OBJECTIVES

- Discuss levels of cerebral palsy (CP) and the impact on physical activity (PA)
- Distinguish among PA dimensions & measures & discuss their importance in health promotion programs for children with CP
- Discuss the importance of PA in health promotion programs for children and youth with CP

BACKGROUND

- CP:
  - Most prevalent physical disability of childhood (1)
  - Nonprogressive neurdevelopmental disorder (1)
  - Postural and movement challenges (1,2)
  - Secondary musculoskeletal problems (1-3)
  - Decreased fitness & PA (2-4)
  - Gross Motor Function Classification System (GMFCS) (5)

- Health Promotion for Children with CP
  - Improve fitness, PA, functional mobility (3,4,6)
  - Intervention effectiveness may require quantitative measures of PA (7-10)

HEALTH PROMOTION

- GMFCS Level (5)
  - Severity of CP
- PA Dimensions (10)
  - Frequency
  - Intensity
  - Type
  - Time
- Child & Family Goals (11)
  - Activity & Participation
  - Facilitators & Barriers (12,13)

MEASURING PA in CP

- Qualitative Measures
  - Child Activity, Participation, & Enjoyment Questionnaire (14)
  - PA Questionnaires (15)
- Quantitative Measures
  - Pedometers (16)
  - Accelerometers
    - StepWatch (6)
    - ActiGraph (17)
PURPOSE

Aim 1: Establish inter-instrument reliability among accelerometers
- ActiGraph (hips), BodyMedia (arms),
  StepWatch (ankles)
Aim 2: Establish criterion validity
- Accelerometer vs. Oxygen Consumption
Aim 3: Determine if accelerometers differentiate PA intensity

PA PROTOCOL

- Quiet resting in supine
- Handwriting task
- Wiping table top
- Folding laundry & carrying
  laundry bag
- Xbox Kinect
  - River Rush/Space Pops
- 6 Minute Walk Test:
  - slow, brisk, & fast paced

MEASURES

- Accelerometry
  - ActiGraph – 1 sec epochs
  - Step & Activity Counts
  - Bodymedia SenseWear – 1 min epoch
  - Steps
  - StepWatch – 3 sec epochs
  - Step Counts
- Indirect Calorimetry
  - Measure oxygen consumption

PARTICIPANTS (n=52)

- 2 clinical sites
- Mean age: 12 years 6 months (SD = 3.3)
- Gender: 28 female (54%); 24 male (46%)

<table>
<thead>
<tr>
<th>GMFCS</th>
<th>n (%)</th>
<th>Distribution</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GMFCS I</td>
<td>26 (50)</td>
<td>Hemiplegia</td>
<td>28 (53.8)</td>
</tr>
<tr>
<td>GMFCS II</td>
<td>14 (26.9)</td>
<td>Diplegia</td>
<td>21 (40.4)</td>
</tr>
<tr>
<td>GMFCS III</td>
<td>12 (23.1)</td>
<td>Quadruplegia</td>
<td>2 (3.8)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Triplegia</td>
<td>1 (1.9)</td>
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</tbody>
</table>

DATA ANALYSIS

Aim 1
- Inter-instrument reliability
  - Intra-class correlation coefficients (ICC)

Aim 2
- Concurrent validity
  - Spearman Correlation

Aim 3
- Determining differences in PA intensity across trials
  - Friedman Test (nonparametric RM ANOVA)

Results: Inter-instrument Reliability

<table>
<thead>
<tr>
<th>Model / Variable</th>
<th>ICC</th>
<th>Lower 95% CI</th>
<th>Upper 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>ActiGraph</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steps</td>
<td>0.986</td>
<td>0.983</td>
<td>0.989</td>
</tr>
<tr>
<td>Vertical</td>
<td>0.985</td>
<td>0.982</td>
<td>0.987</td>
</tr>
<tr>
<td>Vector Magnitude</td>
<td>0.981</td>
<td>0.978</td>
<td>0.984</td>
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<tr>
<td>BodyMedia</td>
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</tr>
<tr>
<td>Steps</td>
<td>0.940</td>
<td>0.929</td>
<td>0.950</td>
</tr>
<tr>
<td>METs</td>
<td>0.805</td>
<td>0.772</td>
<td>0.834</td>
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<tr>
<td>StepWatch</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steps</td>
<td>0.977</td>
<td>0.969</td>
<td>0.982</td>
</tr>
</tbody>
</table>

ICC: Agreement between L & R monitor placement
Results: Concurrent Validity

\[
\begin{array}{|c|c|}
\hline
\text{ActiGraph} & \text{Spearman} \\
\hline
\text{Steps L} & 0.82 \\
\text{Steps R} & 0.83 \\
\text{Vertical L} & 0.84 \\
\text{Vertical R} & 0.83 \\
\text{Vector Magnitude L} & 0.85 \\
\text{Vector Magnitude R} & 0.82 \\
\hline
\end{array}
\]

Correlations between accelerometry data and VO2 data

Results: Concurrent Validity

\[
\begin{array}{|c|c|}
\hline
\text{BodyMedia} & \text{Spearman} \\
\hline
\text{Steps L} & 0.73 \\
\text{Steps R} & 0.75 \\
\text{METs L} & 0.70 \\
\text{METs R} & 0.73 \\
\text{StepWatch} & \\
\text{Steps L} & 0.77 \\
\text{Steps R} & 0.79 \\
\hline
\end{array}
\]

Correlations between accelerometry data & VO2 data

Results: Counts/Minute (Median)

<table>
<thead>
<tr>
<th>Trial</th>
<th>AG (Counts)</th>
<th>AG (Steps)</th>
<th>BodyMedia (Steps)</th>
<th>StepWatch (Steps)</th>
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<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>3</td>
<td>65.33</td>
<td>2.92</td>
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<td>5.12</td>
<td>21.33</td>
<td>9.00</td>
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<td>7</td>
<td>365.72</td>
<td>17.28</td>
<td>73.00</td>
<td>23.12</td>
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<td>8</td>
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<td>24.25</td>
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<td>9</td>
<td>1016.53</td>
<td>29.00</td>
<td>103.67</td>
<td>29.75</td>
</tr>
</tbody>
</table>

Results

- All accelerometers showed inter-instrument reliability
- ActiGraph had slight advantage
- All accelerometers are valid for measuring physical activity intensity
- ActiGraph & StepWatch showed highest correlations
- All accelerometers were significant in detecting differences in physical activity intensity among most trials
- BodyMedia - Did not differentiate between chores (table wiping & towel folding) and videogaming (Xbox Kinect) or between different walking speeds.

Discussion and Conclusions

- Good news!
  - Accelerometry may be a valid and reliable measure of PA in children and youth with CP
- Choosing accelerometers
  - What is your focus?
    - ActiGraph: Increase overall PA level and intensity
    - StepWatch: Increase walking frequency and duration
    - BodyMedia: Increase upper body activity level and intensity
Future Directions

- Compare accelerometer step counts to "hand counts"
- Examine PA patterns on the subsample of youth who wore ActiGraph GT3x+ accelerometers (n=25)
- Use accelerometers to measure free living PA in youth with CP GMFCS Levels I-III
- Use accelerometers to measure intervention outcome effectiveness

References