Physical Activity Among Children and Adolescents: Data from National Health and Nutrition Examination Survey (NHANES) 2003-2006

Richard Troiano, PhD
Overview

• NHANES 2003-2006 accelerometer protocol

• Accelerometer data use highlights
  – Prevalence studies
  – Trends
  – Epidemiological analyses

• Coming attractions
NHANES 2003-2006
ACCELEROMETER PROTOCOL
NHANES 2003-6 PAM Protocol

• Sample
  – Age 6+

• Sensor: ActiGraph 7164
  – Accelerometer: uniaxial (vertical)
  – 1 min epochs

• Location
  – Worn over hip on elastic velcro belt

• Wearing Protocol
  – 7 days, while awake
  – Remove for bathing, swimming, etc.
A Popular Data Resource

SYSTEMATIC REVIEW


Catrine Tudor-Locke, PhD; Sarah M. Camhi, PhD; Richard P. Troiano, PhD


– 54 publications as of December 31, 2011
– 15 focus on or include data for youth
PREVALENCE APPLICATIONS
First Objective PA Data

Physical Activity in the United States Measured by Accelerometer

RICHARD P. TROIANO¹, DAVID BERRIGAN¹, KEVIN W. DODD¹, LOUISE C. MÅSSE¹, TIMOTHY TILERT², and MARGARET MCDOWELL²

¹National Cancer Institute, National Institutes of Health, Bethesda, MD, and ²National Center for Health Statistics, Centers for Disease Control and Prevention, Hyattsville, MD Med Sci Sports Exerc, 2008

- NHANES 2003-2004
- Age-specific thresholds for intensity
- Accumulated minutes above thresholds
- At least 4 days of 10+ hours
### Activity is Much Lower for Teens

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Boys</th>
<th>Girls</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-11</td>
<td>95.4 (4.7)</td>
<td>75.2 (2.0)</td>
</tr>
<tr>
<td>12-15</td>
<td>45.3 (3.4)</td>
<td>24.6 (1.8)</td>
</tr>
<tr>
<td>16-19</td>
<td>32.7 (2.2)</td>
<td>19.6 (2.4)</td>
</tr>
</tbody>
</table>
Girls Are Particularly at Risk

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Boys</th>
<th>Girls</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-11</td>
<td>48.9 (2.8)</td>
<td>34.7 (1.2)</td>
</tr>
<tr>
<td>12-15</td>
<td>11.9 (1.7)</td>
<td>3.4 (0.6)</td>
</tr>
<tr>
<td>16-19</td>
<td>10.0 (1.6)</td>
<td>5.4 (1.4)</td>
</tr>
</tbody>
</table>

* 60+ min/d on 5 out of 7 days
Demographics Plus Weight Status

Physical Activity in US Youth: Effect of Race/Ethnicity, Age, Gender, and Weight Status

BRITNI R. BELCHER, DAVID BERRIGAN, KEVIN W. DODD, B. ADAR EMKEN, CHIH-PING CHOU, and DONNA SPRUIJT-METZ

1Department of Preventive Medicine, Keck School of Medicine, University of Southern California, Los Angeles, CA; and
2National Cancer Institute, National Institutes of Health, Bethesda, MD

- NHANES 2003-2006
- Ages 6-19 years
- Included those with 4+ days of 10+ hours
- Mean counts per minute
- Daily minutes sedentary, moderate, vigorous, and moderate-vigorous PA

Complex patterns of interactions

Belcher, et al., 2010
FIGURE 2—Three-way age group–BMI–race/ethnic interaction of MVPA in females. Within race/ethnic and age groups; †Normal weight differ from overweight by $P < 0.05$. ‡Normal weight differ from obese by $P < 0.05$. *Overweight differ from obese by $P < 0.05$. Within age groups: §Non-Hispanic white differ from non-Hispanic black by $P < 0.05$. ¶Non-Hispanic white differ from Mexican American by $P < 0.05$. #Non-Hispanic black differ from Mexican American by $P < 0.05$.

Belcher, et al., 2010
Step Data

Accelerometer-Determined Steps per Day in US Children and Youth

CATRINE TUDOR-LOCKE, WILLIAM D. JOHNSON, and PETER T. KATZMARZYK
Pennington Biomedical Research Center, Baton Rouge, LA


- NHANES 2005-2006
- Ages 6-19 years
- At least 1 day of 10+ hours
- Age- and sex-specific thresholds for step categories
- Accumulated steps/day, uncensored and censored
  - Censoring steps with low counts approximates pedometer step counts
- Steps/day highest at age 6 and then declines
Few Boys Meet Active Step Criteria

Tudor-Locke, et al., 2010
Girls Appear to do Slightly Better

FIGURE 2—NHANES 2005–2006 PAM participants categorized according to step-defined activity levels for female children aged 6–11 yr, considering both uncensored and censored steps: 1) <7000 “sedentary”; 2) 7000–9499 “low active”; 3) 9500–11,999 “somewhat active”; 4) 12,000–14,999 “active”; and 5) ≥14,500 steps per day “highly active.”

Tudor-Locke, et al., 2010
CHANGES OVER TIME
Trends and Demographic Effects


STEFAN L. GORTMAKER, REBEKKA LEE, ANGIE L. CRADOCK, ARTHUR M. SOBOL, DUSTIN T. DUNCAN, and Y. CLAIRE WANG

1Department of Society, Human Development, and Health, Harvard School of Public Health, Boston, MA; and 2Department of Health Policy and Management, Columbia Mailman School of Public Health, New York, NY


– Ages 6-19 years
– Examined changes from 2003-4 to 2005-6
  • Mean counts/minute and minutes of moderate-vigorous PA
  • Multiple regression
– Included those with 4+ days of 10+ hours
Changes Between Cycles

• Counts/minute:
  – Increased for children, but not adolescents
  – Increased for non-Hispanic white children
  – Decreased for non-Hispanic black and Mexican-American children

• Minutes of moderate-vigorous PA
  – No detectable changes
ASSOCIATIONS
Does the Fractionalization of Daily Physical Activity (Sporadic vs. Bouts) Impact Cardiometabolic Risk Factors in Children and Youth?

Rebecca M. Holman¹, Valerie Carson¹, Ian Janssen¹,²*

¹ School of Kinesiology and Health Studies, Queen’s University, Kingston, Ontario, Canada, ² Department of Community Health and Epidemiology, Queen’s University, Kingston, Ontario, Canada

Published: October 5, 2011

– NHANES 2003-2006
– Ages 6-19 y
– Cardiometabolic risk score:
  • Waist circumference
  • Non-HDL cholesterol
  • C-reactive protein
  • Systolic blood pressure
Sporadic vs. Bouts of MVPA

5-min bouts

10-min bouts

A

B

Odds Ratio for High CRS

MVPA (minutes per day)

Odds Ratio for High CRS

MVPA (minutes per day)
Volume, patterns, and types of sedentary behavior and cardio-metabolic health in children and adolescents: a cross-sectional study

Valerie Carson¹ and Ian Janssen¹,²*

- NHANES 2003-2006
- Ages 6-19 years
- Include 4+ days of 10+ hours, with one weekend day
- Volume and pattern (bouts, breaks) of sedentary time
- TV watching (questionnaire)
- Moderate+ intensity PA
High CRS Predictors

• Low minutes of MVPA
  – Not sedentary volume or pattern

• Reported TV time, but not computer time
  – May be mediated by obesity

• TV and MVPA poorly correlated, so may need independent interventions
OTHER STUDIES
Relation of Activity to:

- Weight status
- Adiposity
- Blood pressure
- Dyslipidemia
- Metabolic risk score

- SES and acculturation among Mexican-American adolescents

- Compare accelerometer and self-report
COMING SOON...
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Splash proof</td>
<td>Waterproof device</td>
</tr>
<tr>
<td>– Off to swim or shower</td>
<td></td>
</tr>
<tr>
<td>Waist worn monitor</td>
<td>Wrist worn monitor</td>
</tr>
<tr>
<td>Waking hours only</td>
<td>24 hour instrument wear</td>
</tr>
<tr>
<td></td>
<td>– Allows measures of sleep duration and efficiency</td>
</tr>
<tr>
<td>Single axis of sensitivity</td>
<td></td>
</tr>
<tr>
<td>1 summary value / minute</td>
<td>Triaxial data (X, Y, &amp; Z planes)</td>
</tr>
<tr>
<td>72,000,000 data point for 7000 participants in 2003-4</td>
<td>80Hz raw data capture</td>
</tr>
<tr>
<td></td>
<td>– 240 points/sec</td>
</tr>
<tr>
<td></td>
<td>72,000,000 data points per participant</td>
</tr>
</tbody>
</table>
NHANES 2011-14 PAM Protocol

• Sample
  – Age 6+ (3+ from 2012)

• Sensor: ActiGraph GT3X+
  – Accelerometer: raw triaxial 80Hz data
  – Ambient light sensor

• Location
  – Worn on nondominant wrist

• Attachment
  – Removable velcro band

• Wearing Protocol
  – 7+ days of continuous wear (24/7)
Protocol Strengths and Benefits

- Maximize protocol compliance by reducing
  - Missing days of wear
  - Missing hours during waking periods

- Ability to detect upper body activities in addition to ambulatory patterns
  - Possibility of novel outcomes with pattern recognition
National Youth Fitness Survey

- Ages 3-15, target 1500 youth examined
- Same locations as NHANES 2012
  - Separate exam trailer
- Some overlap plus unique measures with NHANES
  - Screener, sample person, and family Qx.
  - Dietary recall
  - Height, weight, BMI
## NYFS Exam Components

<table>
<thead>
<tr>
<th>Component</th>
<th>Ages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accelerometer</td>
<td>3 - 15 y</td>
</tr>
<tr>
<td>Treadmill</td>
<td>6 - 15 y</td>
</tr>
<tr>
<td>Lower body strength</td>
<td>6 - 15 y</td>
</tr>
<tr>
<td>Grip strength</td>
<td>6 - 15 y</td>
</tr>
<tr>
<td>Modified pull-up</td>
<td>5 - 15 y</td>
</tr>
<tr>
<td>Plank</td>
<td>3 - 15 y</td>
</tr>
<tr>
<td>Gross motor skills *</td>
<td>3 - 5 y</td>
</tr>
</tbody>
</table>

* Locomotor: run, gallop, hop, leap, horizontal jump, slide
  Object Control: striking a stationary ball, stationary dribble, kick, catch, overhand throw, and underhand roll.
Thank You!