

Physical Activity Assessment in Children and Adolescents

Harold W. Kohl, III, Ph.D., FACSM

Centers for Disease Control and Prevention
Physical Activity and Health Branch
Atlanta, Georgia, USA

July 2004



Objectives

- Review methodological concepts for assessing accuracy.
- Review techniques used to assess physical activity.
- Provide suggestions for research and future directions.

Methodological Concepts

- Repeatability
 - test/retest
 - inter-rater
- Validity
- Sensitivity

- Appropriate validation (gold) standard

Methodological Concepts

- Repeatability
- Validity
- Sensitivity

- Appropriate validation (gold) standard

Methodological Concepts

- *Validation standard*
- A predetermined criterion against which the accuracy of the test instrument is measured. The standard is presumably less variable than the test method.
- Variety of validation standards in physical activity.

Methodological Concepts

Physical Activity

- Any bodily movement that results in energy expenditure
- Measured in distance, time or some arbitrary unit

Methodological Concepts

Energy Expenditure

- Resting metabolism
- Energy expenditure from physical activity
- Thermic effect of food

Methodological Concepts

- *Validation standards in physical activity assessment (indirect and direct)*
- Energy expenditure
- Physical fitness
- Body composition
- Physical activity

Variety of methods of each standard

Methodological Concepts

- Practicality
- Non-reactivity



Physical activity assessment cascade

Calorimetry

Doubly-Labeled Water

Direct Observation

Electronic Monitoring

Self-Report

Physical Activity Assessment

- *Calorimetry*
- Direct or indirect.
- Based on measurement of energy expenditure through heat or CO₂ production.
- Highly accurate.
- Impractical for large studies.

Physical Activity Assessment

- *Doubly-labeled water*
- Based on ingestion of water with radio-isotopic labeled hydrogen and oxygen atoms.
- Energy expenditure measured by measuring unmetabolized portion of water over period of time.
- Highly accurate.
- Impractical for large studies.

Physical Activity Assessment

- *Doubly-labeled water*
- Impossible to detect patterns of physical activity (ie moderate-to-vigorous) or timing (10-minute bouts).
- When combined with assessment of resting metabolic rate, can estimate PA-related energy expenditure.

Physical Activity Assessment

- *Direct Observation*
- Individual observer monitoring a consenting individual for a set period of time.
- Videos and still photos are unlikely alternatives.
- Summary index of energy expenditure.
- Can assess patterns and timing.
- Impractical for large population studies.
- Potentially reactive.

Physical Activity Assessment

- *Direct Observation - reliability*
- Inter-observer reliability appears quite high (> 90%) with appropriate training.
- Time-dependent test-retest – appears higher with shorter intervals.
- May be due to study design and lack of stability of PA behavior in children.

Physical Activity Assessment

- *Direct Observation - validity*
- Mostly studied in younger children and in smaller studies.
- Different validation standards – monitors or indirect calorimetry.
- Generally high to very high validity (correlations between 0.65 and 0.95)

Physical Activity Assessment

- *Monitoring*
- Heart rate monitors, motion sensors, pedometers, accelerometers.
- Assume mathematical relation between measurements and physical activity.
- Many can measure quantity and intensity of physical activity.
- Recent advances make devices more practical.

Physical Activity Assessment

- *Monitoring - reliability*
- Mostly done in test-retest design.
- Modest to high correlations (0.38-0.91) and seems to be dependent on time period between observations.
- Inter-instrument reliability very high ($r = 0.80-0.95$).

Physical Activity Assessment

- *Monitoring - validity*
- Most validity work done with accelerometers.
- Low to modest correlations (0.25-0.50), particularly in uncontrolled settings.
- Heart rate monitors – more variable study designs but overall, not much better

Physical Activity Assessment

- *Self-report*
- Diaries, interviews and self-administered surveys.
- Most often used in population-based research.
- Varying lengths of recall, all assumed to be indicators of “usual” physical activity
- Varying quality of summary indices
- May not be transferrable among populations

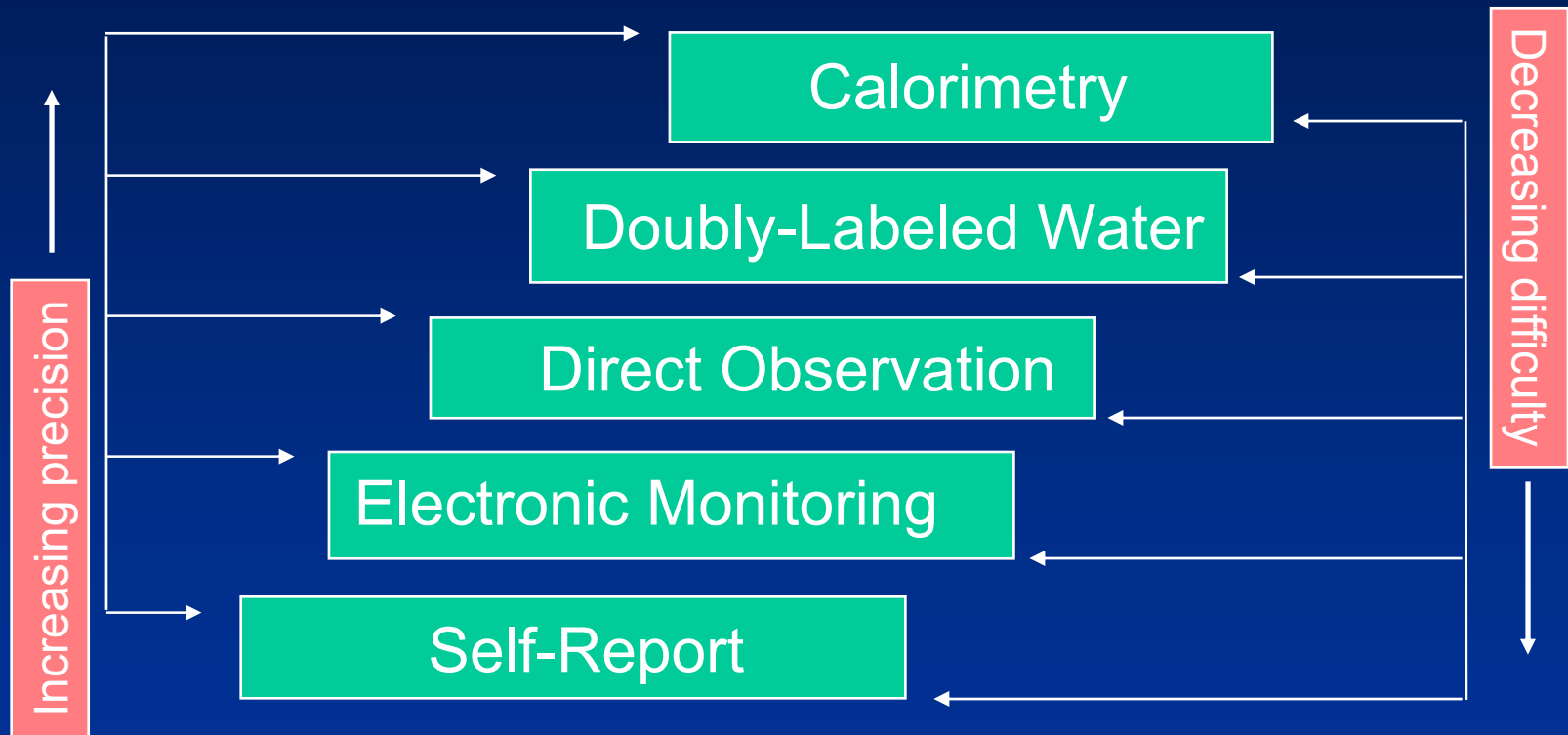
Physical Activity Assessment

- *Self-report - reliability*
- Mostly focused on test-retest reliability (self-report).
- Coefficients range from 0.20 – 0.99 with a strong suggestion of age and gender-dependency as well as time-dependency (between observations).
- Diary in older adolescents may be promising but parental report less impressive.

Physical Activity Assessment

- *Self-report - validity*
- Mostly frequent type of study, but also the most variable number of validation standards used.
- In general low to modest correlations are the norm across a range of study types.
- No expected gradient with better validity standards.
- Consistently nil to low associations in younger (<10 years) children.

Physical activity assessment cascade



Physical Activity Assessment in Youth: Future Directions

- Emphasis must be on measuring more than just total “dose”: understanding intensity, frequency, and patterns is critical – particularly for overweight.
- Self-report – information processing.
- Electronic monitoring (accelerometers) are likely the most productive future trend in physical activity assessment for children and adolescents. More work on electronics is needed.

Physical Activity Assessment in Youth: Future Directions

- Little work has been done on combinatorial strategies (eg. monitoring + self-report).
- Physical inactivity
- Energy costs of various activities in children and adolescents.
- Little work done in categorical analyses of “meeting recommendations” (60 mins/day) and relation to obesity/overweight – surveillance implications. Dose-response



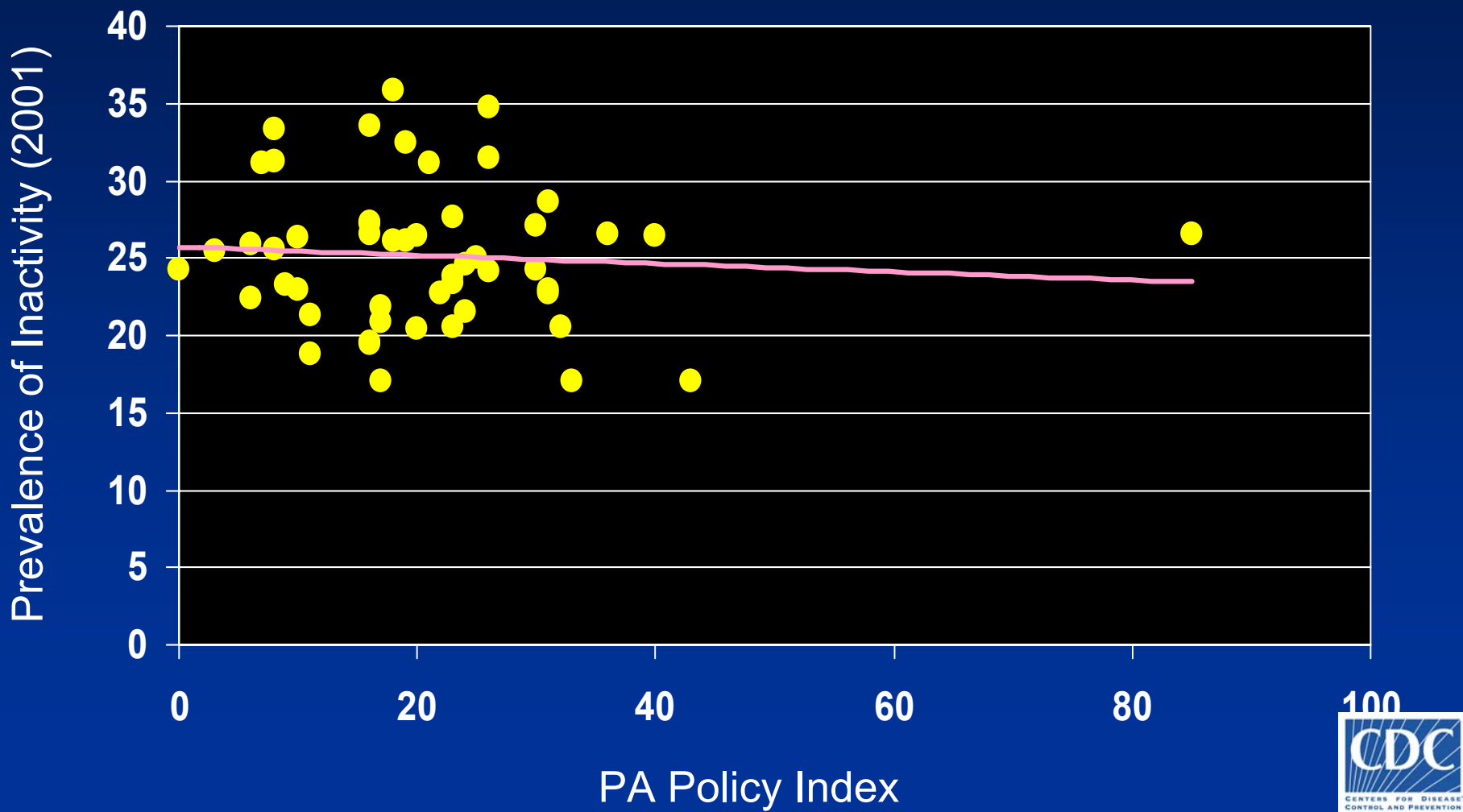
Physical Activity Assessment in Youth: Future Directions

- Intra-individual variation in physical activity assessment: How many days are enough?
- Methods for assessing non-aerobic activities
- How can existing physical activity assessment instruments/methods be adapted/adopted into different populations and subgroups?

Physical Activity Assessment in Youth: Future Directions

- Familial and health care provider assessment.
- “Upstream” assessment of determinants of physical activity – environmental as well as policy influences. Surveillance and research needs.

Relation between state PA policy index and prevalence of physical inactivity



Relation between state PA policy index and prevalence of physical inactivity

