

Physical Activity Epidemiology

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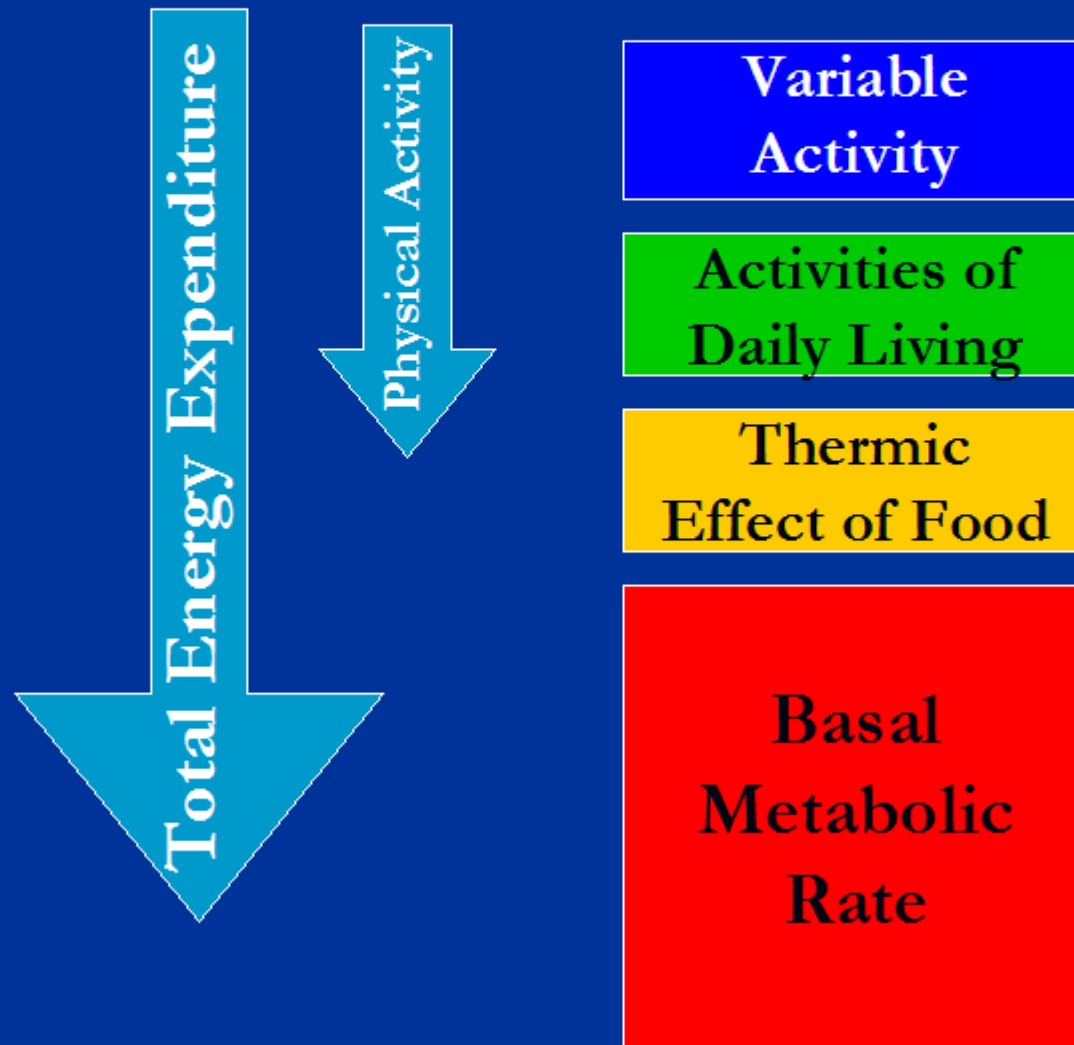
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Physical Activity
Epidemiology Definitions
and Concepts

Physical Activity and Exercise



Total Energy Expenditure



Energy Balance

Energy
Intake



Energy
Expenditure



Exercise vs. Lifestyle Physical Activity



Exercise



Lifestyle Physical Activity

Epidemiology

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

Definitions

- **Rate**
 - **Measures of Morbidity**
 - Incidence Rate
 - Prevalence Rate
 - **Measures of Mortality**
 - Mortality Rate
- **Biologic Plausibility**
- **Confounder**
- **p value**
- **Statistically Significant**

Physical Activity Epidemiology Study Design

Two Main Approaches:

■ Observational Study Design

- The development of disease or health outcome is observed and compared between those that participate in different levels of physical activity
 - Levels of physical activity participation are self-selected by the individual and not under control of the investigator.

■ Experimental Study Design

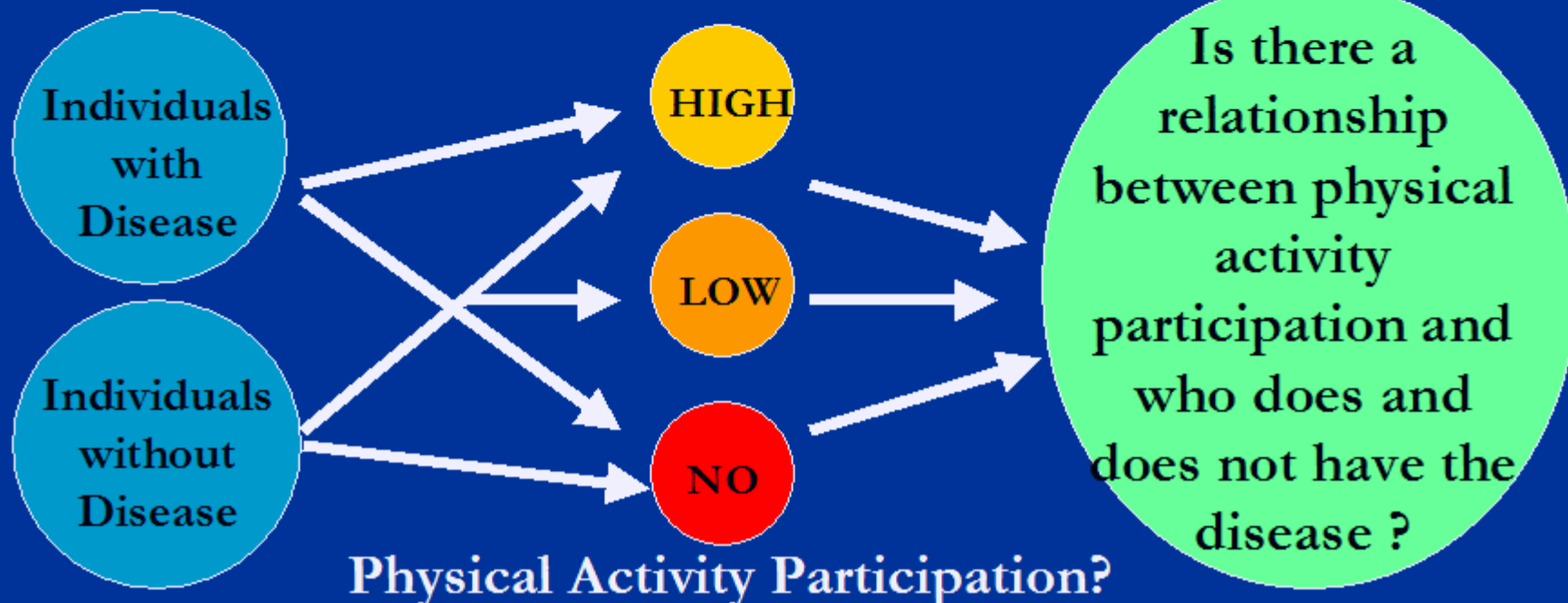
- Random assignment of physical activity levels to individuals without the disease or health outcome of interest
- These individuals are then followed for a period of time to compare their development of the disease or health outcome of interest

Study Designs

- **Observation Study Design(s):**
 - Cross-Sectional
 - Case-Control
 - Prospective
- **Experimental Study Design:**
 - Clinical Trial

Cross-Sectional Study

- The study population consists of individuals who do and do not have the disease or health outcome of interest.
- Compare the occurrence of disease or health outcome with the level of physical activity participation.
 - Provides a snapshot of the relationship between the disease or condition of interest and physical activity at **one point in time**.

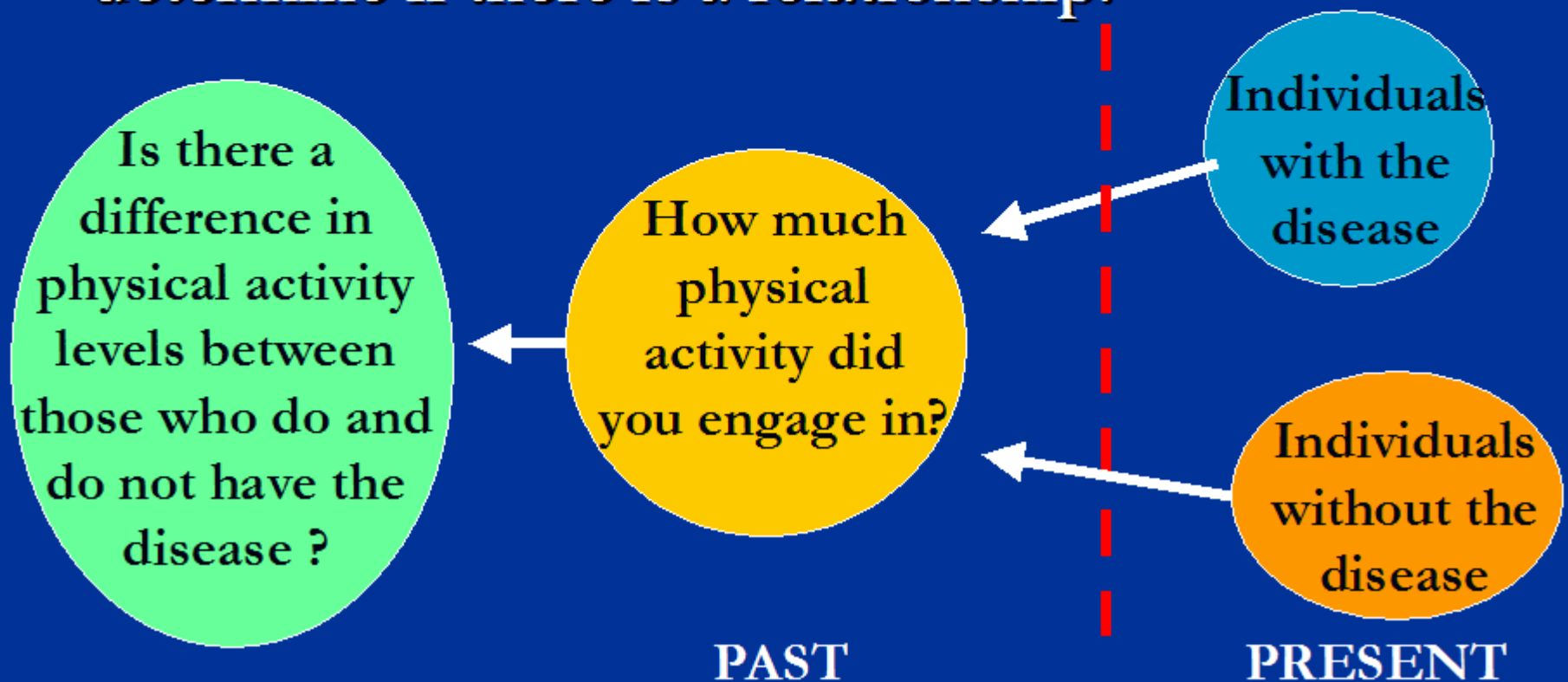


Example of a Cross-Sectional Study

- What is the relationship between type 2 diabetes and physical activity participation?
 - Both diabetes status and physical activity levels were determined at the same time using the same individuals
 - Measurements: fasting and 2 hour post-load plasma glucose concentrations, age, body mass index (BMI), waist to thigh circumference, and past year leisure and occupational physical activity
- Results: Individuals with type 2 diabetes reported being less active than those without diabetes.

Case-Control Study (Retrospective)

- The study population consists of individuals who do and do not have the disease or health outcome
- Compare past physical activity participation between those with and without the disease to determine if there is a relationship.

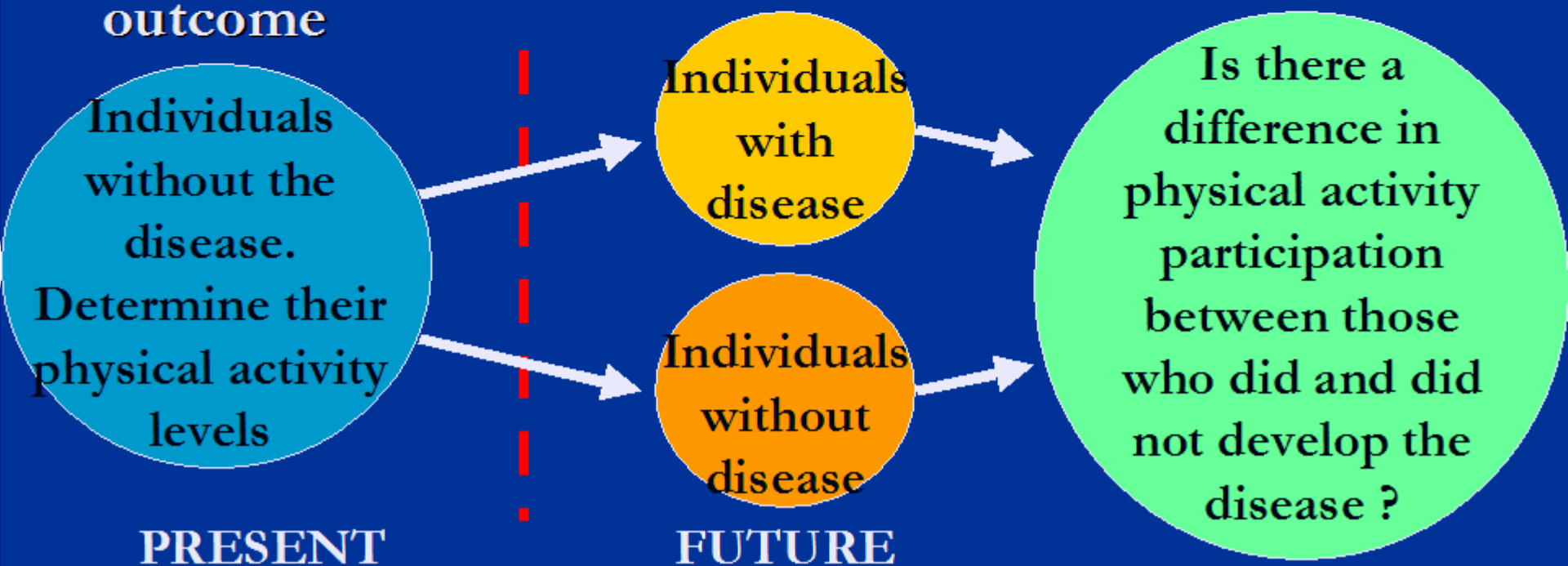


Example of a Case-Control Study

- What is the relationship between lifetime physical activity and type 2 diabetes?
 - Individuals, aged 37-59, with and without type 2 diabetes were asked questions about their physical activity levels over their lifetime
 - Measurements: fasting and 2 hour post-load plasma glucose concentrations, age, body mass index (BMI), waist to thigh circumference, and physical activity at three points during their lifetime as: [1. teenagers (12-18 yrs); 2. young adults (19-34 yrs); 3. older adults (35-49)]
- Results: After controlling for BMI, gender, age, and waist to thigh circumference, individuals with type 2 diabetes reported being less physically active over their lifetime compared to individuals without diabetes

Prospective Study (Longitudinal)

- The study population includes individuals who are free from the disease or health outcome. Levels of physical activity participation are assessed for a pre-determined period of time.
- Compare physical activity participation between those who did and did not develop the disease or health outcome

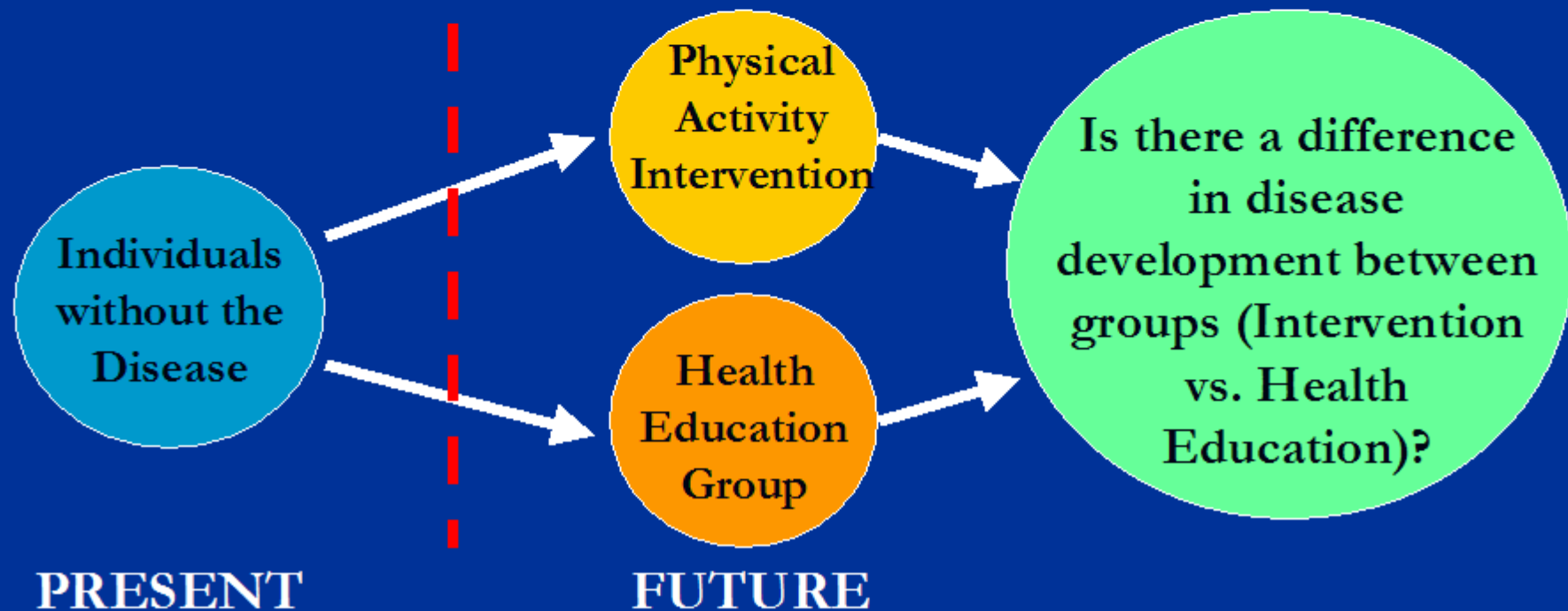


Example of a Prospective Study

- Is there a longitudinal relationship between physical activity and the development of type 2 diabetes in a high risk population.
 - Subjects consisted of 1,728 Native American men and women that did not have diabetes at baseline.
 - Every two years, physical activity levels, diabetes status, body mass index, and various health measures were assessed.
 - Individuals were followed for an average of 6 years.
- Results: In the total cohort, 346 subjects developed type 2 diabetes. The diabetes incidence rate was lower in the more active than in the less active individuals and remained after stratification by BMI [significant ($p < 0.05$) in women].
- This suggests that the adoption and maintenance of a physically active lifestyle can play an important role in the prevention of type 2 diabetes.

Clinical Trial

- Individuals free from the disease are randomly assigned to either a physical activity intervention or health education group. Groups are followed for pre-determined period of time.
- Compare the development of disease between individuals assigned to each group.



Example of a Clinical Trial

- Can a lifestyle intervention (including diet, physical activity, and weight loss) and/or drug therapy (metformin) prevent or delay the onset of type 2 diabetes in individuals with impaired glucose tolerance (IGT)?
 - 3,234 men and women with IGT were randomized to one of three groups: placebo, metformin, or lifestyle modification.
 - Lifestyle Modification Group Goals included a 7% weight loss and at least 150 minutes of physical activity per week.
- Results: Both lifestyle modification and drug therapy reduced the development of type 2 diabetes in high risk individuals when compared with the placebo group. However, the lifestyle intervention was more effective than metformin in reducing risk.

Physical Activity Assessment

Assessment Considerations

- The proper assessment or measurement of physical activity is a challenge, especially in free-living individuals.
- Accurate assessments are needed to better:
 - Understand the specific amounts of physical activity that are needed for health benefits.
 - Determine if a particular behavioral intervention was successful in changing activity behavior.
- Considerations when determining the **accuracy** of an assessment tool:
 - Validity
 - Reliability
 - Sensitivity

Subjective Measures

- **Physical Activity Questionnaires and Surveys**
 - **Can vary by:**
 - **Complexity**
 - Self administered to interviewer administered
 - Single question to multiple components
 - **Time Frame of Recall**
 - Past day, past week, past month, past year, historical/lifetime
 - **Types of Activities Assessed**
 - Leisure, occupational, household/self care activities, transportation

Subjective Measures

PRO's

- Nonreactiveness
- Practicality
- Applicability
- Accuracy

CON's

- Does not reflect total energy expenditure
- Reliability and validity problems
- Misinterpretation of physical activity across different populations

Objective Measures

■ Direct Observation

- Classifies physical activities into distinct categories that can be quantified and analyzed in greater detail.
 - Typically used in children

■ Indirect Calorimetry

- Uses respiratory gas analysis to measure energy expenditure.

■ Doubly-labeled water

- Uses biochemical markers to estimate energy expenditure

Objective Measures

■ Heart Rate Monitor

- Heart rate is a direct indicator of one's physiological response to physical activity
- Heart rate is used as an indirect estimate of energy expenditure
 - Due to linear relationship between exercise workload/intensity, heart rate, and energy expenditure
 - As workload/intensity increases, heart rate and energy expenditure increases

■ Activity Monitors

- Assess the acceleration of the body in one or more planes of movement

Objective Monitors

- Pedometer

- Record steps taken and offer the ability to estimate the distance walked, if stride length is known

Physical Fitness

- A set of attributes that individuals have or can achieve that relates to the ability to perform physical activity.
- Physical Fitness can be broken down into five (5) major components:
 - Cardiovascular fitness
 - Muscular fitness
 - Muscular Strength
 - Muscular Endurance
 - Body Composition
 - Flexibility

Cardiovascular Fitness

Can be measured **directly** using maximal exercise testing (VO_2max) or **indirectly** using submaximal exercise and field test protocols

Maximal Oxygen Uptake (VO_2 max)

- Often used as an objective measure of physical fitness
- VO_2 max and Epidemiology Studies
 - Time consuming
 - Moderate Relationship between physical activity and physical fitness.
 - Other factors that may influence physical activity
 - Genetics
 - Gender
 - Age
 - Relative weight

Submaximal VO_2 and Field Tests

■ Submaximal VO_2 Tests

- Practical option for large Epidemiological Studies
- Use heart rate (HR) to predict O_2 consumption
 - Linear relationship between HR and exercise workload/intensity
 - As workload/intensity increases, HR increases

■ Field Tests

- Prediction Equations to estimate VO_2 max using:
 - Distance covered in a predetermined time
 - Amount of time it took to cover a predetermined distance

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Review Questions (Developed by the Supercourse team)

- Is physical activity the same as physical fitness?
- How much exercise is needed to reap the benefits of PA?
- For what chronic diseases does PA appear to reduce risk?