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Measurement of Activity and Participation of Children who are Wheelchair Users: Actigraph, Geographic Information System (GIS), and Global Positioning System (GPS)

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BACKGROUND

Children with disabilities are more restricted in their participation in leisure, recreational, and sport physical activity (PA) than their average developing peers, therefore, improving their participation in PA in the home, school, and community is an important outcome of rehabilitation interventions.¹

Participation is influenced by factors related to the child, family, and environment. The environment might be more amenable to change compared to the child's health conditions and sometimes functioning abilities.²

Hence improvements in the measurement of participation in physical activity and the influences of the environment are needed.

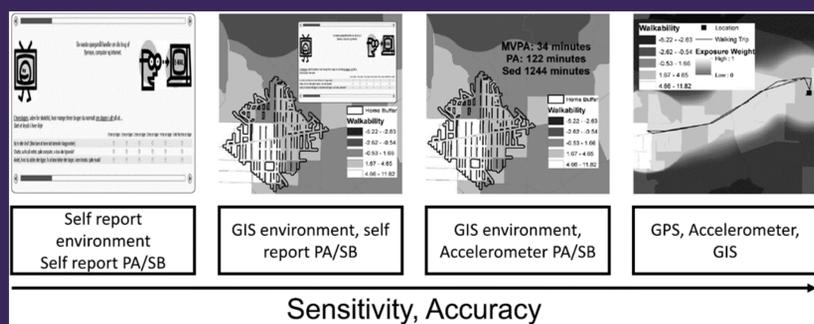
Combination of accelerometry, GPS, and GIS provides a new innovative opportunity to quantitatively measure a child's participation in physical activity in natural, real-life settings and contribute to the understanding of the environmental facilitators and barriers that might impact that participation.³

PURPOSE

Determine the feasibility of a novel combination of accelerometry, GPS, travel diary, and GIS to objectively quantify and compare amount and location of participation in physical activity of children who use wheelchairs.

Explore the mapping of this combined data for analysis of environmental facilitators and barriers that may influence the participation in physical activity of children who use wheelchairs.

FRAMEWORK⁴



METHODS

Participants

Case Series:

1. Sport Wheelchair User (SWC): 10 year old boy (Amb in home, Loftstrands)
2. Manual Wheelchair User (MWC): 12 year old boy (Walker in home)
3. Power Wheelchair User (PWC): 8 year old girl (Crawls)
4. Dependent Wheelchair User (DWC): 6 year old girl (Pushed by caregiver)

Procedures

Accelerometer: GT3X Actigraph⁵



1. Dominant wrist
2. All waking hours for 7 days
3. Records body movement (PA) in three planes through activity counts
4. Activity levels based on counts/min⁶
 - Sedentary physical activity (SPA) < 100 counts/min
 - Light physical activity (LPA) 100 – 2000 counts/min
 - Moderate to vigorous physical activity (MVPA) > 2000 counts/min

GPS: Qstarz Q-1000xt⁷



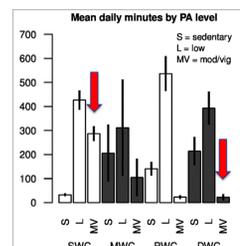
Day's Start	Day's End	How did you get here?	Where did you go?
Home	School	Car	Classroom/School Activity
Home	Work	Bicycle	Shopping
Home	Other	Walking	Sports/Exercise
Home	Home	Wheelchair	Hang Out With Friends/Socialize
Home	Home	Other	Community Activity (Church, Club)

1. Ankle
2. All waking hours for 7 days
3. Records outdoor time and location of movement of child: GPS points
4. Accuracy ~ 3 meters in any direction

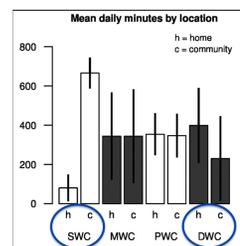
Travel Diary: Child and/or Parent Report

RESULTS

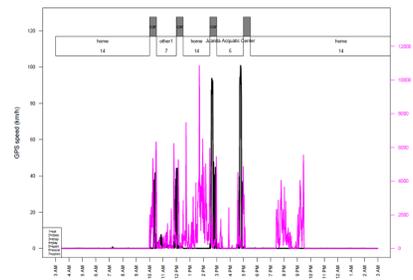
The mean daily amount of minutes each child spent in the 3 physical activity levels based on activity counts. For example, the mean daily minutes of MVPA for the SWC is higher than that of the DWC. SWC and MWC spent more time in higher activity levels than did PWC and DWC.



The mean daily minutes of time spent in the home compared to the community. For example, the SWC spent more mean daily minutes of time in the community compared to his home. In contrast, the DWC spent more mean daily minutes of time in her home than the community.



LifeLog⁸: Synchronized Actigraph and GPS data quantifies duration and intensity of PA by location. Child/Parent-reported travel diary describes types and locations of participation in physical activity during daily life.

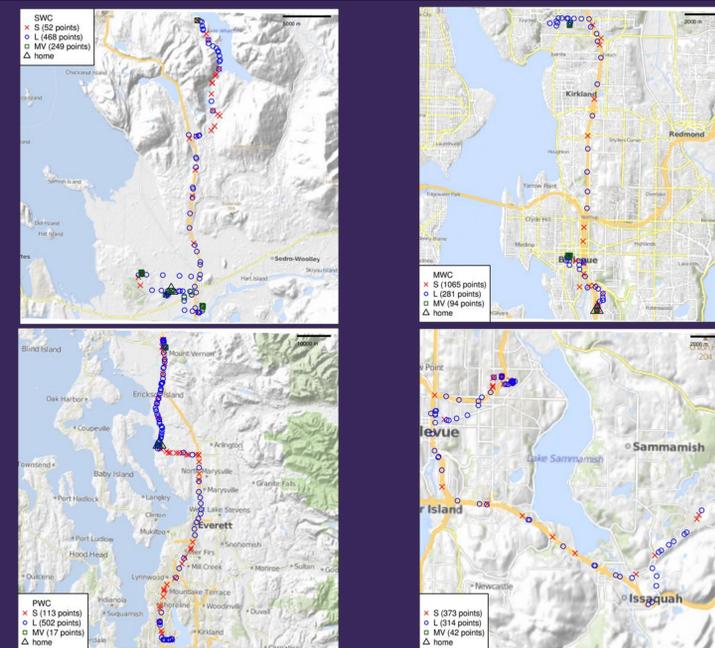


RESULTS

Daily maps of travel with GPS points and PA levels with travel diaries show:

- SWC - 4 episodes MVPA at home, school, physical therapy clinic, city fairgrounds,
- MWC - 3 episodes MVPA at home, school, and sports center,
- PWC - 2 episodes MVPA at home and hippotherapy clinic
- DWC - 1 episode MVPA at home.

Maps capture *where* and *when* different activities/activity levels occur. Future work will explore patterns by wheelchair use. For example, the SWC and MWC have greater number of MVPA episodes in a variety of settings (home, school, and community) whereas PWC and DWC have less MVPA episodes that take place primarily at or close to home.



DISCUSSION/CONCLUSIONS

- Combination of Actigraph, GPS, GIS, and travel diary has potential to provide rich objective data to quantify participation in PA within daily life of a child who uses a wheelchair.
- Appears sensitive to differentiating PA levels for different wheelchair users.
- Mapping of combined data has potential for analysis of environmental factors that may influence participation in PA.
- Potential for this information to help develop interventions to enhance participation in PA in children who use wheelchairs.
- Further work is warranted to validate this novel methodology.

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ACKNOWLEDGMENTS

Walter C. and Anita C. Stolov Research Fund
Seattle Children's Hospital, Seattle, WA
Urban Form Lab, University of Washington, Seattle, WA
On Track Study (http://www.canchild.ca/en/ourresearch/on_track_study.asp)
With funding from the Patient Centered Outcomes Research Institute (PCORI)