

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

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# 3Four50.com

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



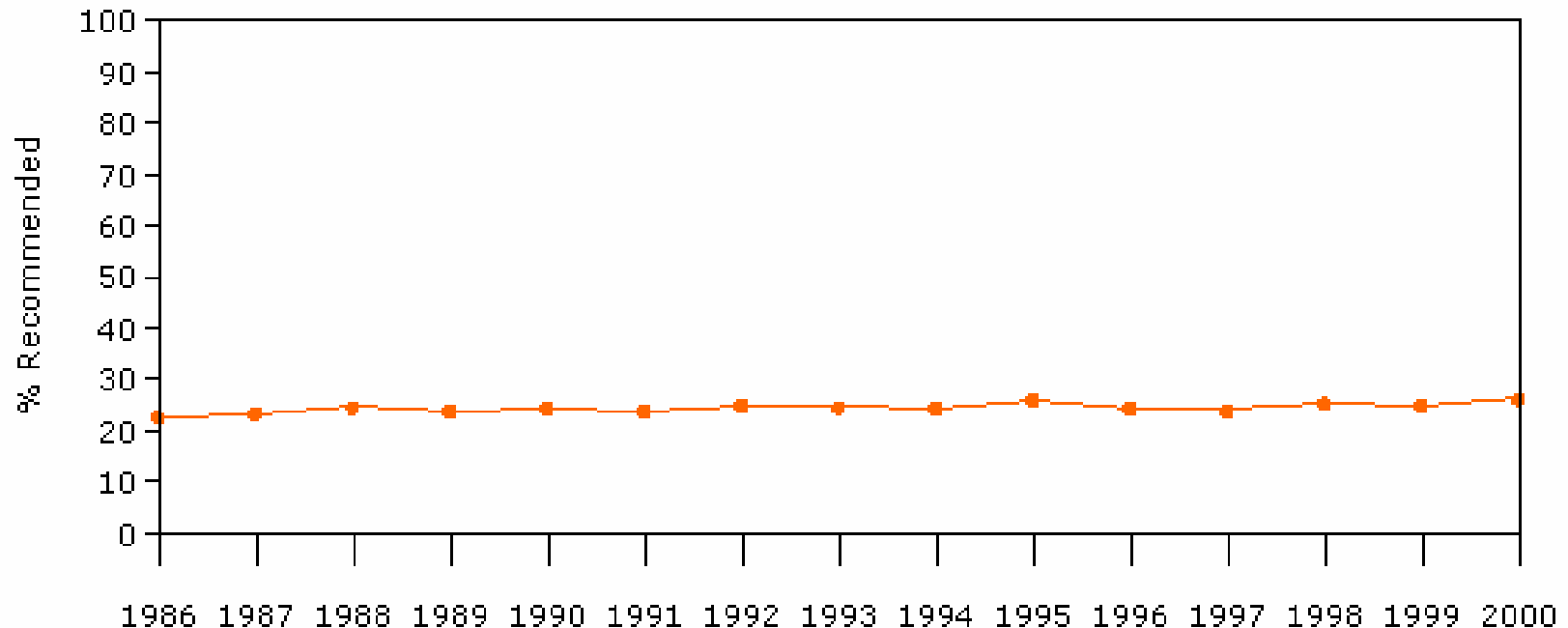
# Youth Physical Activity

- 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

<u>Rel</u>	<u>Val</u>	<u>Grade</u>
❖ .47	.29	5 <sup>th</sup> grade
❖ .59	.45	8 <sup>th</sup> grade
❖ .81	.72	11 <sup>th</sup> grade



# IPAQ

Aim to develop a measure of physical activity  
for international usage

A collaborative process to ensure relevance  
and use



# Intensity of Activity

# Domains of Activity

vigorous



moderate



walking



sedentary



occupational



transportation

household



recreation and sports



# IPAQ 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

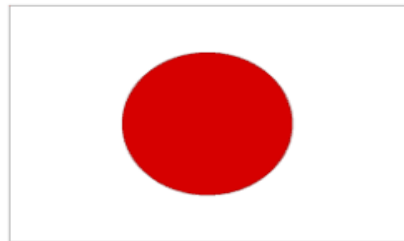
**Walking**

days

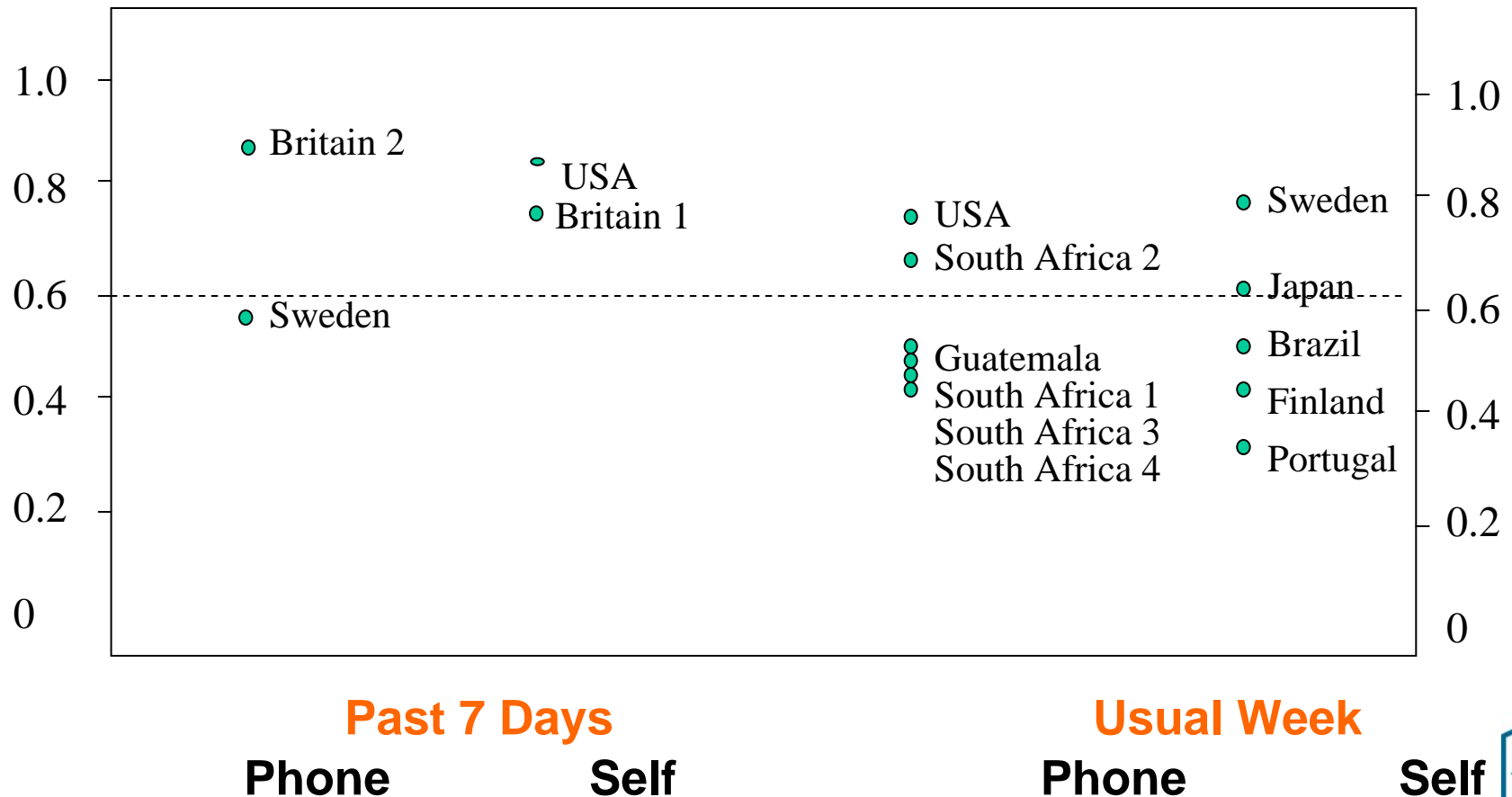
time on average



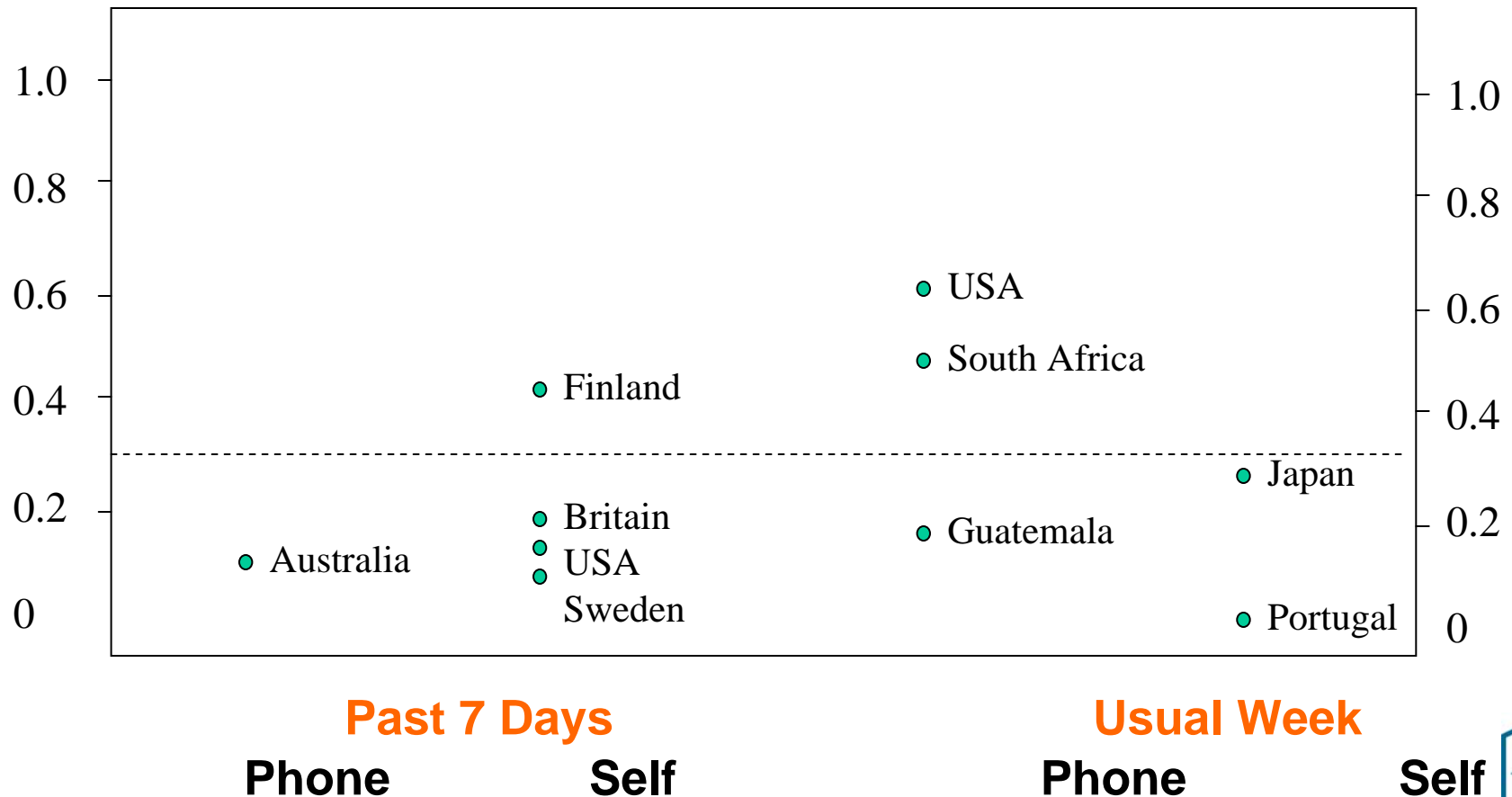
# IPAQ COUNTRIES



# Reliability of IPAQ Short Form: Pearson R



# Validity of IPAQ Short Form: Accelerometer



# Criterion Validation Comparison

	IPAQ*	SDR	MNLTPA	Baecke	MOSPA	Godi
	<b>CSA Total Counts</b>	Caltrac	Caltrac	LSI, Caltrac	Caltrac	Caltra
S7T	.07	.33	.21	.17, .32	.30	.45
SUT	.42					
S7S	.25					
SUS	.30					
L7T	.36					
LUT	.33					
L7S	.33					
LUS	.21					

Average Short,  $r = .26$   
 Average Long,  $r = .32$

\*IPAQ = correlation is an average of all countries



# 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 -

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

Not sensitive to some  
activities

Can't be used in water

Relatively high cost (\$300  
and up)

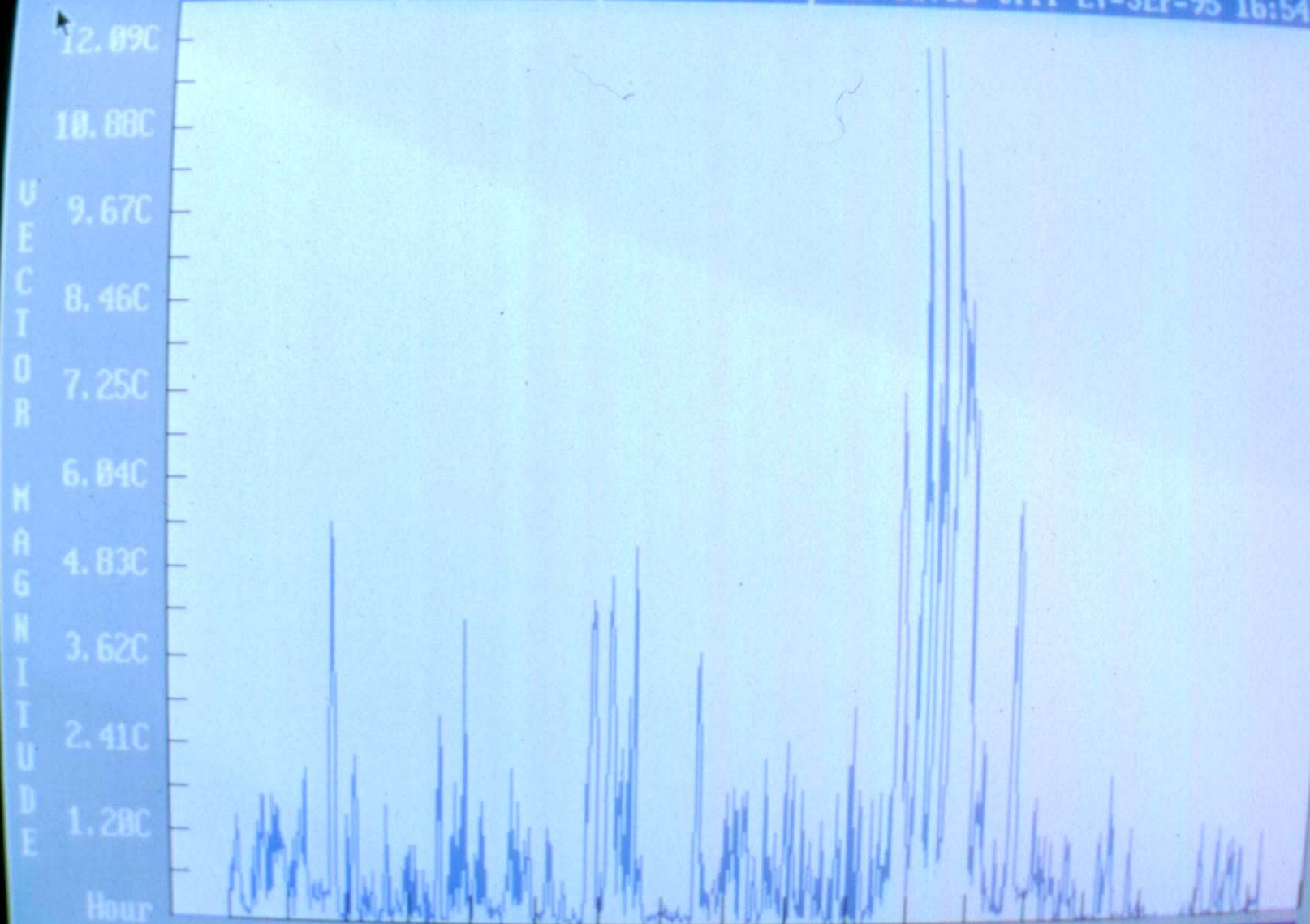
Data management &  
scoring can be challenge

**Recommendation: Actigraph. [www.mtiactigraph.com](http://www.mtiactigraph.com)**

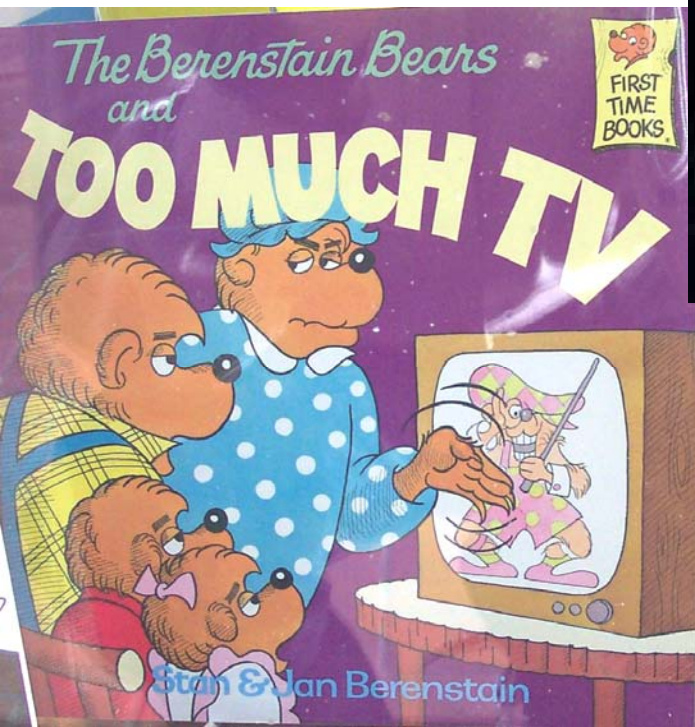
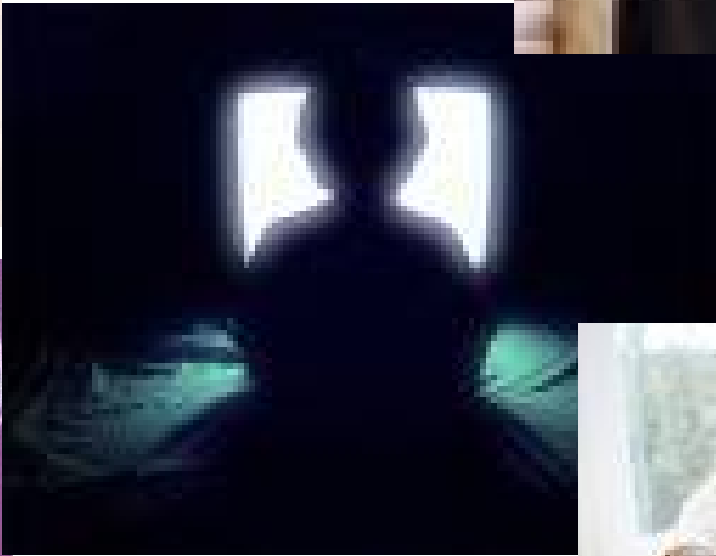
[www.activelivingresearch.org](http://www.activelivingresearch.org)



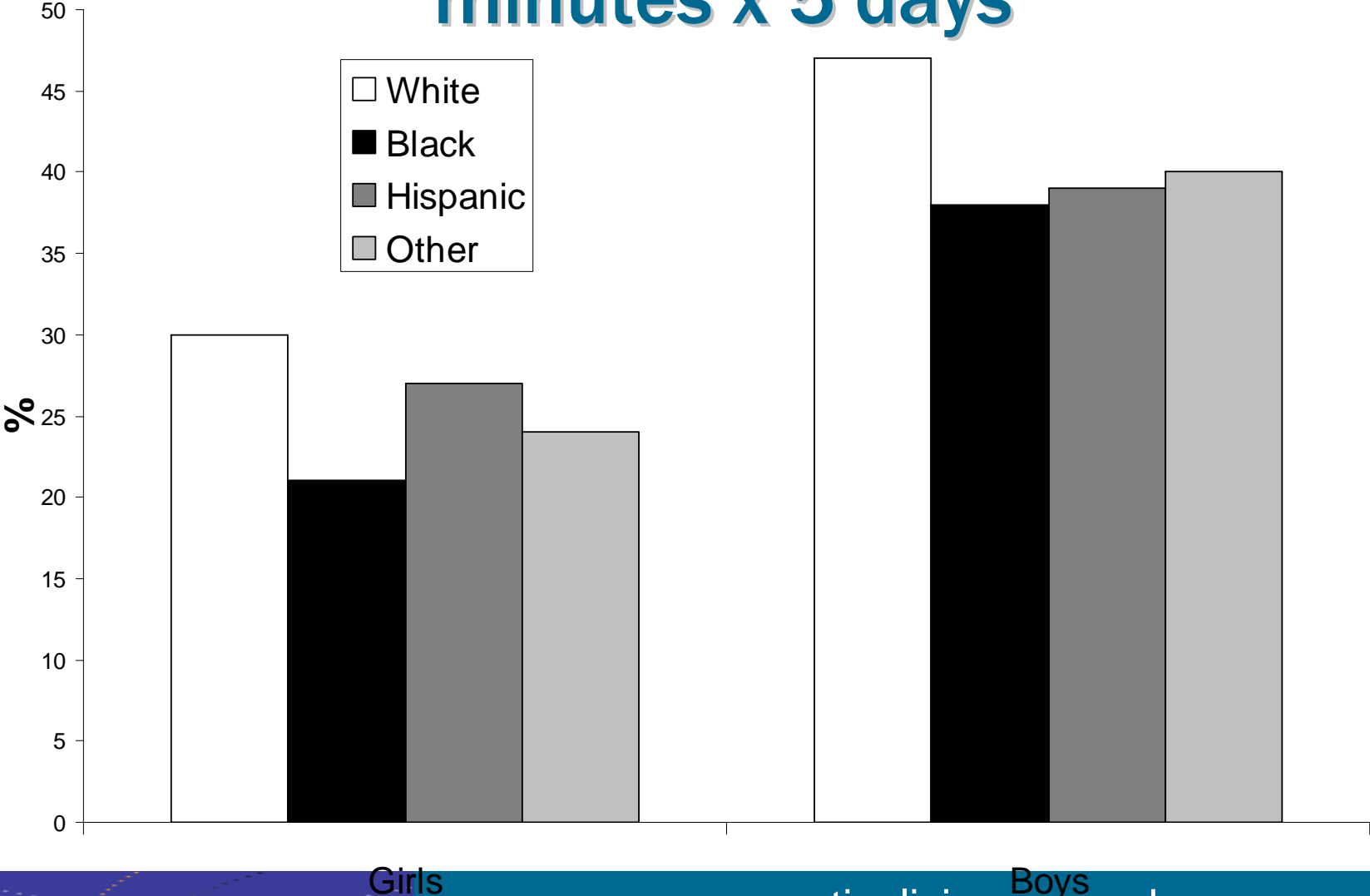
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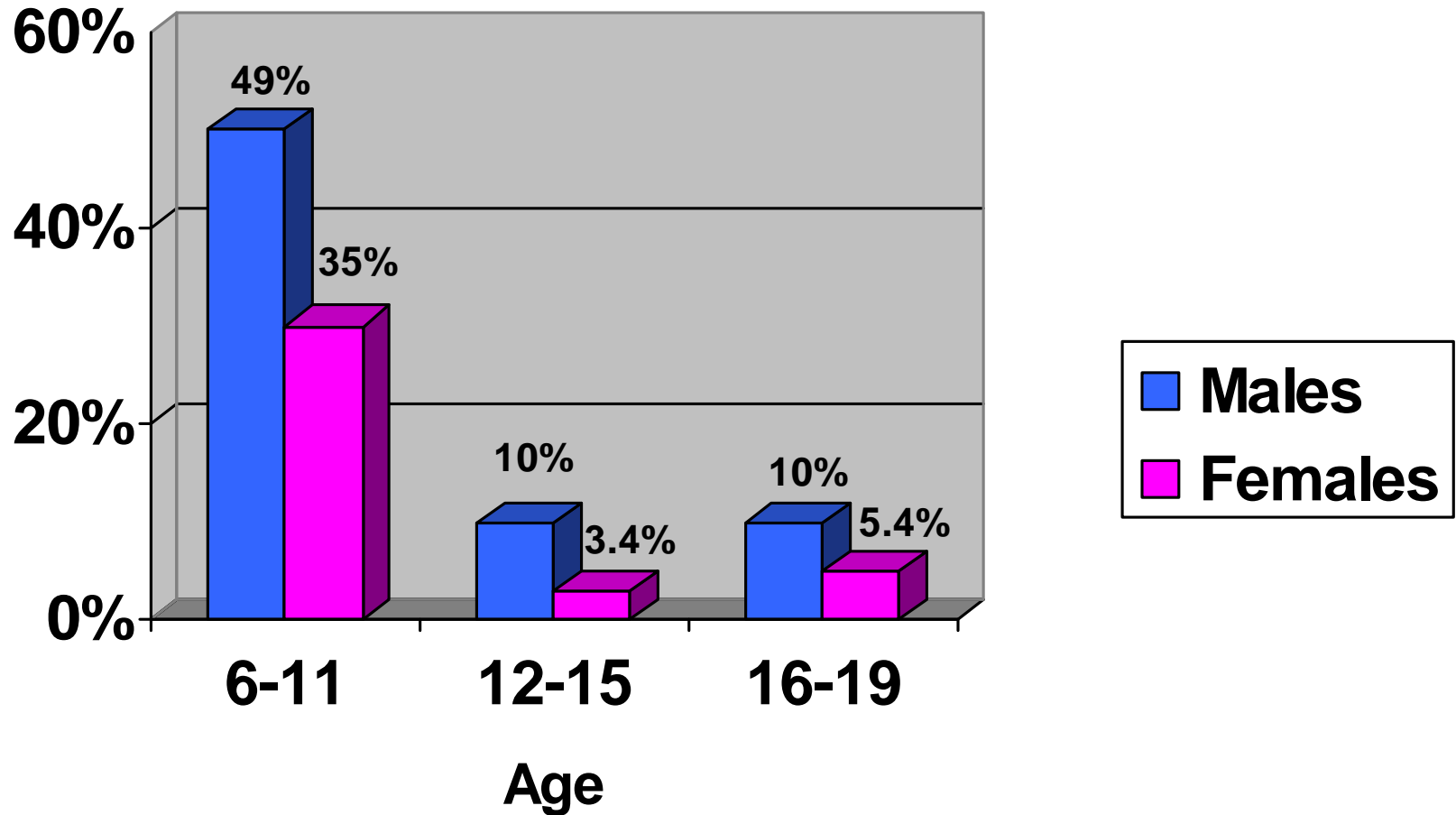


# YRBS 2005: Percent active 60 minutes x 5 days



# Percentage of youth ages 6-19 meeting 60 min/day physical activity guidelines.

Based on accelerometers. NHANES 2003-4



Troiano, MSSE, 2007



## + Pedometers -

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

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**



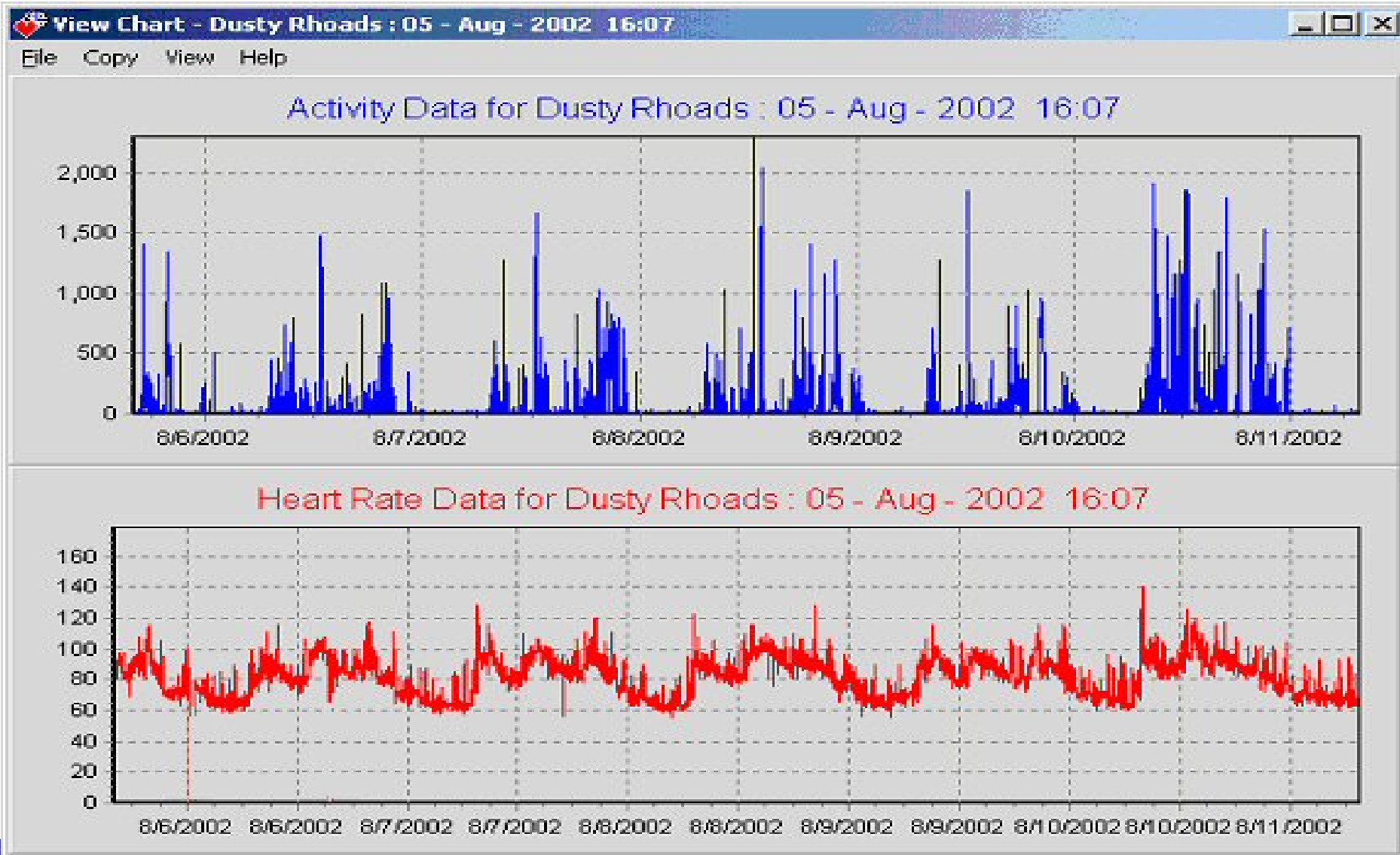
# Heart Rate & Motion Sensors

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:  $R^2 = 0.842$
- HR only:  $R^2 = 0.903$
- HR+M:  $R^2 = 0.942$



# 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



# 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

Built Environment Attribute	Active Transport	Active Recreation or Total Physical Activity
Walkability: mixed land use, street connectivity, residential density	++	0
Sidewalks	?	+
Proximity of recreation facilities (parks, trails, private facilities)	0	++
Aesthetics of recreation facilities	xx	++

Sallis & Kerr. For PCPFS Research Digest. 2007



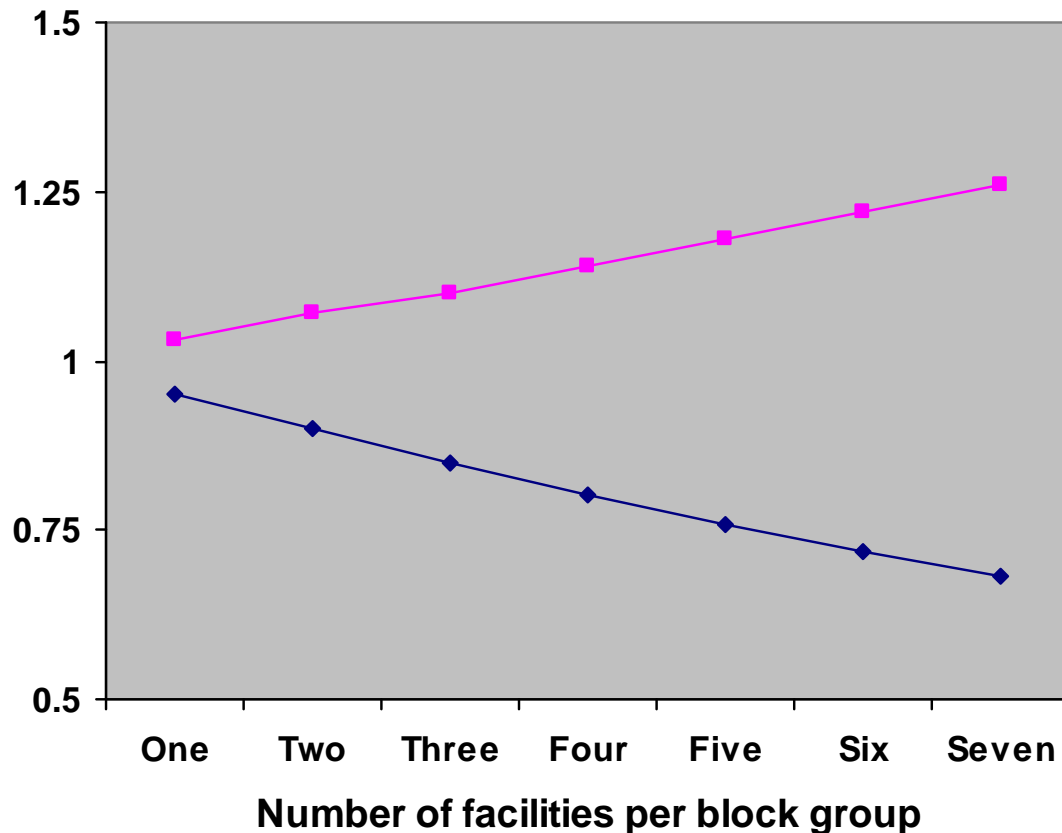
# Walkability & Obesity

- 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
  - Papas MA, et al. The built environment and obesity. *Epidemiologic Reviews* 2007;29:129-143.



# 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)

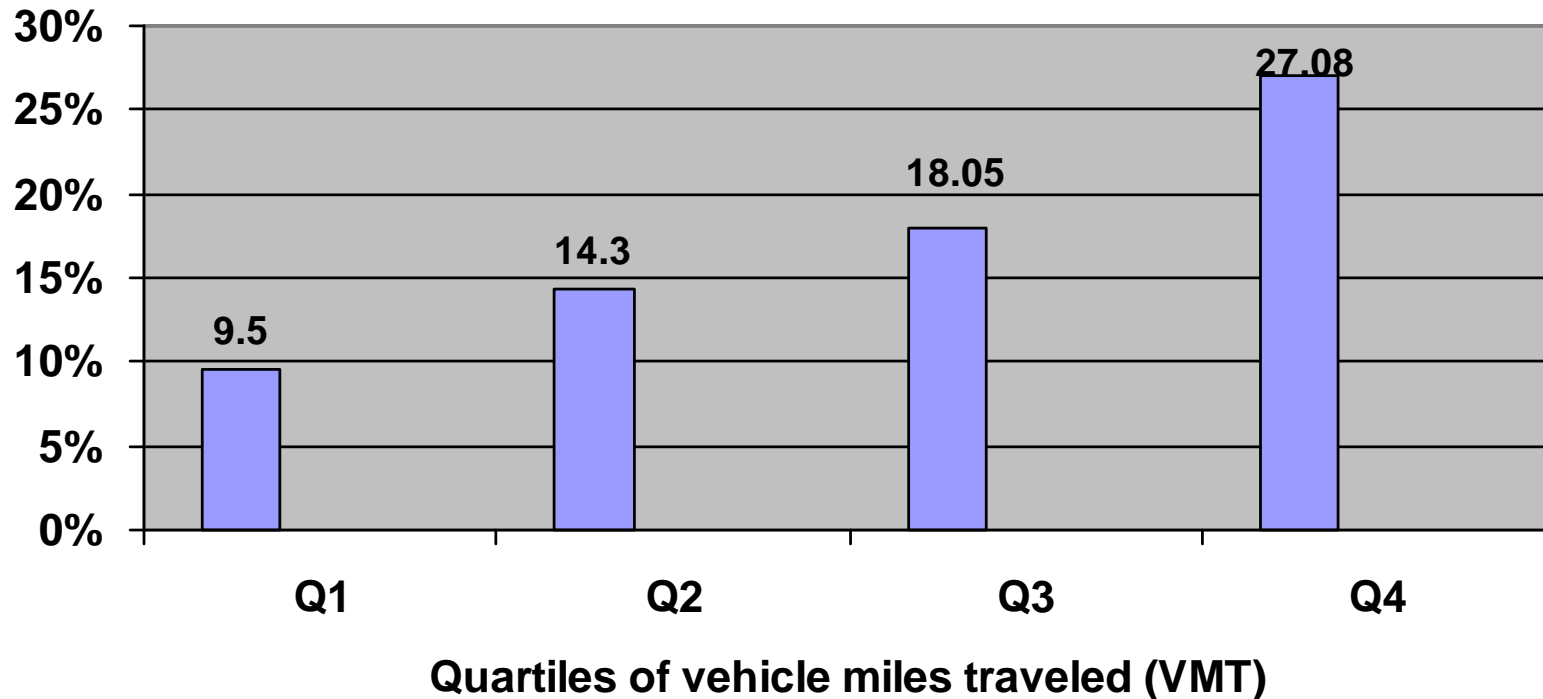


Gordon  
Larsen  
Pediatr  
2006



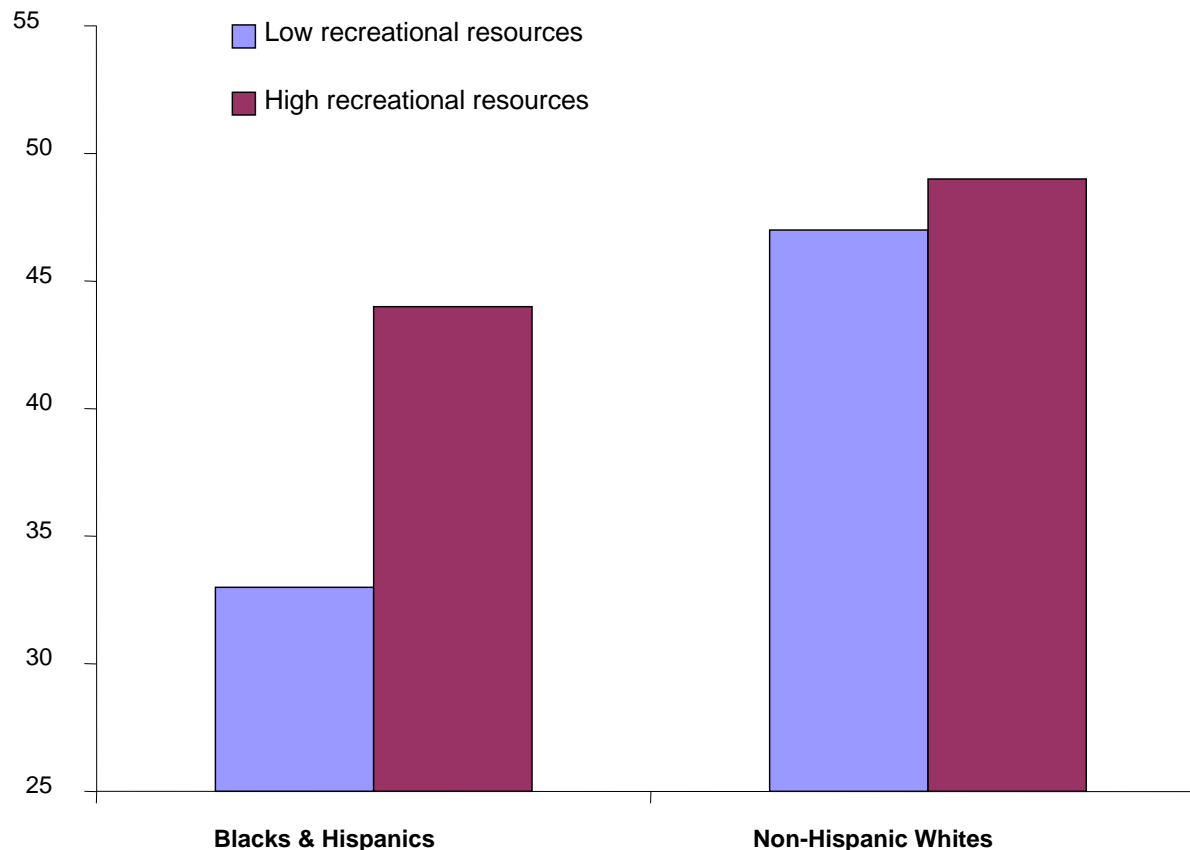
# Walkability > Driving > Obesity?

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



# Built Environments May Be More Important for Minorities

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



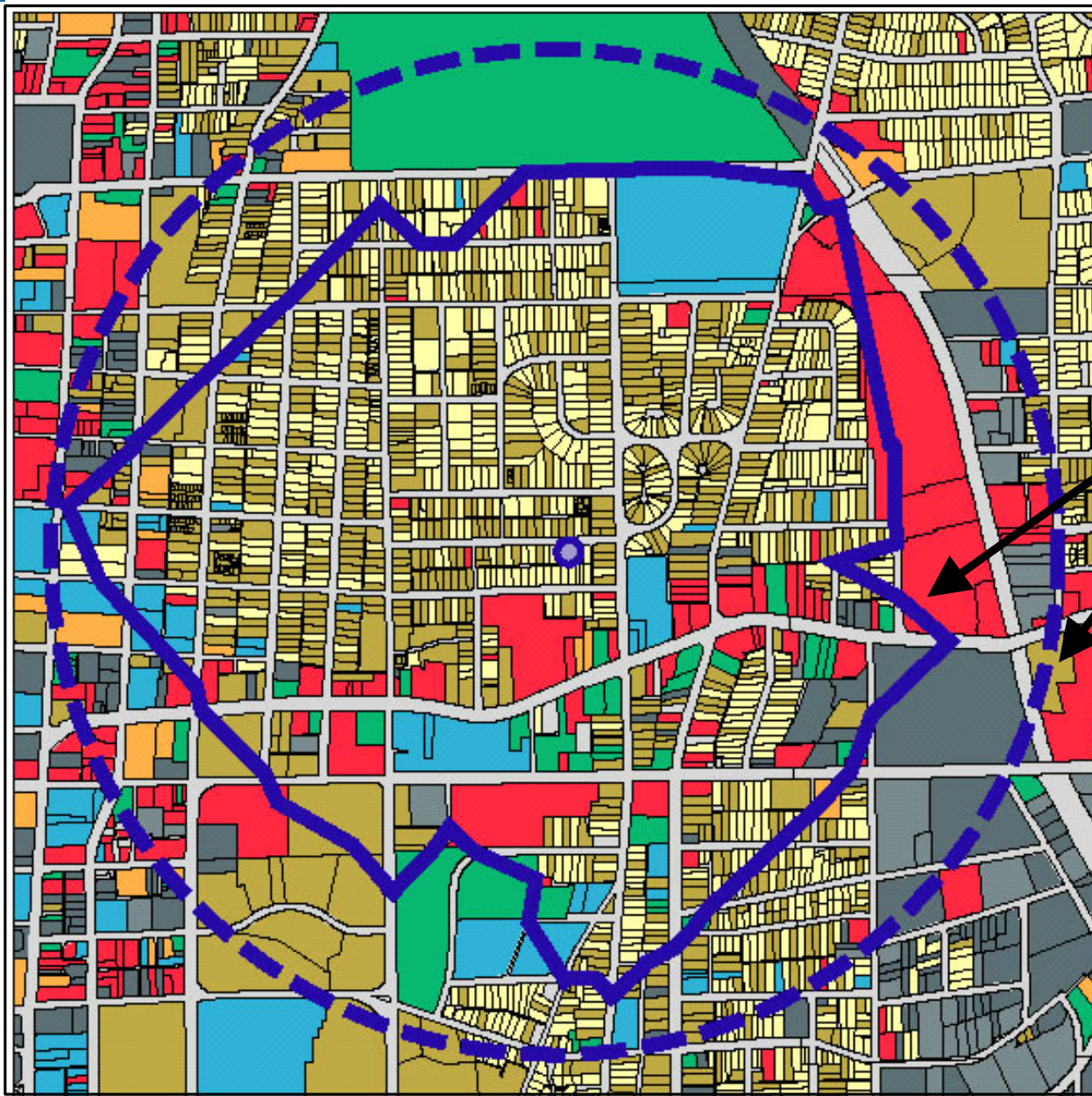
Diez-Roux  
2007



# Assessing PA Environments

- Schools
- Parks
- Trails
- Community design (observation & GIS)
  - Street characteristics
  - Intersections
  - Aesthetics
  - Buildings & amenities





1km Network  
Buffer

-Straight Line  
Buffer

- Commercial
- Office
- Institutional
- Single-Family Residential
- Multi-Family Residential
- Park/Recreational
- Industrial
- Vacant/Unknown



# 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

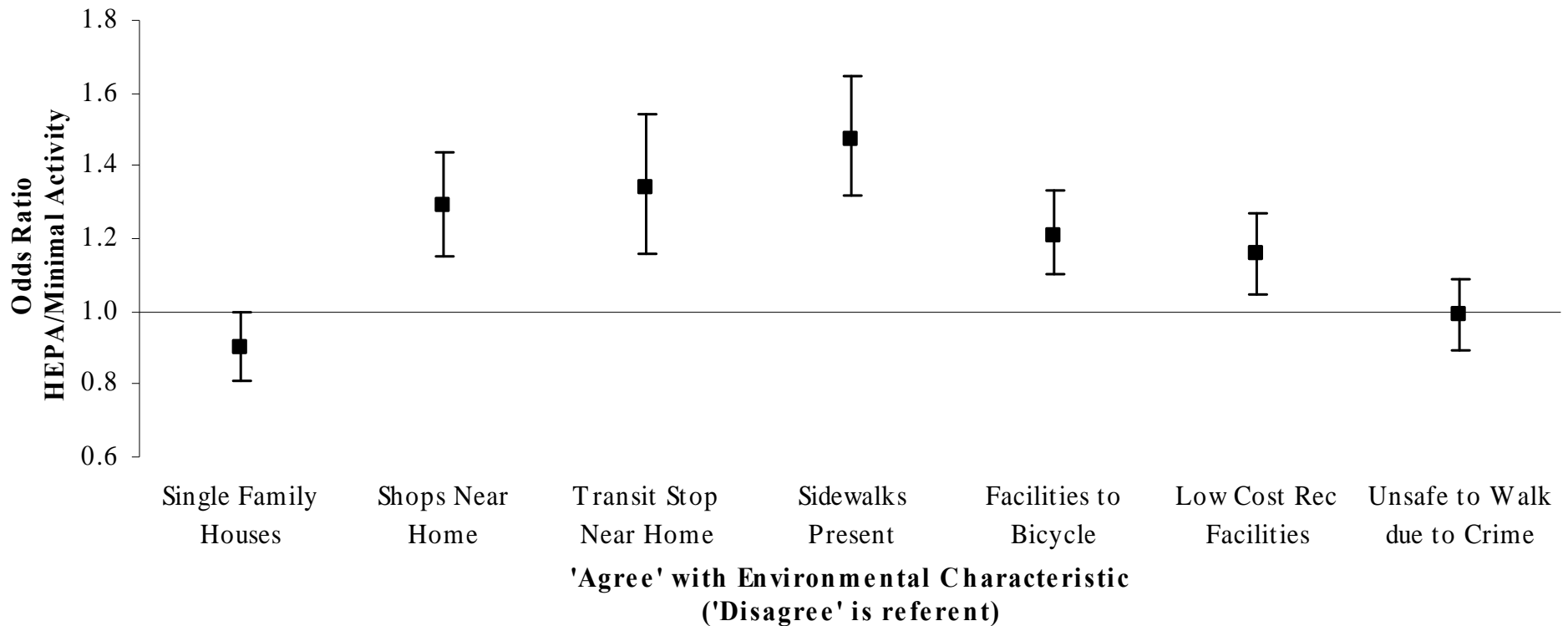


# PANES: Physical Activity Neighborhood Environment Survey

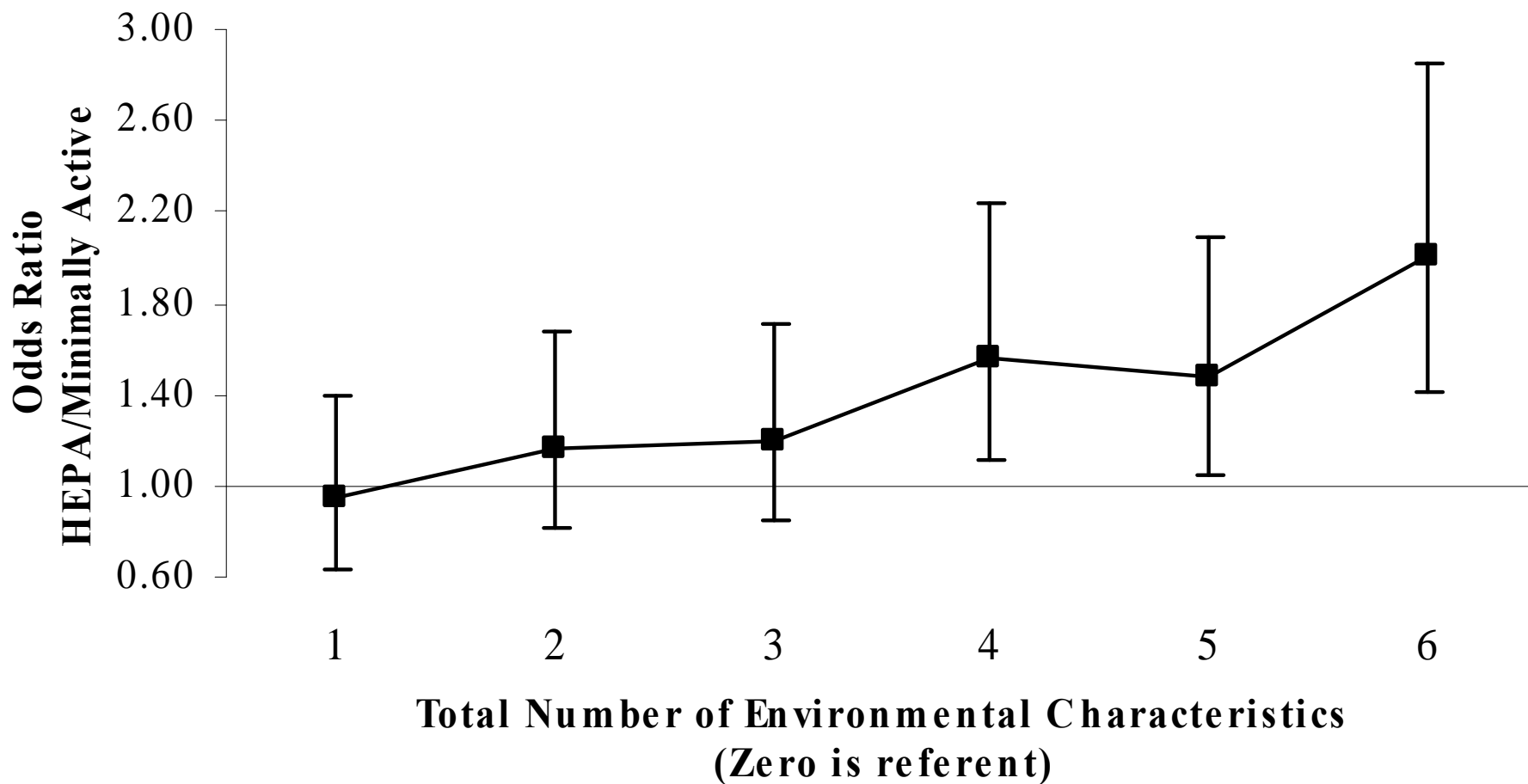
- 17 items; 8 considered core
- One item per construct
- Developed for international use
- Good reliability in US, Swedish, and Nigerian samples
- Not relevant for rural environments



**Associations Between Individual Environmental Characteristics and HEPA/Minimal Activity Among Respondents who Live in Cities with Population  $\geq 30,000$**



## Dose Response between Number of Environmental Characteristics and HEP A/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.drjamesallis.sdsu.edu](http://www.drjamesallis.sdsu.edu)  
[www.activelivingresearch.org](http://www.activelivingresearch.org)

