Disparities and Measurement Related to Physical Activity

Carlos J. Crespo, DrPH
Portland State University
School of Community Health
Major Points

• What do data say about disparities and measurements in physical activity?
• What physical activity disparity data are outstanding, and how can it be collected?
• What key physical activity measures are missing to accelerate obesity prevention?
• How do we implement systems that collect physical activity disparity data at the national level?
Evaluation and Implementation of Public Health Programs

Surveillance: What is the problem?

Risk Factor Identification: What is the cause?

Intervention Evaluation: What works?

Implementation: How do you do it?
Evaluation and Implementation of Obesity Prevention Programs

Problem:
- Obesity
- Disparities

Risk Factors:
- Energy balance
- Disparities in Assessment

Interventions: Disparities in What works

Implementation: Successful for All Populations

Problem

Response
Disparities in Measurements of Physical Activity

- Race/ethnicity
  - Whites
  - Blacks
  - Hispanics
  - American Indians
  - Alaskan Natives
  - Asians
  - Pacific Islanders

- Age Groups
  - Children
  - Youth
  - Older Adults

- Geographic
  - North, South, East, West
  - Urban/suburban/rural
  - Mainland/island

- Gender
  - Male/Female
  - Other

- Health status
  - Chronic diseases
  - Disability:
    - Mental/Physical
Physical Activity Assessment

• Subjective measures:
  – Questionnaires
  – Direct observation

• Objectives measures:
  – Indirect calorimetry
  – Doubly labeled water
  – Heart rate monitors
  – Activity monitors
    • Accelerometry
  – Pedometers
Challenges in Physical Activity Assessment

• Free-living diverse individuals and groups
• Amount and types of physical activity
• Quality of assessment
  – Validity
  – Reliability
Gaps in Measurements of Physical Activity and Inactivity to Promote Active Living among all

Active Living:
- Leisure Time
  - Sports
  - Recreation
  - Active hobbies
- Occupation
- Transportation
- House chores
- Incidental

Sedentary activities:
- TV watching
- Driving
- Sitting at work
- Reading
- Computer
- Entertainment
- Travel
## Disparities in Measurement of Physical Activity across Populations

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Potential model to examine gaps in the literature
Major Points

- What do data say about disparities and measurements in physical activity?
  - Minorities more inactive during leisure time
  - Women less leisure time activity than men
  - Inconsistent occupational physical activity
  - There are geographic variations
Age-specific prevalence of no leisure-time physical activity by race/ethnicity in men.

Age-specific prevalence of no leisure-time physical activity by race/ethnicity in women.

Prevalence of obesity by hours of daily TV watching in US children aged 8-16 years

Percent of children watching 4 or more hours of TV per day by sex and race/ethnicity

Caloric intake by hours of daily television watching among US children aged 8-16 years

Source: Crespo et al., Arch Ped and Adolesc Med. 2001;155:360-5.
Educational achievement and prevalence of no leisure-time physical activity by race/ethnicity in men.

Educational achievement and prevalence of no leisure time physical activity by race ethnicity in women

Acculturation and prevalence of no leisure-time physical activity and among Mexican-Americans

Occupational Physical Activity
Occupation and prevalence of no leisure-time physical activity by race/ethnicity in men

Occupation and prevalence of no leisure-time physical activity by race/ethnicity in women.

Percent distribution of type of usual daily activity by race/ethnicity among men

Percent distribution of type of usual daily activity by race/ethnicity among women

Percent distribution of level of usual daily lifting activity by race/ethnicity among men among men

Percent distribution of level of usual daily lifting activity by race/ethnicity among women

Marital status and prevalence of no leisure-time physical activity by race/ethnicity in men.

Marital status and prevalence of no leisure-time physical activity by race/ethnicity in women.

Geographic Disparities: Percent of adults physically inactive during leisure-time

Behavioral Risk Factor Surveillance System, 1996
State ranking and prevalence of obesity and no leisure time physical activity in US adults

Obesity:
- US median 16.6%
- Mississippi, 22.0%
- Indiana, 21.2%
- West Virginia, 20.6%
- Louisiana 19.7%
- Puerto Rico 19.2%

Physical inactivity:
- US median 28.0%
- Georgia, 51.4%
- Puerto Rico, 47.9%
- Kentucky, 45.6%
- West Virginia, 42.8%
- Ohio, 42.5%

Source: Behavioral Risk Factor Surveillance System, 1996, CDC/NCCDPHP
No leisure-time physical activity and degree of urbanization

- The difference in the prevalence (metro vs rural . . . was greater for men (12.0%) than women (6.7%).”

Prevalence of no leisure-time physical activity by region in persons aged 55 years and over

Monthly variations in no leisure-time physical activity by race/ethnicity

Behavioral Risk Factor Surveillance System, 1994, MMWR May 9, 1997
Disparities by Health Status: Prevalence of no LTPA among persons 60 year and older with physical activity-limiting chronic condition

![Bar chart showing prevalence of no LTPA by health status and gender.](chart)

Prevalence of no LTPA according to selected chronic diseases in US adults 20 y and older, 1988-1994


*non-skin cancer
Major Points

• What physical activity disparity data are outstanding, and how can it be collected?
  – Objective and subjective data are complementary
  – Characteristic of population critical in assessment methodology
  – Cut-points and incomplete data using objective assessment may disproportionately reduce persons with disability and chronic diseases
Challenges in disparities in measurements

• Objective data
  – May be uninformative for program and policy
  – Counts does not change behavior – just a number

• Subjective data
  – Questionable Validity
  – Reliability may be population specific (e.g., sex, age)
  – Can identify preferences, time, place, person and assist in informing policy and intervention
Subjective Measures

**Advantage**
- Nonreactiveness
- Practicality
- Applicability

**Disadvantage**
- Does not reflect total energy expenditure
- Reliability and validity problems
- Misinterpretation of physical activity across different populations
What adults say are their top two or three favorite leisure activities (per 100)

- Reading: 31
- Watching TV: 23
- Spending time with family/kids: 14
- Gardening: 13
- Fishing: 9
- Walking: 8

Source: USA Today
Objective Measures

• Indirect Calorimetry
  – Uses respiratory gas analysis to measure energy expenditure.

• Doubly-labeled water
  – Uses biochemical markers to estimate energy expenditure
  – measures elimination rates of deuterium and O-18 through the regular sampling of isotopes in the body water
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
Objective Measures

• Activity Monitors
  – Assess the acceleration of the body in one or more planes of movement

• Pedometer
  – Record steps taken and offer the ability to estimate the distance walked, if stride length is known
NHANES self report physical activity and accelerometry counts

Figure 1: plot of self-report and accelerometer MVPA (n = 3084) (solid line is the identity line)
## Disparities in Measurement of Physical Activity across Populations

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Leisure Time Physical Activity

Theoretical model to assess gaps in physical assessment in the literature
1=little data=high disparity in measurement, 5=sufficient data=little disparity in measurement
Transportation Physical Activity

Theoretical model to assess gaps in physical assessment in the literature
1=little data=high disparity in measurement, 5=sufficient data=little disparity in measurement)
Major Points

• What key physical activity measures are missing to accelerate obesity prevention?
  – Assessment of non-leisure time activities in free living individuals, e.g., transportation, occupational, incidental.
  – Assessment of age groups with diverse capabilities
  – Combination of different assessment methods
Transportation Physical Activity

• More Evidence is Needed to Determine the Effectiveness of Transportation and Travel Policies and Practices in Increasing Physical Activity (Community guide, 2008)
• While we have to eat every day, we do not have to exercise (LTPA) every day
• We have to transport ourselves every day = it has a purpose
• Active Transportation Increases Adherence to Activity Recommendations (Berrigan, 2006)
Percent of children who walk or bike to school, 1969 and 2001

Safe routes to School
Self-reported perceived barriers to walking or bicycling to school

- Distance to school
- Traffic related
- Weather
- Crime danger
- School Policy
- Other reasons

Self routes to school
Disparities in measurements of physical activity in older adults

- Older adults may engage in physical activities that do not lend themselves to existing physical activity monitors.
- Combination of different assessment tools may be needed to better assess physical activity in older adults.
Challenges in Measuring Physical Activity
Purposeful Physical Activity
Accelerometers work in some situations but not in others, especially among older adults.
Assessment of physical activity in different environments
Correlation between accelerometer physical activity counts and Height

BMI $r = .28$, $p = .25$
Height $r = .48$, $p < .05$

Crespo, Brodowicz, and Smit, Oregon Center on Aging and Technology Council meeting, 2009
Correlation between accelerometer physical activity counts and Weight

BMI $r=.28$, $p=.25$
Weight $r=.48$, $p=.07$

Crespo, Brodowicz, and Smit, Oregon Center on Aging and Technology Council meeting, 2009
Anthropometric Disparities
ActiTrainer Accelerometer and Heart Rate Monitor
ActiTrainer from ActiGraph

• The ActiTrainer system measures and records:
  • Activity intensity levels
  • Calories burned
  • Heart rate
  • Walk/run pace
  • Distance traveled
  • Step count
  • Number/length of nighttime awakenings
  • Sleep efficiency
Challenges in accelerometry and heart rate data collection in older adults

Recruitment

beta-blocker exclusion

Data collection & analysis questions

subject compliance with instructions

accelerometer: periods of inactivity ("zero" counts – real?)

heart rate: intermittent recording (how to handle?)

activity log: can people record daily activities?
Challenges of Actigraph/Actitrainer

• The ActiTrainer is water resistant and can handle sweat, rain and light splashes, but it is not water proof. Avoid taking a shower or swimming with your ActiTrainer.

• In a bicycle the accelerometer data is compromised but the use of the heart rate monitoring feature of the ActiTrainer is still valid.

• Highly useful information can still be obtained by monitoring peak heart rate as well as calculating heart rate recovery time.
Water proof, water resistant
Example accelerometer recording from “complier” (or “good day”)?
Example heart rate recording from “complier” (or “good day”)?
Example of combined heart rate and accelerometer recording on a complier
Example accelerometer recording from “non-complier” (or “bad day”)?

What is happening here?
Accelerometry vs Heart Rate

Activity Classification

69 yr old male (5 d)
83 yr old female (3 d)
83 yr old male (6 d)

Percent Recorded Data

- Accelerometer
- Heart Rate
ActiGraph New Products

• ActiGraph is releasing the GT3X, the first triaxial accelerometer. The GT3X Actigraph will measure acceleration on three axes, allowing for a more comprehensive analysis of activity and movement patterns.
• The GT3X will also feature 4MB of flash memory and an inclination function which can be used to determine posture and identify periods when the device is not being worn.
New technologies

• Actiheart is a heart rate recorder with an integrated accelerometer.

• Can measure activity and heart rate as well as calculate energy expenditure for ambulatory activities such as bike riding, skateboarding, weight lifting, etc.

• Heart rate variability
Actiheart from MetriSense
Actiheart “according to manufacturer”

Description:
• Unique, validated algorithm for calculating energy expenditure
• ECG signal processing for highly accurate and consistent heart rate data
• Omnidirectional accelerometer sampling at 32 Hz
• Digital interpretation reports both movement intensity and duration of motion
• 21 - day recording time at 60-second epochs
• Reliable estimate of oxygen consumption

Advantages:
• No chest band; clips onto two ECG electrodes worn on the chest
• Noninvasive "wear it and forget it" technology
• Compact and lightweight, weighs only 10g
• ASCII data format
• Waterproof design
• Nonvolatile memory
• Improved comprehensive software
• Ideal for use on adults & children
Summary

• Objectives measures of physical activity in older adults are needed

• Assessment of physical activity in older adults requires consideration of fitness, ability, and types of activities being measured.

• More research is needed to identify recruitment, retention, and familiarity of older participants with physical activity assessment technologies
Major Points

• How do we implement systems that collect physical activity disparity data at the national level?
How do we implement systems that collect physical activity disparity data at the national level?

• School level data
  – Children spend large part of their time

• Community level data
  – Built environment impact on selection of activities

• Workplace/occupation data
  – Constant changes in labor saving devices

• Transportation Physical Activity
  – Multimodal forms in different populations
Example of Disparities in Measurement of Physical Activity across Populations

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*=little data **= some data ***=sufficient data

Example of theoretical model – not systematically evaluated of disparities in physical activity assessment according to populations, types of activities, and methods
Thank You