RELATIONSHIP OF ACCELEROMETER-ASSESSED PHYSICAL ACTIVITY AND SEDENTARY BEHAVIOR WITH PREDICTED CVD RISK IN OLDER WOMEN

Results from the OPACH Study

Michael J. LaMonte, PhD¹, Eileen Rillamas-Sun, PhD², Kelly R. Evenson, PhD³, I-Min Lee, MD, ScD⁴, Dori E. Rosenberg, PhD⁵, Chongzhi Di, PhD², David M. Buchner, MD, MPH⁶, John Bellettiere, MS⁷, Andrea Z. LaCroix, PhD⁷

¹University at Buffalo, ²Fred Hutchinson Cancer Research Center, ³University of North Carolina, Chapel Hill, ⁴Harvard University, ⁵Group Health Research Institute, ⁶University of Illinois, Urbana-Champaign, ⁷University of California, San Diego
Low physical activity (PA) and prolonged sedentary behavior (SB) contribute to high **CVD burden** in older adults.

**Assessing** PA and SB is challenging in older adults.

- Most prospective studies use questionnaires (prone to **misclassification**).
- Prevalence of adults ≥60 years old meeting PA Guidelines:
  - 40% (BRFSS: self report), **2.4%** (NHANES: accelerometer)
- Mean SB (sitting time): **4 hr/day** (self-report), **8 hr/day** (accelerometer)

**Use of accelerometers** to objectively measure PA and SB could improve understanding of associations with CVD risk factors and events.
Gaps in Knowledge

- Need data using **objective** measures - few studies on cardiovascular health in older adults have use objective measures of both PA and SB.

- Need data on **light-intensity** PA – accounts for largest portion of daily PA.

- **An Overall Goal of OAPCH:** To provide evidence on what levels of PA and SB are associated with more favorable levels of CVD factors, predicted and observed CVD risk, and thus better cardiovascular health in late life.
Study Aims

Among older community-living women in OPACH:

1. Examine the relationships of accelerometer-measured PA and SB with predicted CVD risk in 4,870 race-ethnically diverse women, ages 63-99.

2. Determine if the relationships differ by age or race-ethnicity subgroups.
Methods

• Triaxial accelerometer worn at hip for up to 7 consecutive days monitoring.
  • Output → integrated vector magnitude ("counts/15 sec interval") … intensity

• Analysis limited to women without known CVD and:
  (1) at least 4 days with ≥10 hours of accelerometer wear, and
  (2) complete information on risk factors needed to compute the Reynolds Risk Score (10-year predicted CVD risk).

• PA and SB time (hours/day) based on OPACH study calibration cutpoints: (Evenson et al. 2015)
  • Sedentary … (0-18 counts/15 sec)
  • Low light-intensity PA … (19-225)
  • High light-intensity PA … (226-518)
  • Moderate-to-vigorous intensity PA (MVPA) … (≥519)
Hip Worn Accelerometer
Energy Expenditure

Calibrating Counts/15 second with Intensity

(Evenson et al. 2015)

Sedentary (0-18), Light intensity PA (19-518), Moderate-Vigorous intensity PA (≥519)

Legend
- AWAKE
- NONWEAR
- SLEEP

Tracing courtesy of John Bellettiere, MS
Acclerometer Energy Expenditure

Time Spent In Activity Categories

- Sedentary: 1 to 1.5 METs
- Light PA: 1.5 to 3 METs
- MVPA: ≥3 METs
Methods

- Cardiovascular Health assessed using **Reynolds Risk Score** (RRS).

- **Computed using**: Age, Systolic BP, hs-CRP, Total Cholesterol, HDL-C, Diabetes status, HbA1c (if diabetic), Smoking status, Family Hx of MI.

- RRS has better discrimination and calibration of actual CVD events than Framingham Risk Score in WHI-OS (Cook et al. 2012)

- **Higher RRS** reflects higher 10-year predicted risk (%) of a first CVD event.

- **Statistical analyses** were conducted using generalized linear regression models to determine relationships between PA or SB and RRS, adjusting for wear time.
## Participant Characteristics at LLS Visit

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean (SD), or %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years</td>
<td>78.9 (6.6)</td>
</tr>
<tr>
<td>Caucasian</td>
<td>52.4%</td>
</tr>
<tr>
<td>Current smoker</td>
<td>2.3%</td>
</tr>
<tr>
<td>Diabetes</td>
<td>27.8%</td>
</tr>
<tr>
<td>BMI, kg/m²</td>
<td>27.9 (5.7)</td>
</tr>
<tr>
<td>Systolic BP, mmHg</td>
<td>125.7 (14.2)</td>
</tr>
<tr>
<td>Total Cholesterol, mg/dL</td>
<td>197.5 (39.7)</td>
</tr>
<tr>
<td>HDL-C, mg/dL</td>
<td>60.4 (14.9)</td>
</tr>
<tr>
<td>hs-CRP, mg/L</td>
<td>3.6 (8.2)</td>
</tr>
<tr>
<td>RRS</td>
<td>13.7 (11.8)</td>
</tr>
<tr>
<td><strong>range</strong>: 0.8 - 94.3</td>
<td></td>
</tr>
</tbody>
</table>
### Spearman Correlations for CVD factors with PA & SB

<table>
<thead>
<tr>
<th>Variable</th>
<th>Wear time adjusted correlation (r)</th>
<th>Total PA</th>
<th>SB</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>-0.25</td>
<td>0.24</td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td>-0.26</td>
<td>0.25</td>
<td></td>
</tr>
<tr>
<td>Systolic BP</td>
<td>-0.11</td>
<td>0.11</td>
<td></td>
</tr>
<tr>
<td>Total Cholesterol</td>
<td>0.11</td>
<td>-0.10</td>
<td></td>
</tr>
<tr>
<td>HDL-C</td>
<td>0.21</td>
<td>-0.19</td>
<td></td>
</tr>
<tr>
<td>hs-CRP</td>
<td>-0.16</td>
<td>0.15</td>
<td></td>
</tr>
<tr>
<td>RRS</td>
<td>-0.33</td>
<td>0.31</td>
<td></td>
</tr>
<tr>
<td>SB</td>
<td>-0.91</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Study Aims

1. Examine the relationships of accelerometer-measured PA and SB with predicted CVD risk in 4,870 race-ethnically diverse women, ages 63-99.

2. Determine if the relationships differ by age or race-ethnicity subgroups.
Wear Time Adjusted Mean Time (hr/d) spent in PA & SB According to Decile of RRS

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>P-Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total PA</td>
<td>6.9</td>
<td>6.6</td>
<td>6.5</td>
<td>6.2</td>
<td>6.2</td>
<td>5.8</td>
<td>5.6</td>
<td>5.7</td>
<td>5.3</td>
<td>5.0</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Low light PA</td>
<td>3.6</td>
<td>3.5</td>
<td>3.5</td>
<td>3.4</td>
<td>3.4</td>
<td>3.3</td>
<td>3.2</td>
<td>3.2</td>
<td>3.1</td>
<td>3.1</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>High light PA</td>
<td>1.9</td>
<td>1.9</td>
<td>1.8</td>
<td>1.8</td>
<td>1.8</td>
<td>1.7</td>
<td>1.6</td>
<td>1.6</td>
<td>1.5</td>
<td>1.4</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>MVPA</td>
<td>1.3</td>
<td>1.2</td>
<td>1.1</td>
<td>0.9</td>
<td>0.9</td>
<td>0.8</td>
<td>0.7</td>
<td>0.7</td>
<td>0.6</td>
<td>0.6</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>SB</td>
<td>12.0</td>
<td>12.0</td>
<td>11.9</td>
<td>12.5</td>
<td>12.5</td>
<td>12.9</td>
<td>12.7</td>
<td>12.7</td>
<td>12.9</td>
<td>13.3</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

Reynolds Risk Score deciles (n=487 each; 1 = lowest risk, 10 = highest risk)
### Linear Regression of RRS on PA & SB

<table>
<thead>
<tr>
<th></th>
<th>$\beta$</th>
<th>95% CI</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low light PA</td>
<td>-1.8</td>
<td>-1.4, -2.2</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>High light PA</td>
<td>-4.4</td>
<td>-3.8, -4.9</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>MVPA</td>
<td>-5.1</td>
<td>-4.5, -5.7</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>SB</td>
<td>1.9</td>
<td>1.6, 2.1</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

Regression coefficient ($\beta$) is the mean difference in RRS for a 1 hour/day greater time spent in PA or SB. All models adjusted for wear time, race-ethnicity, education, and reported general health status, and mutually adjusted for the PA variables and SB.

Because smoking status is highly correlated with PA and SB, and is part of the RRS, the analysis was repeated excluding current smokers; little change was noted.
Study Aims

1. Examine the relationships of accelerometer-measured PA and SB with predicted CVD risk in 4,870 race-ethnically diverse women, ages 63-99.

2. Determine if the relationships differ by age or race-ethnicity subgroups.
What Have Other Studies Found?

- Lifestyle Interventions and Independence for Elders (LIFE) Study
- 818 mobility limited adults (66% women) >70 years old, without known CVD
- Hip worn Triaxial accelerometer; Framingham Score 10-year predicted CHD risk

FitzGerald et al. J Am Heart Assoc. 2015;4:e001288

OPACH Spearman Correlations with RRS:

<table>
<thead>
<tr>
<th>Activity Level</th>
<th>Correlation Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sedentary (0-18 counts/15s)</td>
<td>r = 0.31</td>
</tr>
<tr>
<td>Light intensity PA (18-518)</td>
<td>r = -0.23</td>
</tr>
<tr>
<td>MVPA (&gt;518)</td>
<td>r = -0.38</td>
</tr>
</tbody>
</table>
Conclusions

Based on objectively measured PA and SB, this study in older women:

• Confirms that prolonged SB is adversely related with cardiovascular health.

• Suggests even light intensity PA could have cardiovascular benefit.

• Showed similar patterns of relationships in age and race-ethnic subgroups.

Given the large proportion of daily activity time spent at lower intensity in older adults, these findings suggest important public health implications.

**Prospective results** are needed to confirm these cross-sectional observations.
The OPACH Team!

**WHI-CCC**
- Eileen Rillamas-Sun
- Chongzhi Di
- Julie Hunt
- Lesley Tinker
- Kyle Campbell
- Todd Panek
- Sheri Greaves
- Yuzheng Zhang
- Ross Prentice

**University of California, San Diego**
- Andrea LaCroix
- John Belletteire

**University of Illinois**
- David Buchner

**Harvard University**
- I-Min Lee
- JoAnn Manson

**Stanford University**
- Marcia Stefanick
- Stacy Sims
- Katelyn Taylor
- Bill Haskell

**University of North Carolina, Chapel Hill**
- Kelly Evenson
- Molly Wen
- Amy Herring
- Steve Marshall

**University of Alabama, Birmingham**
- Beth Lewis
- Nita Webb

**Johns Hopkins**
- Ciprian Crainiceanu
- Jiawei Bai

**University at Buffalo**
- Mike LaMonte