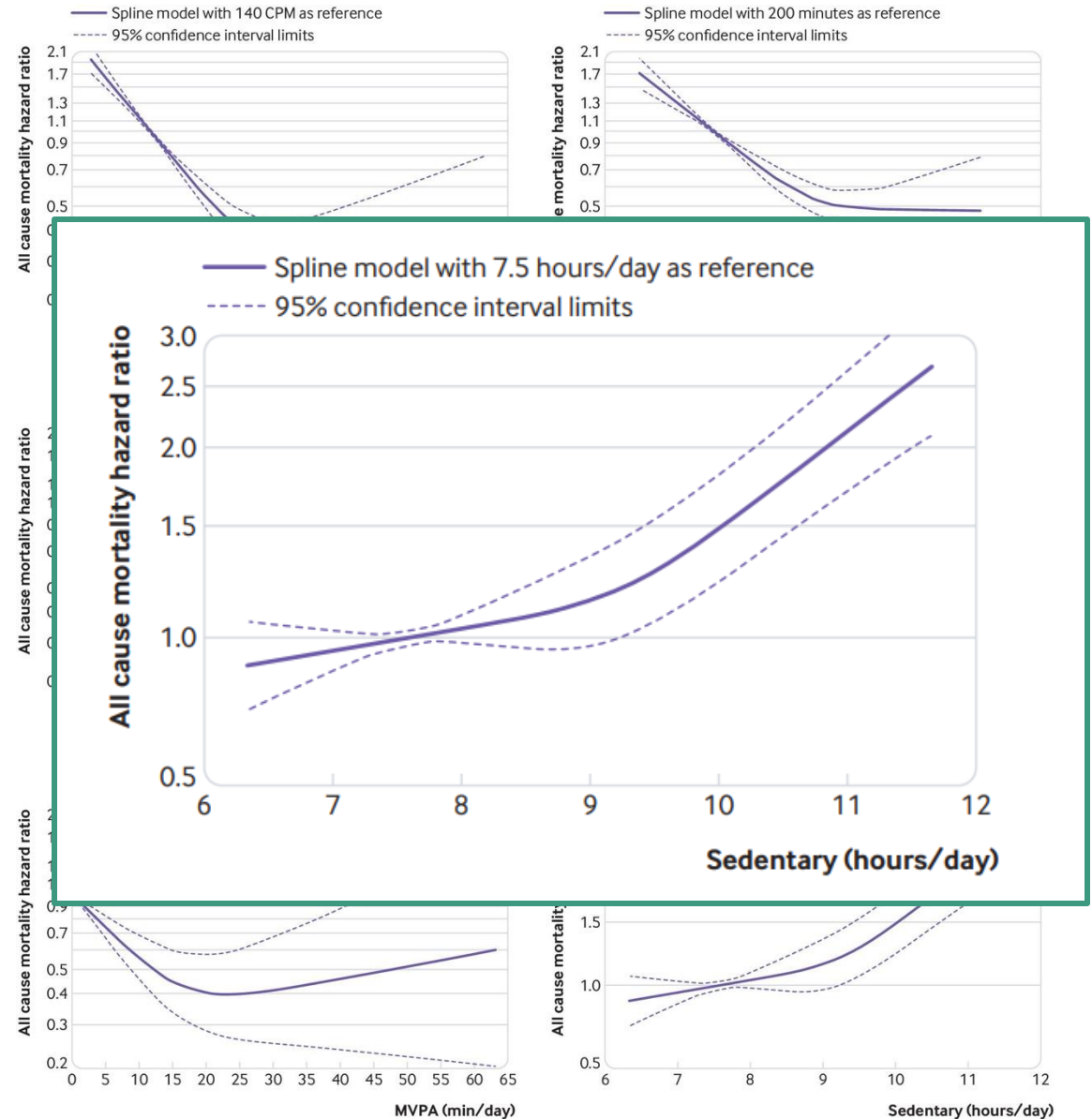
Dose-response associations between total physical activity (top left), light intensity physical activity (LPA) (top right), low LPA (middle left), high LPA (middle right), moderate-to-vigorous intensity physical activity (MVPA) (bottom left), and sedentary time (bottom right, data from REGARDS (Reasons for Geographic and Racial Differences in Stroke)⁹ and FHS (Framingham Heart Study)²⁶ are only included for MVPA) and all cause mortality.



Ekelund U, Tarp J, Steene-Johannessen J, Hansen BH, Jefferis B, Fagerland MW, et al. Dose-response associations between accelerometry measured physical activity and sedentary time and all cause mortality: systematic review and harmonised meta-analysis. *BMJ*. 2019;366:l4570

Dose-response associations between accelerometry measured physical activity and sedentary time and all cause mortality: systematic review and harmonised meta-analysis

- Dose-response between sedentary time and mortality increased gradually from 7.5 hours to 9 hours
- Much greater risk if sedentary > 9.5 hours
 - 10 hours sedentary time associated with 1.48 higher risk of death
 - 12 hours sedentary time associated with 2.92 times higher risk of death



Ekelund U, Tarp J, Steene-Johannessen J, Hansen BH, Jefferis B, Fagerland MW, et al. Dose-response associations between accelerometry measured physical activity and sedentary time and all cause mortality: systematic review and harmonised meta-analysis. *BMJ*. 2019;366:l4570

Does type of sedentary time matter?

European Journal of Epidemiology (2018) 33:811–829
https://doi.org/10.1007/s10654-018-0380-1

META-ANALYSIS



Sedentary behaviour and risk of all-cause, cardiovascular and cancer mortality, and incident type 2 diabetes: a systematic review and dose response meta-analysis

Richard Patterson¹ · Eoin McNamara² · Marko Tainio² · Thiago Hérick de Sá³ · Andrea D. Smith⁴ · Stephen J. Sharp² · Phil Edwards⁵ · James Woodcock² · Søren Brage² · Katrien Wijndaele²

Received: 2 October 2017 / Accepted: 12 March 2018 / Published online: 28 March 2018
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- Increased risk of all cause mortality with > 8 hours per day of sedentary time (PA adjusted)
- Increased risk CVD mortality > 6 hours per day (PA adjusted)
- Risk Type 2 Diabetes and Cancer more linear dose response than CVD and all cause mortality
- **Looking at television time alone**
 - Increased risk > 4 hours per day for CVD and all cause mortality

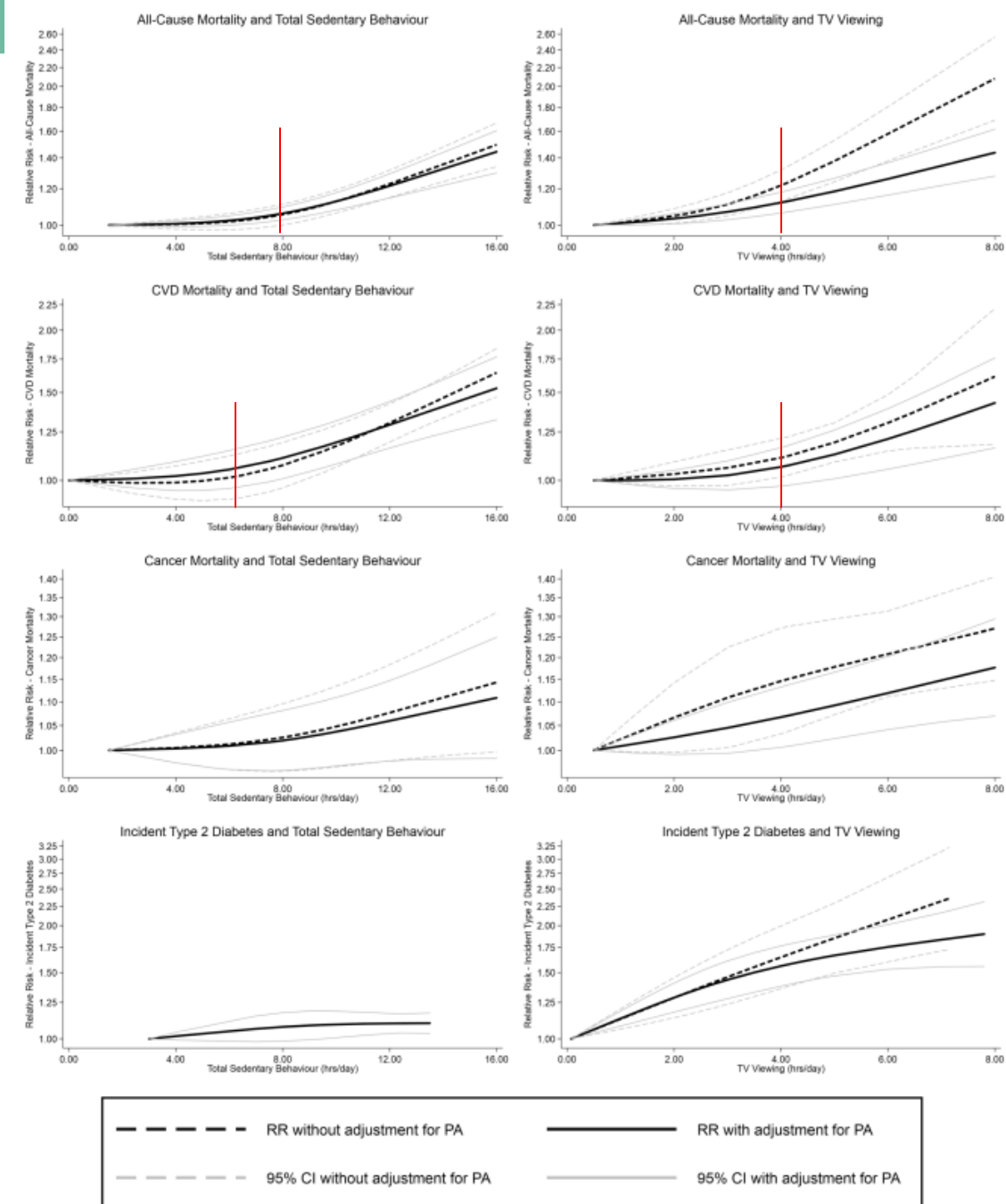


Fig. 2 Non-linear associations between sedentary behaviour and health outcomes presented with and without PA adjustment

Increased risks with sedentary television time

European Journal of Epidemiology (2018) 33:811–829
<https://doi.org/10.1007/s10654-018-0380-1>

META-ANALYSIS

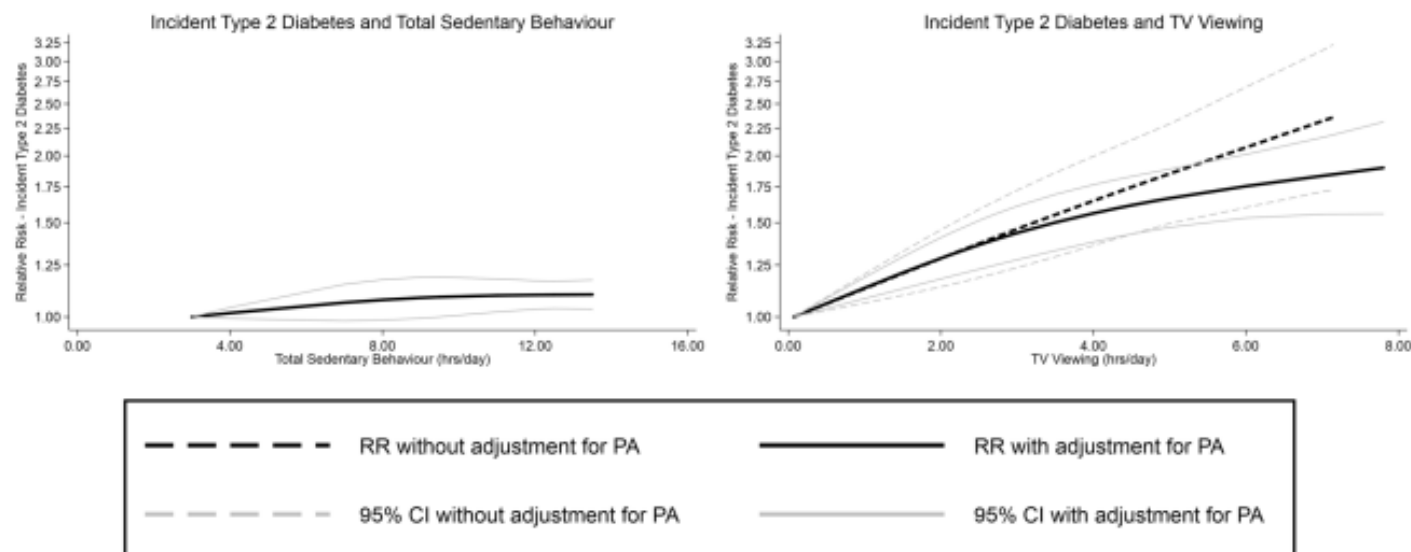


Sedentary behaviour and risk of all-cause, cardiovascular and cancer mortality, and incident type 2 diabetes: a systematic review and dose response meta-analysis

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- Increased risk of T2D associated with sedentary television time
 - Snacking = Increased caloric intake
 - Timing (tends to be after dinner) may exacerbate post prandial glucose and lipid excursion

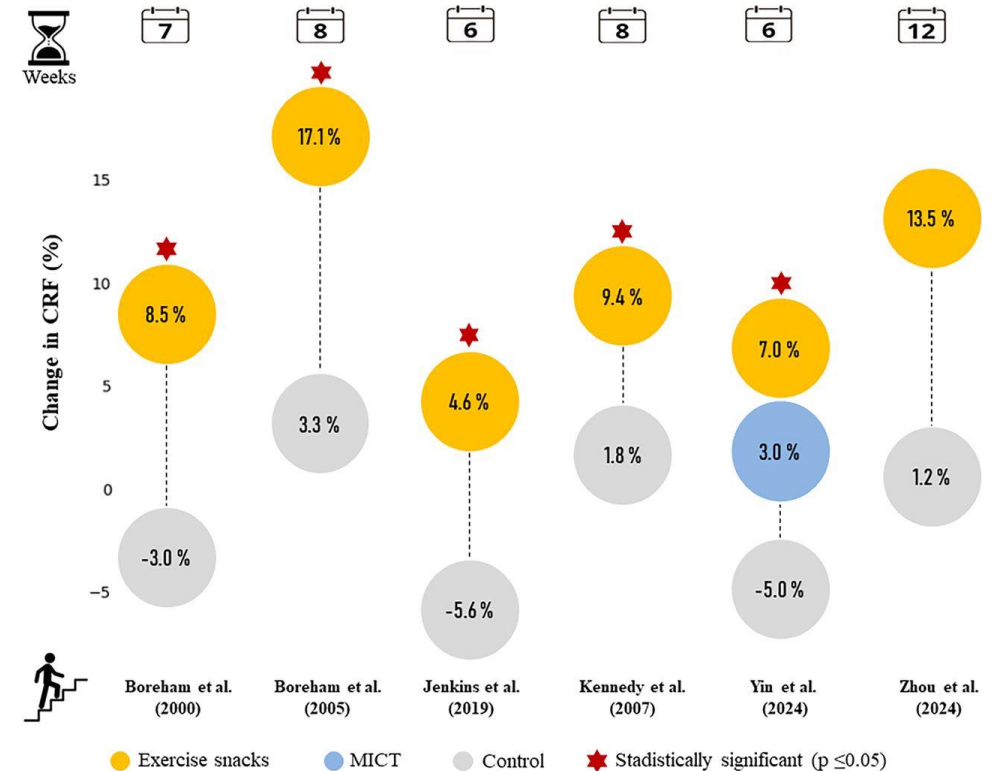


“Exercise Snacks”

- Meta-analysis evaluating impact of adding short bursts of exercise on fitness and cardiometabolic health in physically inactive individuals
 - Exercise protocols varied in freq, intensity, time
 - Length of exercise 14-20 seconds to maximum 5 minutes
 - Performed 2-10 times per day
 - 3,4,5,or 7 days per week
- Results
 - Exercise Snacks significantly increased cardiorespiratory fitness (CRF) in physically inactive adults (age 18.8-44.3)
 - Increased muscular endurance in older adults (age 69.8-74.0)
 - No significant change in muscle strength
 - No change in lipid panel or blood pressure

Rodríguez MÁ, Quintana-Cepedal M, Cheval B, et al Effect of exercise snacks on fitness and cardiometabolic health in physically inactive individuals: systematic review and meta-analysis British Journal of Sports Medicine
Published Online First: 07 October 2025. doi: 10.1136/bjsports-2025-110027

Percentage changes in cardiorespiratory fitness (CRF) from baseline following exercise interventions.



Percentage changes in cardiorespiratory fitness (CRF) from baseline following exercise interventions. Bars represent the mean percentage change in CRF for each group: exercise snacks, moderate intensity continuous training (MICT) and control. Intervention duration (weeks) is indicated above each bar. A red asterisk denotes a statistically significant difference in favour of the exercise snacks group (p ≤ 0.05).

Breaks in Sedentary Time

- Total number of breaks in sedentary time was associated with:
 - Lower waist circumference
 - Improved BMI
 - Improved triglycerides and 2 hour glucose
- All findings in study were independent of total sedentary time and moderate to vigorous exercise time

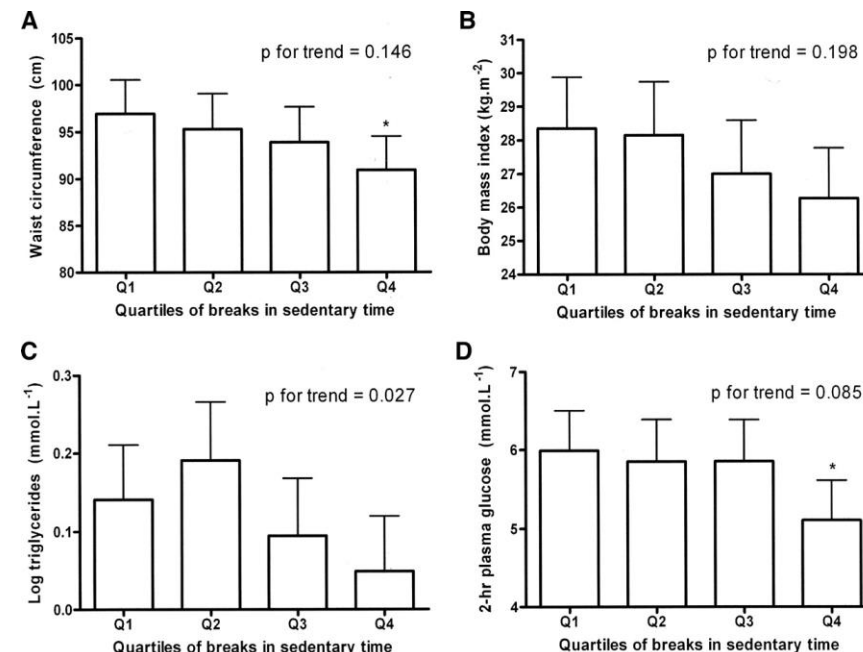
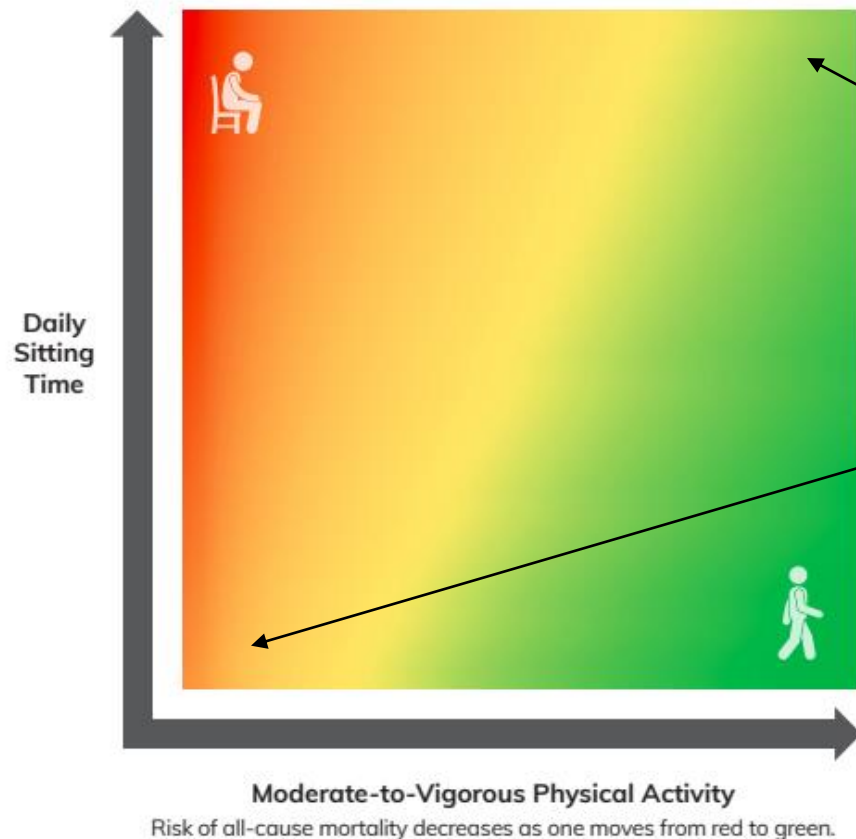


Figure Legend:

Quartiles of breaks in sedentary time with metabolic risk variables: waist circumference (A), BMI (B), triglycerides (C), and 2-h plasma glucose (D). Estimated marginal means (SE) adjusted for age, sex, employment, alcohol intake, income, education, smoking, family history of diabetes, diet quality, moderate- to vigorous-intensity time, mean intensity of breaks, and total sedentary time. Triglycerides (log) are additionally adjusted for lipid-lowering medication. Cut points for quartiles were 506, 612, and 673 breaks; *P < 0.05 compared to quartile 1.

Figure 1-3. Relationship Among Moderate-to-Vigorous Physical Activity, Sitting Time, and Risk of All-Cause Mortality in Adults



- High volumes of moderate to vigorous physical activity may remove the excess 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

Source: This heat map is adapted from data found in Ekelund U, Steene-Johannessen J, Brown WJ. Does physical activity attenuate, or even eliminate, the detrimental association of sitting time with mortality? A harmonized meta-analysis of data from more than 1 million men and women. *Lancet*. 2016;388:1302-1310. doi:10.1016/S0140-6736(16)30370-1.

Sit Less; Move More



Sit Less

Decrease Sedentary Time at Work

- Routine breaks from sitting throughout the day
 - Get up at least hourly
- Standing Desk/Walking Desk
- Exercise Ball instead of a Chair
- Reminders to move
 - Workplace initiative
 - Activity Trackers
- Lunch Time Walk
- Walk and Talk meetings



Sit Less

Decrease Sedentary Time at Home

- Leisure time physical activity instead of computer/tv
- Stand or walk for 1-3 minutes every hour
- Walk or Stand during TV commercial breaks
- Stand or Walk while talking on the phone
- Schedule your next meet up as a walking meeting

Move More

- Switch to active modes of transportation
 - Bike, Walk
 - Get off a stop early from the bus
- Park at the far side of the parking lot
- Take the Stairs
- Walking Meetings



Fitness Trackers

- Motivation
- Accountability
- Reminders to Move



Resources

- WHO: Physical Activity Fact Sheet; <https://www.who.int/en/news-room/fact-sheets/detail/physical-activity>; Accessed 2/27/2019, June 26, 2024
- World Health Organization - Noncommunicable Diseases (NCD) Country Profiles, 2018.USA: https://www.who.int/nmh/countries/2018/usa_en.pdf?ua=1. Accessed 2/27/2019
- World Health Organization – Noncommunicable diseases. <https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases>. Access 5/22/2025
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- Physical Activity Guidelines for Americans: https://health.gov/paguidelines/second-edition/pdf/Physical_Activity_Guidelines_2nd_edition.pdf
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- Henson, Joseph et al. Sedentary Behaviour and disease risk. *BMC Public Health* (2023) 23: 2048.
- Ambarish Pandey, MD et al. Continuous Dose-Response Association Between Sedentary Time and Risk for Cardiovascular Disease: A Meta-analysis. *JAMA Cardio*. 2016; 1(5): 575-583
- Chuanchuan et al. Sitting Time, Leisure-Time Physical Activity, and Risk of Mortality Among US Stroke Survivors: A Prospective Cohort Study from NHANES 2007 to 2018 *Stroke* **New online:** <https://doi.org/10.1161/STROKEAHA.124.049672> (accessed June 2025)
- Patterson et al. Sedentary behaviour and risk of all-cause, cardiovascular and cancer mortality, and incident type 2 diabetes: a systematic review and dose response meta-analysis. *European Journal of Epidemiology* (2018) 33:811–829
- Charles E Matthews et al. Sedentary Behavior in United States Adults: Fall 2019. *Med Sci Sports Exerc*. 2021 Dec 1;53(12):2512–2519