

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

A Catalog of Rules, Variables, and Definitions Applied to Accelerometer Data in the National Health and Nutrition Examination Survey, 2003–2006

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

Suggested citation for this article: Tudor-Locke C, Camhi SM, Troiano RP. A Catalog of Rules, Variables, and Definitions Applied to Accelerometer Data in the National Health and Nutrition Examination Survey, 2003–2006. *Prev Chronic Dis* 2012;9:110332. DOI: <http://dx.doi.org/10.5888/pcd9.110332> .

- 54 publications as of December 31, 2011
- 15 focus on or include data for youth

PREVALENCE APPLICATIONS

First Objective PA Data

SPECIAL COMMUNICATIONS

Rapid Communications

Physical Activity in the United States Measured by Accelerometer

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¹*National Cancer Institute, National Institutes of Health, Bethesda, MD, and* ²*National 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

	Minutes (SEM) of Moderate or Greater Intensity	
Age Group	Boys	Girls
6-11	95.4 (4.7)	75.2 (2.0)
12-15	45.3 (3.4)	24.6 (1.8)
16-19	32.7 (2.2)	19.6 (2.4)

Girls Are Particularly at Risk

	Prevalence (% and SE) Meeting Recommendations*	
Age Group	Boys	Girls
6-11	48.9 (2.8)	34.7 (1.2)
12-15	11.9 (1.7)	3.4 (0.6)
16-19	10.0 (1.6)	5.4 (1.4)

* 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

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- 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

Age-BMI Race-Ethnic Interactions

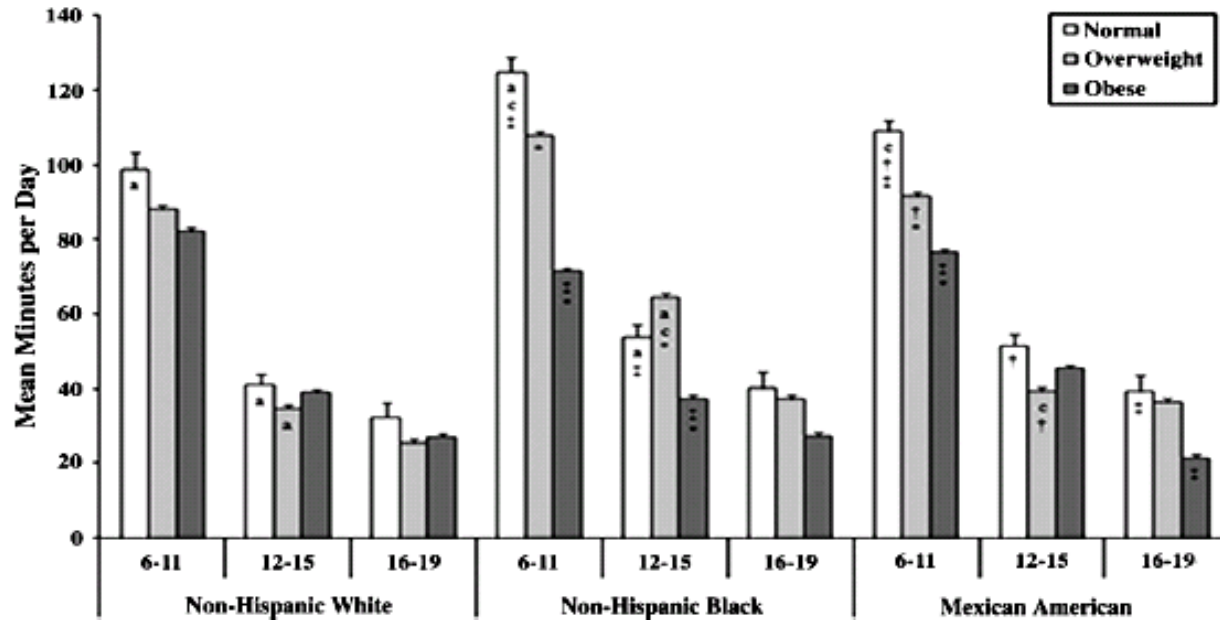


FIGURE 1—Three-way age group–BMI–race/ethnic interaction of MVPA in males. Within race/ethnic and age groups: †Normal weight differ from overweight by $P < 0.05$. ‡Normal weight differ from obese by $P < 0.05$. *Overweight differ from obese by $P < 0.05$. Within age groups: ^aNon-Hispanic white differ from non-Hispanic black by $P < 0.05$. ^bNon-Hispanic white differ from Mexican American by $P < 0.05$. ^cNon-Hispanic black differ from Mexican American by $P < 0.05$.

Complex patterns of interactions

Age-BMI Race-Ethnic Interactions

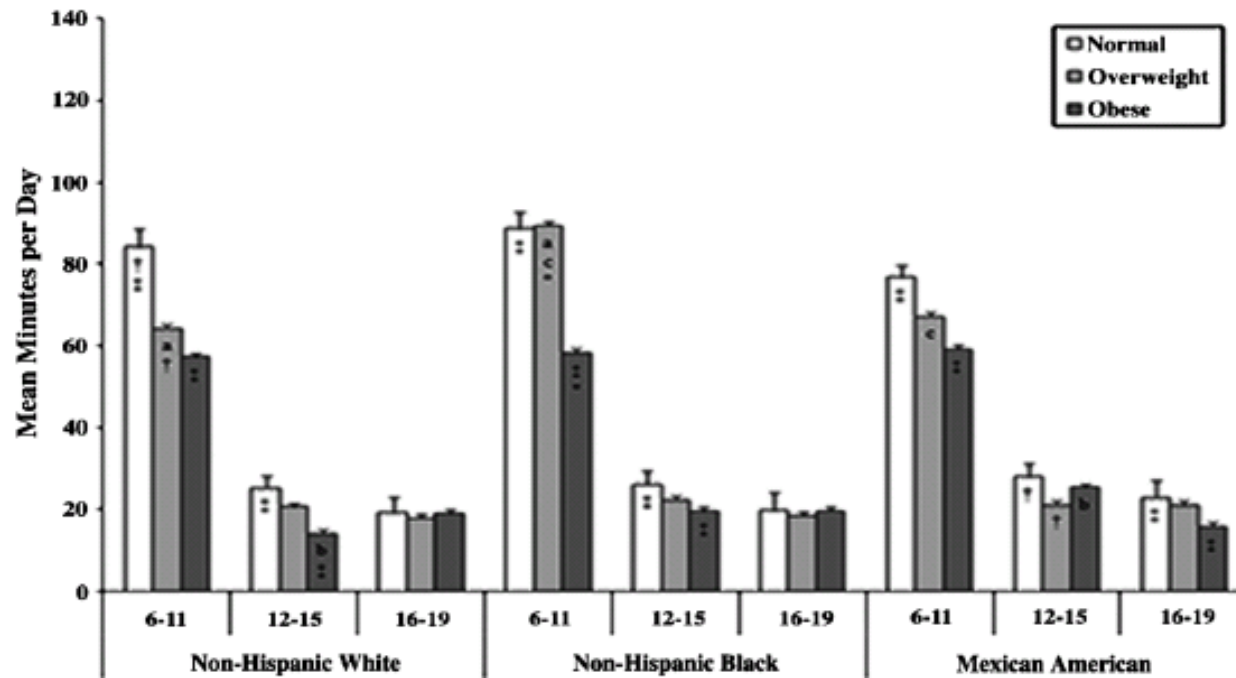


FIGURE 2—Three-way age group–BMI–race/ethnic interaction of MVPA in females. Within race/ethnic and age groups: †Normal weight differ from overweight by $P < 0.05$. ‡Normal weight differ from obese by $P < 0.05$. *Overweight differ from obese by $P < 0.05$. Within age groups: ^aNon-Hispanic white differ from non-Hispanic black by $P < 0.05$. ^bNon-Hispanic white differ from Mexican American by $P < 0.05$. ^cNon-Hispanic black differ from Mexican American by $P < 0.05$.

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 Med Sci Sports Exerc, 2010

- 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

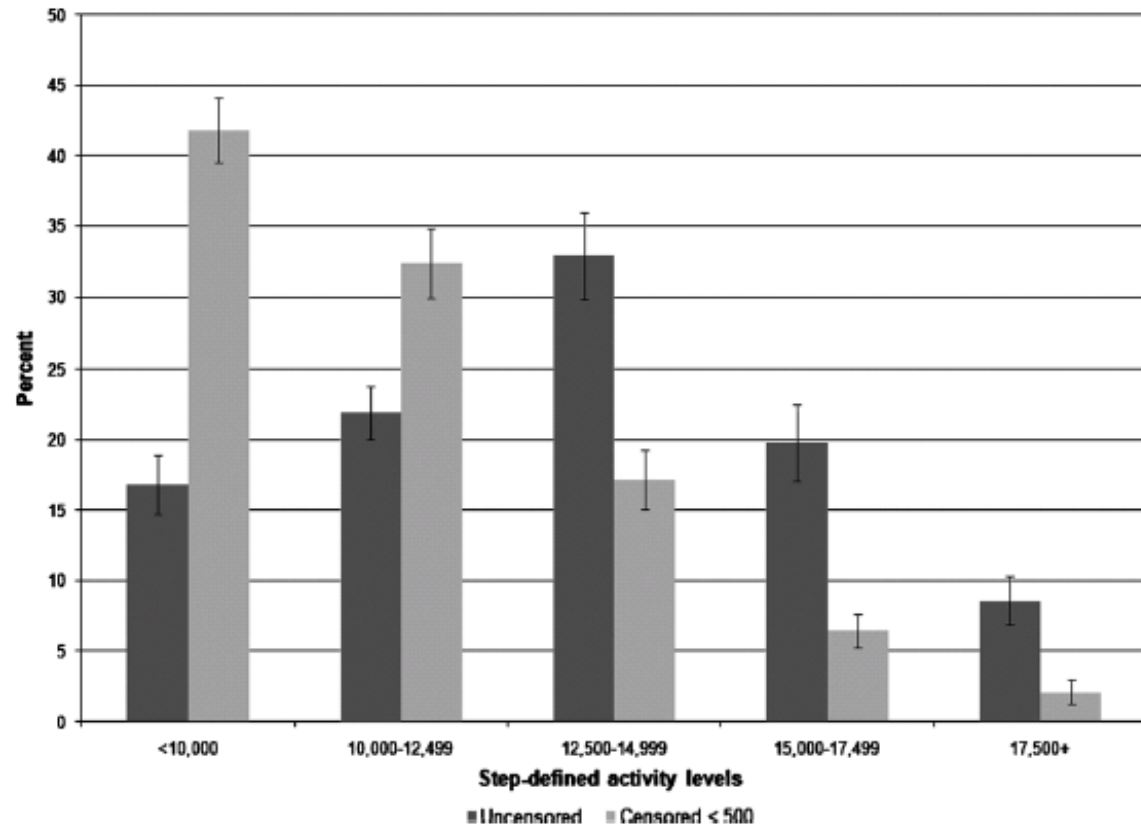


FIGURE 1—NHANES 2005–2006 PAM participants categorized according to step-defined activity levels for male children aged 6–11 yr, considering both uncensored and censored steps: 1) <10,000 “sedentary”; 2) 10,000–12,499 “low active”; 3) 12,500–14,000 “somewhat active”; 4) 15,000–17,499 “active”; and 5) $\geq 17,500$ steps per day “highly active.”

Girls Appear to do Slightly Better

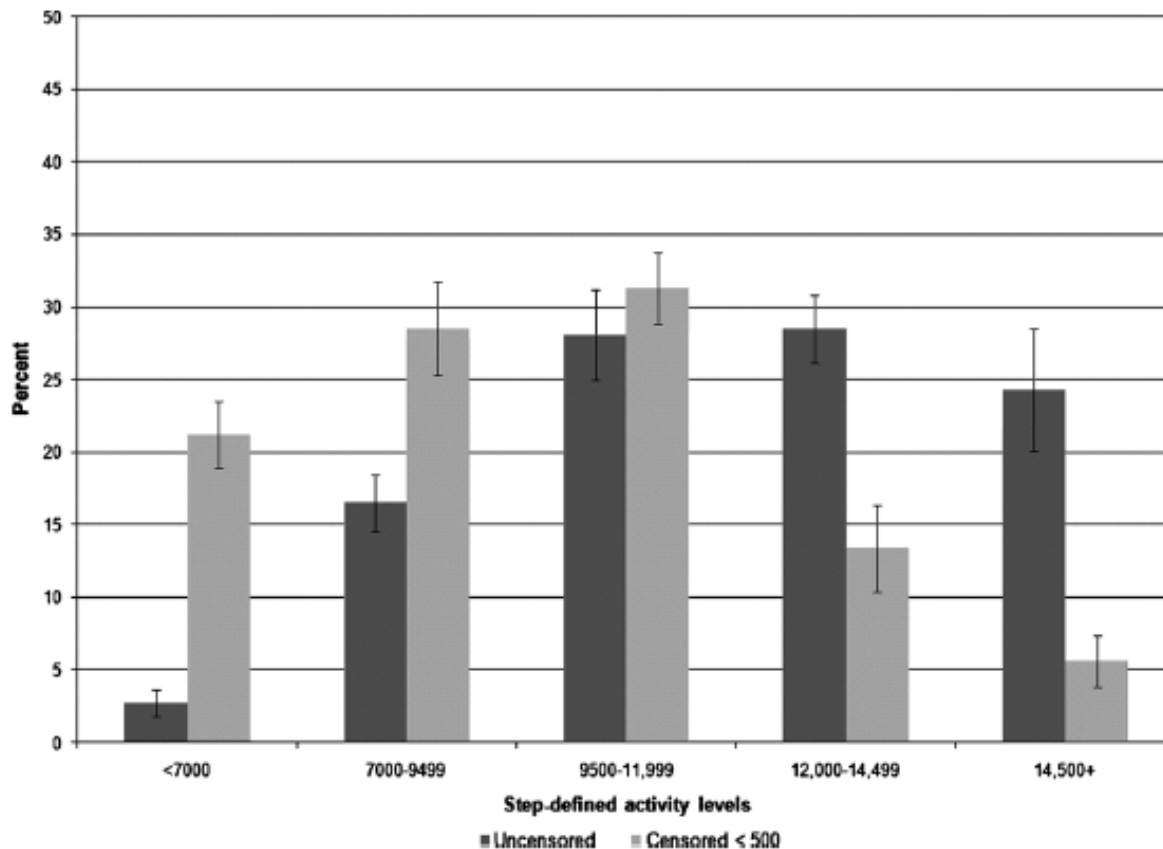


FIGURE 2—NHANES 2005–2006 PAM participants categorized according to step-defined activity levels for female children aged 6–11 yr, considering both uncensored and censored steps: 1) <7000 “sedentary”; 2) 7000–9499 “low active”; 3) 9500–11,999 “somewhat active”; 4) 12,000–14,999 “active”; and 5) $\geq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

CHANGES OVER TIME

Trends and Demographic Effects

EPIDEMIOLOGY

Disparities in Youth Physical Activity in the United States: 2003–2006

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Med Sci Sports Exerc, 2012

- 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

Do Activity Bouts Matter?

OPEN ACCESS Freely available online



Does the Fractionalization of Daily Physical Activity (Sporadic vs. Bouts) Impact Cardiometabolic Risk Factors in Children and Youth?

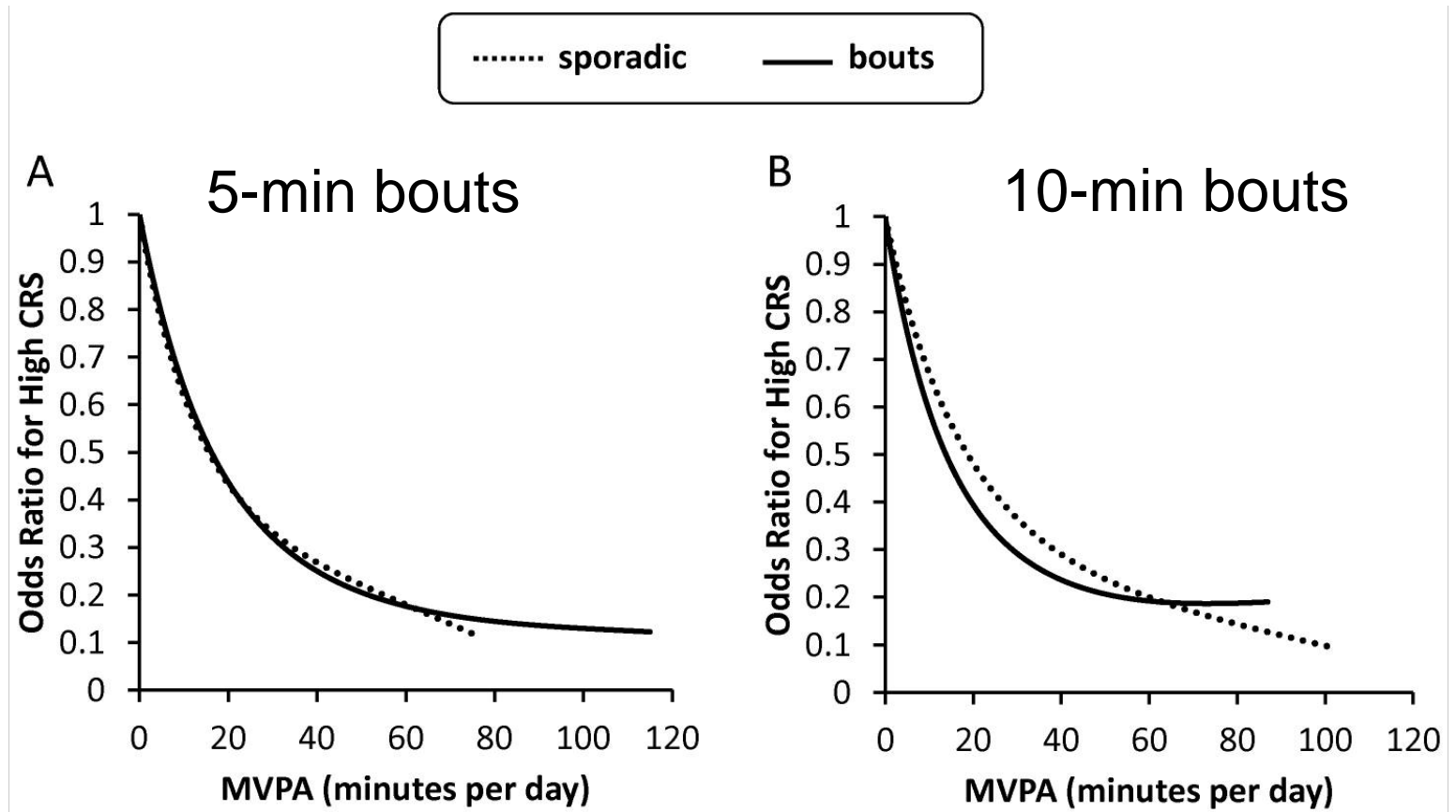
Rebecca M. Holman¹, Valerie Carson¹, Ian Janssen^{1,2*}

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



Sedentary Behavior

Carson and Janssen *BMC Public Health* 2011, **11**:274
<http://www.biomedcentral.com/1471-2458/11/274>



RESEARCH ARTICLE

Open Access

Volume, patterns, and types of sedentary behavior and cardio-metabolic health in children and adolescents: a cross-sectional study

Valerie Carson¹ and Ian Janssen^{1,2*}

- 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...

NHANES: Advancing with Technology



2003-2006 Protocol

- Splash proof
 - Off to swim or shower
- Waist worn monitor
- Waking hours only
- Single axis of sensitivity
- 1 summary value / minute
- 72,000,000 data point for 7000 participants in 2003-4



2011-2014 Protocol

- Waterproof device
- Wrist worn monitor
- 24 hour instrument wear
 - Allows measures of sleep duration and efficiency
- Triaxial data (X, Y, & Z planes)
- 80Hz raw data capture
 - 240 points/sec
- 72,000,000 data points per participant

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

Component	Ages
Accelerometer	3 -15 y
Treadmill	6 -15 y
Lower body strength	6 -15 y
Grip strength	6 -15 y
Modified pull-up	5 -15 y
Plank	3 -15 y
Gross motor skills *	3 - 5 y

* 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!



Review Citation

Tudor-Locke C, Camhi SM, Troiano RP. A Catalog of Rules, Variables, and Definitions Applied to Accelerometer Data in the National Health and Nutrition Examination Survey, 2003–2006. *Prev Chronic Dis* 2012;9:110332.