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SEARCH

SPORT EDUCATION FOR ACTIVE
AND RESPONSIBLE CITIZENSHIP
THROUGH HEALTH CARING



MODULE 2

**ENCOURAGING
SPORTS PRACTICE
FOR ONE'S OWN
PSYCHO-PHYSICAL
WELLBEING AND
TO CONTROL
NATIONAL SOCIAL
AND HEALTH COSTS**



SEGMENT 9

Conclusions: Man as a Machine

Defining Physical Activity

- Physical Activity (PA): Any bodily movement produced by **skeletal muscle contraction** with an **increase in energy expenditure**.
- Physical activity is **not a measure of exercise or fitness** ability.

Physical Activity can be defined in 3 points:

- Involves Movements
- Produced by Muscular Contraction
- Involves Energy Expenditure



Physical Activity involves Muscular Contraction

Muscle Contraction:

- Static or isometric - no change in joint angle
- Dynamic or isotonic - change in joint angle
- Both static and dynamic are used in PA



Physical Activity Intensity determines Energy system use and Energy expenditure

- **Energy Systems:**

- Aerobic - oxygen dependent
- Anaerobic - oxygen independent
- Each are called upon based on the activity intensity level.



Physical Activity Intensity and Levels:

Physical activity level or its relative intensity can be measured in terms of energy expenditure.



How is Human work Output determined?

Measurement of Work and Power through:

ERGOMETRY: Measurement of work output

ERGOMETER: Devices used to measure work, as for example:

1. Bench step ergometer
2. Cycle ergometer
3. Arm ergometer
4. Treadmill



Estimation of Energy Expenditure

- Energy cost of horizontal treadmill walking or running
 - **O₂ requirement increases as a linear function of speed –
→energy expenditure**
- Expression of energy cost in metabolic equivalents (MET)
 - 1 MET = energy cost at rest (VO₂)
 - 1 MET = 3.5 ml•kg⁻¹•min⁻¹



Benefits of Physical Activity

- Physical Fitness

Defined as a set of attributes that people have or achieve that relates to the ability to perform physical activity.

Components:

- Cardiorespiratory endurance
- Muscle strength, endurance, and power
- Flexibility
- Balance
- Reaction time
- Body composition

- Health Related Fitness

Sub-component of physical fitness

Components:

- Cardiorespiratory fitness
- Muscular strength
- Muscular endurance
- Flexibility
- Body composition

- Skill Related Fitness

Also known as performance-related fitness, contributes to more skilled and efficient functioning

Components:

- Agility
- Balance
- Coordination
- Power
- Reaction Time
- Speed



Physical In-Activity or Sedentary Behavior



Physical In - Activity

Represents the non – achievement of physical activity guidelines

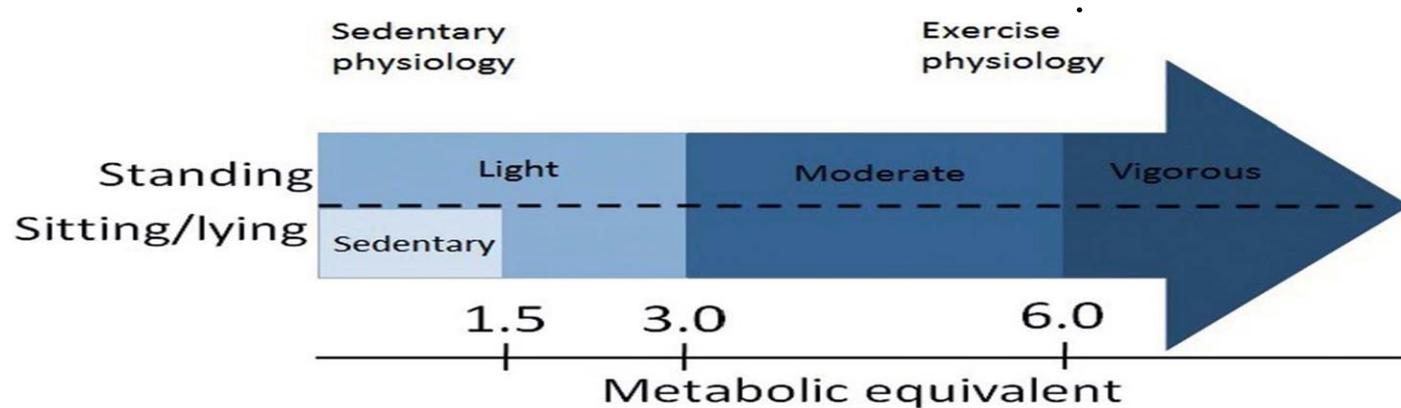


Sedentary Behavior

11- Any waking behaviour is characterized by an energy expenditure ≤ 1.5 METs (1 MET = $3.5 \text{ ml.kg}^{-1}.\text{min}^{-1}$ oxygen consumption), compared to a sitting, reclining, or lying posture.



Sedentary Behavior: Definition and Measurement



Health Effects of Physical Inactivity

Deconditioning:

this kind of syndrome can appears after a long period of physical inactivity and associated loss of muscle strength

Physical Inactivity: Deconditioning

- **Deconditioning**

- Reduction or cessation in exercise and increases in physical inactivity that results in partial or complete reversal of physiological adaptations to activity

Common causes: Reduced physical activity, bed rest, casting, paralysis, and aging

- **Detraining**

- Process by which adaptations to exercise are gradually lost or reduced
 - Specific to exercise, thus it is the form of deconditioning most relatable to inactivity
 - Linked to numerous comorbidities and poor health outcomes

Physical Activity and Health

- Leisure time PA has been monitored through various means: Survey (NHANES, BRFSS), self-report, direct measures (pedometers, accelerometers), etc.
- Current research shows that Americans of all ages are not meeting the daily recommended amount of PA.
- The lack of PA coincides with the current epidemic of childhood obesity.

PA in Children and Adolescents

- Incorporating PA from an early age is beneficial for preventing chronic disease in adulthood.
- 10.4% of 2- to 5-year-olds, 19.6% of 6- to 11-year-olds, and 18.1% of 12- to 19-year-olds are obese.
 - This is two to four times increase since the 1970s.
- PA during childhood decreases metabolic risk factors for type 2 diabetes.
- Gains in bone mineral density developed during childhood PA help prevent osteoporosis in adult years.

PA Benefits in Adults

- Weight control

Reduced risks:

- Type 2 Diabetes
- Hypertension
- CVD
- Colon cancer
- All cause mortality

PA in Older Adults

- Recent evidence has shown that PA levels in Americans tend to decline as age increases.
- PA is just as protective, if not more protective, in decreasing risk of heart disease in older adults.
- PA can help with osteoarthritic conditions and improve mobility, thus decreasing the risk for falls.

Health Benefits of Regular Physical Activity and Exercise

- Evidence to support the inverse relationship between regular PA and/or exercise and premature mortality, CVD/CAD, hypertension, stroke, osteoporosis, T2DM, metabolic syndrome (Metsyn), obesity, 13 cancers, depression, functional health, falls and cognitive function

Box 1.4 Benefits of Regular Physical Activity and/or Exercise

Improvement in Cardiovascular and Respiratory Function

- Increased maximal oxygen uptake resulting from both central and peripheral adaptations
- Decreased minute ventilation at a given absolute submaximal intensity
- Decreased myocardial oxygen cost for a given absolute submaximal intensity
- Decreased heart rate and blood pressure at a given submaximal intensity
- Increased capillary density in skeletal muscle
- Increased exercise threshold for the accumulation of lactate in the blood
- Increased exercise threshold for the onset of disease signs or symptoms (e.g., angina pectoris, ischemic ST-segment depression, claudication)

Reduction in Cardiovascular Disease Risk Factors

- Reduced resting systolic/diastolic pressure
- Increased serum high-density lipoprotein cholesterol and decreased serum triglycerides
- Reduced total body fat, reduced intra-abdominal fat
- Reduced insulin needs, improved glucose tolerance
- Reduced blood platelet adhesiveness and aggregation
- Reduced inflammation

Decreased Morbidity and Mortality

- Primary prevention (i.e., interventions to prevent the initial occurrence)
 - Higher activity and/or fitness levels are associated with lower death rates from CAD
 - Higher activity and/or fitness levels are associated with lower incidence rates for CVD, CAD, stroke, Type 2 diabetes mellitus, metabolic syndrome, osteoporotic fractures, cancer of the colon and breast, and gallbladder disease
- Secondary prevention (i.e., interventions after a cardiac event to prevent another)
 - Based on meta-analyses (i.e., pooled data across studies), cardiovascular and all-cause mortality are reduced in patients with post-myocardial infarction (MI) who participate in cardiac rehabilitation exercise training, especially as a component of multifactorial risk factor reduction (Note: randomized controlled trials of cardiac rehabilitation exercise training involving patients with post-MI do not support a reduction in the rate of nonfatal reinfarction).

Other Benefits

- Decreased anxiety and depression
- Improved cognitive function
- Enhanced physical function and independent living in older individuals
- Enhanced feelings of well-being
- Enhanced performance of work, recreational, and sport activities
- Reduced risk of falls and injuries from falls in older individuals
- Prevention or mitigation of functional limitations in older adults
- Effective therapy for many chronic diseases in older adults

CAD, coronary artery disease; CVD, cardiovascular disease.

Adapted from (45,70,94).

Health Benefits of Improving Muscular Fitness

- The health benefits of enhancing muscular fitness (*i.e.*, the functional parameters of muscle strength, endurance, and power) are well established
- Higher levels of muscular strength are associated with a significantly better cardio-metabolic risk factor profile, lower risk of all-cause mortality, fewer CVD events, lower risk of developing physical function limitations and lower risk for nonfatal disease

PA Guidelines

The current Public Health Guidelines for Physical Activity recommend that adults accumulate:

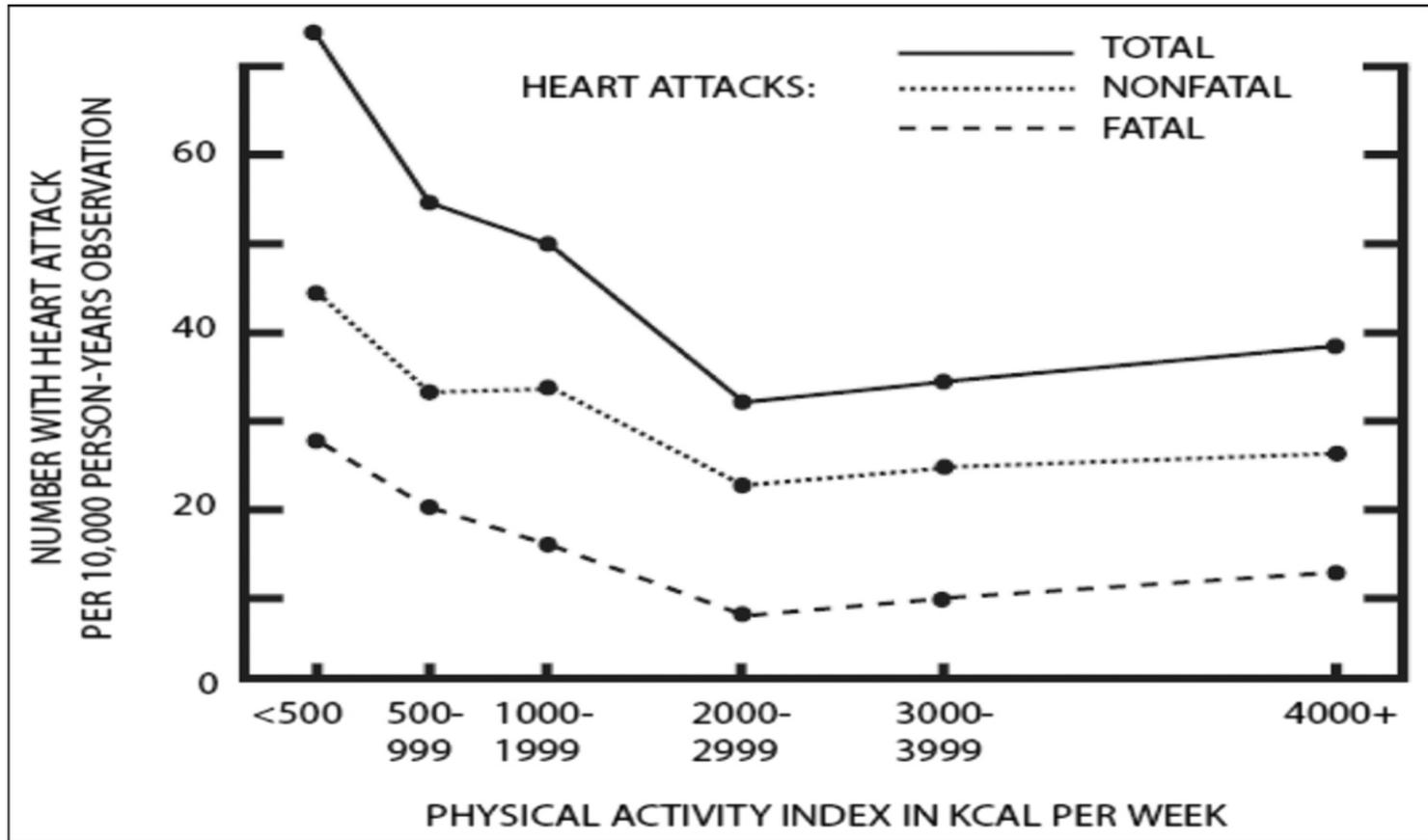
- a minimum of **moderate intensity activity**
- **or a minimum of 75 minutes each week of vigorous intensity activity,**
- as well as **2 days each week of resistance training.**

Cardiorespiratory Health

150 minutes a week

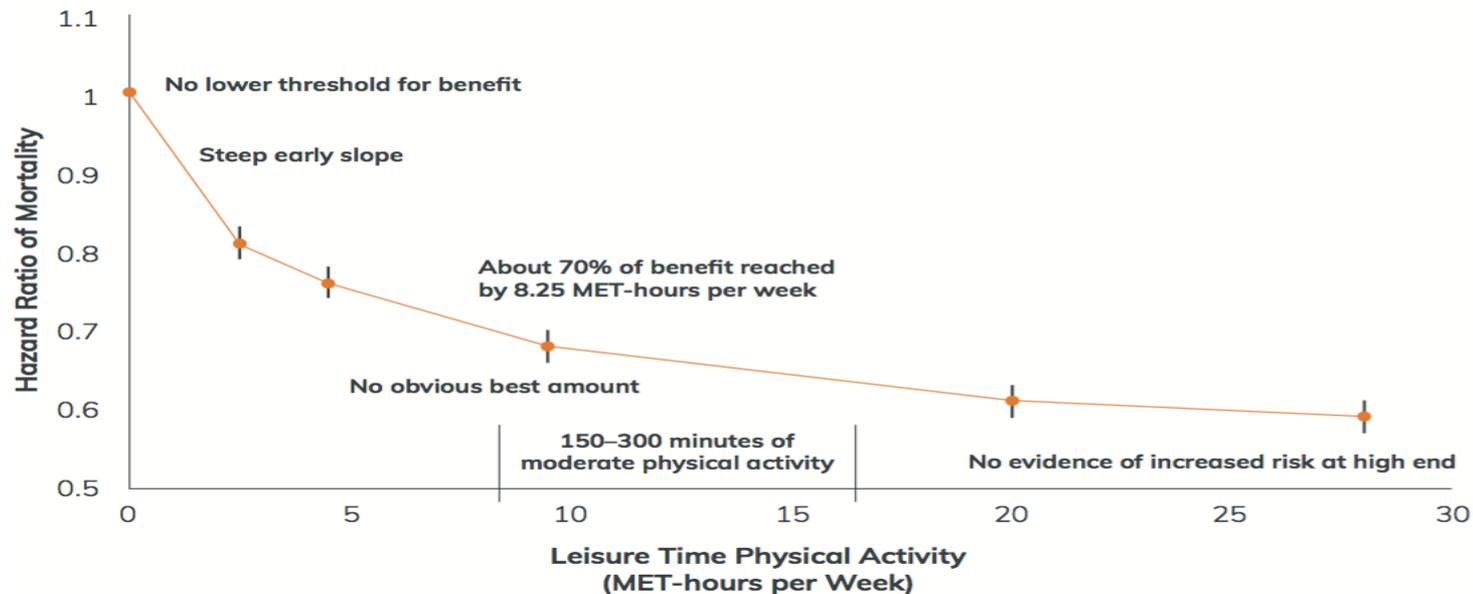
- Physical activity strongly reduces both the risk of dying from cardiovascular disease and the risk of developing cardiovascular disease, including heart attack, stroke, and heart failure.
- Regularly active adults have lower rates of heart disease and stroke and have lower blood pressure, better blood lipid profiles and better physical fitness.
- **Significant reductions in risk of cardiovascular disease occur at activity levels equivalent to 150 minutes a week of moderate-intensity physical activity.**
- As with all-cause mortality, benefits begin with less than 150 minutes a week
- Strong evidence shows that greater amounts of physical activity result in even further reductions in risk of cardiovascular disease.

Morris and Paffenbarger et al 2000



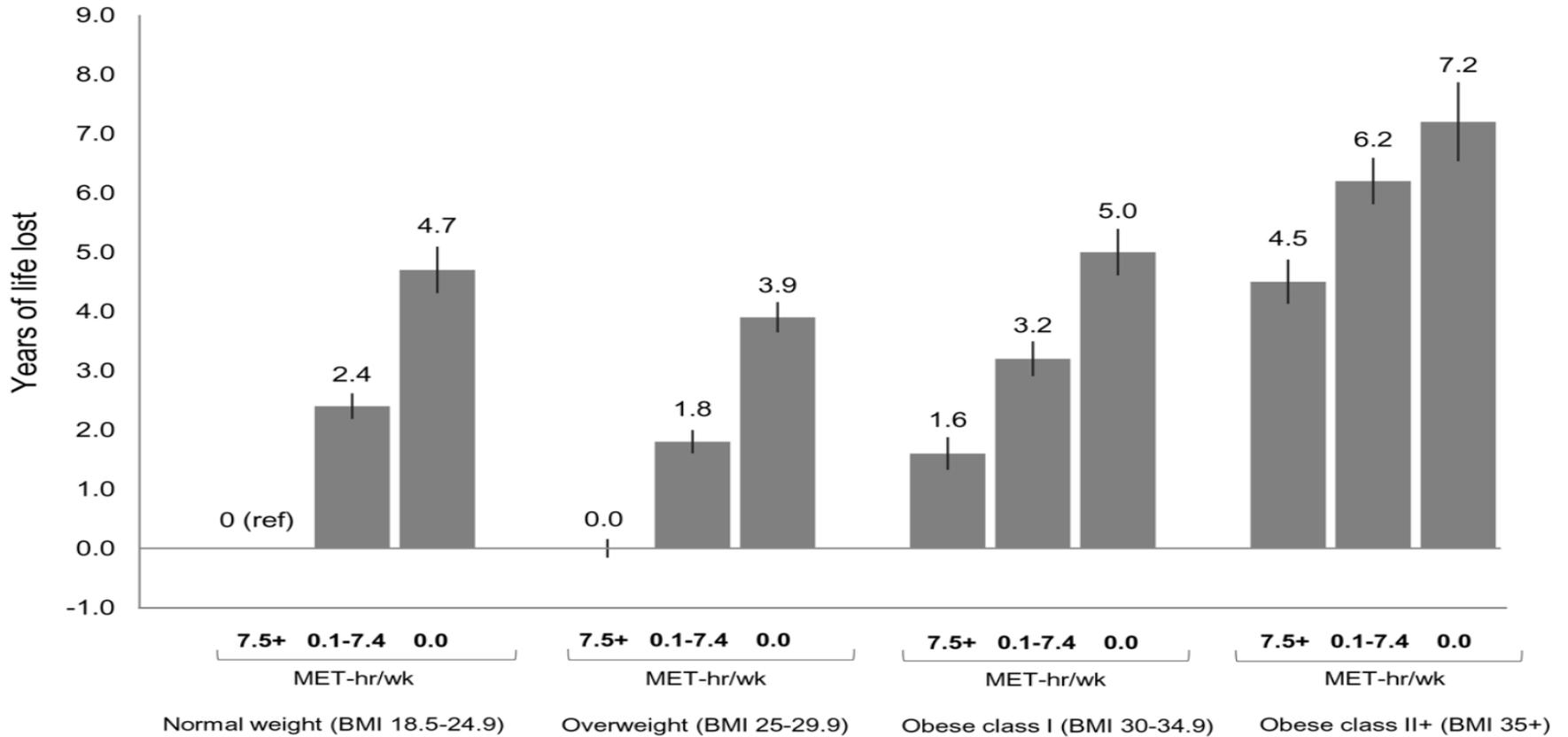
- 150 minutes a week have a 33 percent lower risk of all-cause
- Moderate intensity physical activity is sufficient
- Greater benefit from more PA – No evidence of increased risk

Figure 2-1. Relationship of Moderate-to-Vigorous Physical Activity to All-Cause Mortality



Source: Adapted from data found in Moore SC, Patel AV, Matthews CE. Leisure time physical activity of moderate to vigorous intensity and mortality: a large pooled cohort analysis. PLoS Med. 2012;9(11):e1001335. doi:10.1371/journal.pmed.1001335.

Minimum requirement 150 minutes of moderate exercise is equivalent to 7.5 MET-h/week



Physical activity and caloric intake both must be considered when trying to control body weight

People who want to lose more than 5 percent of body weight need to do **more than 300 minutes of moderate-intensity activity** a week to meet weight-control goals.

Many people need **more than the equivalent of 150 minutes of moderate-intensity activity** a week to maintain their weight.

Regular physical activity also helps control body weight or reduce body fat in children and adolescents ages 3 through 17 years.
(minimum 60 minutes every day)



Bone and Musculoskeletal Health

90 minutes a week

- Progressive muscle-strengthening activities preserve or increase muscle mass, strength and power.
- Greater amounts (through higher frequency, heavier weights, or more resistance) improve muscle function to a greater degree.
- Improvements occur in children and adolescents as well as in younger and older adults.
- Resistance exercises improve muscular strength in persons with conditions such as stroke, multiple sclerosis, cerebral palsy and spinal cord injury.
- Aerobic activity help slow the loss of muscle with aging

Functional Ability and Fall Prevention

Physical function, or *functional ability*, is the capacity of a person to perform tasks or behaviours that enable him or her to carry out everyday activities, such as climbing stairs, or to fulfill basic life roles, such as personal care, grocery shopping, or playing with grandchildren.

Loss of functional ability is referred to as *functional limitation*.

Middle-aged and **older adults who are physically active have lower risk of functional limitations** than do inactive adults.

Physical activity can prevent or delay the onset of substantial functional or role limitations. Older adults who already have functional limitations also benefit from regular physical activity.



Brain Health

Brain health can be defined in many ways, but the Guidelines focuses on the following areas:

- Youth—brain maturation and development and academic achievement;
- Older adults—dementia and cognitive impairment; and
- Across the lifespan—cognition, anxiety and depression, quality of life, and sleep.

Some of the benefits of physical activity on brain health such as reduced feelings of state anxiety (short-term), improved sleep, and improved aspects of cognitive function occur immediately after a session of moderate-to-vigorous physical activity (acute effect).

With regular physical activity, improvements are seen in trait anxiety (long-term anxiety), deep sleep, and components of executive function (including the ability to plan and organize; monitor, inhibit, or facilitate behaviours; initiate tasks; and control emotions)

Table 2-3. The Benefits of Physical Activity for Brain Health

Outcome	Population	Benefit	Acute	Habitual
Cognition	Children ages 6 to 13 years	Improved cognition (performance on academic achievement tests, executive function, processing speed, memory)	●	●
	Adults	Reduced risk of dementia (including Alzheimer's disease)		●
	Adults older than age 50 years	Improved cognition (executive function, attention, memory, crystallized intelligence,* processing speed)		●
Quality of life	Adults	Improved quality of life		●
Depressed mood and depression	Children ages 6 to 17 years and adults	Reduced risk of depression Reduced depressed mood		●
Anxiety	Adults	Reduced short-term feelings of anxiety (state anxiety)	●	
	Adults	Reduced long-term feelings and signs of anxiety (trait anxiety) for people with and without anxiety disorders		●
Sleep	Adults	Improved sleep outcomes (increased sleep efficiency, sleep quality, deep sleep; reduced daytime sleepiness, frequency of use of medication to aid sleep)		●
	Adults	Improved sleep outcomes that increase with duration of acute episode	●	

Note: The Advisory Committee rated the evidence of health benefits of physical activity as strong, moderate, limited, or grade not assignable. Only outcomes with strong or moderate evidence of effect are included in this table.

*Crystallized intelligence is the ability to retrieve and use information that has been acquired over time. It is different from fluid intelligence, which is the ability to store and manipulate new information.

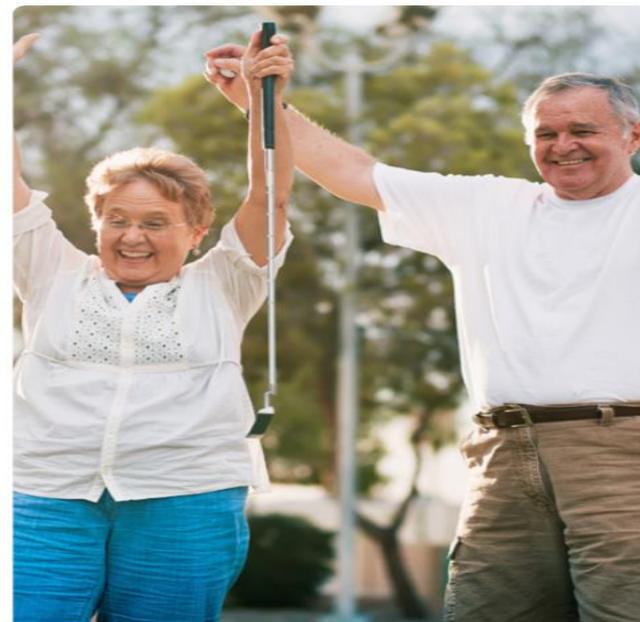
Cognition

Moderate- or vigorous-intensity physical activity improve cognition, including performance on

- Academic achievement tests
- Neuropsychological tests (mental processing speed, memory, and executive function)

Physical activity also lowers the risk of developing **cognitive impairment**, such as **dementia**, including Alzheimer's disease.

These improvements from physical activity are present for people who have normal as well as impaired cognitive health, including conditions such as **attention deficit hyperactivity disorder (ADHD)**, **schizophrenia**, **multiple sclerosis**, **Parkinson's disease**, and **stroke**.



Anxiety, Depression and Sleep

Participating in moderate-to-vigorous physical activity over longer durations (weeks or months of regular physical activity)

- reduces symptoms of anxiety in adults and older adults.
- reduces the risk of developing depression in children and adults

Adults who are more physically active sleep better.

Greater volumes of moderate- to-vigorous physical activity are associated with - **reduced sleep latency** (taking less time to fall asleep),

- **improved sleep efficiency (higher percentage of time in bed actually sleeping),**
- **improved sleep quality,**
- **more deep sleep.**

Greater volumes of moderate-to-vigorous physical activity are also associated with significantly less daytime sleepiness, better sleep quality, and **reduced frequency of use of sleep-aid medications.**

The improvements in sleep with regular physical activity are also reported by people with **insomnia and obstructive sleep apnea.**

CANCER

Physically active adults have a significantly lower risk of developing several commonly occurring cancers, as well as lower risk of several other cancers. Research shows that adults who participate in greater amounts of physical activity have reduced risks of developing cancers of the:

- Bladder;
- Breast;
- Colon (proximal and distal);
- Endometrium;
- Esophagus (adenocarcinoma);
- Kidney;
- Lung;
- Stomach (cardia and non-cardia adenocarcinoma).

Table 2-4. Health Benefits Associated With Regular Physical Activity for People With Chronic Health Conditions and Disabilities

Cancer Survivors
<ul style="list-style-type: none">▪ Improved health-related quality of life▪ Improved fitness
Breast Cancer Survivors
<ul style="list-style-type: none">▪ Lower risk of dying from breast cancer▪ Lower risk of all-cause mortality
Colorectal Cancer Survivors
<ul style="list-style-type: none">▪ Lower risk of dying from colorectal cancer▪ Lower risk of all-cause mortality
Prostate Cancer Survivors
<ul style="list-style-type: none">▪ Lower risk of dying from prostate cancer
People with Osteoarthritis (knee and hip)
<ul style="list-style-type: none">▪ Decreased pain▪ Improved physical function▪ Improved health-related quality of life▪ No effect on disease progression at recommended physical activity levels
People with Hypertension
<ul style="list-style-type: none">▪ Lower risk of cardiovascular disease mortality▪ Reduced cardiovascular disease progression▪ Lower risk of increased blood pressure over time
People with Type 2 Diabetes
<ul style="list-style-type: none">▪ Lower risk of cardiovascular disease mortality▪ Reduced progression of disease indicators: hemoglobin A1C, blood pressure, body mass index, and lipids
People with Dementia
<ul style="list-style-type: none">▪ Improved cognition

Table 2-4. Health Benefits Associated With Regular Physical Activity for People With Chronic Health Conditions and Disabilities

People with Multiple Sclerosis
<ul style="list-style-type: none">▪ Improved physical function, including walking speed and endurance▪ Improved cognition
People with Spinal Cord Injury
<ul style="list-style-type: none">▪ Improved walking function, muscular strength, and upper extremity function
People with diseases or disorders that impair cognitive function (including ADHD, schizophrenia, Parkinson's disease, and stroke)
<ul style="list-style-type: none">▪ Improved cognition

How much is enough?

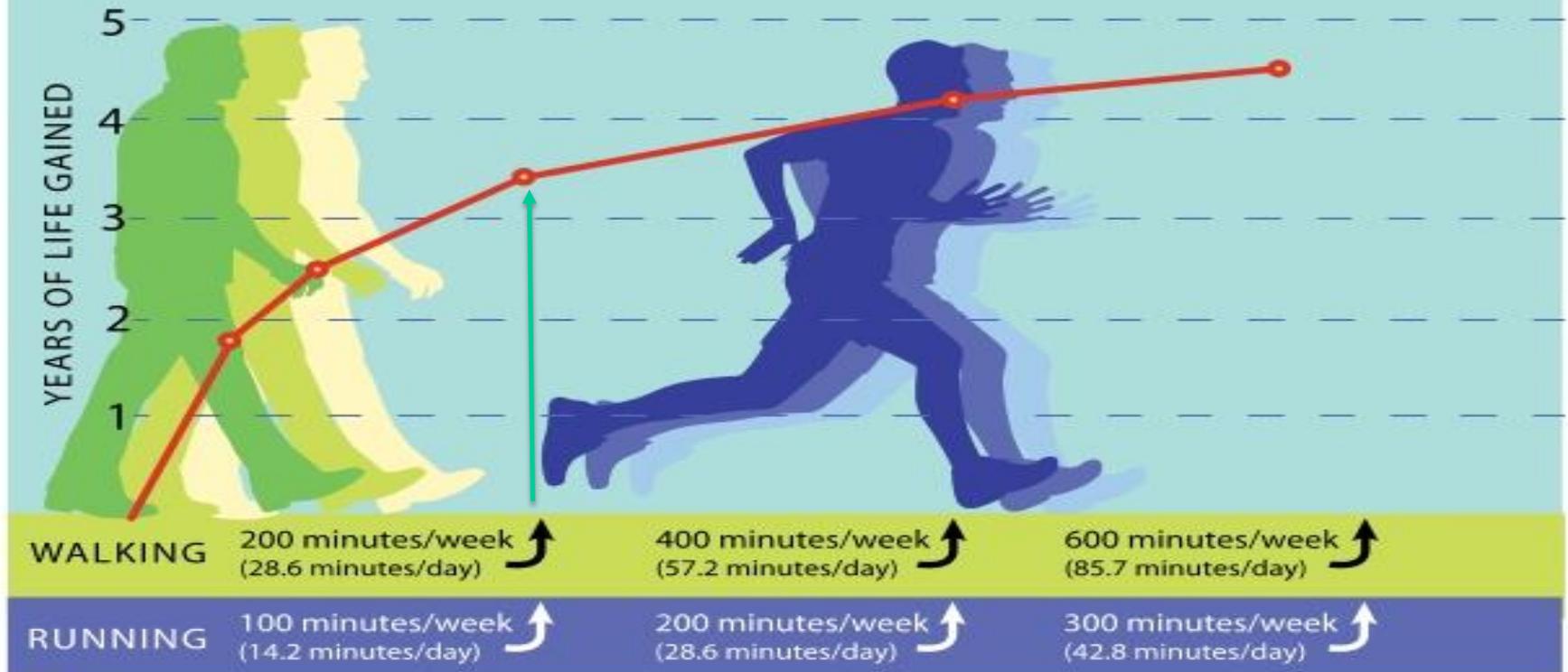
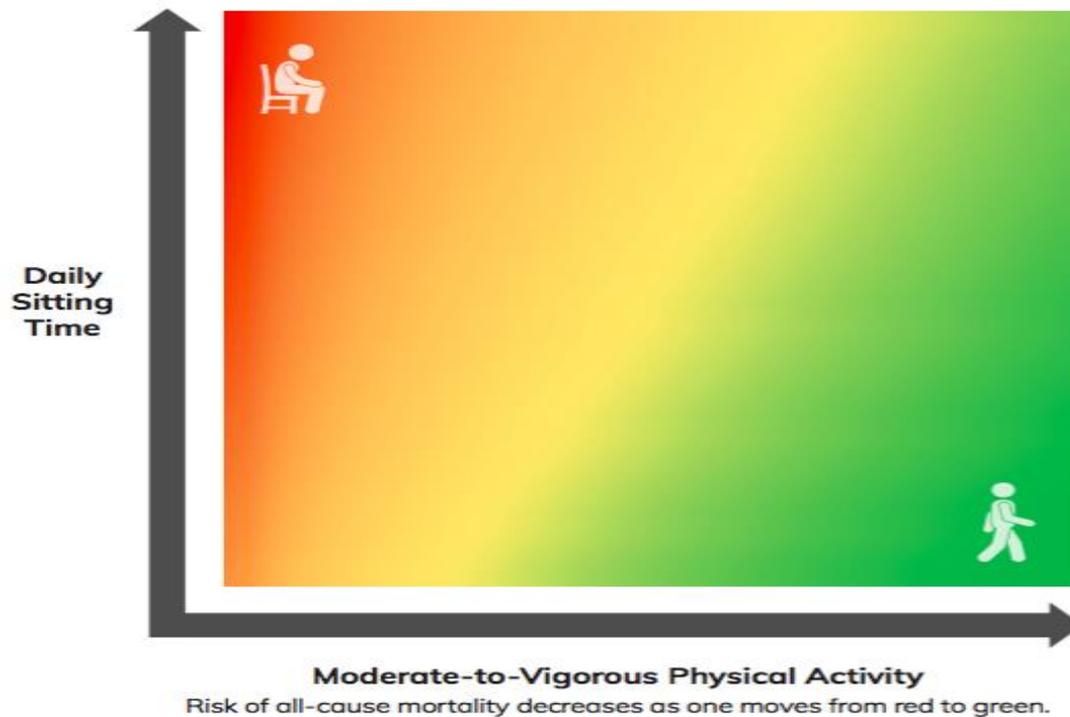


Figure 1-3. Relationship Among Moderate-to-Vigorous Physical Activity, Sitting Time, and Risk of All-Cause Mortality in Adults



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.

KEYWORDS

Power

Basal activity

Movement

Lifestyles

Social diseases

Cell

Digestive system

Respiratory system

Cardiovascular system

Diet

Red blood cells

Phosphates

Metabolism

Calorie

Biochemical chains

Anaerobic activities

Aerobic activities

Adipose tissue

Low calorie diet