Combining Survey and Wearable Data on Exercise and Sleep

Stephanie Eckman, Robert Furberg, Ashley Amaya
427 devices available from 266 vendors

217 registered clinical trials using Fitbit devices

More than 450 papers published since 2012
Comparison of Survey & Fitbit Data

with Robert Furberg & Ashley Amaya
Healthy Behavior Data Challenge

- CDC-sponsored contest to improve BRFSS
  - Behavioral Risk Factor Surveillance Study

- RTI solution: collect BRFSS items + Fitbit data
  - Screened Mechanical Turkers for Fitbit ownership
  - Administered BRFSS items
  - Retrieved Fitbit data
  - Linked to survey data

- Won 2\textsuperscript{nd} place in national competition
3-Step Data Collection Protocol

- **Screener**
  - Only Fitbit owners
  - Willing to donate data

- **Survey**
  - Height
  - Weight
  - Physical activity (outside of work)
  - Sedentary behaviors
  - Sleep
  - Demographics

- **Data retrieval options:**
  - Participants manually export
  - Researchers with access manually export
  - Custom Application Programming Interface (API) integration
  - **Commercial third-party vendors with scalable APIs**

- **http://www.fitabase.com**
  - 1-time donation of 1 month data
# Fitbit Measures

## Physical Activity
- # Steps
- Distance on foot
- Days of physical activity
- Minutes moderate-to-vigorous physical activity
- Calories burned
- Active minutes
- Duration of exercise
- Flights of stairs climbed

## Sleep
- Sleep minutes
- Duration awake
- # of times awake
- Time to fall asleep
- Time in REM sleep

## Sedentary
- Hours sedentary, excluding sleep
Participation

Survey only 133
Fitbit only 11
Survey + Fitbit 141

74% Male
82% White

Median: 31
Mean: 33
Days of Fitbit Data per Person
Comparison of Survey & Fitbit Data

- **No Physical Activity**
- **Some Physical Activity**

The chart shows a comparison of Fitbit total steps between individuals with no physical activity and those with some physical activity. The data indicates a higher range of total steps for individuals with some physical activity compared to those with no physical activity.
Comparison of Survey & Fitbit Data
Comparison of Survey & Fitbit Data

Minutes of Physical Activity

Reported Minutes (outside of work) vs. Fitbit Minutes
Using Latent Models to Estimate Health Behaviors from Linked Survey & Device Data

with Robert Furberg
Data Sources

- AddHealth study Wave 5
  ~ 12,000 Wave 5 completes
  ~ 8% report owning device
  ~ 51% approve data transfer
Research Question

- Comparison of 2 sources on sleep and exercise
  - Survey responses
  - Device data
    - Via Validic

- Both subject to error
  - For different reasons
Latent Class/Variable Models to Uncover Truth

- 2 sources, both measured with error

- Similar to Oberski et al JASA, 2017
  - Comparison of survey & administrative data

Evaluating the Quality of Survey and Administrative Data with Generalized Multitrait-Multimethod Models

D. L. Oberski, A. Kirchner, S. Eckman & F. Kreuter
Latent Class Model to Estimate Truth

True values

- Sleep
- Vigorous Exercise
- Moderate Exercise

Observed Values

- Sleep
- Vigorous Exercise
- Moderate Exercise

Sources

- Fitness Tracker
- Survey
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