Objective Measures of Physical Activity: 
Considerations for Data Management, Processing, and Public Release

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Definition of Physical Activity and Associated Constructs

- Physical Activity (PA): Any bodily movement produced by the contraction of skeletal muscles that increases energy expenditure above a basal level.

- PA experts measure activity in Metabolic Equivalents (METs)

- Categorized by Intensity:
  - Light (1.6 to 3 METs)
  - Moderate (3 to <6 METs)
  - Vigorous (6+ METs)

REFERENCE:
Assessment of Physical Activity

Questionnaires

- Most widely used
- Inexpensive
- Validity issues and potential for misclassification
Assessment of Physical Activity

**Accelerometers**

- Quantify acceleration resulting from movement (*plus* gravity and noise).
- Processing techniques used to separate gravity and noise from PA-associated motion.
- Data outputs provide an estimate of acceleration due to PA-associated motion
  - Raw data
  - Activity counts
Accelerometer Counts are **NOT** Linearly Associated with METs

Light PA: 1.6 to 3 METs  
Moderate PA: 3 to <6 METs  
Vigorous PA: 6+ METs

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![Graph showing the relationship between counts per minute and measured METs for various activities.](image)

Assessment of Physical Activity in NHANES

1971-1975
NHANES I

1976-1980
NHANES II

1982-1984
NHANES II

1988-1994
NHANES III

1999-Present
Continuous NHANES

✪ = Accelerometers
Assessment of Physical Activity using Accelerometers

*Special Considerations*

- Procedural Considerations
- Data Management Considerations
- Data Release Considerations
Procedural Considerations

- **Cost**

- **Wear location and protocol decisions**
  - NHANES 2003-2004 and 2005-2006:
    - Hip
    - Not waterproof – remove when bathing or swimming
    - Take off at night
  - NHANES 2011-2012 and 2013-2014
    - Wrist/Non-dominant arm
    - Water proof

- **Settings**
  - Sampling rate
  - Raw data vs counts
Data Management Considerations

- **Data processing**
  - Proprietary algorithms to produce counts
  - Disagreement on the interpretation or raw data

- **Computational resources**
  - 20,736,000 data points/day/person
  - ~150 million data points/person
  - ~7 TB of data in NHANES
Data Release Challenges

- Hosting extensive data
- Data release product
- Protecting confidentiality
Best Practices: The NHANES Experience

- 24 hour wear protocol and wrist location improve compliance dramatically

- Raw Output Data
  - Proprietary data processing tools not validated

- Commercially available accelerometers are not recommended for research at this point
Lessons Learned:
The NHANES Experience

- A combination of a temperature and a heart rate sensor improves non-wear detection
- In-house content expertise facilitates timely and efficient data management
- Implications involved in being on the cutting-edge
Thank you!