Protocol for a scoping review: **The use of accelerometers on preschool aged children: a methodological review**

Becky Breau[1,2], Claire Mazzia[1,2], Jess Haines[2,3], David W.L. Ma[1,2], Ali M. Versluis[4] Lori Ann Vallis [1,2] and Guelph Family Health Study

[1] Department of Human Health and Nutritional Sciences, University of Guelph, Guelph, Ontario, Canada
[2] Guelph Family Health Study, University of Guelph, Guelph, ON, Canada
[3] Family Relations & Applied Nutrition, University of Guelph, Guelph, ON, Canada
[4] Research and Scholarship Team, University of Guelph Library, Guelph, ON Canada

Correspondence: lvallis@uoguelph.ca

Abstract
Background:
Investigation of physical activity (PA) levels in Canadian preschool aged children (6 months-6 years) is essential in order to determine whether or not they are meeting current national recommendations of 180 minutes of any type of PA per day. However, major methodological inconsistencies may be preventing proper representation of how much and what types of activities these children are actually completing on a daily basis. Although advances in wearable technology have permitted researchers to capture free –living movement in adult, adolescent and school-aged child populations, few studies have validated and calibrated the use of accelerometers in preschool aged children. Among the studies that have been completed in this population, major methodological inconsistencies exist with regards to data processing and other methodological considerations, making it impossible to compare results across studies. To improve tracking of PA in children aged 6 months-6 years, a standardized best practices protocol should be developed; therefore, a review of the current data processing technics is imperative.
Methods:
Intervention studies and randomized and non-randomized clinical trials describing PA tracking through use of accelerometers in children aged 6 months-6 years from the last ten years are eligible for inclusion. Eligible outcome measures include accelerometer model, accelerometer placement, sample rate, epoch length, and data processing measures including "non-wear" time definition, description of a "valid day" and cut points used for defining each intensity of PA. The search strategy will use Medline (via OvidSP), Cochrane Library, CINAHL, Web of Science and Global Health. A search of the gray literature will be conducted through Google Scholar (first 20 pages) and ProQuest conference papers and proceedings, ProQuest dissertations and Open Access Theses and Dissertations.
Discussion:
This review will aim to provide a summary of the current methodological techniques used to track PA in a preschool aged population found within the literature. Emphasis will be placed on the frequency of reporting for the outcome measures listed above.

Keywords:
Scoping Review, Accelerometer, preschool, toddler, physical activity, sedentary, measurement.

Background

Past research has examined physical activity (PA) levels in *school aged* children and adults, however few studies examine these levels in *preschool* aged children. It is essential to investigate PA levels present in this age group, not only because childhood obesity rates continue to rise (Guinhouel et al. 2011), but also because research indicates lifelong exercise habits develop during early childhood, specifically during the preschool years of development (Malina, 1996). Although PA amounts are frequently investigated in children and youth, very few reviews have examined the methodologies used to track PA levels, even fewer have reviewed methodologies specific to accelerometery in preschoolers (Cain et al 2013, Cliff et al. 2008). Accelerometers have made the collection of PA data in a free-living environment over the span of several days more affordable, efficient and objective, however no standardized protocol for analyzing accelerometer data in preschoolers currently exists. This standardization is critical as it has been shown that different data acquisition and processing techniques for accelerometer data can impact PA outcomes extensively, yielding inaccurate representations of daily PA levels in this population (Masse et al. 2005). The need for a more standardized data collection method was emphasized by the Canadian Society for Exercise Physiology (CSEP) when current levels of PA in Canadian preschoolers were investigated to determine if PA guidelines are being met by these children (Tremblay et al., 2017). A review of recent methodologies used when tracking PA in preschoolers via accelerometers will provide a thorough summary of the body of evidence that will inform a best practice guide for the investigation of PA in preschoolers when using accelerometers. It will also help identify gaps in the literature and emphasize the need for accurate and detailed reporting of all methodological processes when analyzing accelerometer data from all populations, including preschool aged children.

Methods

This protocol adheres to relevant items on the PRISMA for systematic review protocols (PRISMA-P) checklist (Moher et al. 2015). The overall approach of the review will closely follow the PRISMA guidelines for systematic reviews and Meta-Analyses.

Study Registration

This protocol is archived in the University of Guelph Library online repository.

Review Question

This review aims to comprehensively explore the data processing techniques chosen for analyzing and reducing accelerometery data from preschool aged children. Specifically, frequency of reporting methodologies such as accelerometer model, accelerometer placement, sample rate, epoch length, and data processing measures including "non-wear" time definition, description of a "valid day" and cut points used for defining each intensity of PA will all be assessed.

Eligibility Criteria

Primary study design, characteristics, and population. This review will include intervention studies and both randomized and non-randomized clinical trials available in English and completed within the last 10 years. Observational studies are not eligible for inclusion. Studies using any accelerometer model with children between the ages of 6 months and 6 years old for any duration of time are eligible for inclusion.

Outcome measures. As various data processing techniques and methodological considerations need to be made when analyzing accelerometer data in preschool aged children, many outcome measures will be observed. To be included in this review, studies must include one or more of the following outcomes: accelerometer model, accelerometer placement, sample rate, epoch length, and data processing measures including "non-wear" time definition, description of a "valid day", inclusion criterion and cut points used for defining each intensity of PA (sedentary, light physical activity, and moderate-to-vigorous physical activity).

Information sources

A variety of databases will be used to increase the search sensitivity and to capture both published and unpublished literature. Electronic searches will be completed using the following databases: Medline (via OvidSP), Cochrane Library, CINAHL, Web of Science and Global Health. A search of the gray literature will be conducted through Google Scholar (first 20 pages) and ProQuest conference papers and proceedings, ProQuest dissertations and Open Access Theses and Dissertations.

Search strategy

The literature search will be completed in July 2018 and will be limited to publications in English, published within the last 10 years. A draft of the MEDLINE search terms can be seen in Table 1. Search strategies were adapted to the syntax of other databases, subject headings were used where appropriate. A research librarian with the University of Guelph was consulted on the search strategy (AMV). Searches will be uploaded to EndNoteX8™ (Clarivate Analytics; Philadelphia, Pa, United States) and duplicate results will be documented and removed. Documentation of all search strategies and results will be provided in the final report.

Study Selection

Studies will be subjected to two rounds of screening. Primary screening of title and abstracts will be performed independently by BB and CM any incongruities will be resolved by consensus and arbitrated by LAV if a decision cannot be reached. The following questions will be used during the preliminary round conducted by BB and CM to assess the relevancy of title and abstract:

1) Does the title and/or abstract describe an intervention study, a randomized/ non-randomized clinical trial or a technical note?
2) Does the title and/or abstract describe a study involving use of accelerometers in children between the ages of 6 months and 6 years?

Studies will be excluded if both reviewers agree that one or more of these descriptions are not satisfied. If it is *unclear* whether or not one or more of these descriptions have been fulfilled, the study will proceed to full text screening. Conflicts between inclusion and exclusion by reviewers will be resolved by consensus and mediated by LAV. The full text of the remaining studies will be examined by BB and CM during a secondary screening using the initial two questions as well as the following question:

3) Does the study report <u>at least one</u> of the following outcomes: accelerometer model, accelerometer placement, sample rate, epoch length, "non-wear" time definition, description of a "valid day", inclusion criterion, cut points used or threshold used?

Studies will be excluded if both reviews answer "no" to the previous question; conflicts will be resolved by a consensus and mediated by LAV. Records of study citations and reasons for exclusion will be recorded at this stage of screening.

Data Extraction

Data from studies meeting the study selection criteria will be independently extracted by BB and CM. Data extraction will be done independently by BB and CM, any incongruities will be resolved by consensus and arbitrated by LAV if a decision cannot be reached.

Study-level data will consist of study period (year) and population. Population characteristics will consist of: mean age, and sex (male, female).

Other data to be extracted:
- Model of accelerometer used: company and version of accelerometer and data processing software used.
- Accelerometer placement: body site and positioning of accelerometers on participants.
- Sample rate of accelerometer
- Epoch length
- Definition of "non-wear time": algorithm used to detect non-wear periods.
- Valid day definition: minimum wear time needed in a day for the day to be considered valid.
- Inclusion criterion: the amount of wear time (days and time per day) needed for the participant to be included in the study.
- Cut points used: thresholds for determining dividing accelerometer outputs into varying intensities of PA (Sedentary behaviour, light PA and moderate-to-vigorous PA)
- Acceleration threshold used
- Other method of categorizing PA intensity

Presentation of results

- Details of the study population characteristics and outcomes assessed will be presented in a summary table.
- Details of the frequency of reporting of each outcome measure will also be reported in a table.

Discussion

This review will aim to provide a summary of the current methodological techniques used to track PA using accelerometers in a preschool aged population found within published literature. Emphasis will be placed on the frequency of reporting for the outcome measures listed above.

Acknowledgements

References

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Table 1: Initial search strategy conducted in Medline (viaOvidSP) on 07/24/18

#	Search Terms	Results
1	(acceleromet* or actigraph* or GT3X or MTI or CSA or GeneActiv or ActivePal or activity monitor* or wearable device* or track*). ab,kf,ti. [ab= abstract, kf= keyword, ti= title]	158 549
2	exp Accelerometry/	6436
3	exp Fitness Trackers/	162
4	(child* or infant* or preschool* or pre-school or toddl er* or kid*). ab,kf,ti. [ab= abstract, kf= keyword, ti= title]	1 948 697
5	exp Child, Preschool/	855 802
6	exp Infant/	1 069 323
7	(physical activity or fitness or exercise or sedentary or MVPA or moderate-to-vigorous or vigorous or intensity* or threshold or cutpoint* or cut point* or cut-point* or METS). ab,kf,ti. [ab= abstract, kf= keyword, ti= title]	899 613
8	exp Exercise/	167 392
9	exp Sedentary Lifestyle/	6888
10	exp Pediatric Obesity/	5524
11	**1** or **2** or **3**	159953
12	**4** or **5** or **6**	2 620 055
13	**7** or **8** or **9** or **10**	966 342
14	**11** and **12** and **13**	3554
15	**14** and 2008:2018(sa_year)	2996