Improving Physical Activity Measurement. For Childhood Obesity In Indian Country Conference. 12/3/08

James F. Sallis, Ph.D.
San Diego State University

www.activelivingresearch.org
Oxford Health Alliance's key message:

3 risk factors –
   – tobacco use, poor diet, lack of physical activity

Contribute to Four chronic diseases –
   – heart disease, type 2 diabetes, lung disease and some cancers

Which, in turn, contribute to more than 50 per cent of deaths in the world
Youth Physical Activity

• Children are more active than adults
• PA patterns are more sporadic
• Declines with age
• Most accepted guidelines
  – 60 minutes of moderate-to-vigorous PA daily
  – 2 hours or less of TV viewing daily
Promoting exercise has not worked

Trend in Recommended Physical Activity for U.S. Overall

Source: Centers for Disease Control and Prevention Behavioral Risk Factor Surveillance System
Dimensions of PA

Frequency: times per week

Intensity: rate of energy expenditure
  – METs: multiples of resting energy expenditure

Time: duration of activity

Type: description or category of specific activity

Volume: total amount of PA (F X I X T)
  – often measured in kcal or kcal/kg

Domains
  – Leisure, transport, occupation, household
Types of PA Assessments

• Self-report
• Objective monitors
• Direct observation
• Physiological marker—not discussed
Benefits of PA Self-Report

• Easily obtained from large samples
• Low cost
• High content validity (assess many dimensions)
• Can be specific to sample
• Lack of assessment reactivity
Limitations of PA Self-Reports

• Inaccurate reporting likely
  – High cognitive demand; memory limits
  – Ambiguity of terms (e.g., “moderate”, “vigorous”)
  – Social desirability

• Lack of cross-sample comparability
  – Proliferation of measures prevents cross-study comparison
Results of Review (Youth)
Sallis & Saelens, 2000

17 instruments for age 9 and above
- 7 some interview, 8 self-administer, 2 proxy
- only one assessed all dimensions
- most separated moderate and vigorous

Test-retest reliabilities .60 - .98

Concurrent Validity
- most measures tested only once
- about 1/2 had correlations > .50 with accelerometers or heart rate
- higher for interview than proxy or self-admin
PACE PA Screener
• 2 simple items, validated in 11-17 year olds
• Based on current youth guidelines
• Test-retest ICC=.77
• Validity vs accelerometer=0.39 (p<.0001)
• Used in US national study & in 35-country study
• Related to BMI in almost all countries; more than diet or TV viewing

Add up all the time you spend in physical activity each day (don't include your physical education or gym class).

Over the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day?

Over a typical or usual week, on how many days are you physically active for a total of at least 60 minutes per day?
Age of youth & PA recall

Interviewer-administered 7-day recall

Reliability: $r$ of separate recalls of same days

Validity: $r$ of reported hard + very hard PA compared to time in HR>160 bpm

<table>
<thead>
<tr>
<th>Grade</th>
<th>Rel</th>
<th>Val</th>
</tr>
</thead>
<tbody>
<tr>
<td>5th grade</td>
<td>.47</td>
<td>.29</td>
</tr>
<tr>
<td>8th grade</td>
<td>.59</td>
<td>.45</td>
</tr>
<tr>
<td>11th grade</td>
<td>.81</td>
<td>.72</td>
</tr>
</tbody>
</table>
IPAQ

Aim to develop a measure of physical activity for international usage

A collaborative process to ensure relevance and use
Intensity of Activity

- vigorous
- moderate
- walking
- sedentary

Domains of Activity

- occupational
- transportation
- household
- recreation and sports
IPQAQ Short

Assesses physical activity undertaken in all domains –
At work, at home, for transport, leisure/recreation

- **Vigorous** days
  - time on average
  - total weekly vigorous time

- **Moderate-Intensity** days
  - time on average
  - total weekly vigorous time

- **Walking** days
  - time on average
  - total weekly vigorous time
IPAQ Long

Assesses different types of physical activity undertaken each domain separately

At work

At home

For transport

For sport, recreation, leisure

Vigorous days

time on average

Moderate-Intensity days

time on average

Walking days

time on average

www.activelivingresearch.org
Reliability of IPAQ Short Form: Pearson R

Past 7 Days

Phone | Self

Usual Week

Phone | Self

Slide courtesy of Professor B Ainsworth

www.activelivingresearch.org
Validity of IPAQ Short Form: Accelerometer

Past 7 Days

Phone Self

Usual Week

Phone Self

Slide courtesy of Professor B Ainsworth

www.activelivingresearch.org
## Criterion Validation Comparison

<table>
<thead>
<tr>
<th>IPAQ*</th>
<th>SDR Caltrac</th>
<th>MNLTPA Caltrac</th>
<th>Baecke LSI, Caltrac</th>
<th>MOSPA Caltrac</th>
<th>Godi Caltra</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSA Total Counts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S7T</td>
<td>.07</td>
<td>.33</td>
<td>.21</td>
<td>.17, .32</td>
<td>.30</td>
</tr>
<tr>
<td>SUT</td>
<td>.42</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S7S</td>
<td>.25</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SUS</td>
<td>.30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L7T</td>
<td>.36</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LUT</td>
<td>.33</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L7S</td>
<td>.33</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LUS</td>
<td>.21</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*IPAQ = correlation is an average of all countries

Average Short, r = .26

Average Long, r = .32

Slide courtesy of Professor B Ainsworth
Conclusions

1. IPAQ instruments have acceptable measurement properties, at least as good as established self-report measures.
2. “Past 7 days” version recommended
3. Both telephone and self-administered can be used
4. IPAQ short form recommended for monitoring population levels of PA for middle-aged adults.
5. Long form recommended for research purposes
6. Subsequent studies confirmed substantial overestimation, due to item order
Accelerometers

**Pros:**
- Best available measure
- Small electronic device worn on waist
- Records intensity level for each minute (or fraction)
- Can be worn for days at a time; 7 days is common
- Data downloaded to computer for flexible scoring
- Can be used with virtually all ages

**Cons:**
- Not sensitive to some activities
- Can’t be used in water
- Relatively high cost ($300 and up)
- Data management & scoring can be a challenge

**Recommendation:** Actigraph. [www.mtiactigraph.com](http://www.mtiactigraph.com)
YRBS 2005: Percent active 60 minutes x 5 days

Girls

- White
- Black
- Hispanic
- Other

Boys

- White
- Black
- Hispanic
- Other
Percentage of youth ages 6-19 meeting 60 min/day physical activity guidelines. Based on accelerometers. NHANES 2003-4

Troiano, MSSE, 2007
**Pedometers**

**Pros**

- Small electronic or mechanical devices worn on waist to count steps
- Gives only total steps, but new models have memories for storing data for multiple days
- Low cost ($10-$20)
- Many brands available

**Cons**

- Not sensitive to intensity
- Not sensitive to some activities
- Can’t be used in water
- Not validated for youth
- Can’t tell if device was not worn

**Recommendation:** Use for intervention; sparingly for evaluation
**Heart Rate Monitors**

Requires sensor strap around chest & receiver worn on wrist

HR is good indicator of vigorous PA; poor indicator of moderate PA

Can be used for water activities

Records data for each minute; download to computer

Useful for short-term assessments, such as in PE class. Not practical for long-term assessment because sensor strap slips when sweating

May be better for educational purposes than program eval

Recommendation: Use for intervention or combined w.accelerometer
Heart Rate & Motion Sensors

Single-unit PA measurement instruments that integrate heart rate and accelerometry (HR+M) significantly (p<0.001) increases the precision of prediction equations for physical activity energy expenditure (PAEE) (Strath 2005).

- ACC only: R²=0.842
- HR only: R²=0.903
- HR+M: R² =0.942
Accelerometer and HR Data
**Direct Observation**

- High reliability; across measures rel r=.84 to .98
- Moderate validity w/variety of criteria, e.g., HR monitors
- All FITT components can be assessed; esp type
- Can assess related variables

- High cost of training & observer time
- Limited ability to follow subjects
- Possible reactivity
- Substantial burden of data entry
- Best for specific settings

www.activelivingresearch.org
PA in Recreational Settings

• SOPLAY: Direct observation system
• For unstructured PA in specific settings (gym, sports field, park)
• Assesses number of users & PA levels (sedentary, walking, very active)
• Contextual variables: equipment, supervision, type of PA
• Good reliability w-trained observers
PA in Parks

- **SOPARC**: Direct observation system
- Designed for use in parks
- Assesses number of users & PA levels (sedentary, walking, very active)
- Assesses age group, sex, race/ethnicity of each person observed
- Contextual variables: equipment, supervision, type of PA
- Good reliability w/ trained observers
Evaluating Physical Education

- SOFIT: Direct observation system
- Student PA: lying, sitting, standing, walking, very active
- Lesson context: e.g., management, fitness activities,
- Teacher behavior: e.g., promotes fitness, instructs
- Trained observers are highly reliable
- Use in many large PE evaluation trials
Assessing PA Environments

Many expert groups recommend multi-level interventions and conclude that environments & policies must be changed to increase PA and control obesity

– U.S. Surgeon General
– Institute of Medicine
– Centers for Disease Control & Prevention
– World Health Organization
– International Obesity Task Force
High walkable, low income
Shopping
Low walkable, High income Residences
## Summary of Research on Built Environment & Adults’ Physical Activity

<table>
<thead>
<tr>
<th>Built Environment Attribute</th>
<th>Active Transport</th>
<th>Active Recreation or Total Physical Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walkability: mixed land use, street connectivity, residential density</td>
<td>++</td>
<td>0</td>
</tr>
<tr>
<td>Sidewalks</td>
<td>?</td>
<td>+</td>
</tr>
<tr>
<td>Proximity of recreation facilities (parks, trails, private facilities)</td>
<td>0</td>
<td>++</td>
</tr>
<tr>
<td>Aesthetics of recreation facilities</td>
<td>xx</td>
<td>++</td>
</tr>
</tbody>
</table>

Sallis & Kerr. For PCPFS Research Digest. 2007
Walkability & Obesity

• At least 11 studies show adults living in areas that are walkable or have good access to recreation facilities have lower BMIs & lower risk of obesity

•
Access to Recreation Facilities Related to MVPA & Overweight in Youth

Availability of recreational & PA facilities and relative odds of overweight and bouts of moderate and vigorous physical activity (MVPA)

Number of facilities per block group

Gordon Larsen
Pediatr 2006

www.activelivingresearch.org
Walkability > Driving > Obesity?

The more miles a person travels by vehicle, the more likely they are to be obese

Lopez Zetina 2006
Built Environments May Be More Important for Minorities

Percent being active with high and low recreational resources within 1 mile of home

Diez-Roux 2007

www.activelivingresearch.org
Assessing PA Environments

• Schools
• Parks
• Trails
• Community design (observation & GIS)
  – Street characteristics
  – Intersections
  – Aesthetics
  – Buildings & amenities
Neighborhood Environment Self-Reports

NEWS: Neighborhood Environment Walkability Scale

- Residential density
- Mixed use—diversity
- Mixed use—access
- Street connectivity
- Walking & cycling infrastructure
- Aesthetics
- Safety from crime
- Safety from traffic
PANES: Physical Activity Neighborhood Environment Survey

• 17 items; 8 considered core
• One item per construct
• Developed for international use
• Good reliability in US, Swedish, and Nigerian samples
• Not relevant for rural environments
Associations Between Individual Environmental Characteristics and HEPA/Minimal Activity Among Respondents who Live in Cities with Population ≥ 30,000
Dose Response between Number of Environmental Characteristics and HEPA/Minimal Activity (Pooled City Sample)
Recommendations

• Use accelerometers to measure PA
  – For public health surveillance
  – To assess interventions
• Use direct observation in specific settings, like schools and parks
• Evaluate PA environments and use data for advocacy
• Many good instruments are available
Download many measures from
www.drjamessallis.sdsu.edu
www.activelivingresearch.org