

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)

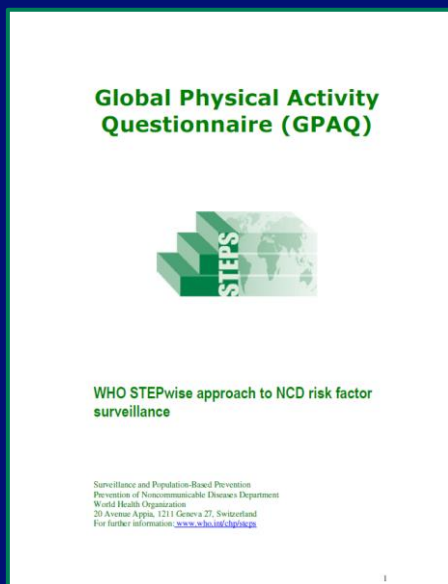
REFERENCE:

US Department of Health and Human Services (USDHHS). Physical Activity Guidelines Advisory Committee Report, 2008.

Assessment of Physical Activity Questionnaires

Questionnaires

- Most widely used
- Inexpensive
- Validity issues and potential for misclassification



Physical Activity			
<p>Next I am going to ask you about the time you spend doing different types of physical activity in a typical week. Please answer these questions even if you do not consider yourself to be a physically active person.</p> <p>Think first about the time you spend doing work. Think of work as the things that you have to do such as paid or unpaid work, study/training, household chores, harvesting food/crops, fishing or hunting for food, seeking employment. <i>[Insert other examples if needed]</i>. In answering the following questions 'vigorous-intensity activities' are activities that require hard physical effort and cause large increases in breathing or heart rate, 'moderate-intensity activities' are activities that require moderate physical effort and cause small increases in breathing or heart rate.</p>			
Questions	Response		Code
Activity at work			
1	Does your work involve vigorous-intensity activity that causes large increases in breathing or heart rate like <i>[carrying or lifting heavy loads, digging or construction work]</i> for at least 10 minutes continuously? <i>[INSERT EXAMPLES] (USE SHOWCARD)</i>	Yes 1 No 2 <i>If No, go to P 4</i>	P1
2	In a typical week, on how many days do you do vigorous-intensity activities as part of your work?	Number of days <input type="text"/>	P2
3	How much time do you spend doing vigorous-intensity activities at work on a typical day?	Hours : minutes <input type="text"/> : <input type="text"/> hrs mins	P3 (a-b)
4	Does your work involve moderate-intensity activity that causes small increases in breathing or heart rate such as brisk walking <i>[for carrying light loads]</i> for at least 10 minutes continuously? <i>[INSERT EXAMPLES] (USE SHOWCARD)</i>	Yes 1 No 2 <i>If No, go to P 7</i>	P4
5	In a typical week, on how many days do you do moderate-intensity activities as part of your work?	Number of days <input type="text"/>	P5
6	How much time do you spend doing moderate-intensity activities at work on a typical day?	Hours : minutes <input type="text"/> : <input type="text"/> hrs mins	P6 (a-b)

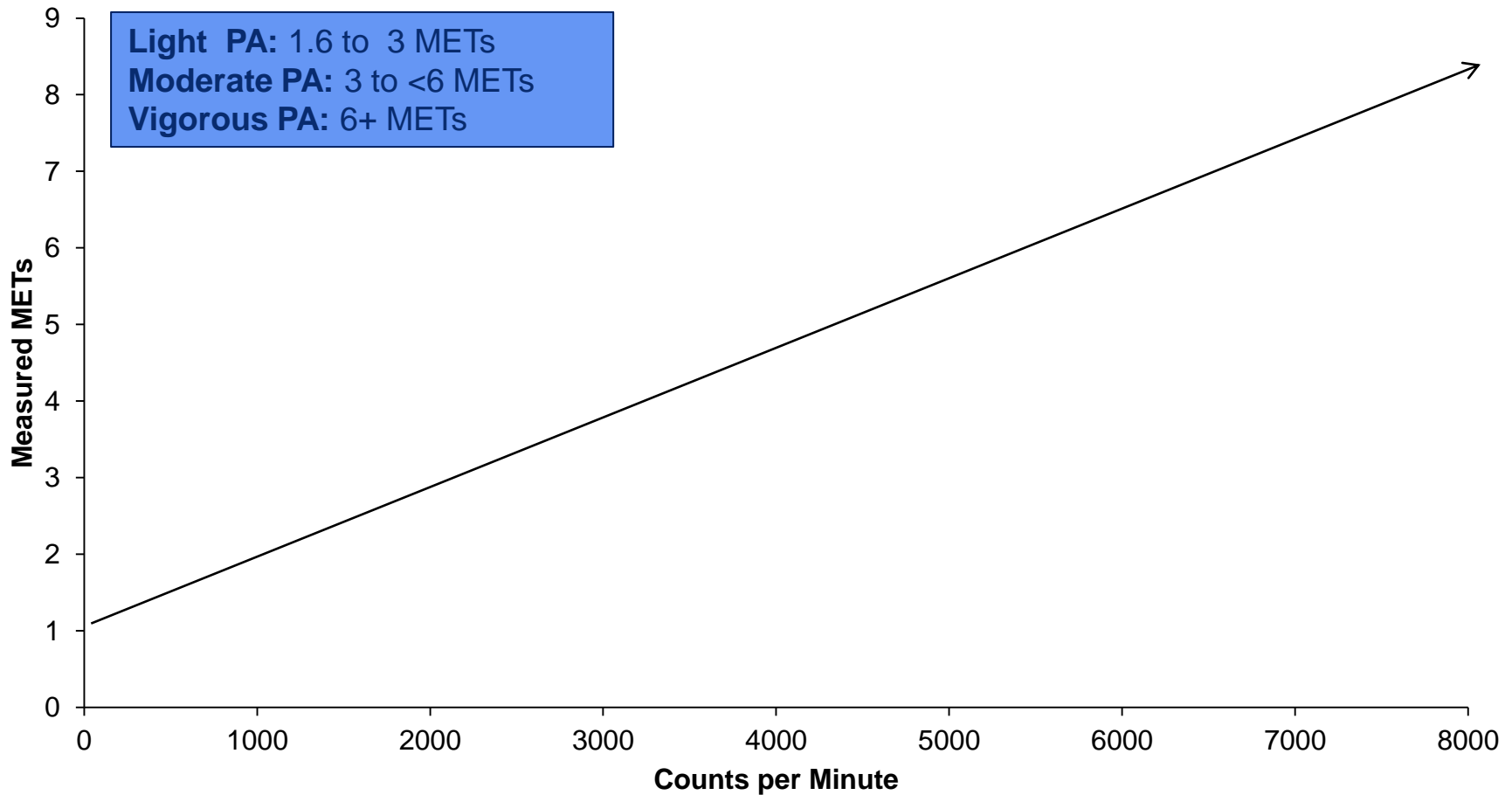
Assessment of Physical Activity

Accelerometers

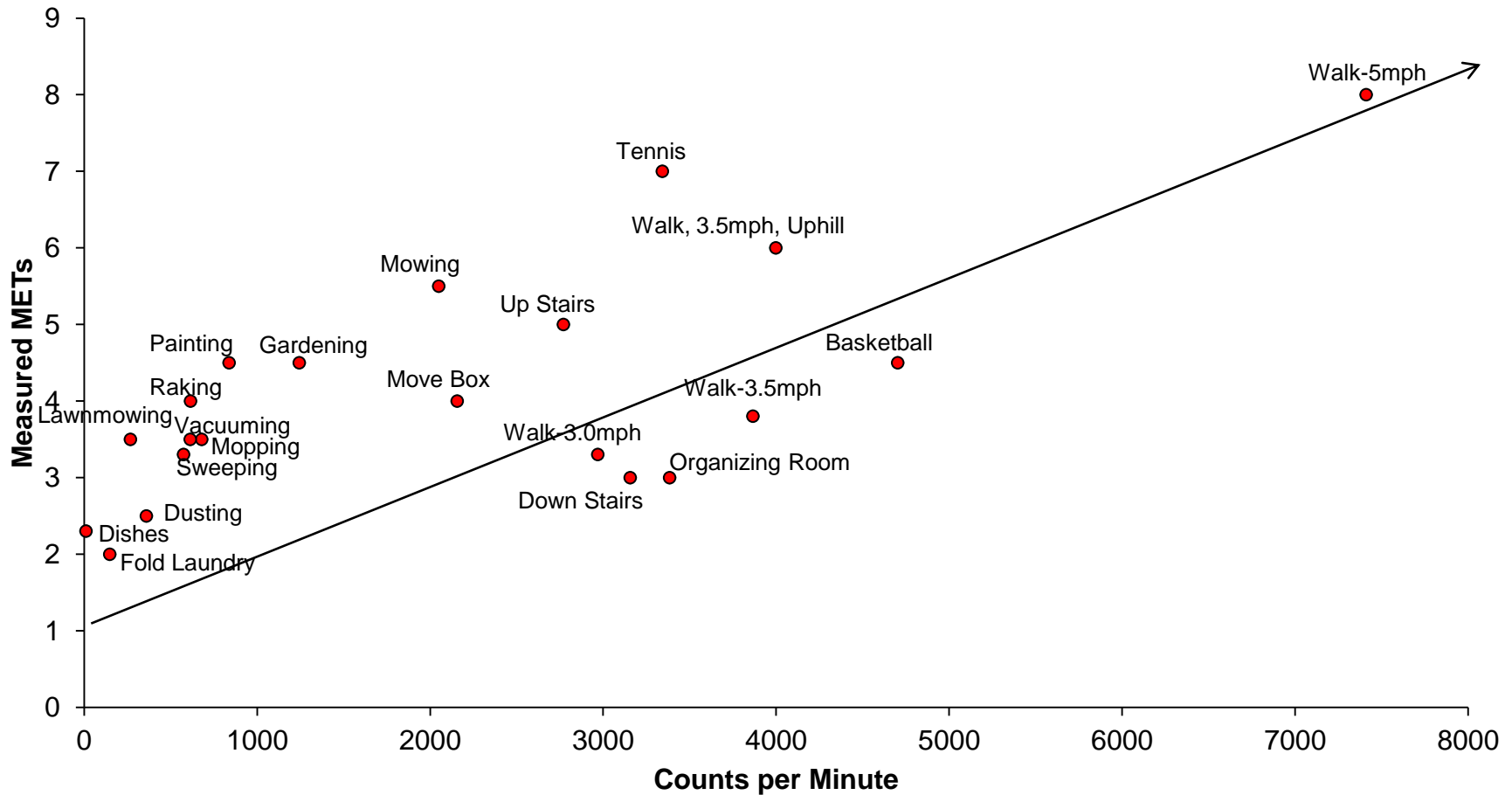
- **Quantify acceleration resulting from movement** (*plus gravity and noise*).
- **Processing techniques used to separate gravity and noise from PA-associated motion.**
- **Data outputs provide an estimate of acceleration due to PA-associated motion**
 - Raw data
 - Activity counts



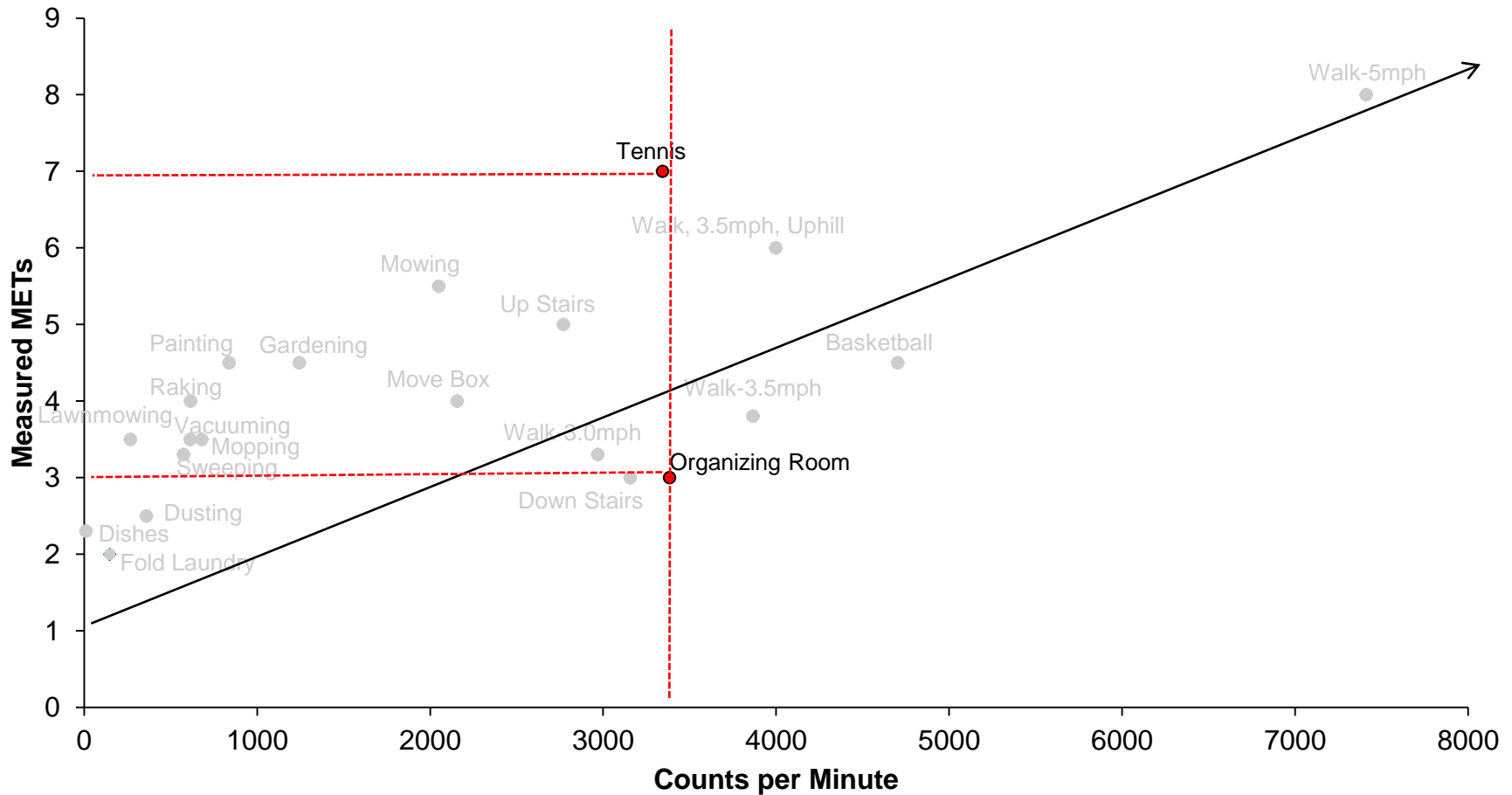
Accelerometer Counts are NOT Linearly Associated with METs



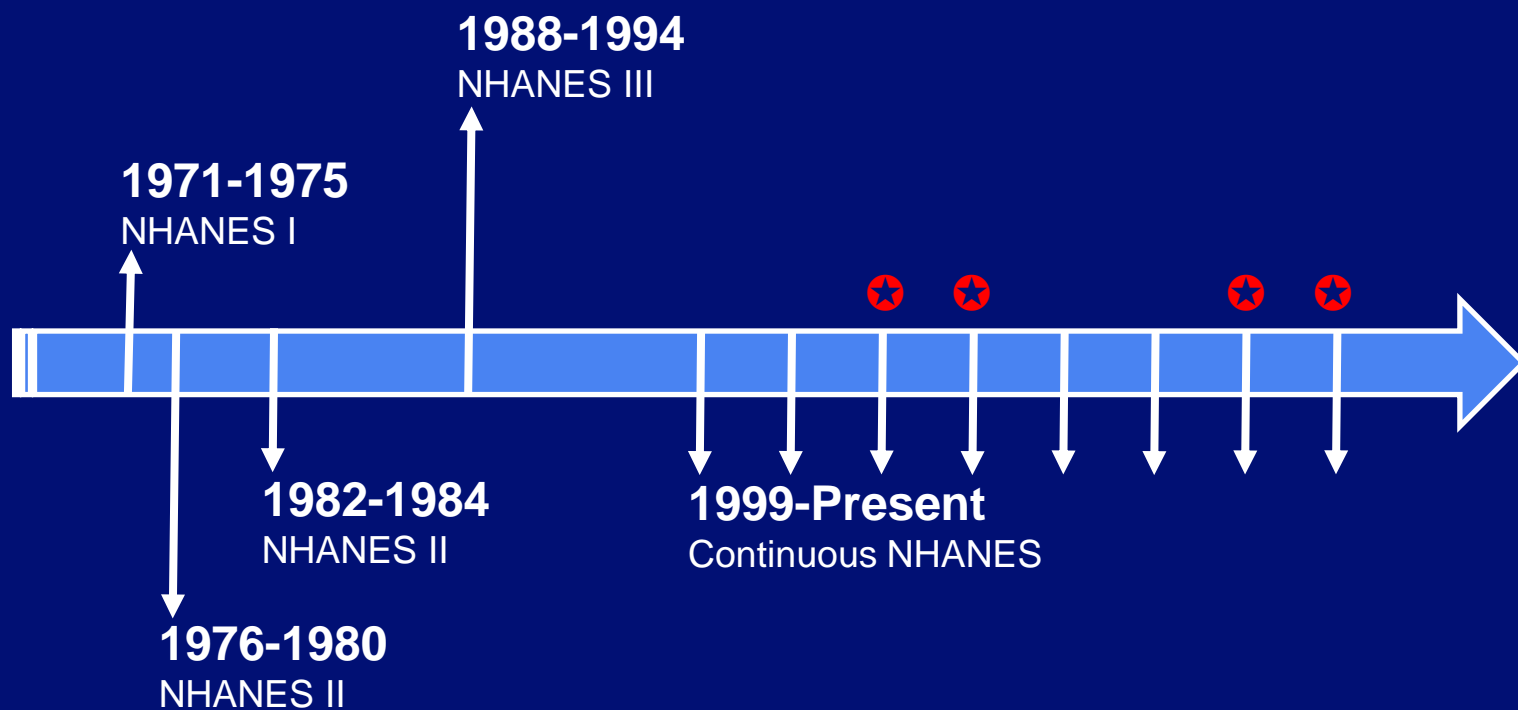
Accelerometer Counts are NOT Linearly Associated with METs



Accelerometer Counts are NOT Linearly Associated with METs



Assessment of Physical Activity in 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 of 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!