

# Physical Activity for Healthy Aging

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Vancouver Summer Program

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# Outline

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1:30 – 2:30

**Physical Activity Definitions, Domains, and Guidelines**

2:30 – 2:45

**Break #1**

2:45 – 3:35

**Physical Activity and Healthy Aging**

3:35 – 3:45

**Break #2**

3:45 – 4:30

**A Brief Introduction to Exercise Prescription for Healthy Aging**

# Physical Activity Definitions, Domains, and Guidelines

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# Definitions

## *What is Physical Activity?*



**Physical Activity is any bodily movement that increases energy expenditure above resting levels** (Caspersen, 1985)

# Definitions

## *Structured vs. Unstructured Physical Activity*

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**Exercise**

(Structured PA)



**Lifestyle Physical Activity**

(Unstructured PA)

# Definitions

## *Physical Activity Intensity*

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The intensity of physical activity is measured in metabolic equivalents (METs).

- 1 MET = Basal Metabolic Energy Expenditure

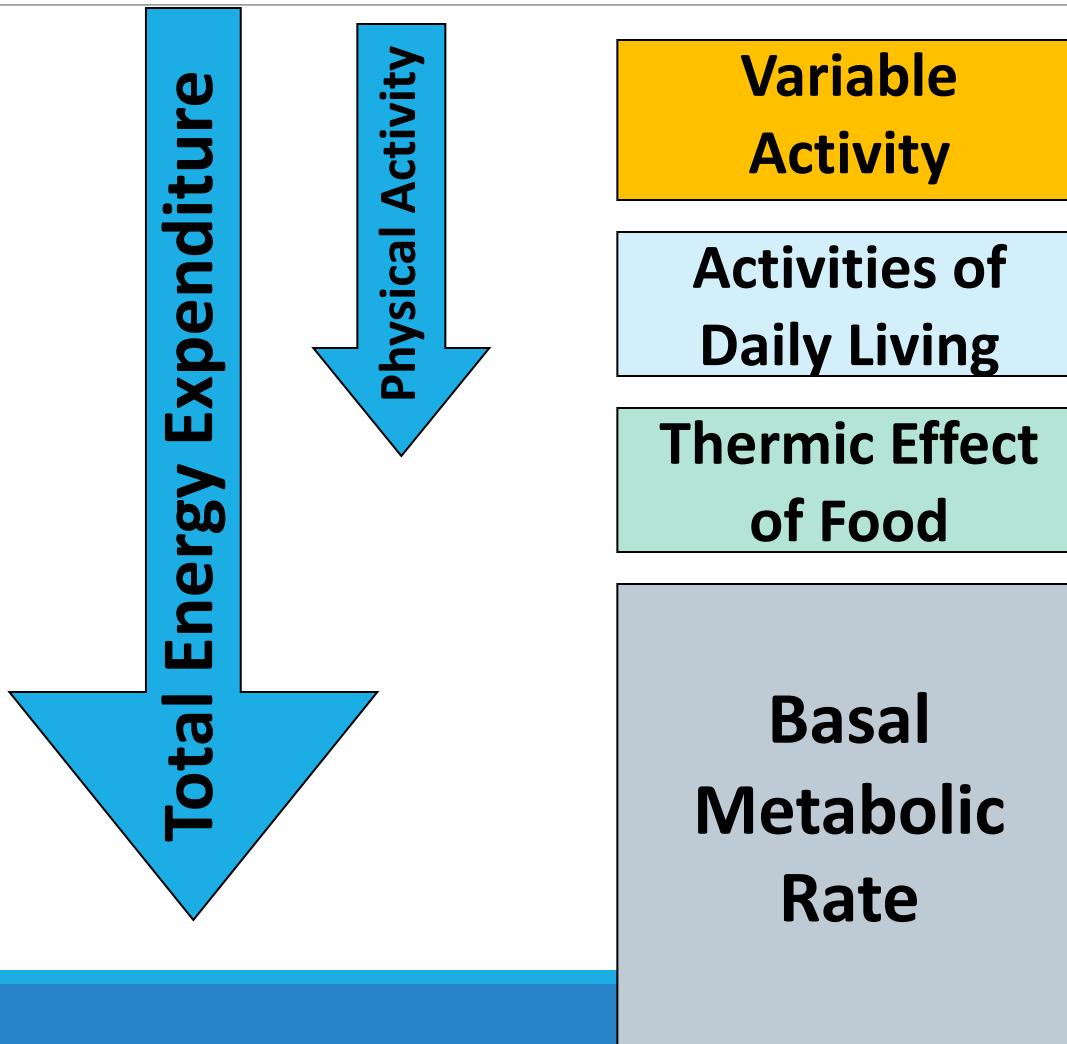
Physical activity intensity is then classified as:

- Sedentary (<1.5 METs)
- Light (1.5 – 3.0 METs)
- Moderate (3.0 – 6.0 METs)
- Vigorous (>6.0 METs)
  - Moderate-to-Vigorous (i.e., >3.0 METs) is commonly used to describe physical activity intensity



# Definitions

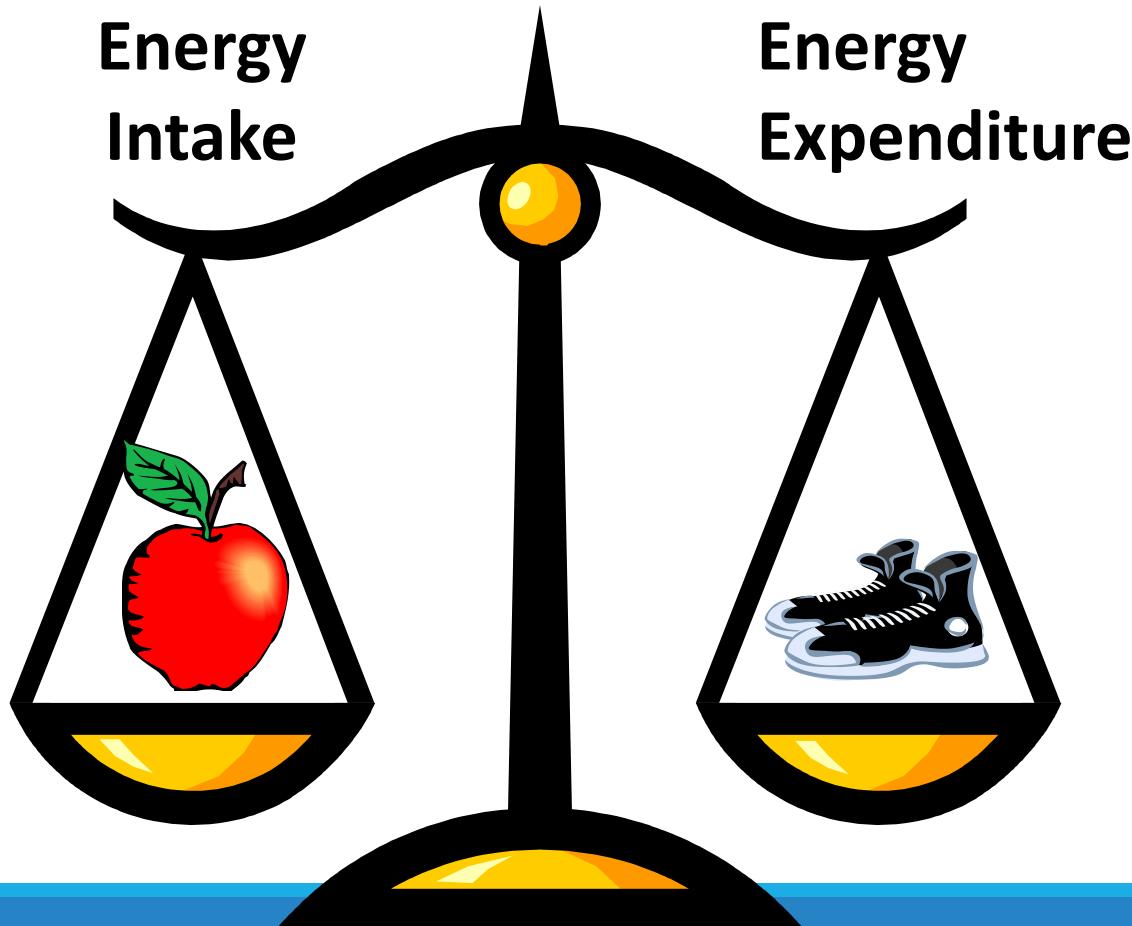
## *Energy Expenditure*



# Definitions

## *Energy Expenditure*

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# Definitions

## *What is Exercise?*

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A subset of physical activity which is planned, structured and repetitive, and has a final or intermediate objective of improving or maintaining physical fitness (*Caspersen et al., 1985*)

Maximizing the benefits of exercise requires the precise prescription of **FITT** (*Baechle & Earle, 2008*)

Frequency

Intensity

Time

Type



Aerobic Training



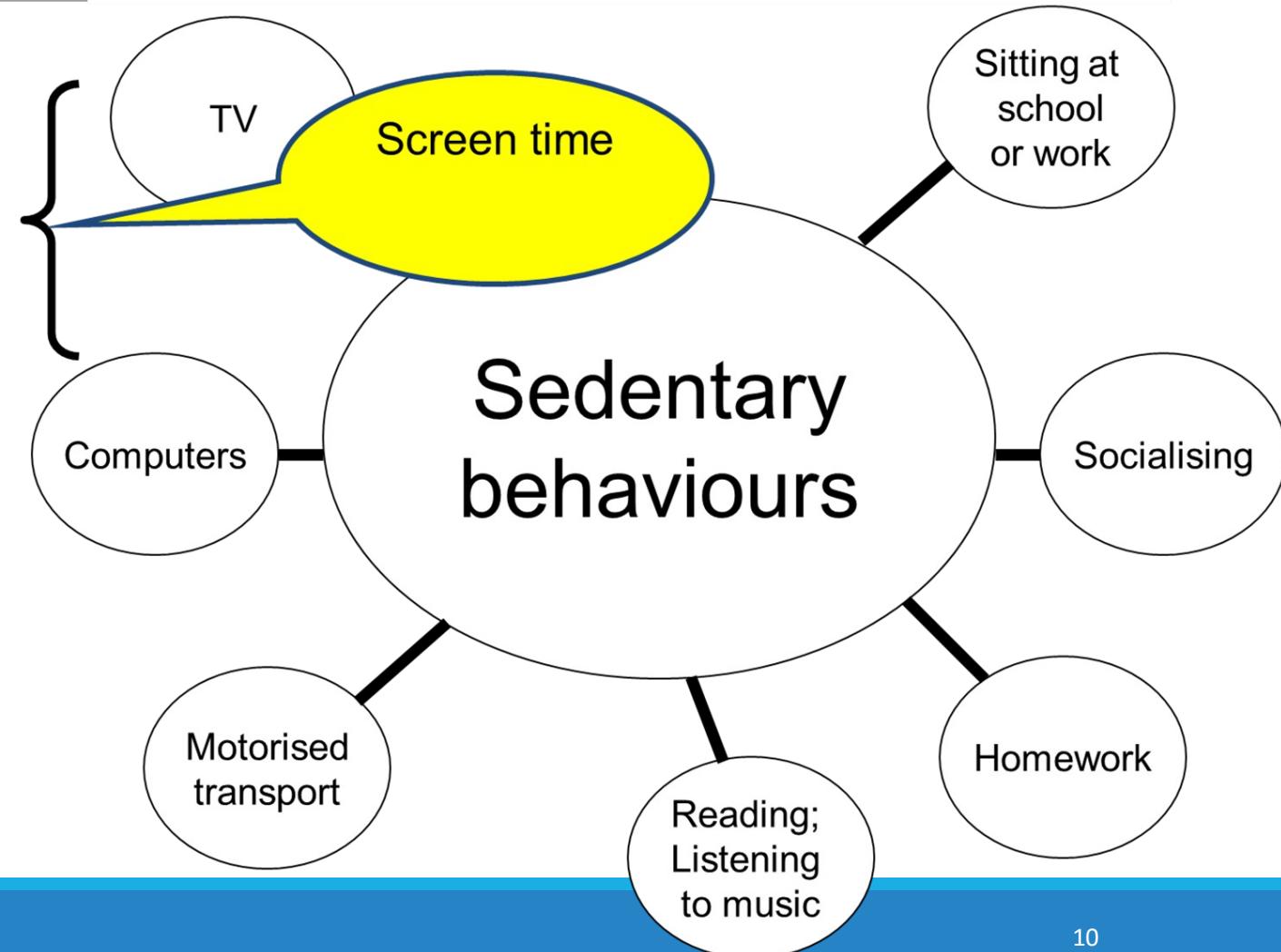
Resistance Training

Aerobic Training + Resistance Training = Multimodal Training

# Definitions

## *What is Sedentary Behaviour?*

Any waking behaviour that incurs <1.5 METs and is done from the seated or lying position (Pate et al., 2008)



# Practice Question

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Lebron James spends 90 minutes each day exercising (30 minutes aerobic training, 60 minutes resistance training) and 60 minutes practicing basketball. How many minutes does he spend each day in physical activity?

- A. 90 minutes
- B. 60 minutes
- C. 150 minutes
- D. 0 minutes



# Definitions

## *Study Designs in Physical Activity Research*

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**Epidemiology:** The study of how a disease or health outcome is distributed in populations and what factors influence or determine distribution.

**Observational Studies:** The development of a disease or health outcome is observed and compared based on different levels of physical activity.

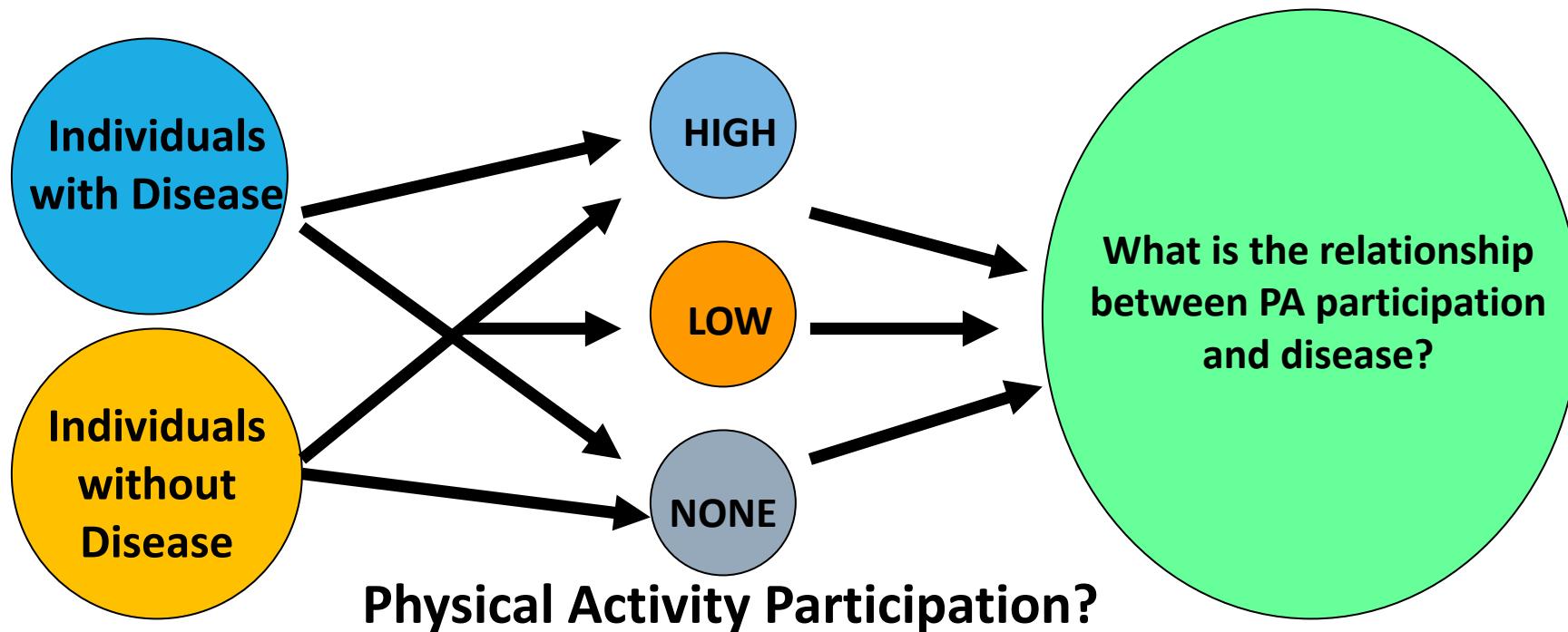
- **Strength:** Can help determine different risk factors for disease
- **Weakness:** Cannot determine causal effect
- **Study Types**
  - Cross-Sectional
  - Case-control
  - Cohort (Longitudinal)

**Experimental Studies:** Participants are assigned to different groups that are prescribed different amounts of physical activity

- **Strength:** Can be used to determine the causal effect of physical activity
- **Weakness:** Involve changing people's behaviour
- **Study Types**
  - Quasi-experimental
  - Cross-over (RANDOMIZED)
  - Clinical Trial (RANDOMIZED)

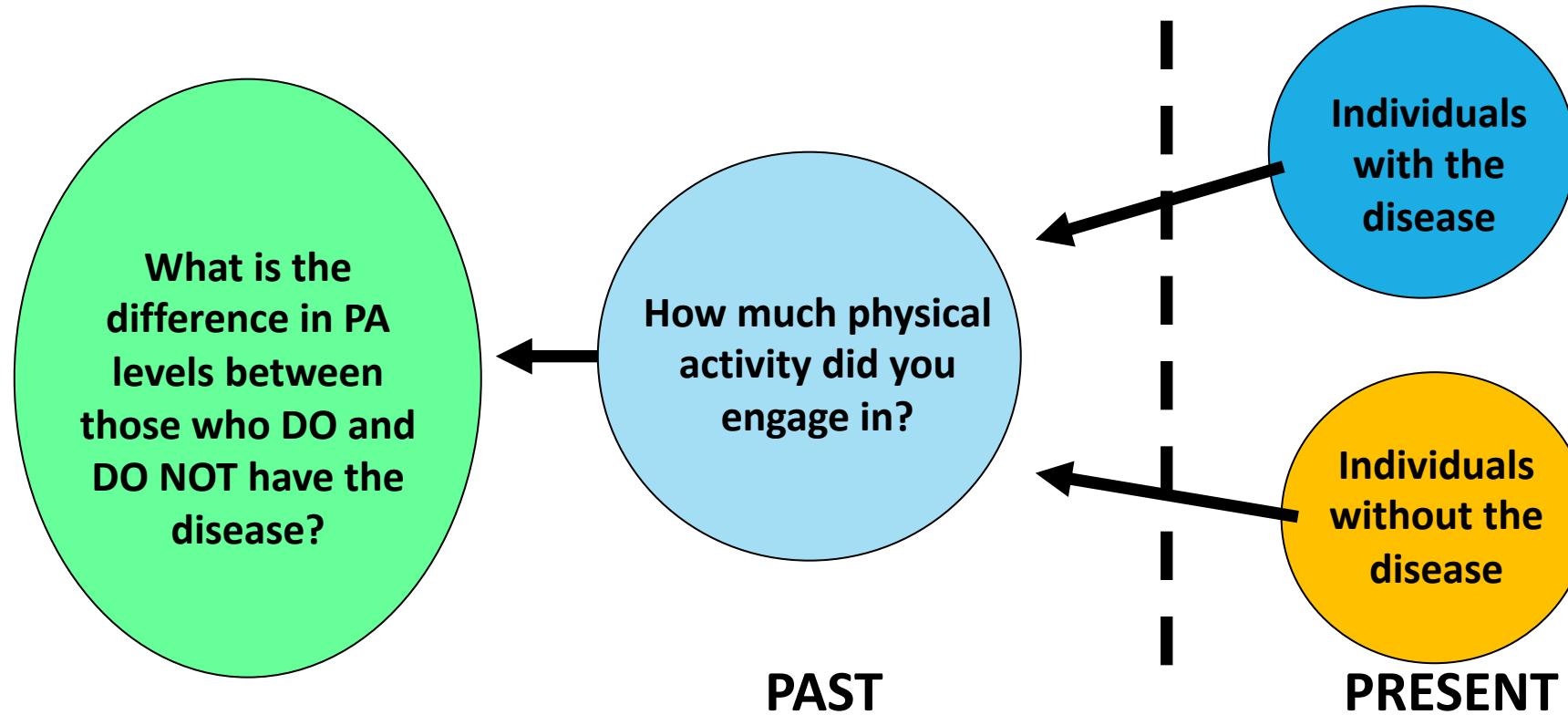
# Definitions

## *Observational Study Designs: Cross-Sectional*



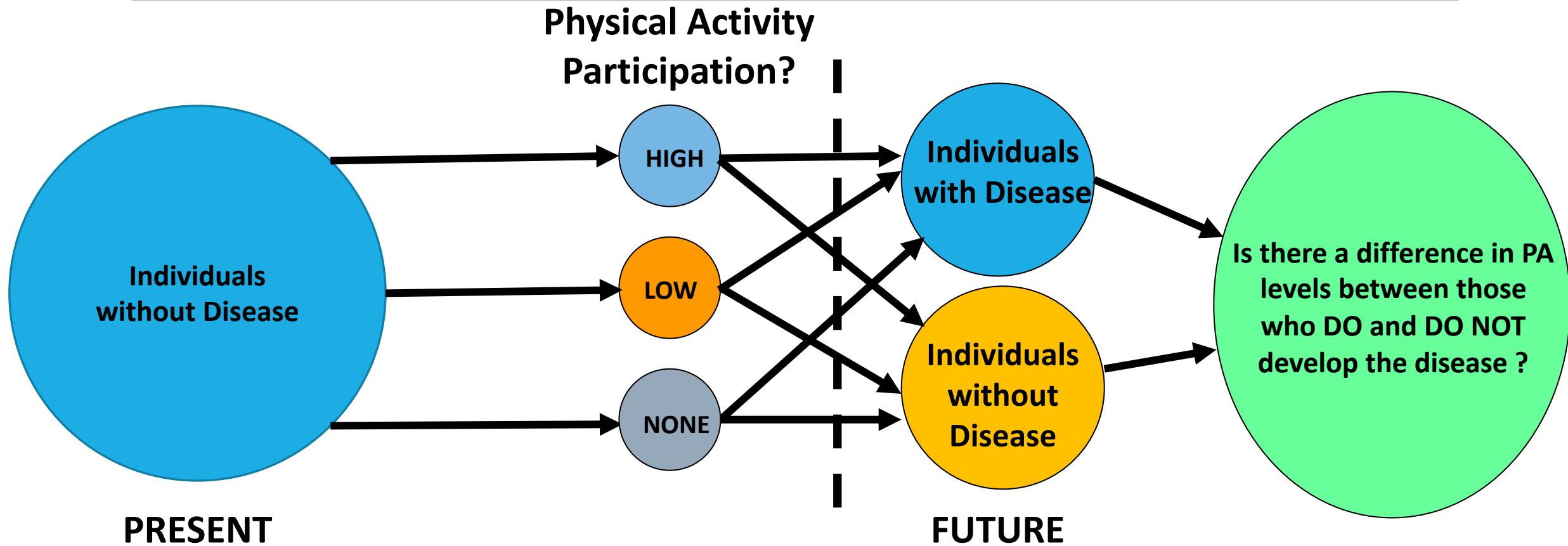
# Definitions

## *Observational Study Designs: Case-Control*



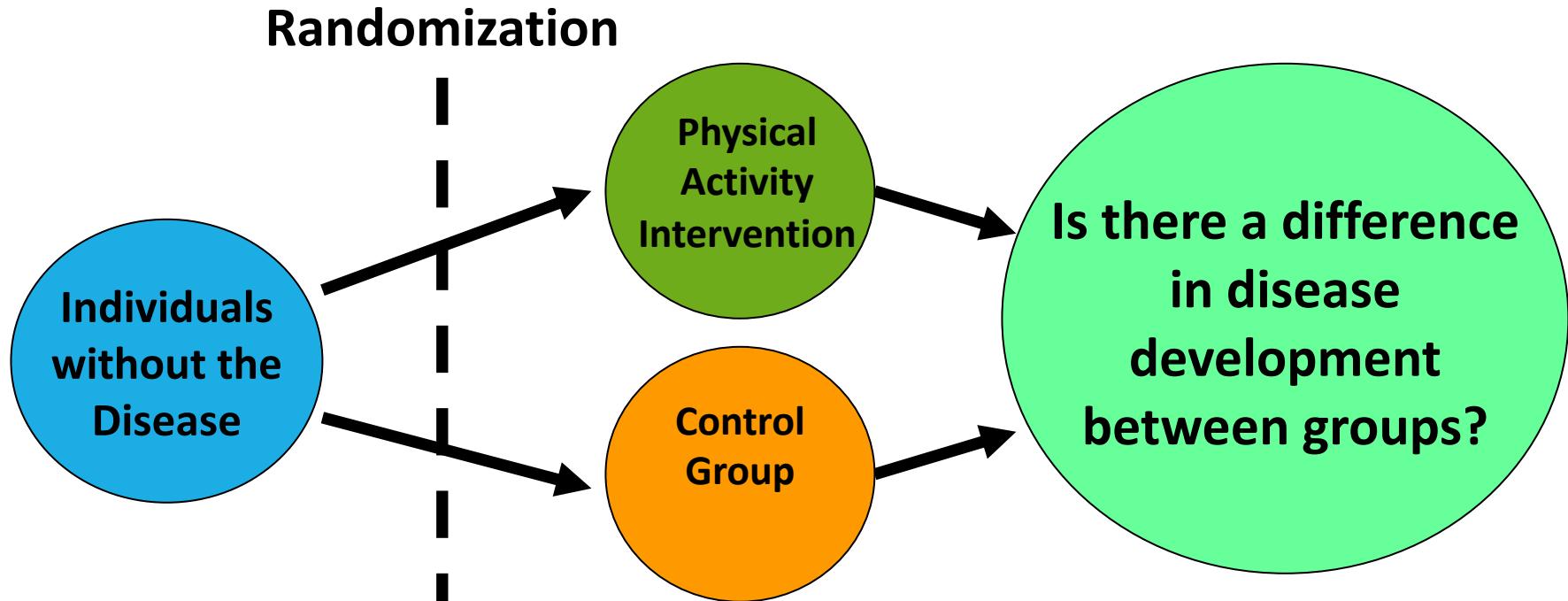
# Definitions

## *Observational Study Designs: Cohort*



# Definitions

## *Experimental Designs: Clinical Trial*



# Practice Question

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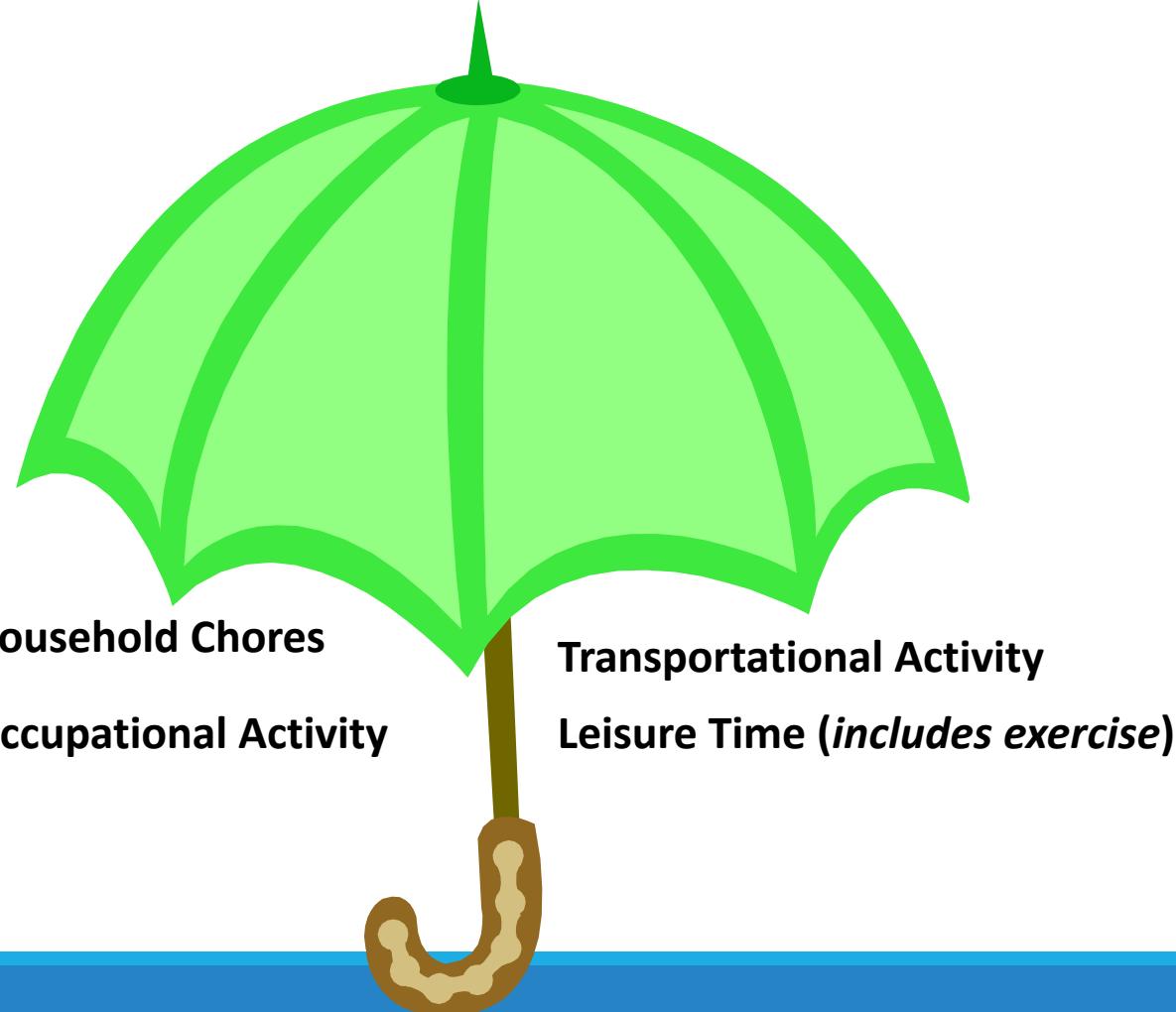
The Diabetes Prevention Program was one of the hallmark studies of the early 2000s. The study investigated whether a lifestyle intervention of dieting and physical activity, and/or a drug therapy (Metformin) could prevent or delay the onset of Type 2 Diabetes Mellitus in individuals with impaired glucose tolerance. Individuals were randomized to either the lifestyle intervention, the drug therapy, or a control group. What type of study design was this:

- A. Cross-Sectional
- B. Cohort
- C. Clinical Trial
- D. Case-Control

# Domains

## *Physical Activity*

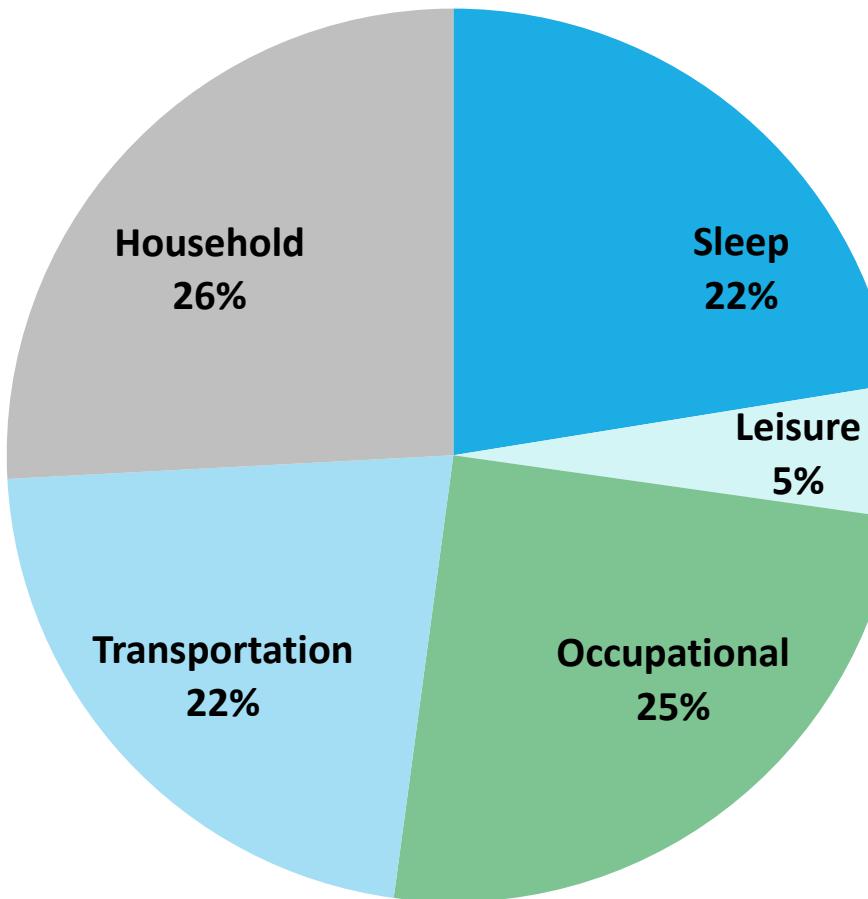
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# Domains

## *Energy Expenditure*

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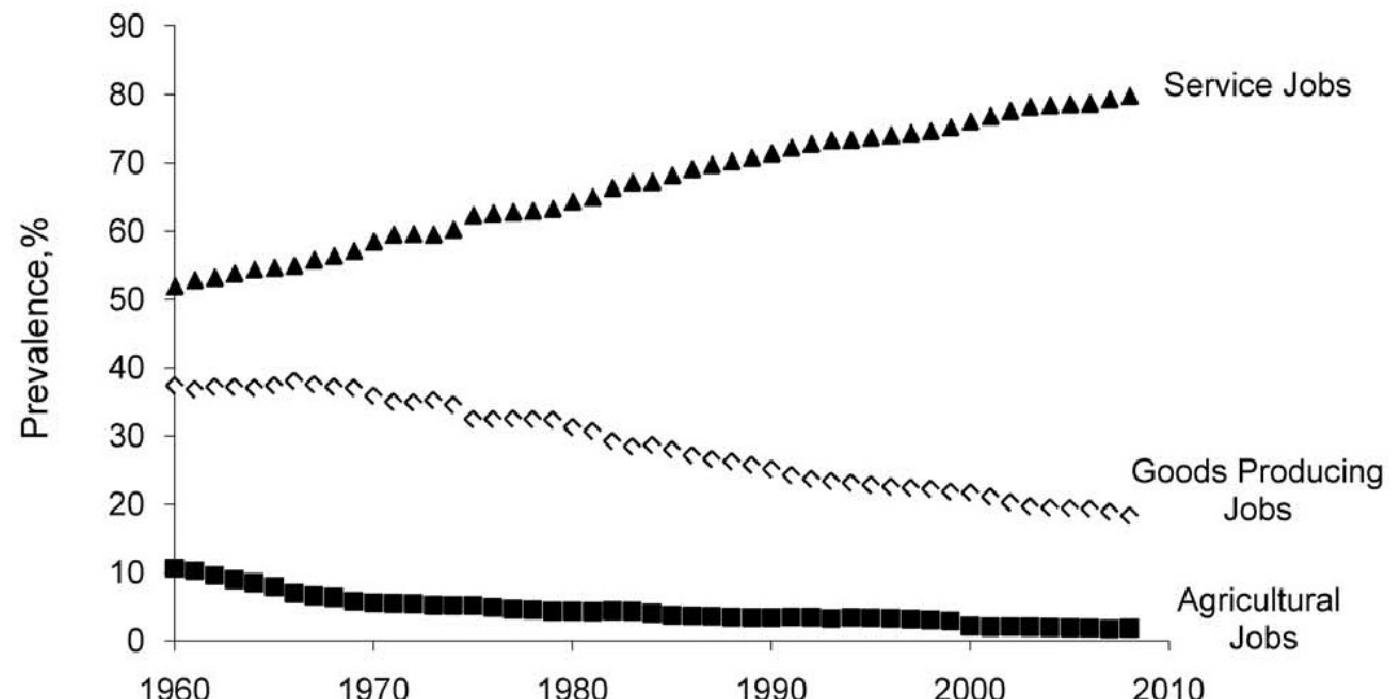


# Domains

## *Occupational Physical Activity*

### Trends over 5 Decades in U.S. Occupation-Related Physical Activity and Their Associations with Obesity

Timothy S. Church<sup>1\*</sup>, Diana M. Thomas<sup>2</sup>, Catrine Tudor-Locke<sup>1</sup>, Peter T. Katzmarzyk<sup>1</sup>, Conrad P. Earnest<sup>1</sup>, Ruben Q. Rodarte<sup>1</sup>, Corby K. Martin<sup>1</sup>, Steven N. Blair<sup>3</sup>, Claude Bouchard<sup>1</sup>



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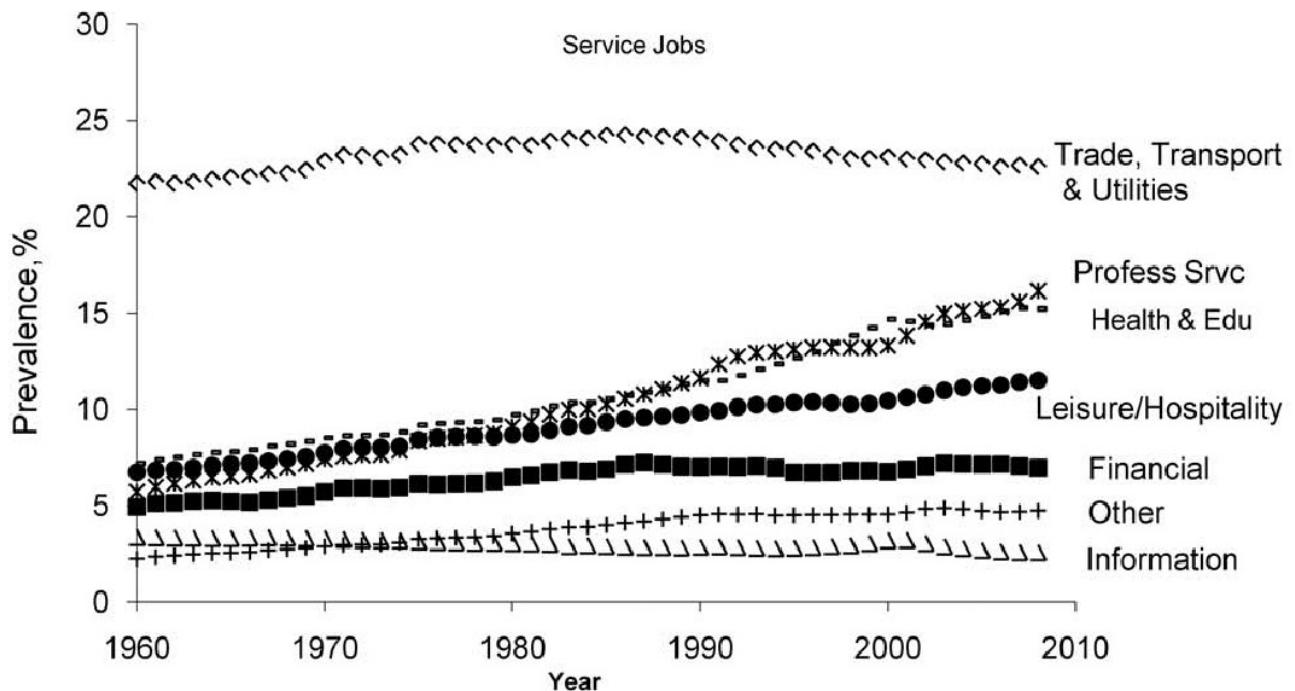


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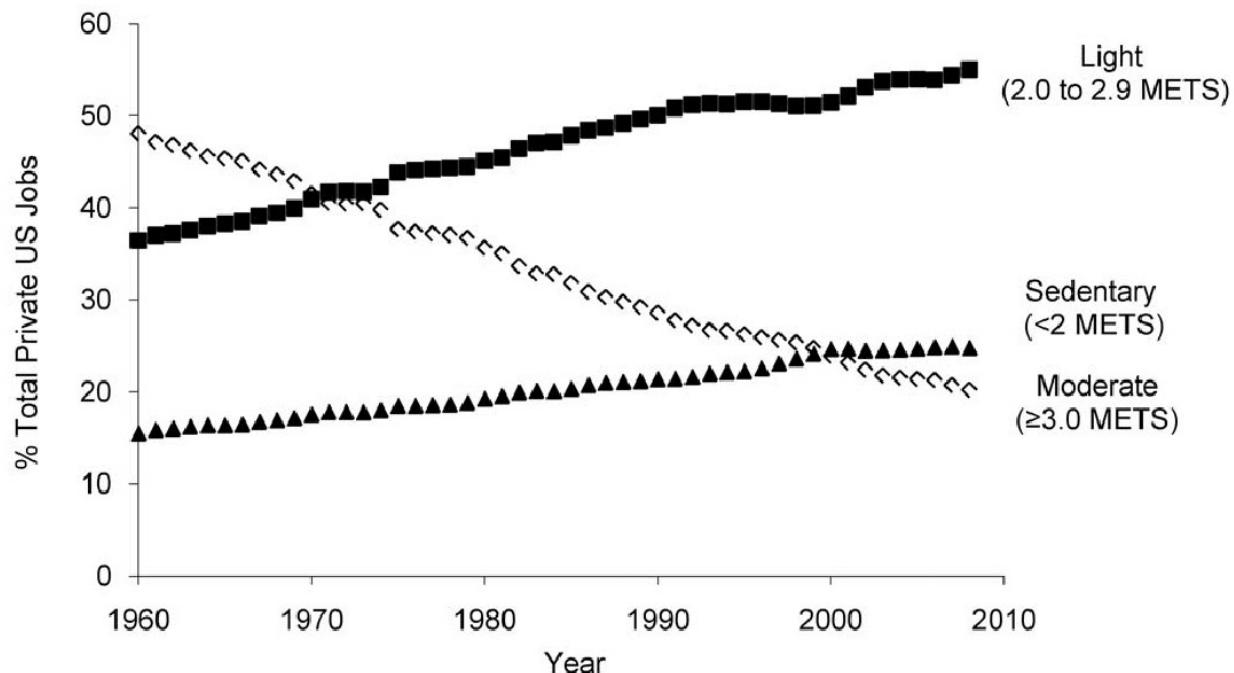


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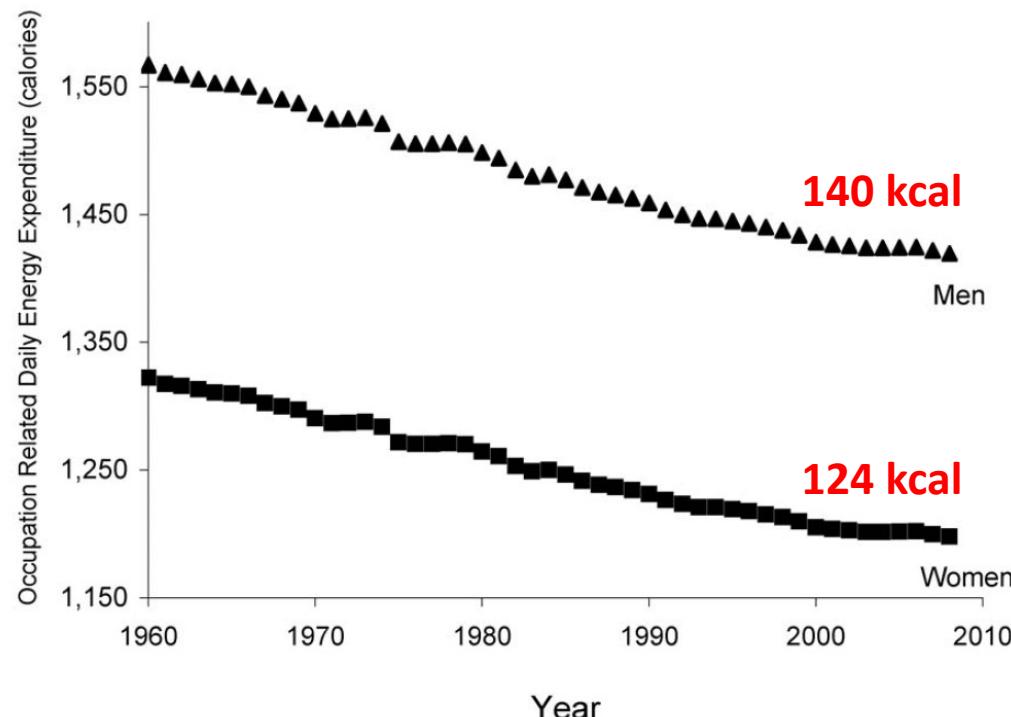


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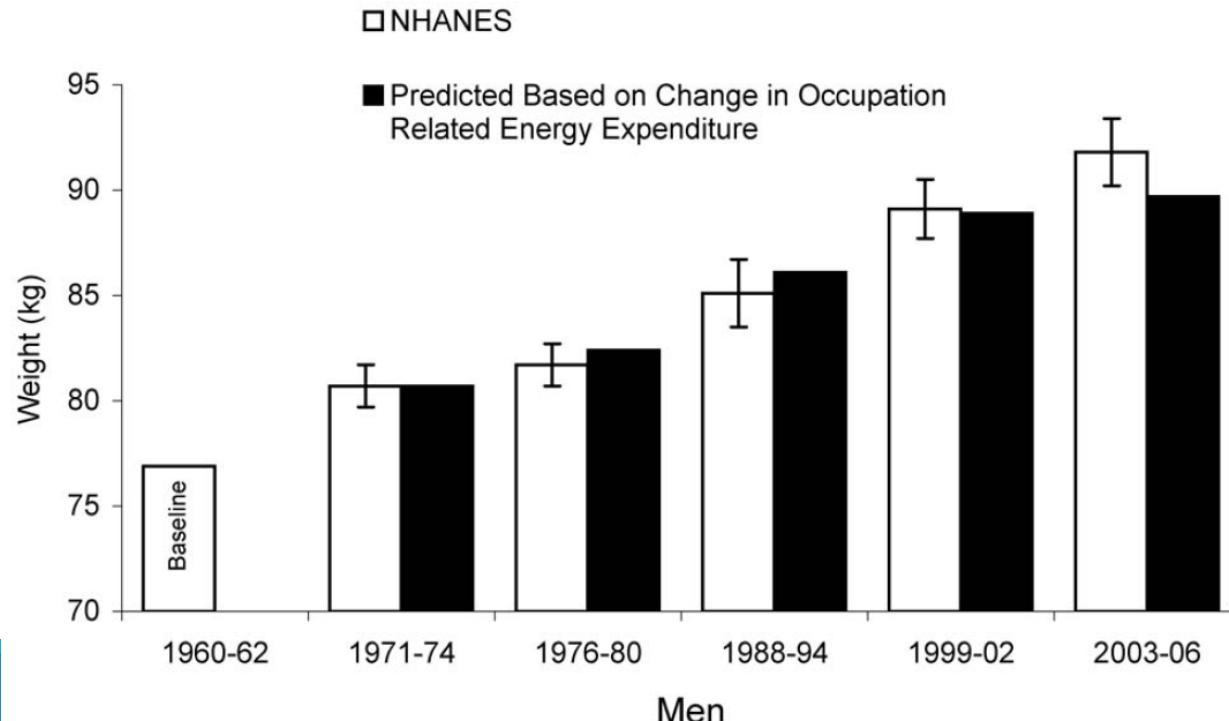


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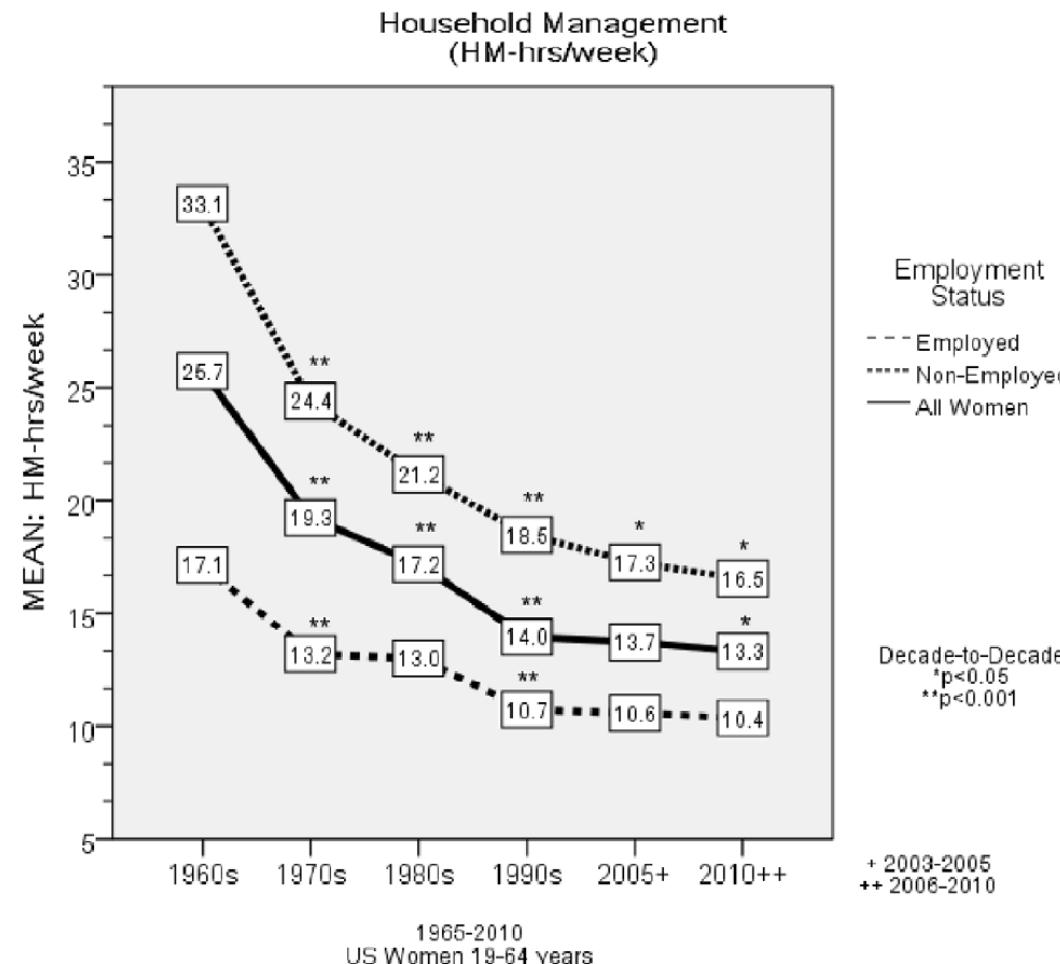


# Domains

## *Household Physical Activity*

### 45-Year Trends in Women's Use of Time and Household Management Energy Expenditure

Edward Archer<sup>1\*</sup>, Robin P. Shook<sup>1</sup>, Diana M. Thomas<sup>2</sup>, Timothy S. Church<sup>3</sup>, Peter T. Katzmarzyk<sup>3</sup>, James R. Hébert<sup>4,5</sup>, Kerry L. McIver<sup>1</sup>, Gregory A. Hand<sup>1</sup>, Carl J. Lavie<sup>6</sup>, Steven N. Blair<sup>1,4</sup>

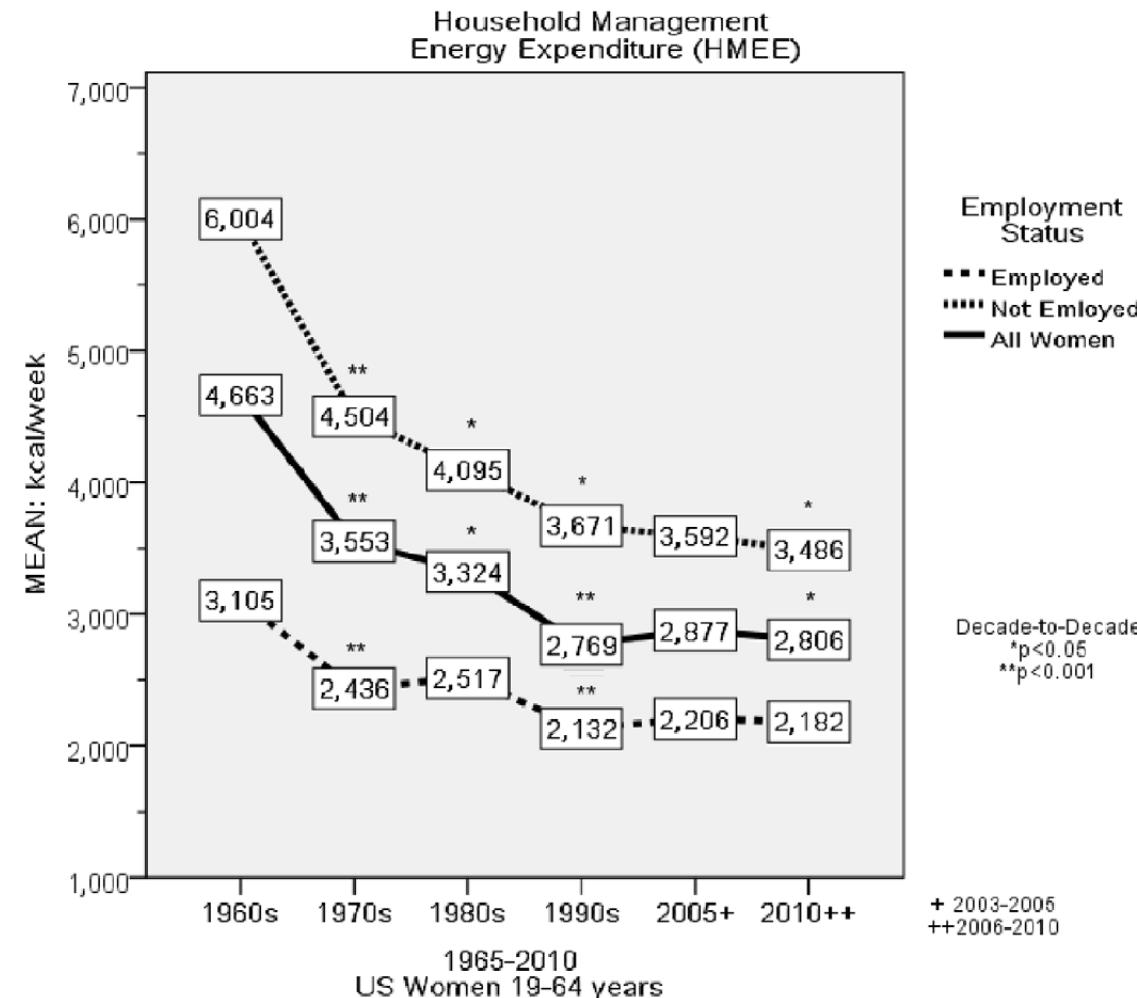


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# Domains

## *Transportational Physical Activity*

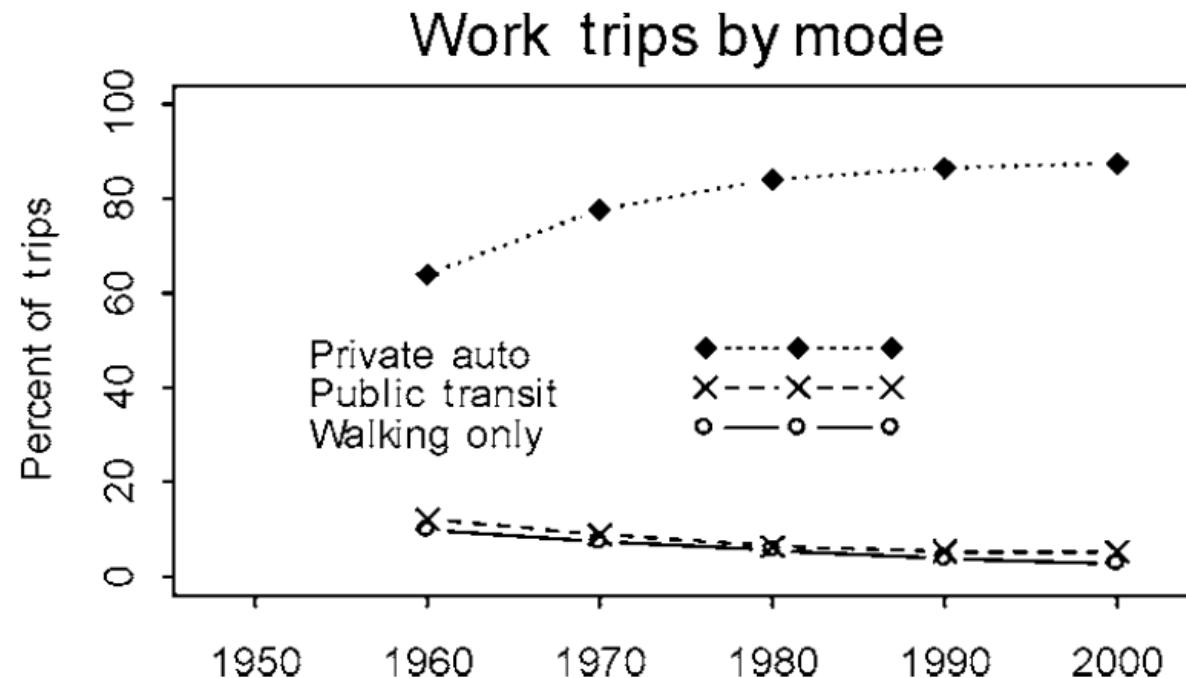
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# Domains

## *Transportational Physical Activity*

Ross C. Brownson, Tegan K. Boehmer, and Douglas A. Luke  
*Department of Community Health and Prevention Research Center, Saint Louis University School of Public Health, St. Louis, Missouri 63104; email: brownson@slu.edu, boehmert@slu.edu, dluke@slu.edu*



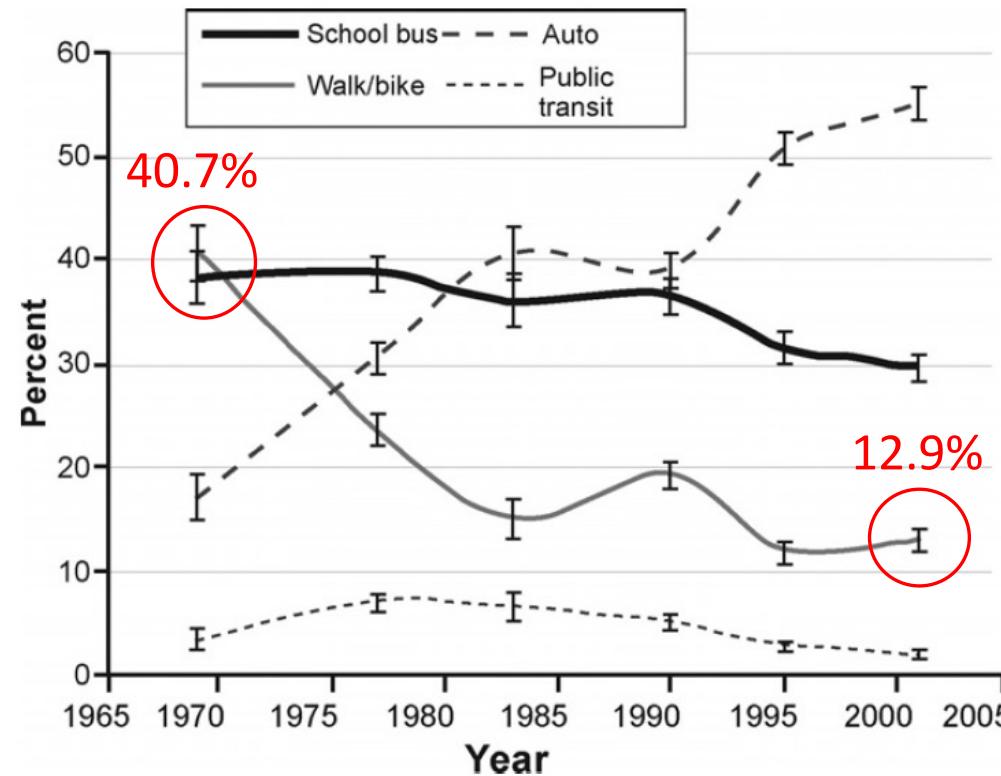
**Figure 5** Trends in transportation activity and automobile dependence, 1950–2000.

# Domains

## *Transportational Physical Activity*

### Active Transportation to School Trends Among U.S. Schoolchildren, 1969–2001

Noreen C. McDonald, PhD



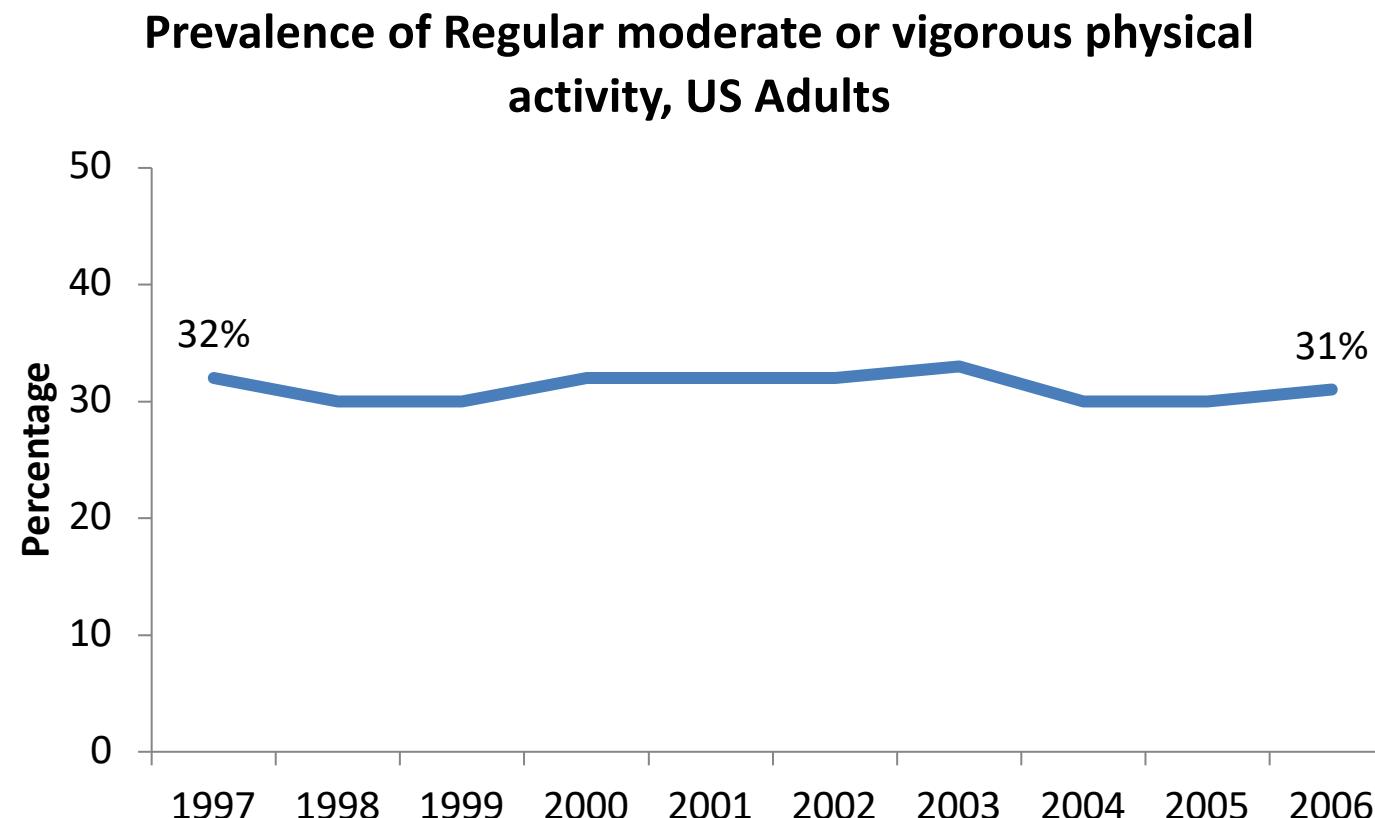
**Figure 1.** Standardized<sup>a</sup> mode shares for trips to school.

<sup>a</sup>Standardized to 2001 age and race distribution. Error bars represent the 95% confidence interval.

# Domains

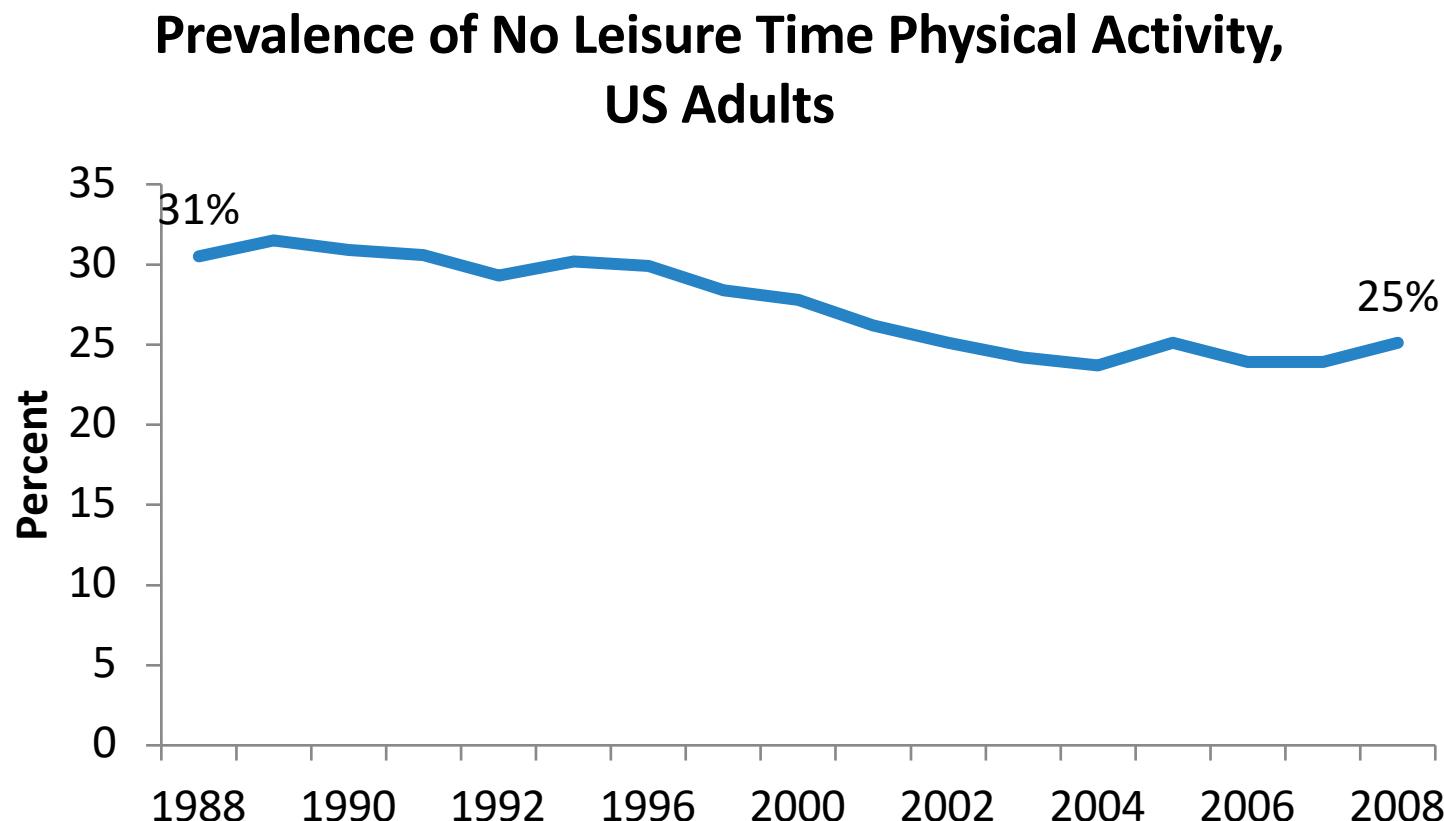
## *Leisure Time Physical Activity*

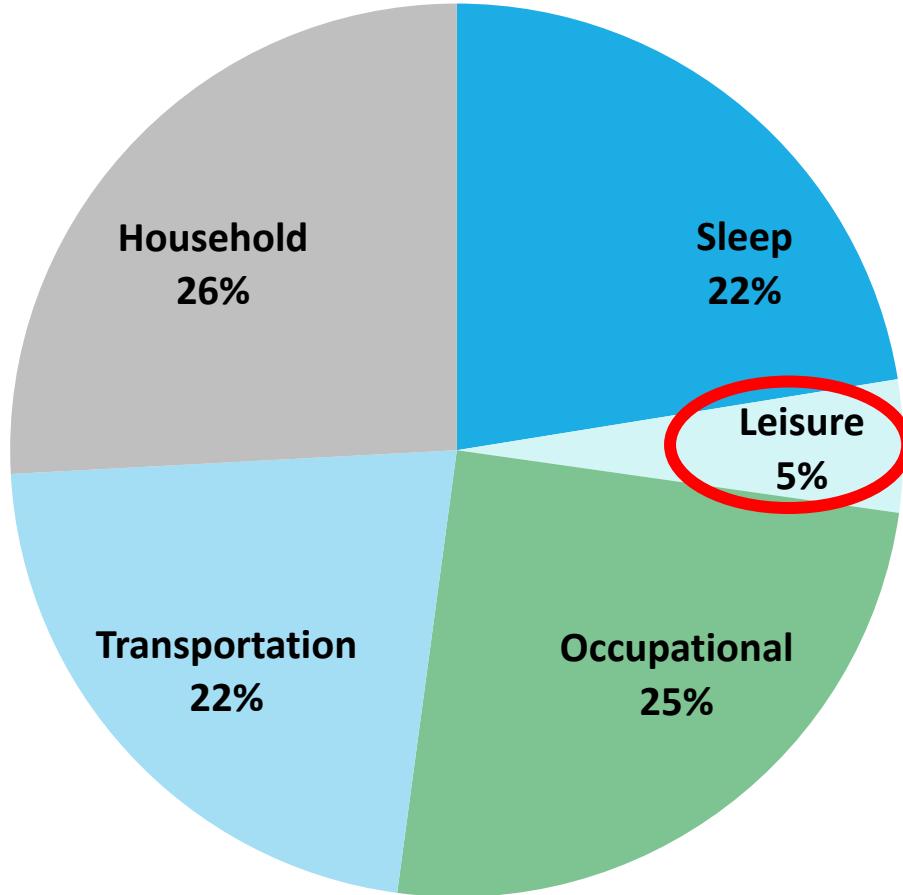
Planned, structured, repetitive, and purposive physical activity



# Domains

## *Leisure Time Physical Activity*





# Practice Question

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Jon Snow , the 998<sup>th</sup> commander of the Night's Watch, spends 1 hour each morning practicing sword fighting with the rest of his mean. He then spends 2 hours helping to clean Castle Black. Once he is done with his work and his chores, he then plays with his dog Ghost for 1 hour. How much time does he spend performing physical activity in the following domains:

- Occupational                           **1 hour**
- Household                              **2 hours**
- Leisure Time                           **1 hour**





**CSEP | SCPE**  
THE GOLD STANDARD IN EXERCISE  
SCIENCE AND PERSONAL TRAINING

## Canadian Physical Activity Guidelines

The cover of the "Physical Activity Guidelines for Americans 2nd edition" is shown. It features two photographs at the top: a woman and a child outdoors, and a person doing yoga on a rocky beach. Below the photos is the title "Physical Activity Guidelines for Americans" in large white font. Underneath the title is "2nd edition". At the bottom are five colored circles, each containing a black icon representing a different type of physical activity: walking, gardening, pushing a stroller, playing, and using a wheelchair.

# Physical activity guidelines for Chinese children and adolescents: The next essential step

Jincheng Xu <sup>a,\*</sup>, Can Gao <sup>b</sup>

<sup>a</sup> Research Center for Exercise and Biological Science, China Institute of Sport Science, Beijing 100061, China

<sup>b</sup> Sports Hospital, National Institute of Sports Medicine, Beijing 100061, China

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Available online 4 July 2017

# 2018 Physical Activity Guidelines for All Adults

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The 2018 Physical Activity Guidelines suggest that all adults should:

1. Move more and sit less throughout the day. Some physical activity is better than none.
2. For substantial health benefits, adults should do at least 150 – 300 minutes/week of moderate-intensity, or 75 – 150 minutes/week of vigorous-intensity aerobic physical activity.
  - A. Preferably, aerobic activity should be spread throughout the week
3. Additional health benefits are gained by engaging in physical activity above 300 minutes/week.
4. Do muscle-strengthening activities of moderate-to-vigorous intensity and that involve all major muscle groups on +2 days/week

# 2018 Physical Activity Guidelines for Older Adults

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In addition to the current guidelines for all adults, older adults have the following additional guidelines:

1. Older adults should also do balance training as part of their weekly physical activity
2. Older adults should determine their level of effort for physical activity relative to their level of fitness
3. Older adults with chronic conditions should understand whether and how their conditions affect their ability to do regular physical activity safely
  - A. If an older adult cannot do +150 minutes/week of aerobic activity, due to chronic conditions, they should be as physically active as their abilities and conditions allow.

# Summary

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Physical activity is any bodily movement that increases energy expenditure beyond resting levels.

- Light Intensity (1.5-3.0 METs)
- Moderate-to-Vigorous (>3.0 METs)
- Exercise is a subcategory of physical activity

Sedentary behaviour is any waking behaviour that requires less than 1.5 METs and is performed while seated or lying down

- Includes TV watching and computer use

## The Physical Activity Guidelines

- For substantial health benefits, adults should perform at least 150 minutes/week of moderate-to-vigorous physical activity
- Additional suggestions for older adults

# Pause



# Physical Activity and Healthy Aging

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# Physical Activity and Health

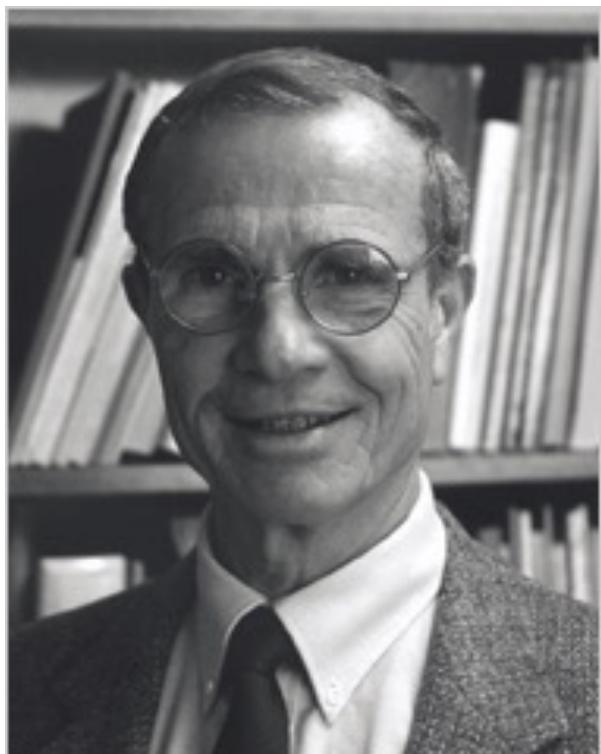
*Not a new phenomena*

	Age-standardized deaths per 1000 people/year	
<i>Men ages 35-64 years</i>	First clinical episode	Within 3 months of first clinical episode
Conductors	0.5	0.3
Drivers	1.1	0.5

# Physical Activity and Health

*Not a new phenomena*

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Ralph Paffenbarger Jr.  
(1922 – 2007)

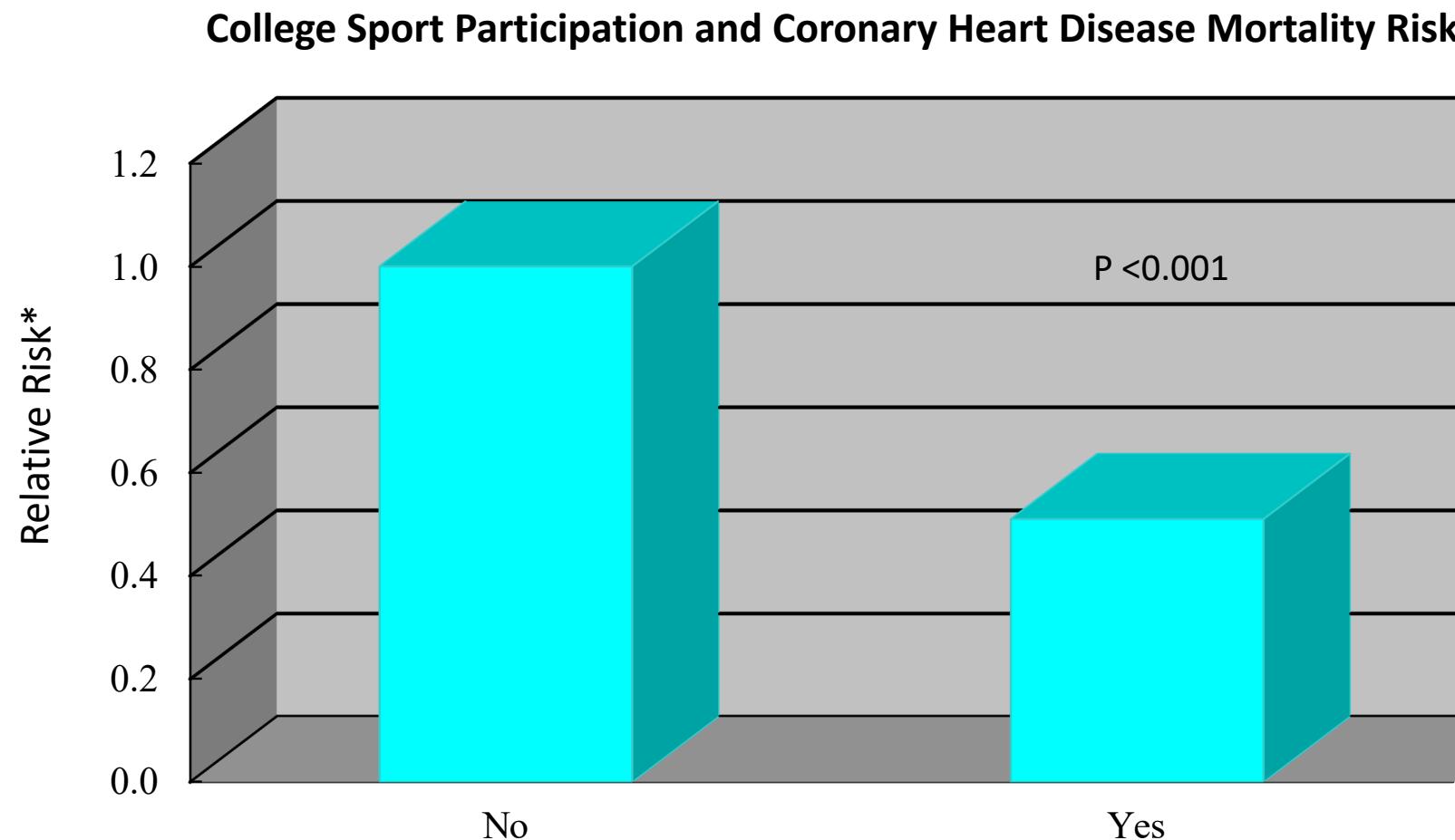


HARVARD  
UNIVERSITY

Recruited Harvard alumni between 1916 – 1950  
(Males only)

# Physical Activity and Health

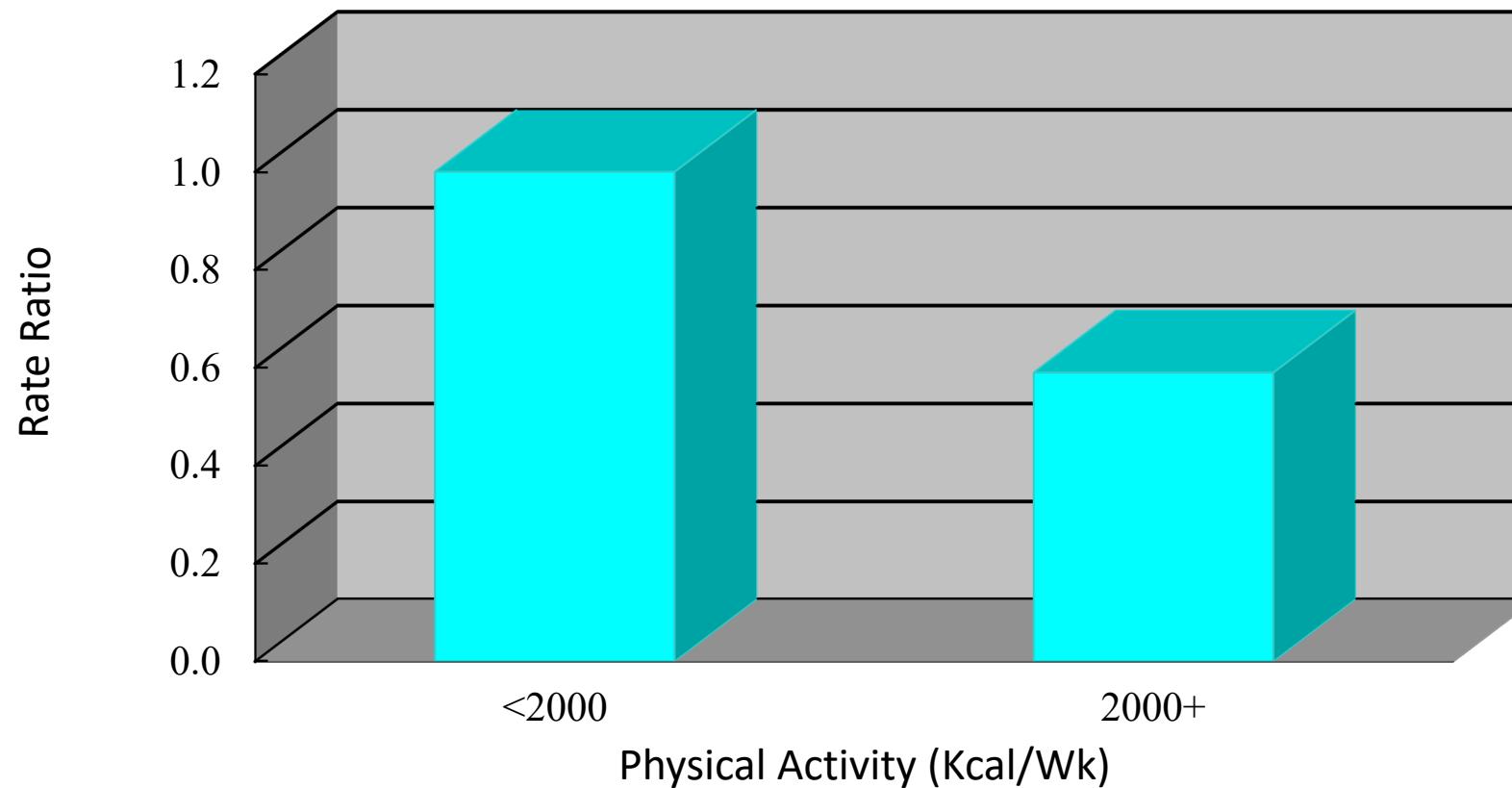
## *The Harvard Alumni Study*



# Physical Activity and Health

## *The Harvard Alumni Study*

**Physical Activity Level and Relative Risk of Myocardial Infarction in Middle-Aged Men**



# Physical Activity and Health

## *The Harvard Alumni Study*

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Added years of life to age 80, active vs inactive men:

<u>Age at study entry</u>	<u>Added years</u>
35-39	2.5
40-44	2.3
45-49	2.1
50-54	2.1
55-59	2.0
60-64	1.8
65-69	1.4
70-74	0.7
75-79	0.4
35-79	2.2

# Physical Activity and Health

## *Aerobics Center Longitudinal Study (ACLS)*

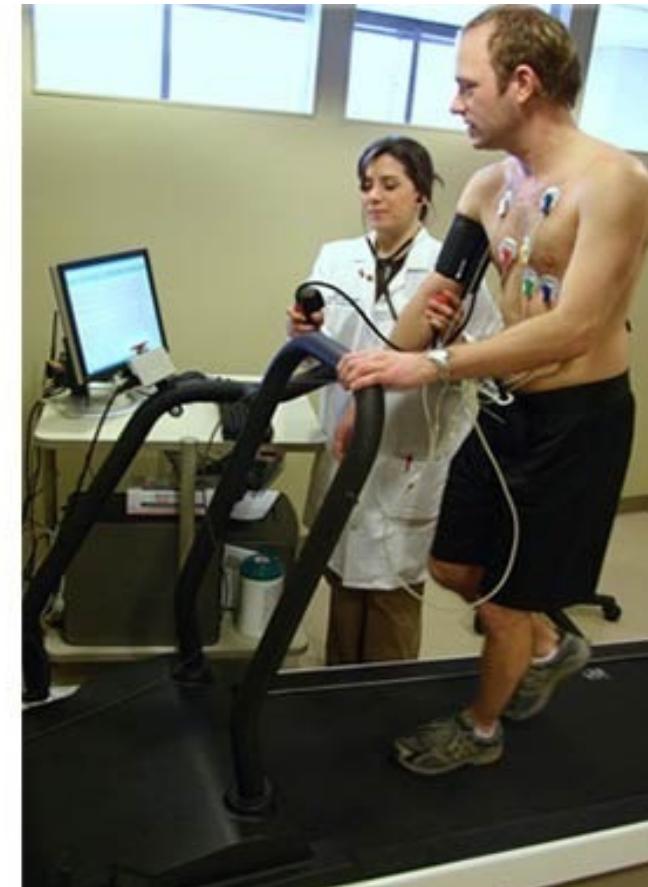
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Established in the 1970s by Dr. Kenneth H. Cooper

Participants are patients who came to the Cooper Clinic in Dallas, Texas (USA) for periodic comprehensive preventative medical examinations

- All participants perform a cardiorespiratory fitness test at study entry

**Main Exposure Interest:** Cardiorespiratory Fitness

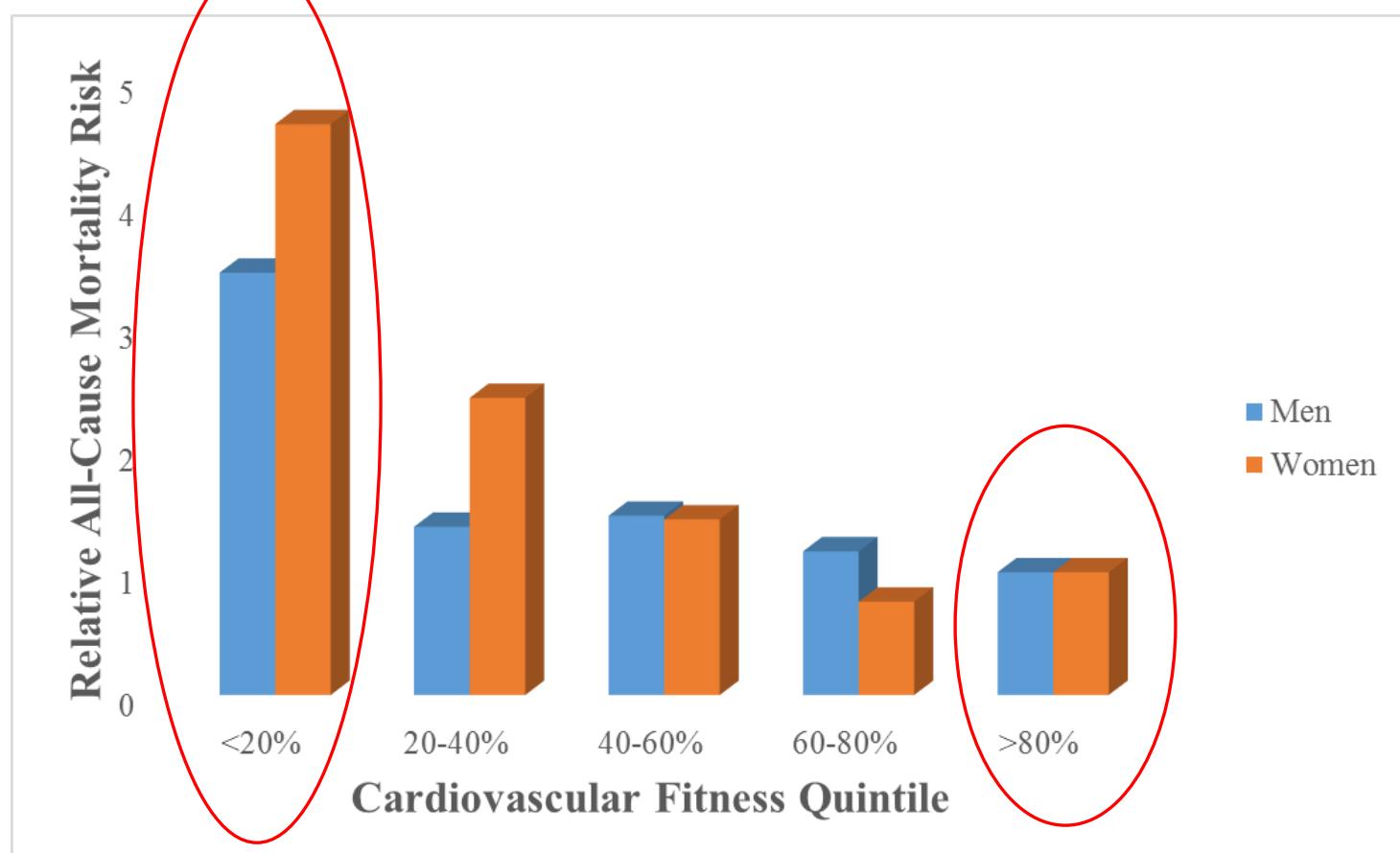


# Physical Activity and Health

## *Cardiovascular Fitness and Mortality Risk*

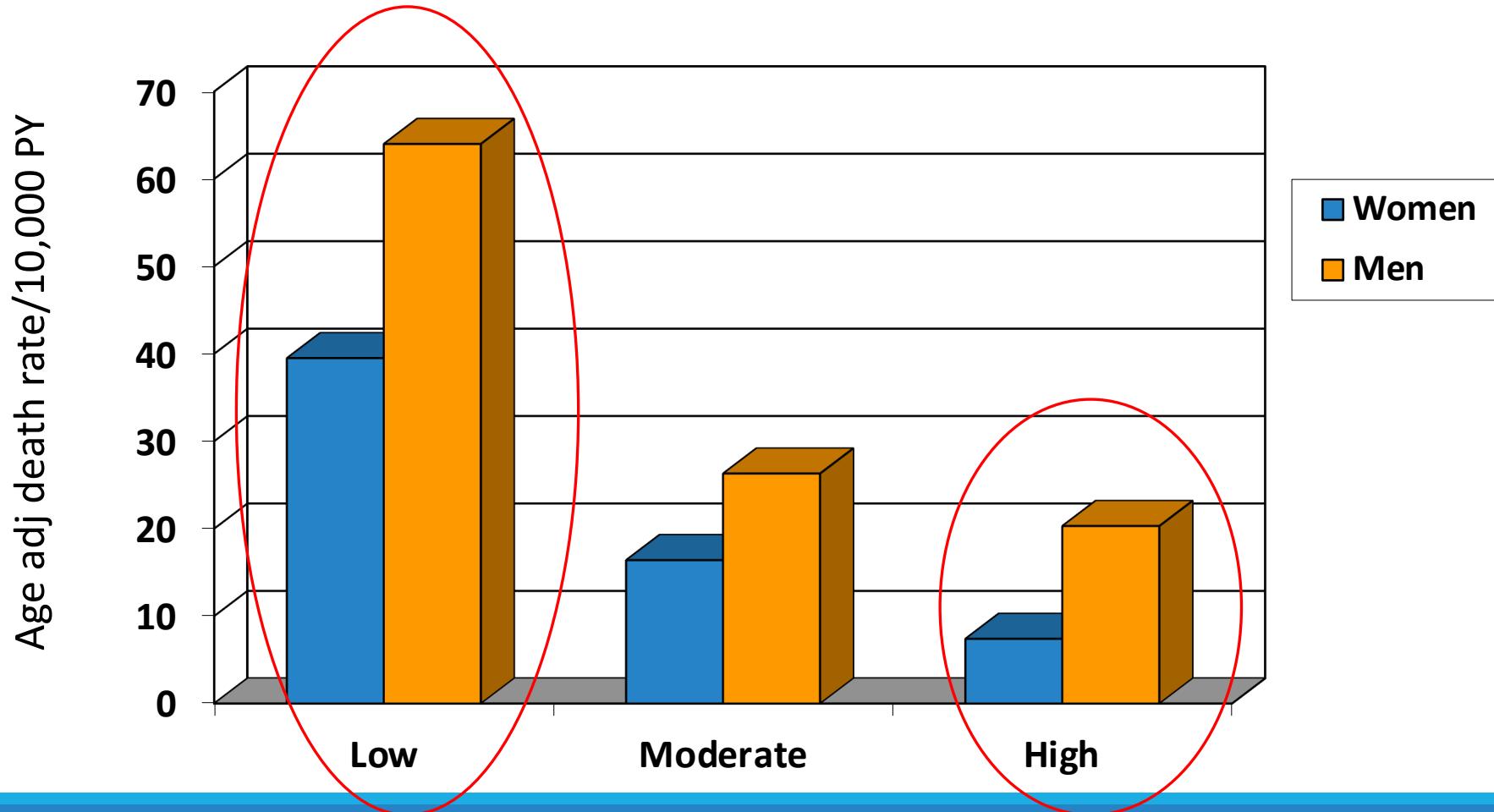


**Steven Blair**



# Physical Activity and Health

## *Cardiovascular Fitness and Mortality Risk*



# Physical Activity and Health

## *What about obesity?*

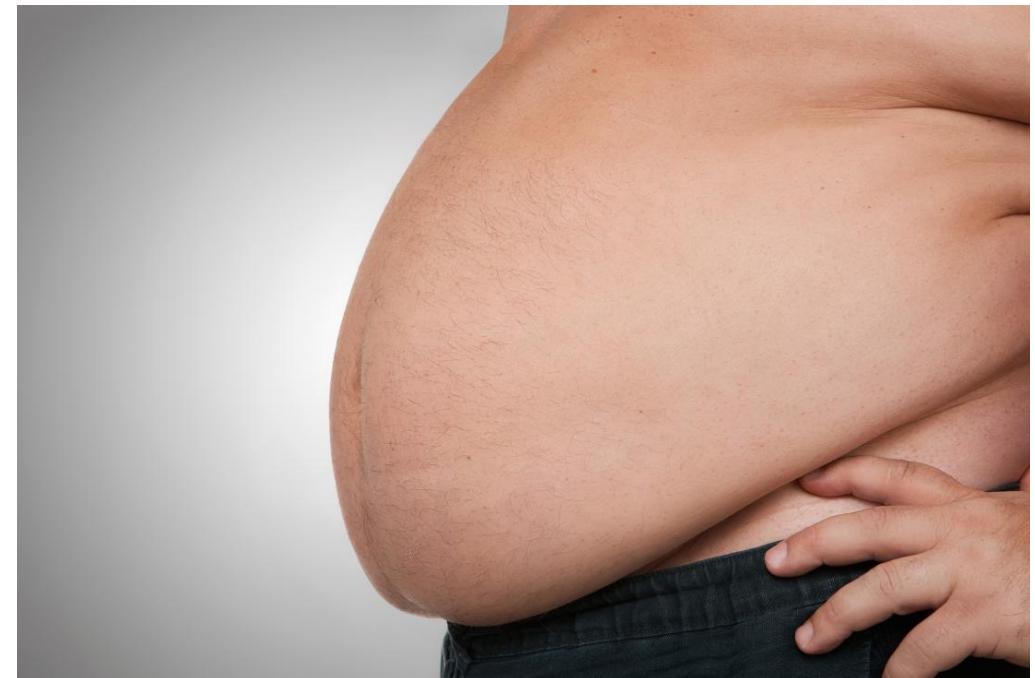
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Body Mass Index (BMI): A common measure to determine weight status

- $BMI = \text{Weight (kg)} / [\text{Height (m)}]^2$

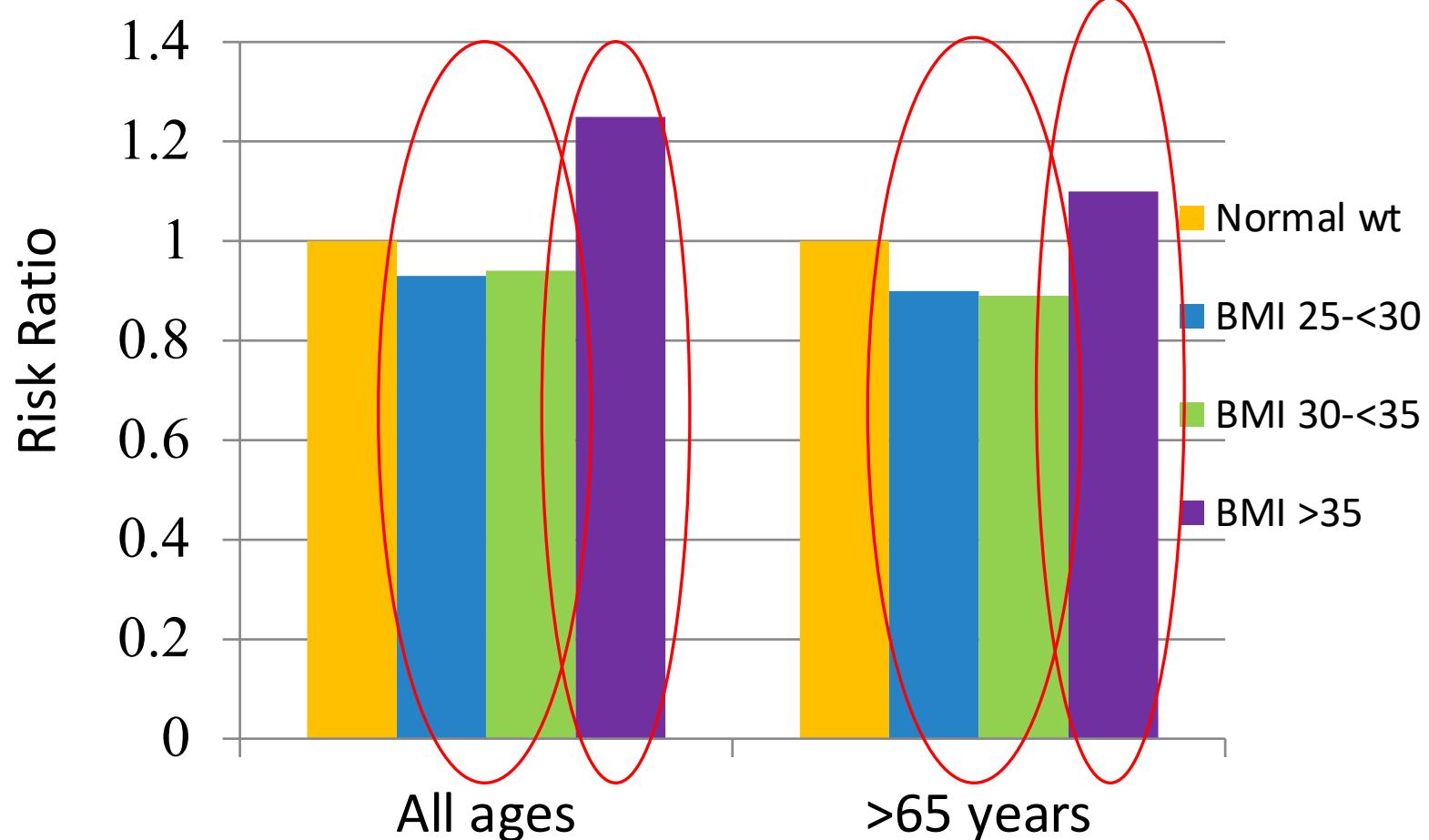
Classifications of BMI according to the World Health Organization

- **Underweight:** BMI of < 18.5
- **Normal weight:** BMI of 18.5 – 25
- **Overweight:** BMI of 25 – 30
- **Obesity:** BMI of >30



# Physical Activity and Health

## *What about obesity?*



# Practice Question

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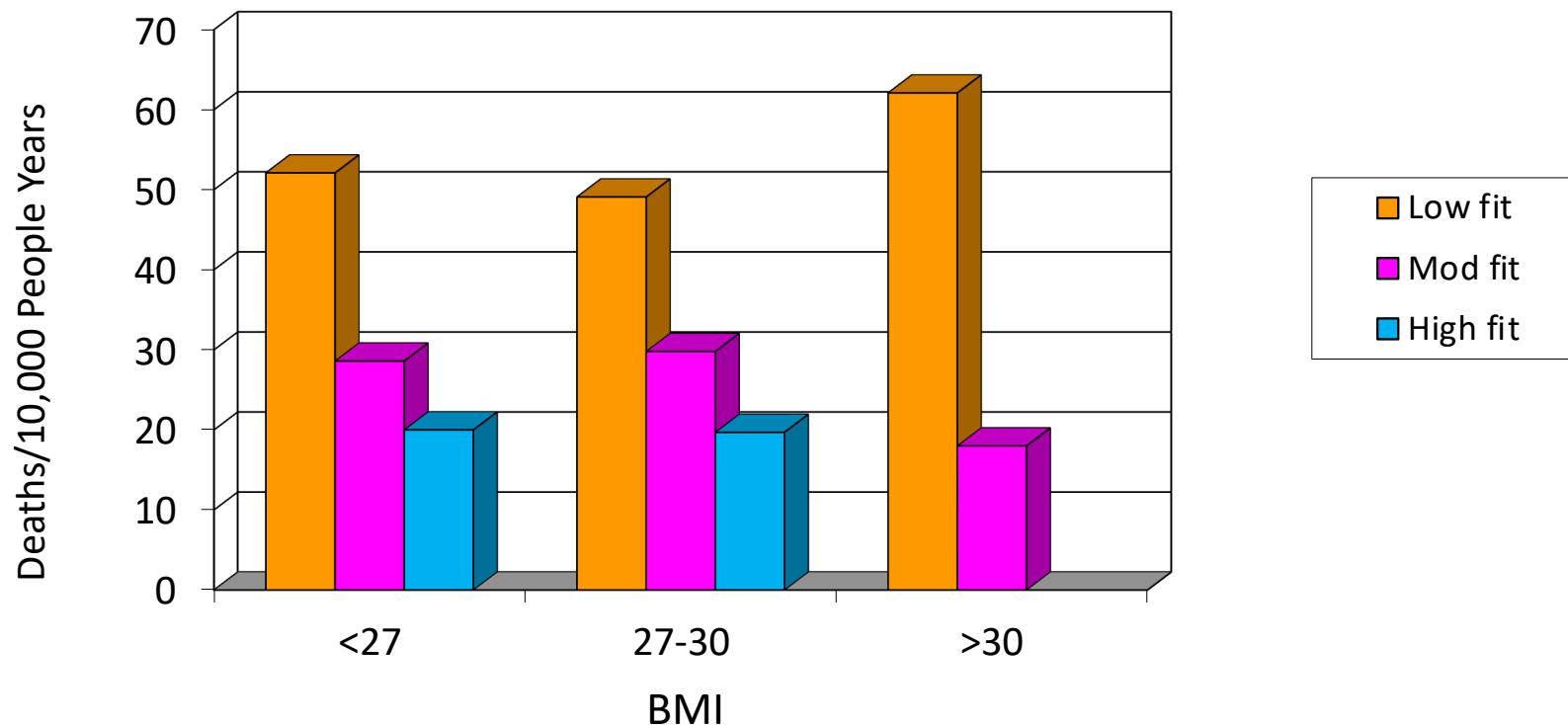
What is more important for health?

- A. Body weight
- B. Physical fitness

# Physical Activity and Health

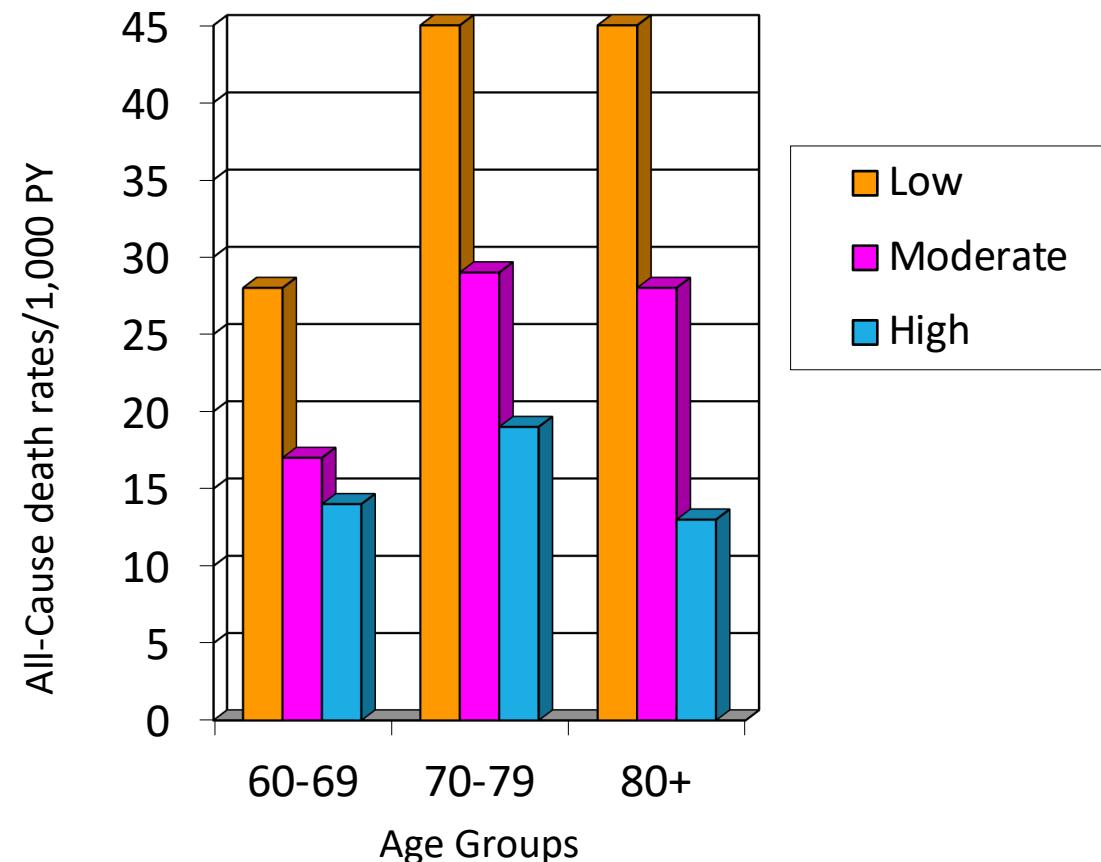
## *Fitness vs. Fatness*

Cardiovascular fitness is a better indicator of mortality risk than BMI!



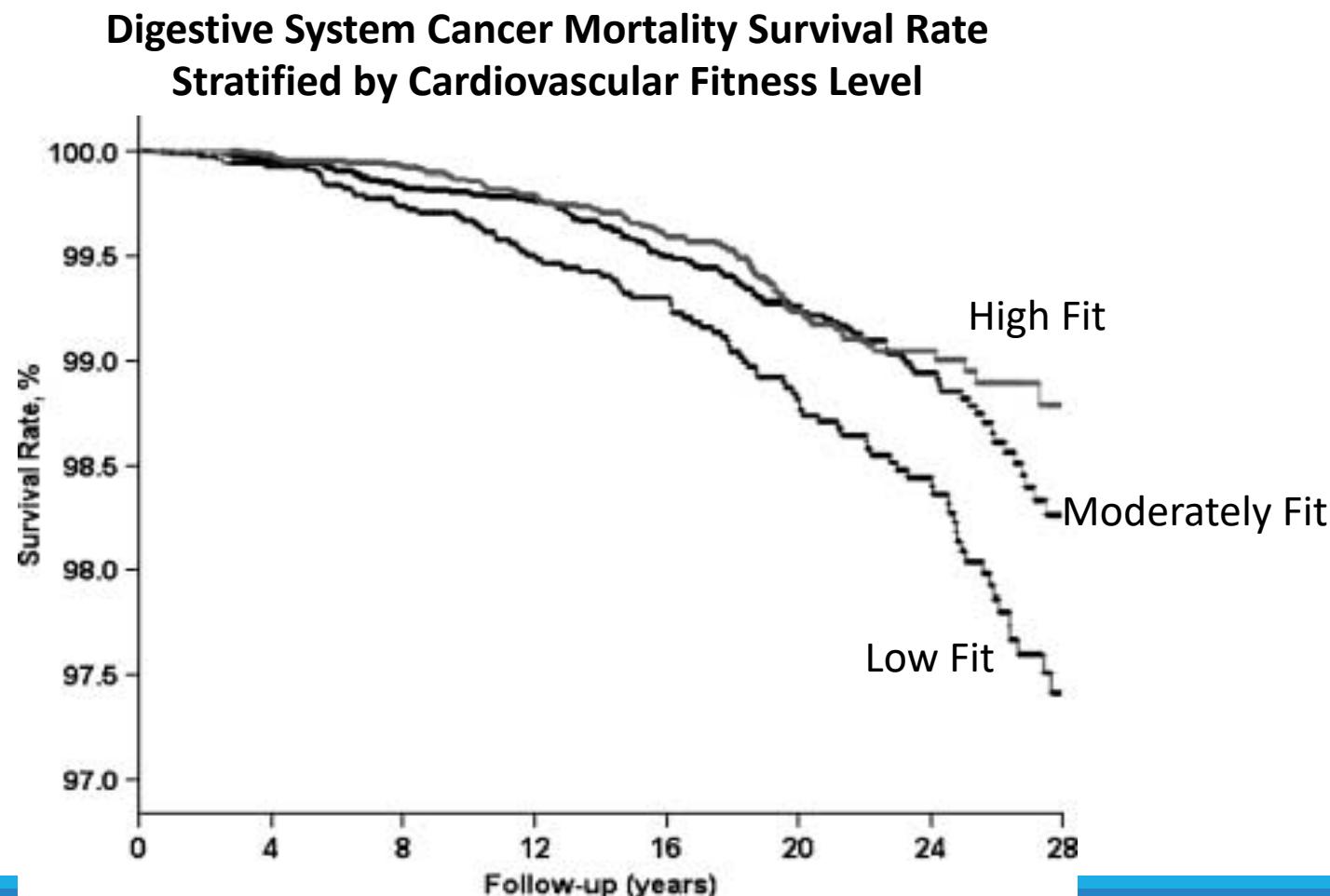
# Physical Activity and Health

## *Cardiovascular Fitness and Mortality Risk in Older Adults*



# Physical Activity and Health

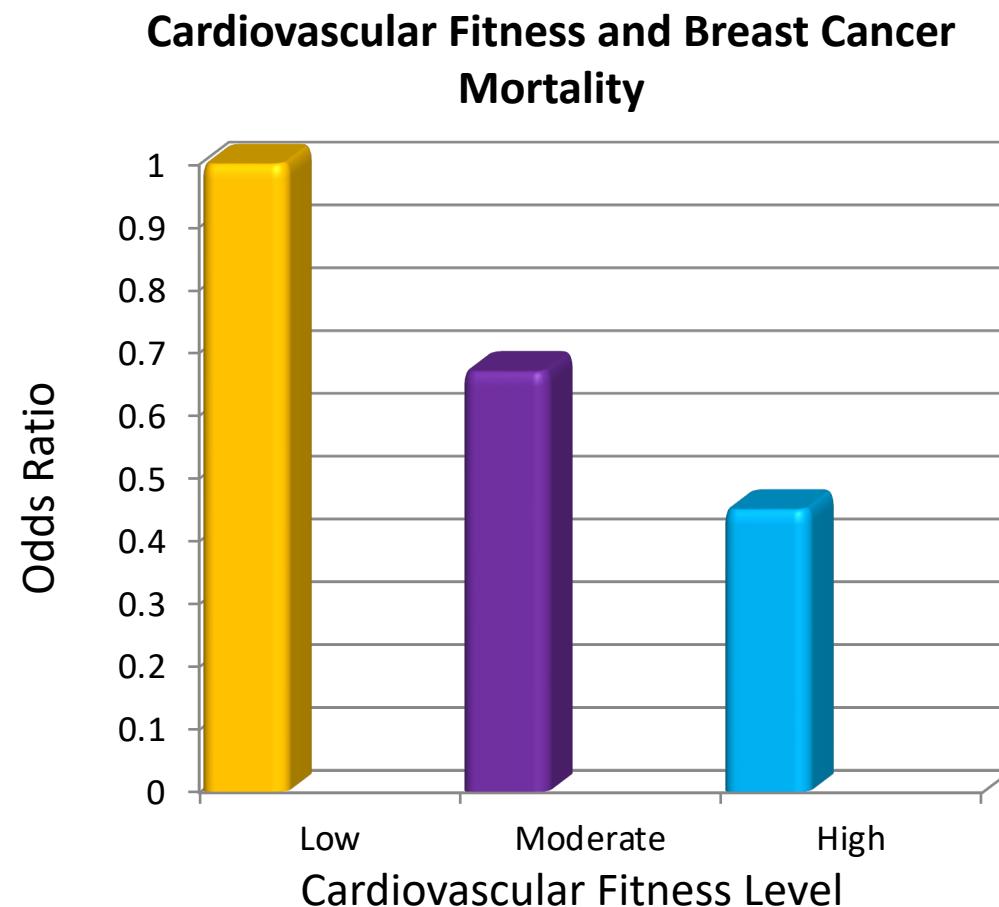
## *Cardiovascular Fitness and Cancer*



# Physical Activity and Health

## *Cardiovascular Fitness and Cancer*

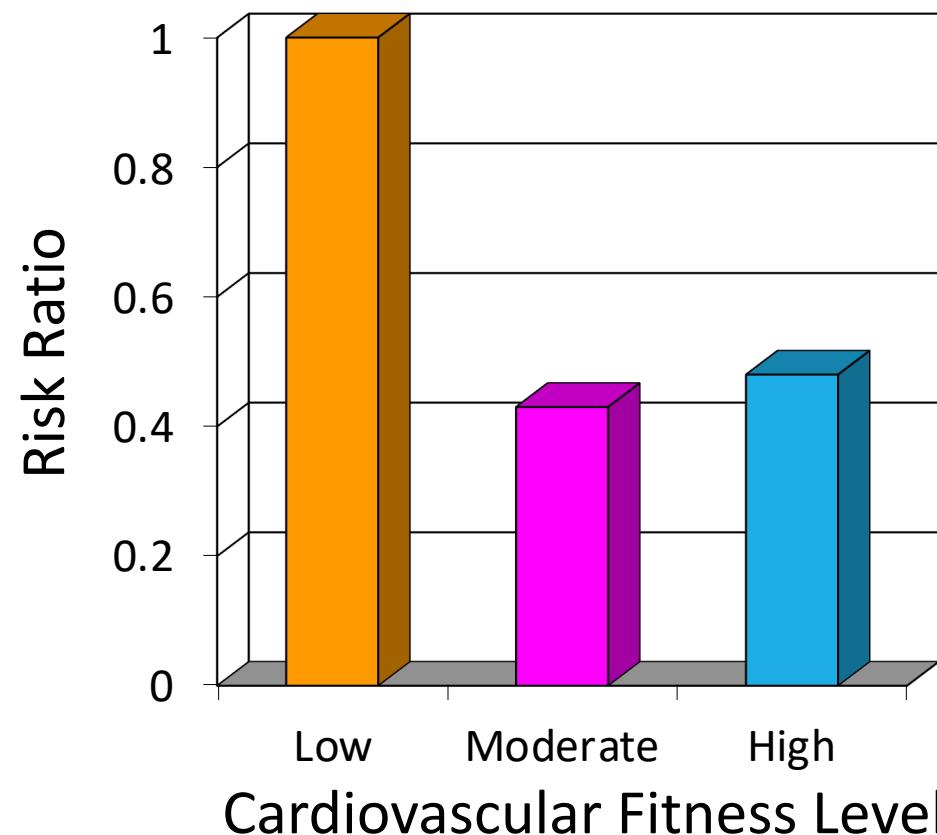
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# Physical Activity and Health

## *Cardiovascular Fitness and Dementia*

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# Physical Activity and Health

## *Muscular Strength*

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Muscular strength: The amount of force a muscle can produce with maximal effort

- Typically assessed using a 1 repetition maximum (1 RM) test

Like cardiovascular fitness, it can be used as a proxy for physical activity level



# Practice Question

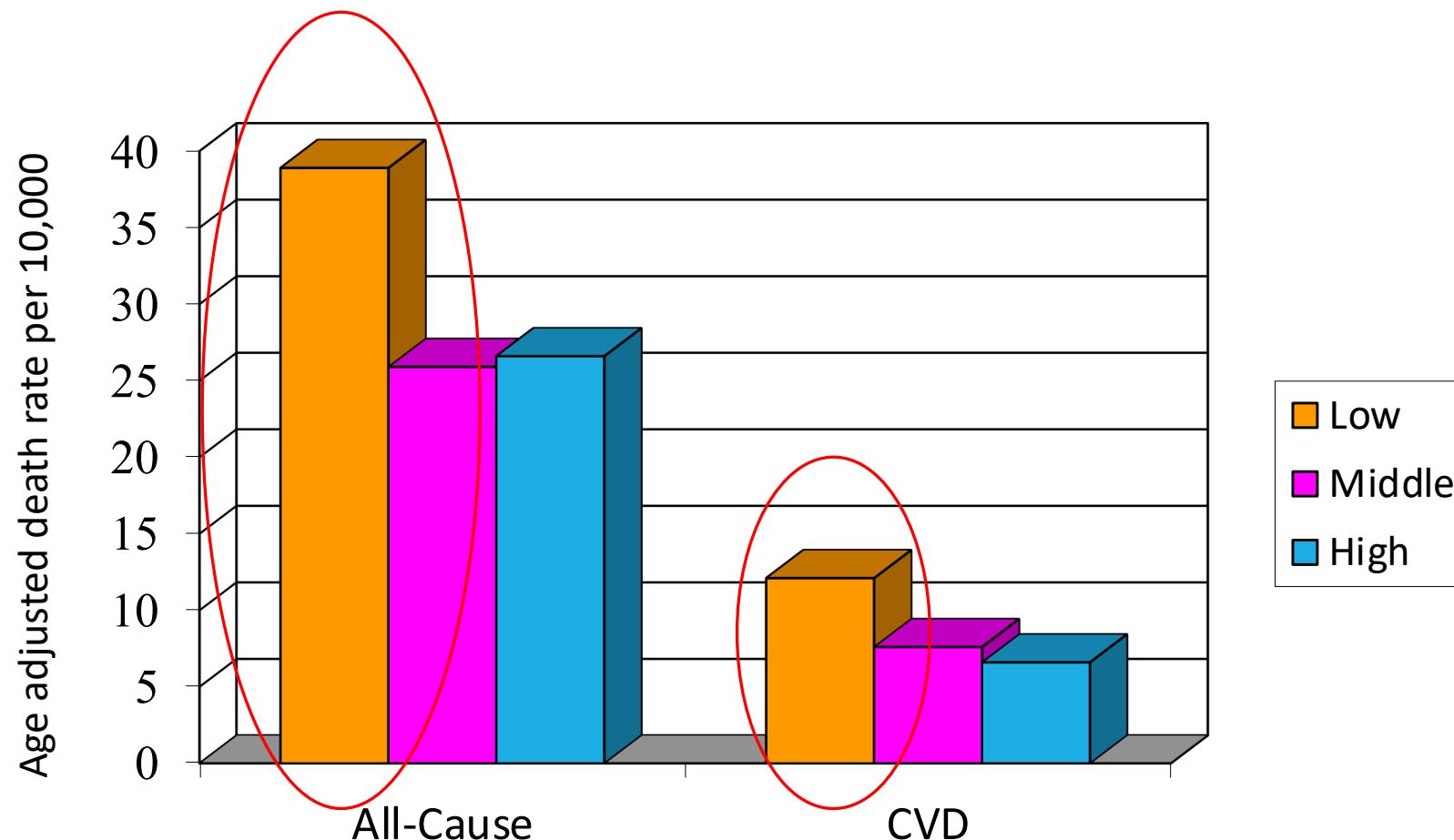
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Muscular strength and cardiovascular fitness are used as a proxy (i.e., a substitute measure) of physical activity. What are the pro's and con's to this approach?

PRO's	CON's
Fitness is associated with physical activity level	Physical activity is a behaviour, fitness is a health parameter
Can be done in one short assessment	Can't measure changes in physical activity
Good measures of overall health	

# Physical Activity and Health

## *Muscular Strength and Mortality Risk*



# Health benefits of Physical Activity

## *A Summary of the Evidence*

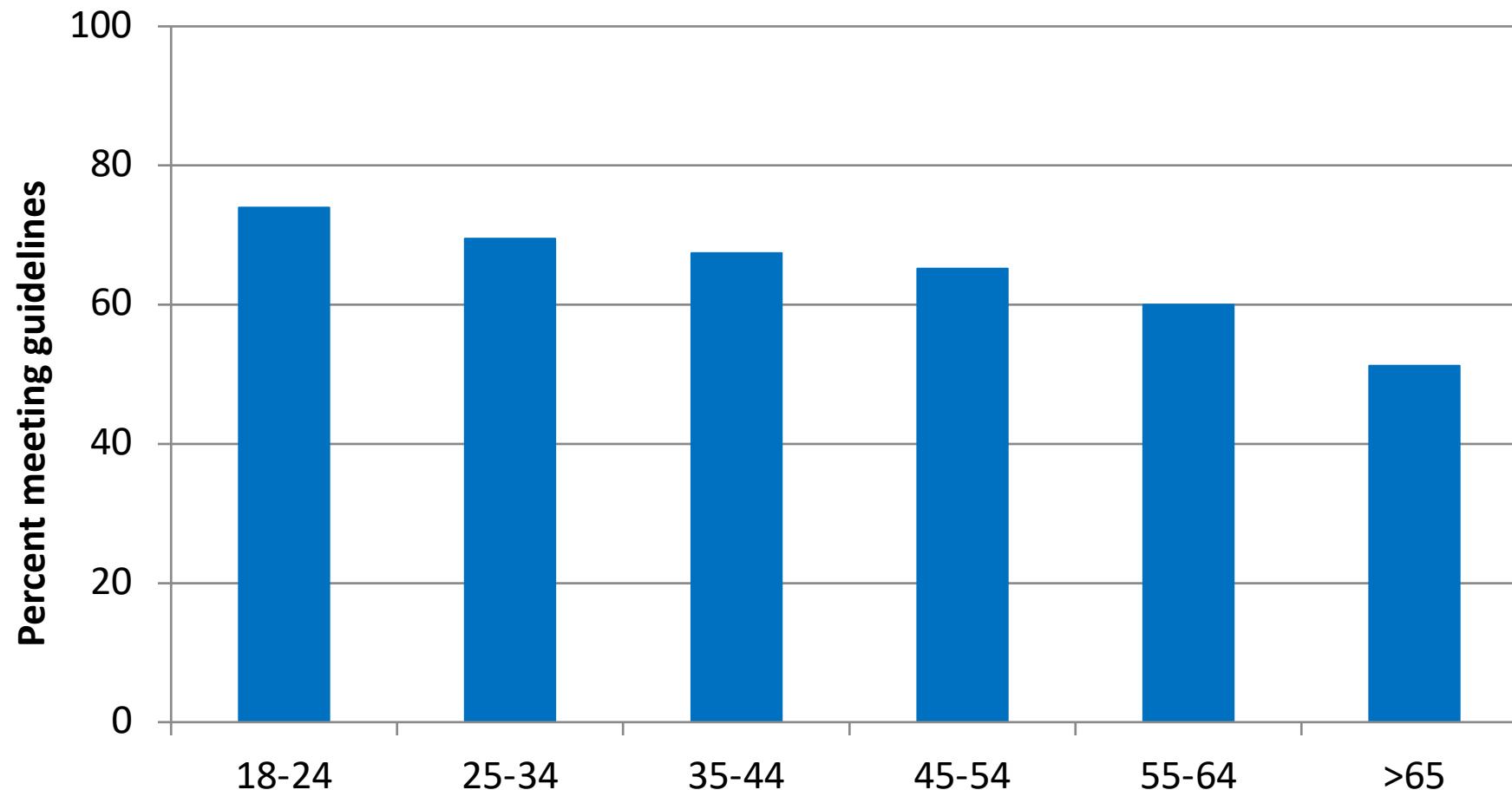
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Greater physical activity is associated with:

- Lower risk of early death
- ↓risk of Heart disease
- ↓risk of Stroke
- ↓risk of Type 2 Diabetes Mellitus
- ↓risk of hypertension
- ↓risk of adverse blood lipid profile
- ↓risk of Metabolic Syndrome
- ↓risk of Colon and breast cancers
- Prevention of weight gain
- Weight loss when combined with exercise
- Improved cardiorespiratory and muscular fitness
- ↓risk of depression
- Prevention of falls
- Better cognitive function
- Better functional health
- Reduced abdominal obesity
- Weight maintenance after weight loss
- ↓risk of hip fracture
- Increased bone density
- Better sleep quality

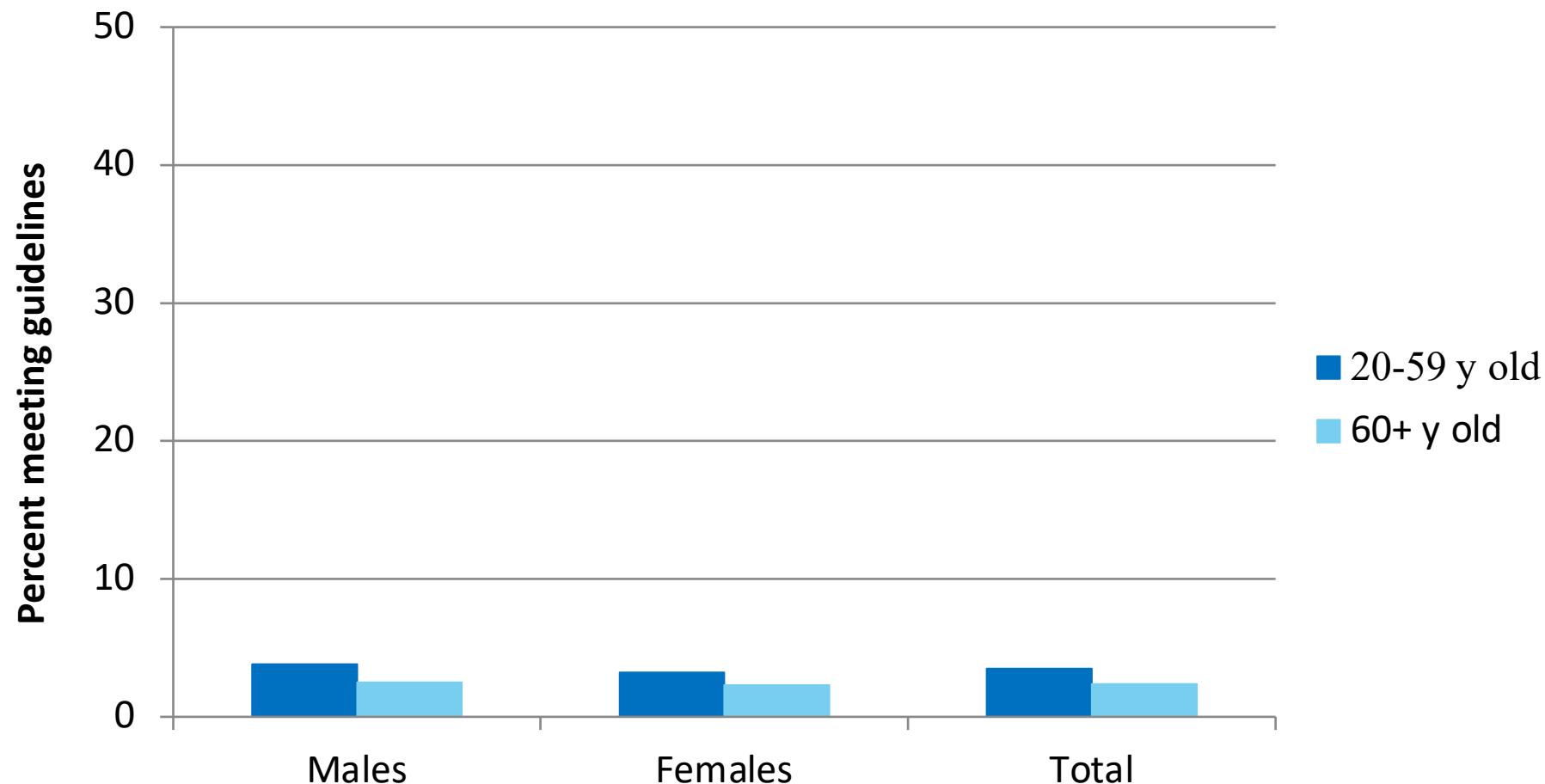
# Are People Getting the Message?

*Prevalence of Meeting PA Guidelines (BRFSS 2007)*



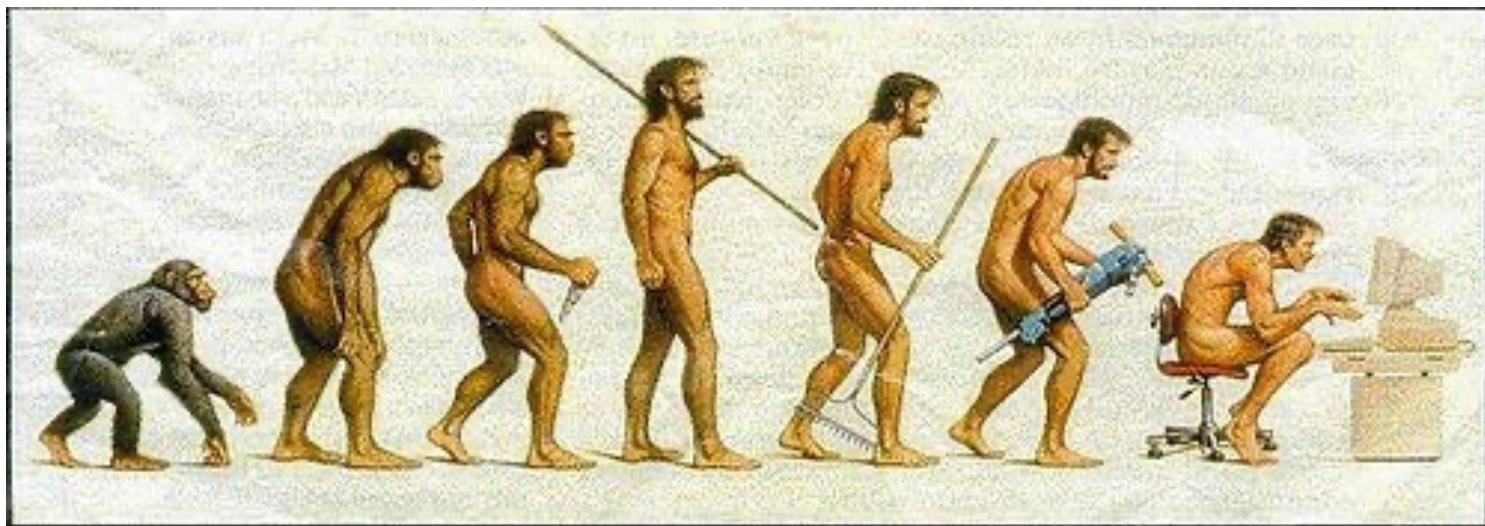
# Are People Getting the Message?

*Prevalence of Meeting PA Guidelines (Accelerometry)*



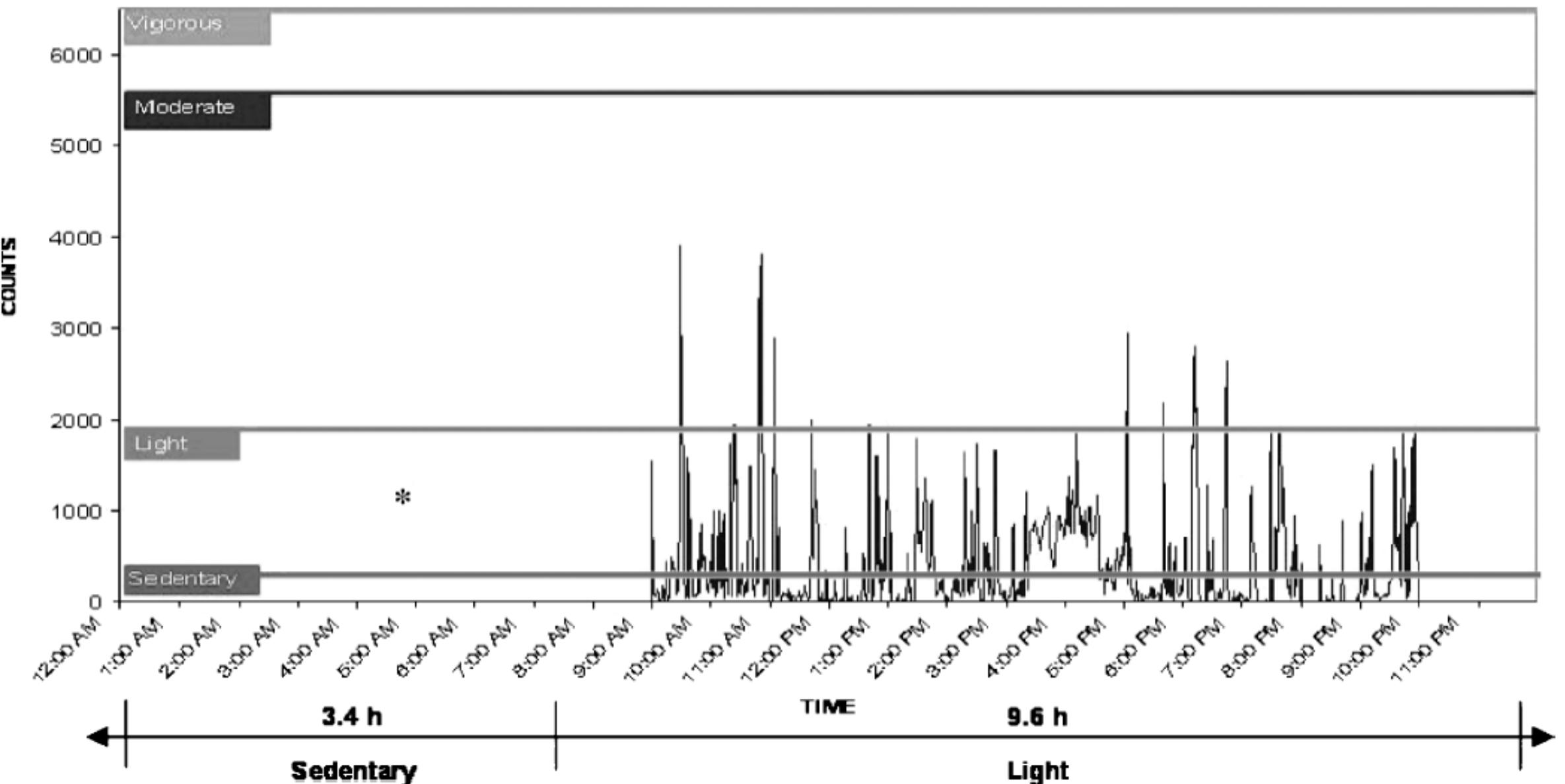
# What about Sedentary Behaviour?

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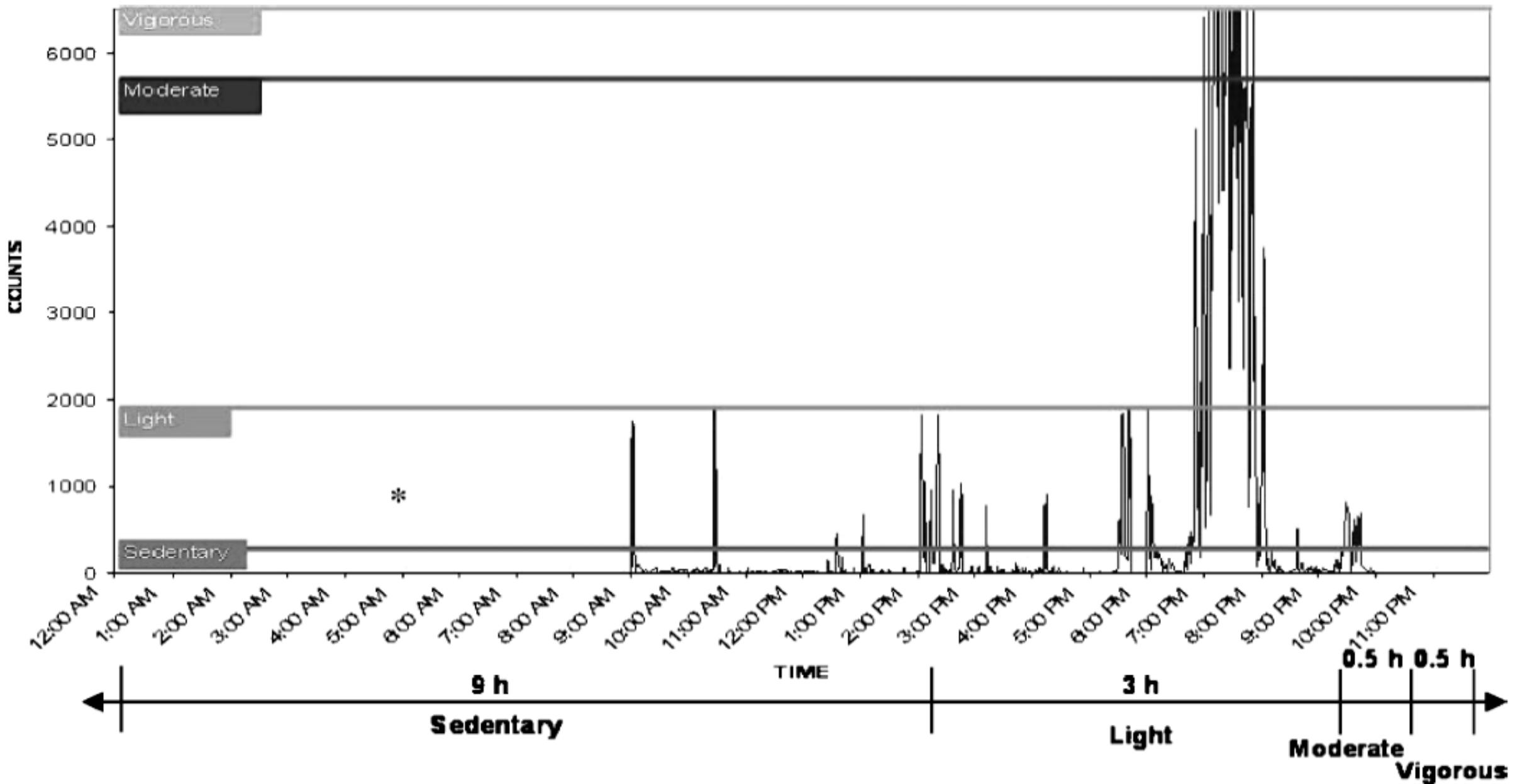


**Somewhere, something went terribly wrong**

**Excessive sedentary behaviour is distinct from insufficient exercise or physical activity!**



**Figure 1.** Actigraph representation of activity of a 30-yr-old woman. (Count cutoffs determined from the energy expenditure prediction equation developed by Freedson and colleagues (2).) \*Monitor was not worn.



**Figure 2.** Actigraph representation of activity of a 28-yr-old man. (Count cutoffs determined from the energy expenditure prediction equation developed by Freedson and colleagues (2).) \*Monitor was not worn.

# What about Sedentary Behaviour?

## *The Physiology of Inactivity*

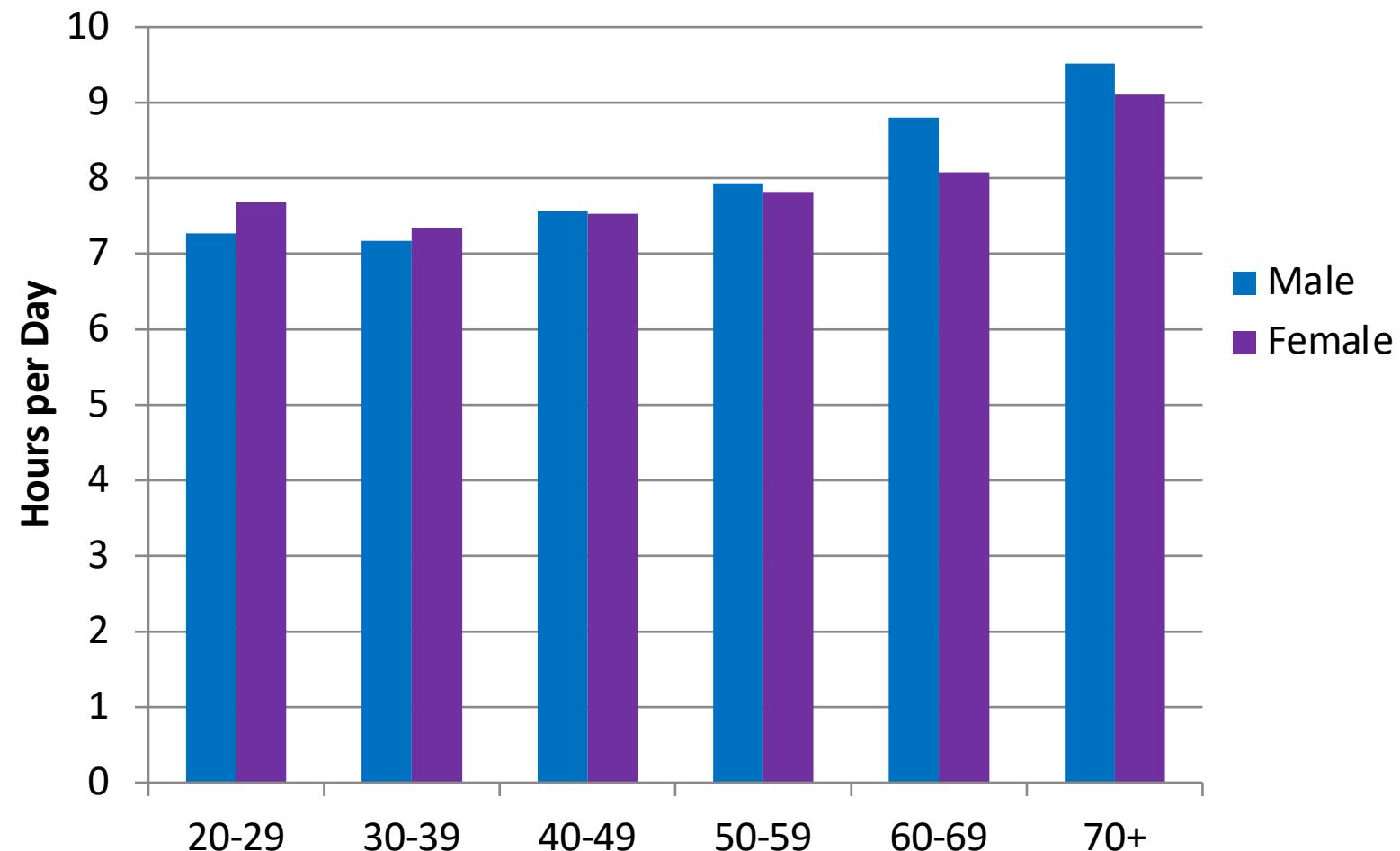
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Sedentary behaviour reduces muscle contraction leading to:

- Suppression of skeletal muscle lipoprotein lipase (LPL) activity
  - ↓ Triglyceride uptake
  - ↓HDL levels
- Reduced glucose uptake in skeletal muscle
  - Reductions in insulin sensitivity
  - ↑Glucose levels in the blood stream

# Sedentary Behaviour and Health

*How many hours do people spend in Sedentary Behaviour?*



# Sedentary Time and Mortality

Study	N (person-yrs FU)	Age (years)	Mortality outcome		
			All cause	CVD	Cancer
<b>EPIC Norfolk</b> (Wijndaele et al)	13,197 (124,902)	≥ 45			

What is the association between sedentary behaviour and cognitive function? A systematic review

Ryan S Falck,<sup>1</sup> Jennifer C Davis,<sup>1</sup> Teresa Liu-Ambrose<sup>1,2</sup>

<b>CFS</b> (Katzmarzyk et al)	17,013 (204,732)	≥ 18			
<b>CPS2</b> (Patel et al)	123,216 (1,610,728)	≥ 50			♀

With thanks to Dr Katrien Winndaele; Metabolic Sciences, Cambridge; see Thorp, A., Owen, N., Neuhaus, M. and Dunstan D.W. (2011). Sedentary behaviors and subsequent health outcomes: A systematic review of longitudinal studies, 1996-2011. *American Journal of Preventive Medicine*, 41, 207-215.

# Summary

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Physical activity is essential for healthy aging and is associated with numerous health benefits

- It's currently unclear whether fitness level or physical activity level is more important for health

Sedentary behaviour is also an independent risk factor for numerous chronic health conditions

- It's unclear whether physical activity level is more important than sedentary behaviour

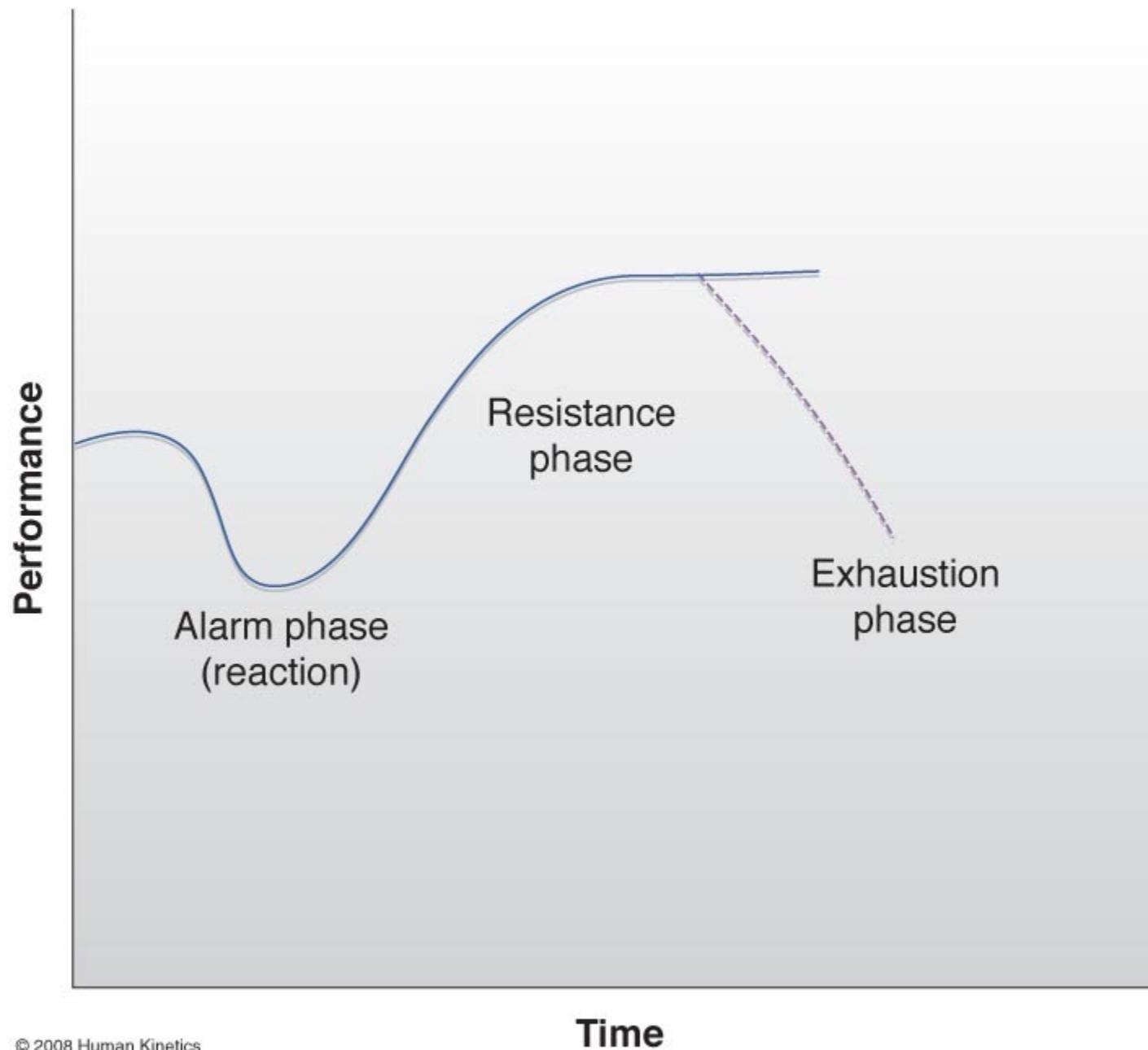
Physical inactivity is still a serious public health problem

# Pause



# A Brief Introduction to Exercise Prescription for Healthy Aging

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# The FITT Principle

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Exercise prescription is based on 4 key variables:

**Frequency:** *How often the exercise occurs (e.g., days/week)*

**Intensity:** *How hard the exercise is (e.g., heart rate)*

**Type:** *The type of exercise performed (i.e., weight training or aerobics)*

**Time:** *How long the exercise is performed*

***Frequency x Time= VOLUME OF TRAINING***

# The FITT Principle

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The most important variables for improving fitness are:

1. Volume
2. Intensity

# Types of Exercise Training

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# Aerobic Exercise and Older Adult Health

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Improves cardiovascular function

Improves glucose tolerance

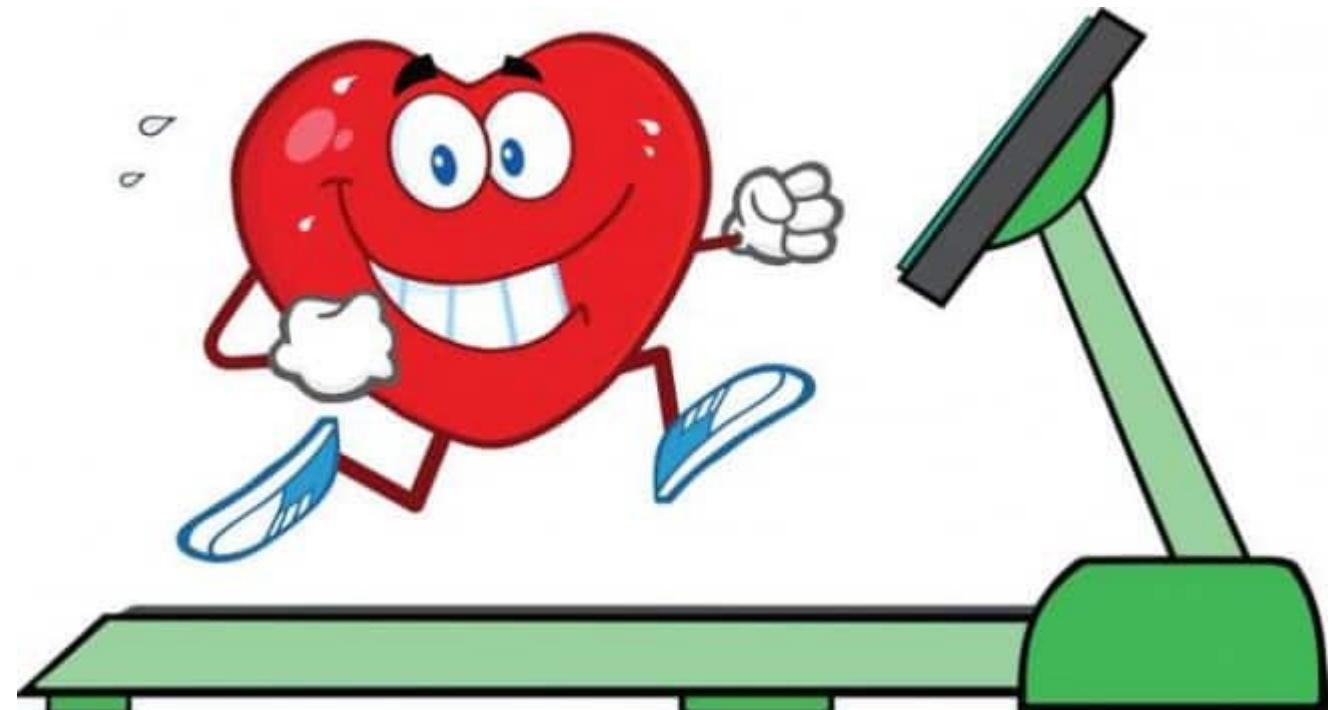
Can improve sleep

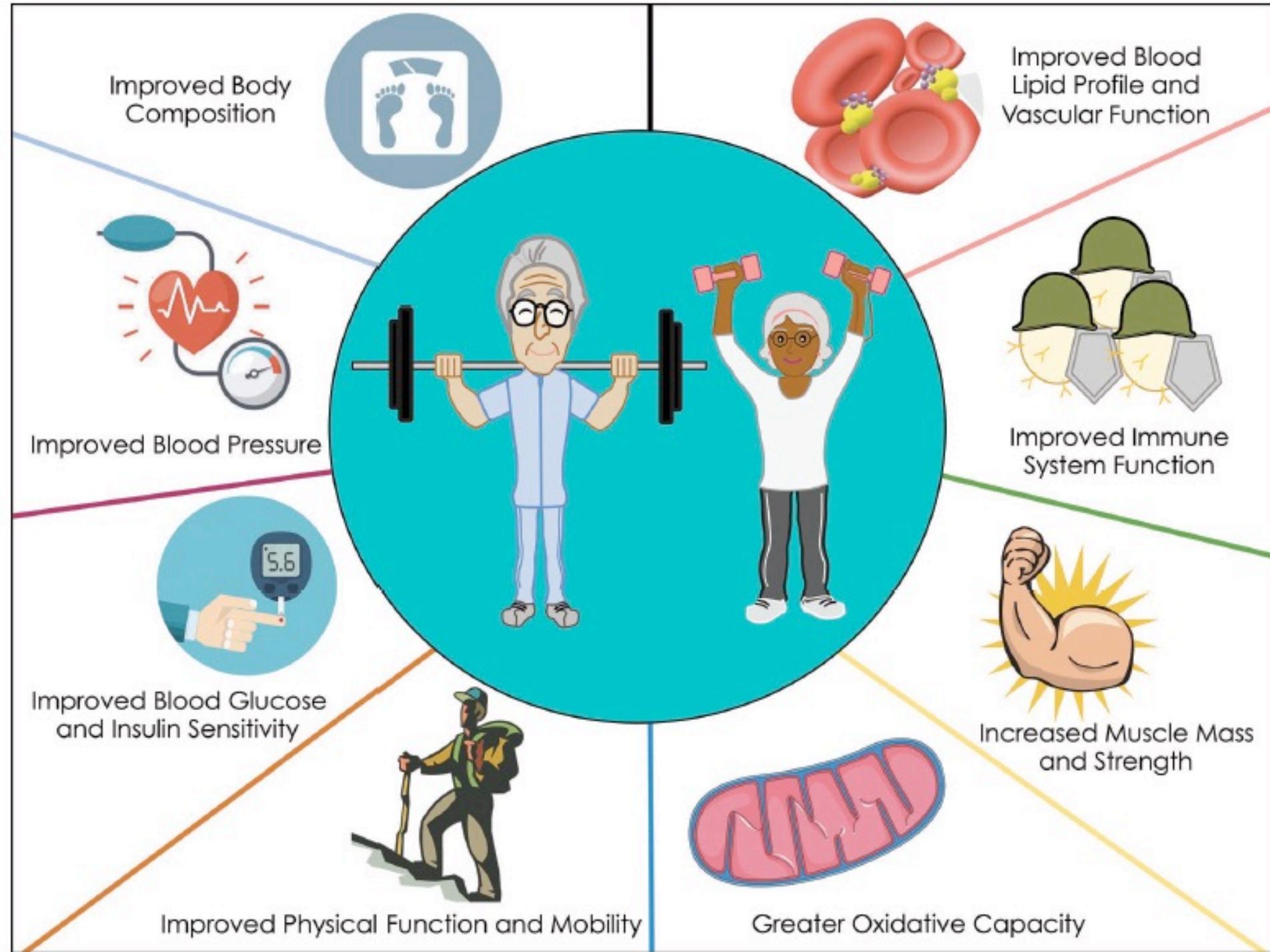
Weight regulation

Strengthens the immune system

Improves cognitive function

Falls risk reduction





# Wolff's Law: The Principle of Specificity

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Adaptation occurs according to the demands and loads placed on the system



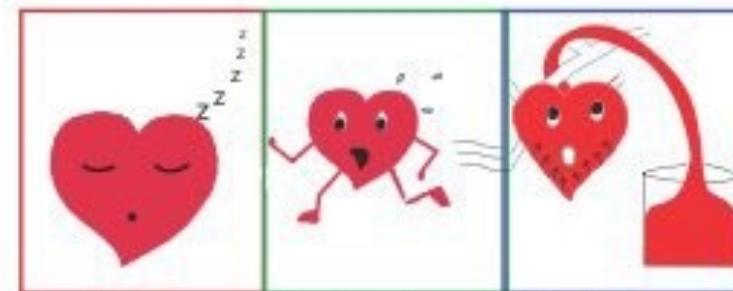
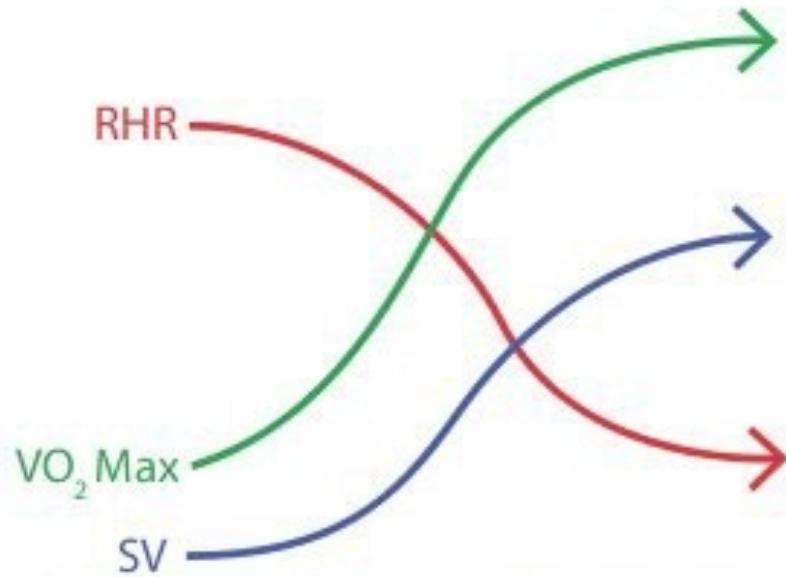
# Practice question

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If Albert begins an exercise program wherein she performs aerobic training 5x/week for 1 hour, which of the following fitness parameters would you expect to improve the most:

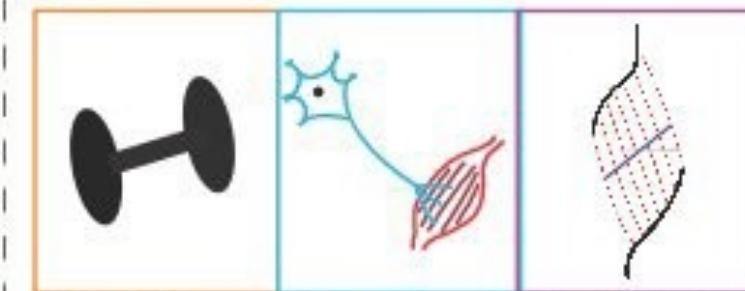
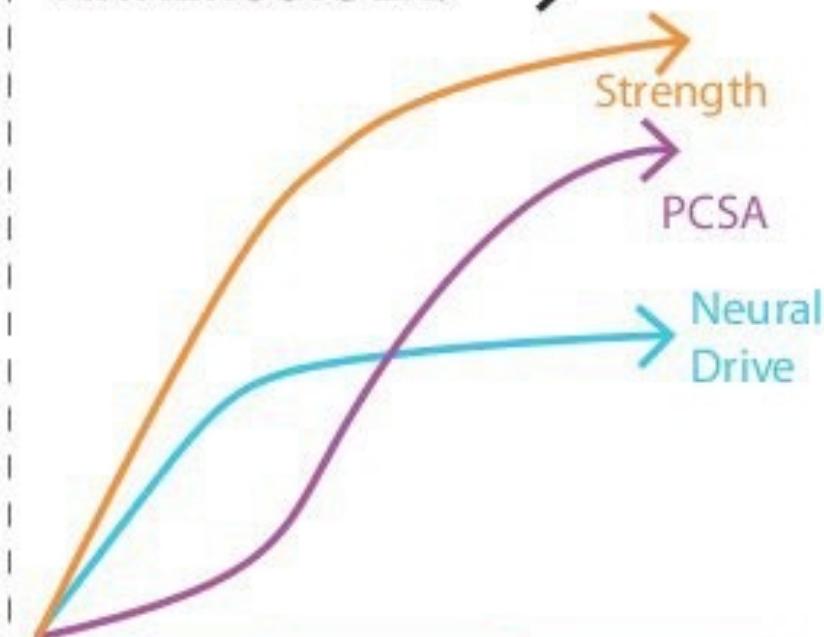
- A. Muscular fitness
- B. Cardiovascular fitness**
- C. Flexibility
- D. None of the above

## AEROBIC EX. →



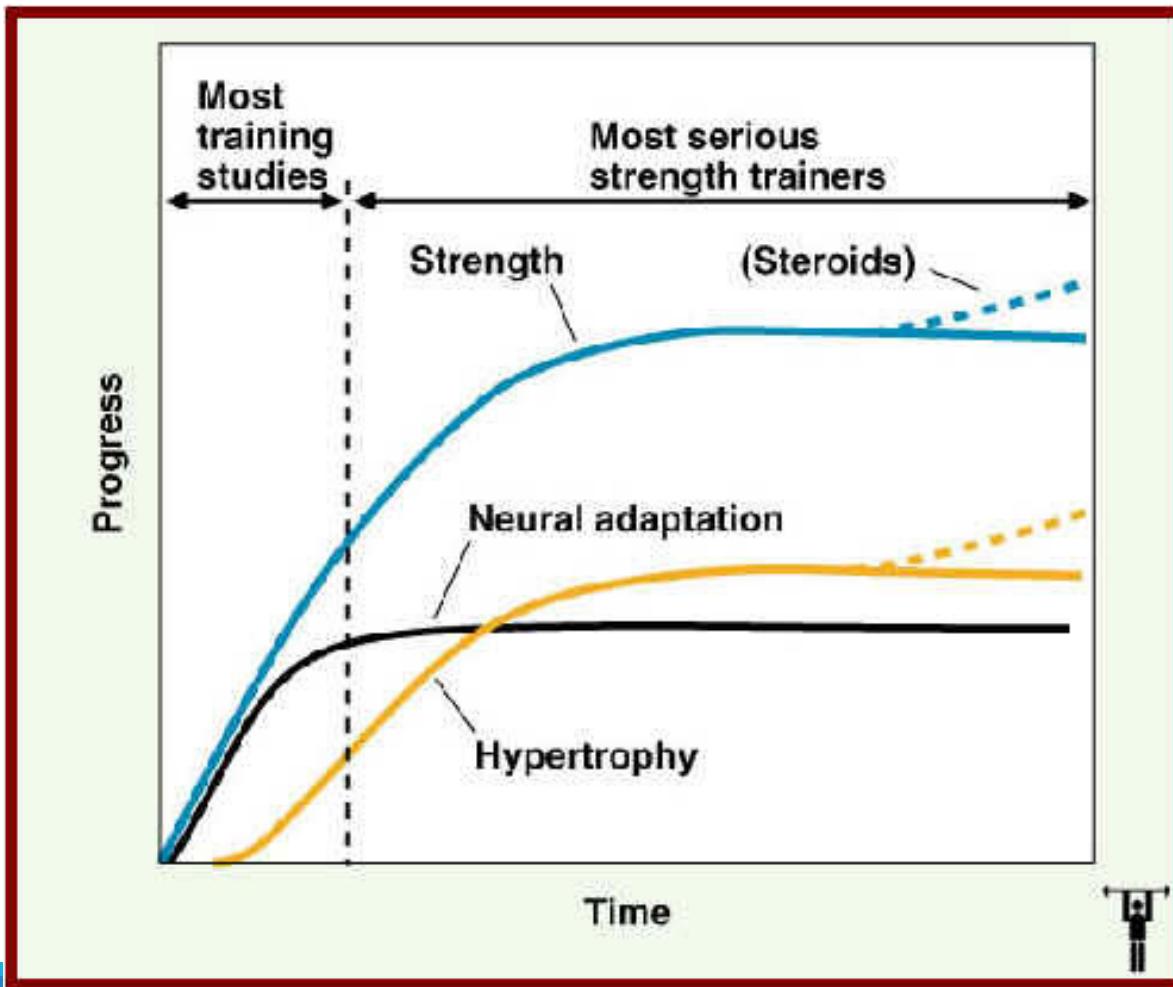
Resting Heart Rate (RHR)  
Maximal Oxygen Consumption (VO<sub>2</sub> Max)  
Stroke Volume (SV)

## ANAEROBIC EX. →



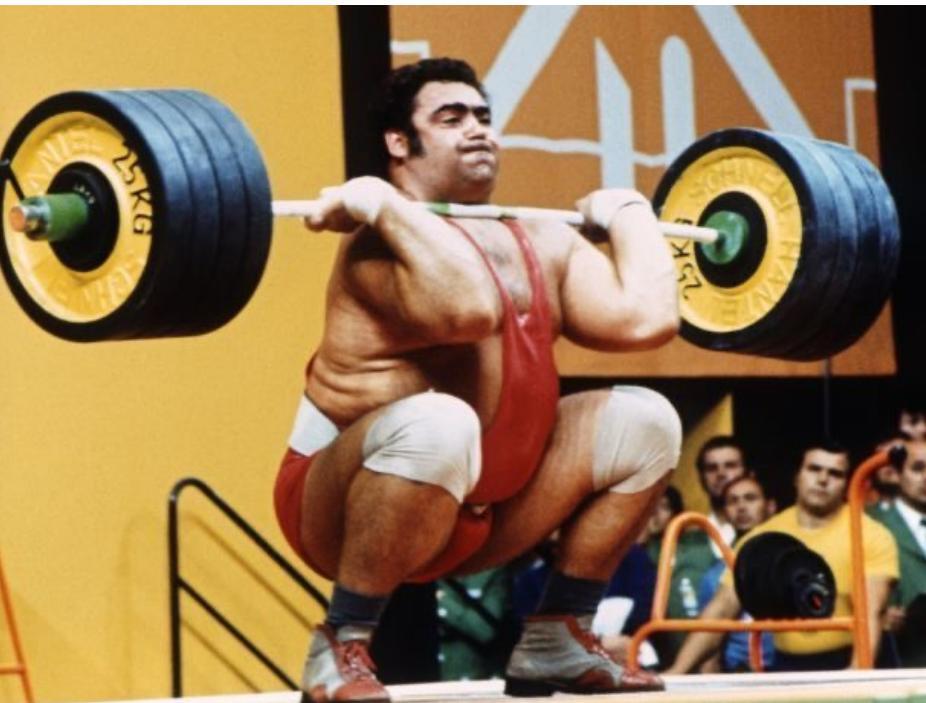
Strength  
Neural Drive  
Physiologic Cross-Sectional Area (PCSA)

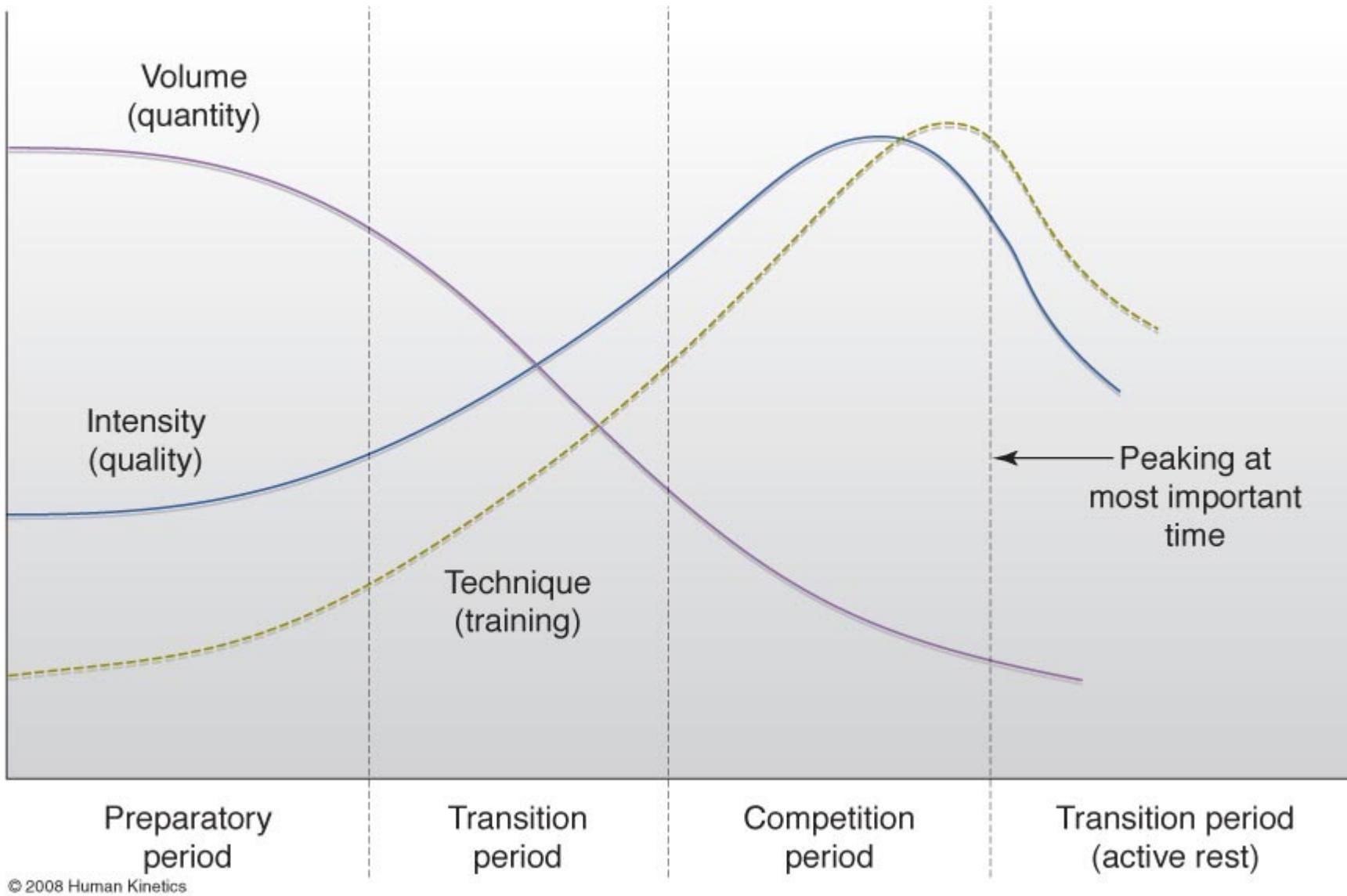
# The Adaptation Process to Resistance Exercise



# Periodization

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Adapted, by permission, from Stone and O'Bryant, 1987.

# Current Exercise Guidelines for Older Adults

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The current ACSM guidelines for older adults provide recommendations for

- Aerobic Training
- Resistance Training
- Balance Training
- Flexibility Training

# Current Exercise Guidelines for Older Adults

	Aerobic Training	Resistance Training	Flexibility Training	Balance Training
<b>Frequency</b>	≥5 days/week of moderate intensity or ≥3 days/week of vigorous intensity	≥2 non-consecutive days/week	≥2 days/week	As many days of the week as possible
<b>Intensity</b>	Moderate or Vigorous	Moderate or Vigorous	n/a	n/a
<b>Time</b>	30 minutes of moderate or 20 minutes of vigorous	8-10 exercises using major muscle groups; 10-15 repetitions	≥10 minutes each day	≥10 minutes each day

*NOTE: Anything is better than nothing, and the greatest benefits of exercise occur in starting to exercise after being completely sedentary*

# Exercise and Affect

*Does exercise always “feel good”?*

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# How fitting is FITT?

## *The need to consider exercise adherence in prescription*

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The manipulation of FITT does not seem to have an effect on exercise adherence (Rhodes et al., 2009)

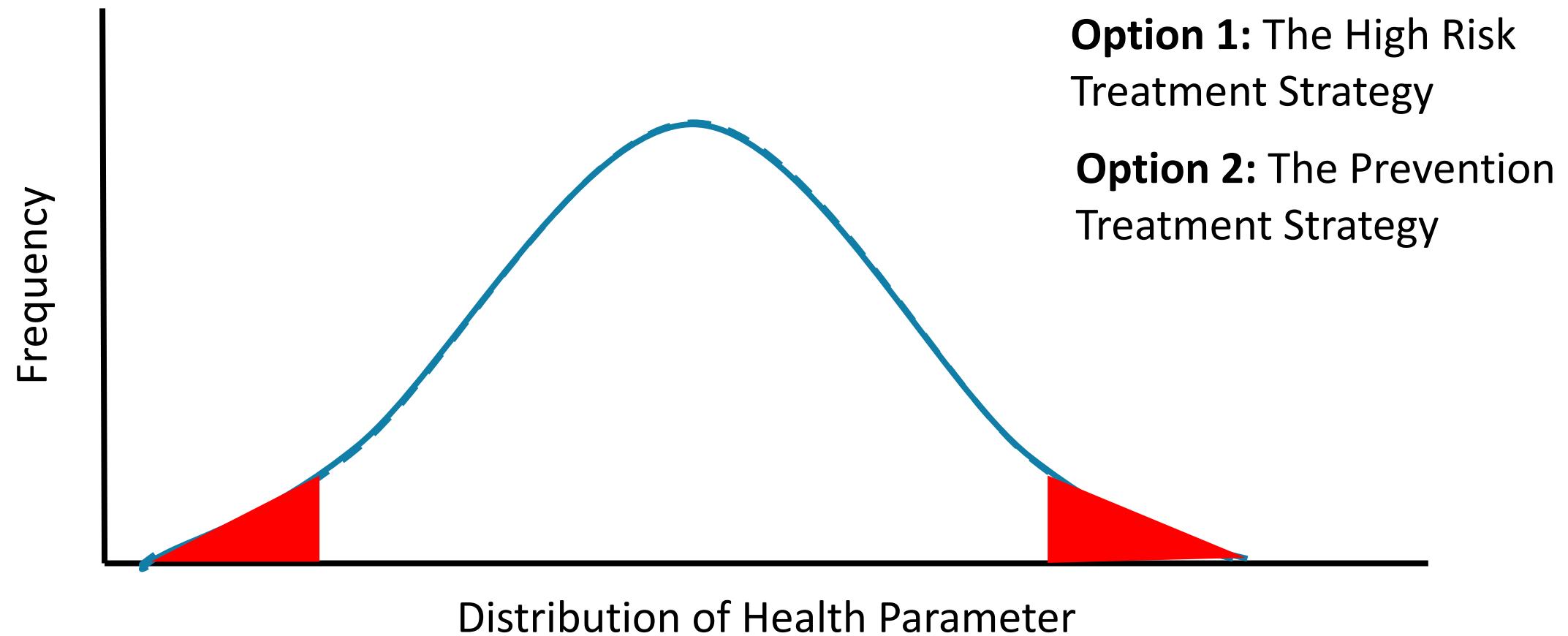
- Social cognitive, personality, environmental, or SES factors are likely of greater importance in determining adherence to an exercise program

Physical inactivity is likely based on HOW exercise is prescribed (Burnet et al., 2019)

- FITT is missing an important component **FUN**
- Exercise prescription cannot be a one-size fits all solution

# How precise do we need to be with exercise prescription?

*The Rose Paradox*



**Option 1: The High Risk Treatment Strategy**

**Option 2: The Prevention Treatment Strategy**

# How precise do we need to be with exercise prescription?

## *The Rose Paradox*

Pros	Cons
Targeted Intervention for Individual	Difficulties and Cost of Screening
Participant Motivation	Palliative and temporary-not radical
Clinician Motivation	Limited potential for 1) individual; and 2) population
Cost-effective use of resources	Behaviourally Inappropriate
Benefit vs. risk ratio is high	

# How precise do we need to be with exercise prescription?

## *The Rose Paradox*

Pros	Cons
Radical	Small benefit to individual (The Prevention Paradox)
Large potential for the population	Poor subjective motivation
Behaviourally Appropriate	Poor clinician motivation
	Benefit vs. risk ratio is lower

# Practice Question

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Based on what we've talked about today, which is more important?

- A. For older adults to be as physically active as they can be
- B. For older adults to do aerobic training 5x/week, resistance training 2x/week, and balance training as many days of the week as possible

# Summary

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Exercise can have positive effects on the body and brain of older adults

The precise prescription of exercise can maximize the benefits

- However, most people will benefit from regular exercise (i.e., physical activity) in any form

All older adults should try to get at least 150 minutes/week of moderate-to-vigorous physical activity and limit their sedentary behaviour as much as possible.

# Questions?

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