Physical Therapy and Rehabilitation Sciences Department

**Validity of Accelerometry to Measure Physical Activity Intensity for Clinical Trials in Youth with Cerebral Palsy**

**Investigators**
Margaret E. O'Neil, PT, PhD, MPH, Drexel University
Maria Fragala-Pinkham, PT, DPT, MS, Franciscan Hospital for Children
Nancy Lennon, PT, MS, Nemours/AI duPont Hospital for Children
Stewart Trost, PhD, The University of Queensland, Queensland, Australia
Stephen M. Haley, PT, PhD, Boston University, School of Public Health, Health and Disability Research Institute

**Summary/Overview**
Cerebral palsy (CP) is the most common physical disability of childhood. Although CP is a non-progressive neuromuscular disorder, children with CP often experience decreased physical activity and functional mobility as they grow and age. Despite these limitations, most youth with CP are ambulatory.

Current trends in rehabilitation interventions include activity-based intervention strategies to promote fitness, physical activity and participation. Intervention effectiveness includes measures of physical activity and fitness. To date, most activity-based intervention studies have examined physical activity using self-report measures (or parent proxy self-report measures). It is important to include objective measures of physical activity dimensions (frequency, intensity, duration) when examining outcome effectiveness of activity-based interventions. Accelerometers are used to objectively measure physical activity in children and youth with typical development and may be appropriate for children and youth with CP. It is especially important to establish the validity of accelerometers to measure physical activity intensity when determining "dosing" for activity-based interventions.
The two specific aims of this project are to:

1) Validate the accuracy of accelerometers in estimating levels of physical activity intensity based on energy expenditure for youth with CP.

2) Establish specific calibration equations for physical activity intensity (energy expenditure) for youth with CP

Research Plan

This project uses a cross-sectional measurement study design. The study is being conducted in the clinical research laboratory at Franciscan Hospital for Children (FHFC), Boston, MA and the Gait Laboratory at Nemours/Al duPont Hospital for Children, Wilmington, DE. Participants are 52 youth with CP aged 6-18 years, GMFCS levels I – III recruited via convenience sampling from hospital clinics, schools and through networks with rehabilitation professionals in the greater Boston and Wilmington areas.

Each participant took part in a 2.5 hour data collection session in which parent and youth complete demographic and health behavior questionnaires. Parents completed the PEDI-CAT and youth were measured on height and weight to calculate BMI. All youth participated in a physical activity protocol while wearing pairs of accelerometers to measure activity and step counts (StepWatch at the ankle; ActiGraph at the hips; and BodyMedia Sensewear at the upper arms) and a portable indirect calorimetry unit (Cosmed k4b2). The Physical Activity Protocol consisted of eight activity trials ranging from light – vigorous intensity. Data collection was recently completed and we are in the process of analyzing data. Preliminary results from the first 25 participants are included below:

Preliminary Analysis and Results

The purpose of this preliminary study analysis was to examine reliability and validity of physical activity measures for 25 youth with CP who are ambulatory. A cross-sectional measurement study design was used. The study was conducted in two hospital outpatient rehabilitation departments. Inclusion criteria were that youth: 1) are ambulatory; 2) aged 6-18 years; 3) GMFCS Levels I – III; 4) able to follow multi-step directions; and 5) able to tolerate a 2.0 – 2.5 hour data collection session while wearing accelerometers and a portable indirect calorimeter. Fifty-two participants are enrolled with a mean age 11.98 years (SD 3.35). Participants were mostly girls (52%), having a clinical diagnosis of spastic hemiplegia (50%) and classified at GMFCS Level I (48%).

Parents and children completed health questionnaires. Parents completed the PEDI-CAT. Children were measured for height, weight and BMI was calculated. Children wore accelerometers bilaterally on the upper arms (Bodymedia SenseWear), hips (ActiGraph GT3X) and ankles (StepWatch) and a Cosmed K4b2 portable indirect calorimeter while performing a PA protocol consisting of eight activity trials (5-6 minutes each). Each activity trial required increased VO2 consumption (PA intensity). Trials included supine resting, writing, spraying and wiping a counter, folding laundry, playing active X-Box Kinect games, and walking at three different self-selected speeds (comfortable/slow, brisk, fast). Intra-class coefficient correlations (ICCs) were generated to evaluate inter-instrument reliability (left to right side placement). Spearman correlations were used to evaluate concurrent validity between accelerometer activity and step count data and VO2 data measured by the Cosmed K4b2 portable unit. Statistical significance was set at an alpha level of 0.05.

Inter-instrument reliability was established for all accelerometer activity and step count data for these 25 subjects. All ICCs (0.93-0.99) were significant. Validity was established
between accelerometer activity and step count data and VO2 data. Spearman correlations were significant and were very good for vertical axis ActiGraph activity counts (r=0.82) and StepWatch step counts (r=0.81) and were good for BodyMedia step counts (r=0.70).

Inter-instrument reliability was slightly better for the ActiGraph compared to the other accelerometers. Validity was equally good for ActiGraph and StepWatch and less good for BodyMedia SenseWear. Accelerometry may be an appropriate research and clinical measure of PA for youth with CP who are ambulatory.

Impact
If concurrent criterion validity is established between accelerometry data (activity and step counts) and indirect calorimetry data (oxygen consumption) then we will have determined that accelerometers are appropriate objective measures of physical activity intensity for youth with CP. These measurement devices may then be used to determine “dosing” and to examine outcome effectiveness of activity-based interventions.

Funding
Jette, Alan (PI): Improving Outcome Measurement for Medical Rehabilitation Clinical Trials; NIH: R24 HD065688-01; Boston University, School of Public Health, Health and Disability Rehabilitation Institute (HDRI), Boston Rehabilitation Outcomes Center (ROC)

Pediatric Pilot Study Funding: 2010 – 2013

Participating Sites
Franciscan Hospital for Children, Boston, MA
Nemours/AI duPont Hospital for Children, Wilmington, DE

Related Links
Boston University, School of Public Health, HDRI, Boston ROC: http://www.bu.edu/bostonroc/pilot-studies/previous/

Franciscan Hospital for Children: http://www.franciscanhospital.org/Home/ProgramsServices/ResearchCenter/page.aspx/1043

Nemours/AI duPont Hospital for Children: http://www.nemours.org/service/medical/gaitanalysis.html

Contact us
Maggie O’Neil: moneil@drexel.edu
Maria Fragala-Pinkham: mfragala@fhfc.org