Study Protocols

Learning environments' activity potential for preschoolers (LEAPP): study rationale and design

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Significance for public health

This study represents the first examination of the differences in physical activity levels among preschoolers attending various early learning environments. As such, it is important that the methodology undertaken be shared in the event that other researchers doing comparable work want to adopt a similar approach. Results of this research may inform the work of health promotion, public health, and early learning stakeholders. Specifically this work may impact early learning curricula, policies, and practices in service of helping Canada's preschool cohort become sufficiently physically active.

Abstract

Background. The purpose of this paper is to provide an overview of the study protocol for the Learning Environments' Activity Potential for Preschoolers (LEAPP) study, the goal of which is to describe the activity levels of preschoolers attending various early learning venues and explore which attributes of these facilities (*e.g. curriculum*, policies, equipment, etc.) support activity participation.

Design and Methods. This cross-sectional study aimed to recruit approximately 30 early learning environments requesting participation from preschoolers aged 2.5-5 years. Data collection included: Actical accelerometers (MiniMitter, Oregon, USA) to measure the activity levels of children for five consecutive days (15-second epoch length) while in care; the Environment and Policy Assessment and Observation tool to explore the early learning environment's impact on activity; anthropometric data; the Child Temperament Questionnaire to assess the influence of preschoolers' temperament on physical activity; and demographic information from parents/guardians and early learning staff. ANOVA and linear regression analyses will be conducted to assess variances in activity levels among preschoolers attending different early learning types and to explore the impact of early learning environments on their activity levels. Independent sample *t*-tests will be used to examine differences in activity levels based on sex and weight status.

Expected impact of the study for public health. This research will provide the first Canadian data to address environmental influences on preschoolers' activity levels in differing early learning environments. Additionally, this work will highlight the extent to which activity levels vary among preschoolers enrolled in full-day kindergarten, centre-, and home-based childcare.

Background

The preschool years have been identified as an ideal time to inter-

vene to promote physical activity (PA), as childhood interventions can promote lifelong healthy behaviours prior to the development of unhealthy habits.[1] Unfortunately, a recent systematic review of 39 studies revealed that only 54% of preschool-aged participants engaged in a minimum of 60 minutes of daily activity.[2] This low rate of activity participation is especially worrisome given that Taylor and colleagues noted that the activity levels of a large sample of New Zealand preschoolers (*n*=244) decreased by 50% between 3 and 4 years of age, and remained significantly lower at age 5.[3]

There is limited research documenting Canadian preschoolers' PA. Obeid and colleagues found that preschoolers participated in 220 minutes of daily PA, 75 minutes of which was moderate-to-vigorous physical activity (MVPA).[4] In contrast, Temple and colleagues noted that children attending home-based childcare engaged in 1.76 minutes of MVPA per hour, translating into approximately 13 minutes of MVPA during childcare hours.[5] With regard to centre-based childcare, Vanderloo and colleagues found similar rates of activity participation among preschoolers (11.45 minutes of MVPA and 132.61 minutes of total activity per day during childcare hours).[6] Although the preschoolers in Obeid *et al*.[4] study did meet the Canadian physical activity guidelines, Temple[5] and Vanderloo[6] found much lower rates of activity among the participants in their studies. This discrepancy could be accounted for by the fact that Temple's and Vanderloo's teams explored activity during childcare hours, as compared to the full day.

The early learning environment has received recent scholarly attention in relation to PA.[7,8] Approximately 80% of preschoolers with working parents attend childcare,[9] and in Ontario, many preschool-aged children now attend full-day kindergarten (FDK) (50,000 children in 2012). Therefore, the implementation of policies in early learning centres may be an ideal way to increase PA in this population,[10] especially since recent findings conclude that children are inactive during the majority of their time in childcare.[11] Previous research suggests that preschoolers learn many lessons in early learning centres, including those related to PA behaviours.[12] Moreover, many parents/guardians report that they rely on early learning staff to ensure their preschoolers engage in sufficient activity,[13] which places these educators *[…] in a unique position to support and encourage an active lifestyle among very young children*.[14] However, childcare providers have expressed many challenges in facilitating PA participation in early learning centres (*e.g*., inadequate equipment, insufficient space, safety concerns, and weather).[15]

Research has indicated that preschoolers' PA levels can be influenced by various attributes of the early learning environment, including: indoor/outdoor play space; the availability of gross motor equipment; staff training in relation to PA; and dedicated time for gross motor activities.[6,11,16,17] Despite these results, what remains unclear is *how* early learning environments differ with regard to supporting PA. This research is necessary as the early learning centre itself has been identified as a stronger predictor of PA than any demographic factor,[11]

and it has been noted to account for approximately 50% of the variation in activity levels among preschoolers.[18] While the early learning environment has been acknowledged as a significant influence on preschoolers' activity behaviours internationally, no Canadian data exist which assesses this relationship. This research is vital to ensure Canadian early learning facilities are supporting and promoting sufficient levels of PA among young Canadian children. Moreover, regulations for early learning environments (*e.g.*, amount, frequency, and type of PA) may vary; and therefore, these data are necessary.

Exploring the association between preschoolers' PA levels and both body composition and temperament are also warranted. For example, temperament may be associated with the child's choice to engage or not engage in active opportunities available in the childcare environment, which in turn, may be linked with the body composition of that child. Findings from Tucker and colleagues' focus group discussions with childcare providers highlight the importance of examining child temperament as it was suggested that variations in preschoolers' PA levels may be a result of their personality and/or preferences.[19] To this end, research purports that girls with high activity temperament expend more energy and are leaner, emphasizing the relationship between temperament and both activity and body composition.[20]

Few studies have examined the link between body mass index (BMI) and objectively measured activity levels of preschoolers,[21] and among those that have considered this relationship, the findings have been inconsistent. Greater attention to this area would not only provide grounds for discussion regarding the potential link between body composition and preschoolers' activity levels, but may also help identify which intensity levels are associated with adiposity gains if any. Finally, researchers consistently note sex differences in activity participation among preschoolers.[2,5] Specifically, girls have been noted to engage in less PA than boys. Further research to explore this variation in PA levels among preschoolers in the early learning environment is warranted. The purpose of this paper is to provide a detailed methodological account of the Learning Environments' Activity Potential for Preschoolers (LEAPP) study. The primary objectives of this research are to: i) assess the PA levels of preschool-aged children attending different early learning environments (*i.e.*, FDK, centre-, or home-based childcare; see Table 1 for a full description of the three different early learning venues) and ii) explore which attributes of early learning environments influence PA. Because PA levels of preschoolers have been noted to differ based on sex,[2,5] weight status,[21] and potentially child temperament,[19] a secondary objective of this study is to explore differences in preschoolers' PA based on these three variables.

Study design and participants

Preschoolers were eligible to participate in this two-year descriptive cross-sectional study if they were between the ages of 2.5 and 5 years, and attended a participating centre- or home-based childcare facility or a FDK program in London, Ontario. Children who attended childcare on a part-time basis were also eligible to participate. Data collection occurred over five consecutive days (*i.e.,* Monday to Friday). Procedures for this study were pilot tested and revised as needed.[6] Ethical approval for the study's protocol was received from the Health Sciences Research Ethics Board at The University of Western Ontario.

Recruitment strategy

Using a cluster recruitment strategy, this study aimed to enlist approximately 30 different early learning environments (10 from each type of facility). To achieve this goal, the recruitment strategy was tailored to the three different environments. Researchers initially undertook purposeful sampling of all FDK schools. Because the FDK program was implemented in only nine schools in the public school board during the first year of the study, all nine principals were contacted. During the second year of the study, five additional schools were selected for participation from the public school board based on their geographic location, in an attempt to ensure a diverse representation of preschoolers and schools within the city. However, as a result of a work-to-rule job action in 2012-2013, the five schools invited were unable to participate. Consequently, five schools offering FDK from the Catholic school board were invited to participate.

Due in part to the lack of regulation (or governing body), no document listing all home-based childcare facilities in London, Ontario was available. Nonetheless, a variety of ways to connect with home childcare providers were used. Researchers retrieved a number of childcare

Table 1. Description of early learning environments in Ontario.

Early learning arrangement	Other names	Governing legislation	Max n. of children	Staff education and training	Minimum daily outdoor play time
Centre-based childcare	Daycare, nursery school, preschool	Day Nurseries Act (1990), R.R.O., Regulation 262	16 (with 2 ECEs)*	College diploma – Early Childhood Education	1 hour in the morning and 1 hour in the afternoon (weather permitting)*
Home-based childcare	Family childcare, home daycare	*If licensed:* Day Nurseries Act (1990), R.R.O., Regulation 262	5 (in addition to providers' own children)*	No requirements	*If licensed:* 1 hour in the morning and 1 hour in the afternoon (weather permitting)* *If unlicensed:* No regulated outdoor time
Full-day kindergarten	School, junior kindergarten (JK), senior kindergarten (SK)	Education Act (1990), R.S.O., Chapter E.2	26 (with 1 teacher and 1 ECE)**	*Teacher:* University undergraduate degree and teacher's college *ECE:* College diploma Early Childhood Education	Varies depending on school schedule *Traditional:* 70 min *Balanced:* 55 min

Note. All information presented is specific to the preschool population. A traditional school schedule provides students with two recess periods (15 minutes each) and one lunch period (40 minute recess period). A balanced school schedule provides students with two nutritional breaks throughout the course of the day (one 20 minute recess period and one 25 minute recess period). ECE = early childhood educator. *Ministry of Child and Youth Services. (1990). Day Nurseries Act. R.R.O. Regulation 262 Amended to O. Reg. 14/02 General – 37. **Ministry of Education. (1990). Education Act. Chapter E.2. Ministry of Education. (2010). Full Day Junior Kindergarten and Kindergarten. Ontario Regulation 224/10.

providers' contact information from the London District Home Child Care Network website; a locally-run site which presented the information based on geographic location in the city. Childreach (a non-profit organization aimed at providing resources/programming to parents/guardians and childcare providers) offered, for review, an advertisement book where providers promote their businesses; the contact information of 23 additional home-based childcare facilities listed in this book were recorded. To achieve sufficient numbers of home-based childcare facilities other avenues were explored, inclusive of advertisements: in a local newspaper, in a parent and caregiver magazine, on parent and childcare provider resource websites (*i.e.*, www.londonmoms.ca and www.daycarebear.ca), and on Childreach's Facebook™ page. Additional recruitment methods included snowball sampling, searching for home-based childcare advertisements via Kijiji Canada Classifieds™ – London, and through other childcare organizations. Because of the lack of a central listing for home-based facilities in the city, coupled with the small numbers of children who attend these venues and met the study inclusion criteria, all home-care providers identified through the above mechanisms were contacted by the research team.

Centre-based childcare facilities were selected from the *Licensed Child Care – Early Childhood Education in London 2011-12* document (which lists all centres based on geographic location within London, Ontario) available online. Because we were unable to recruit a random sample of FDK classrooms or home-based childcare facilities, we employed a similar purposeful selection procedure (as described above) to recruit a sample of geographically diverse childcare centres.

Study protocol

To collect data on preschoolers enrolled in a FDK program, ethical approval was sought from the local school boards and once received, a short explanation of the study was sent via e-mail from the School Boards' Research Officers to principals whose school had the newly implemented FDK program. Shortly after the e-mail was sent, each principal was contacted directly by a member of the research team. Similarly, centre- and home-based childcare providers/directors were contacted directly by e-mail and phone. If principals and directors were willing to participate, a date and time were scheduled to drop off the information packages for parents/guardians and staff. Teachers/early childhood educators (ECEs)/childcare providers were responsible for sending the information packages home with the children. Once parental/guardian consent was received, research staff returned to the facility to measure the participating preschoolers' height and weight, and to program the accelerometers. This was done in a corner of the room away from class activities to provide the children with as much privacy as possible. The researchers provided teachers/ECEs/childcare providers with training and a brief demonstration on how to administer and store the accelerometers. The programmed accelerometers were left with the staff, along with additional instructions in case they encountered any problems. Children were asked to wear the accelerometers on their right hip for five consecutive days during early learning program hours only. At the start of each day, the children were fitted with their accelerometer by staff using an elastic belt around the waist; the accelerometers were then removed by staff at end-of-day prior to departure. Early learning staff were asked to log the time the accelerometers were put on/removed each day. Throughout the week of data collection, researchers returned to conduct the environmental audit of the participating classrooms/homes [using the Environment and Policy Assessment and Observation (EPAO) tool – discussed below] for one full day. The researchers quietly/unobtrusively used this tool to assess and observe the early learning environment so as not to

disturb the ongoing activities of the classroom. Each researcher completed the observation review in a quiet corner of the participating classrooms. All efforts were made by the researchers not to interact with the children and/or staff at each site. Tokens of appreciation were given to all parents/guardians of participating children, teachers/ECEs/childcare providers for their assistance throughout the week, and directors/principals to thank the school/centre. Data collection for this study concluded in Spring 2013.

Measurements

Physical activity

PA was assessed using Actical accelerometers (MiniMitter, Oregon). Capable of measuring objectively the amount and intensity of activity in multiple planes, these small (28 mm × 27 mm ×10 mm), lightweight (17.5 g), and waterproof devices have demonstrated acceptable validity and reliability in measuring preschoolers' PA.[22] Consistent with the preschooler literature,[5] an epoch length of 15-seconds was applied to capture the PA among this group, as well as to prevent the misclassification of activity intensities.

Given that research on the number of days necessary to capture habitual activity levels among preschoolers is limited, reliability analyses will be conducted to determine how many hours/days are necessary to provide accurate activity data, and will inform the decision regarding the minimum number of hours/days of accelerometry wear time required to include in the analysis. The proportion of the day participants spend in sedentary, light, moderate, vigorous, and total PA will be identified. Population-specific cut-points developed by Pfeiffer and colleagues (22) (sedentary activity [<50 counts×15 s^{-1}], light activity [$\geq 50 \leq 714$ counts×15 s^{-1}×epoch^{-1}], moderate activity [$\geq 715 \leq 1410$ counts×15 s^{-1}×epoch^{-1}], vigorous activity [≥ 1411 counts×15 s^{-1}×epoch^{-1}]) will be applied to the accelerometry data. Data will then be summed into minutes of daily activity to determine PA prevalence while in the early learning program.

Early years environment

The EPAO tool was developed to quantify and examine objectively the physical and social environmental attributes thought to impact PA and dietary behaviours of children in early learning environments.[23,24] Having demonstrated strong reliability,[22] we utilized the PA portion of the EPAO, which consists of the following eight subscales: Sedentary Opportunities, Sedentary Environment, Active Opportunities, Staff Behaviours, Physical Activity Training and Education, Physical Activity Policies, Portable Play Environment, and Fixed Play Environment (please see Table 2 in Bower *et al*., 2008 for a complete description of each subscale).[7,23] Examination of these factors in the early learning environments is used to identify potential predictors of PA among preschool-aged children.

The EPAO consists of a day-long observation and inventory of each participating site's PA environment, in addition to a document review (*i.e.,* an examination of PA-related policies, curriculum, training, etc.). Two researchers completed the eight PA subscales of the EPAO for each site as a means of reducing potential researcher variability. This tool was also used in the research team's feasibility study.[6]

Body composition

Prior to the start of data collection, a number of anthropometric measurements were collected from participants. Specifically, the children's height (to the nearest 0.1 cm) was measured using a Seca 214 *Road Rod* Portable Stadiometer, while participants' weight (to the

nearest 0.1 kg) was captured using the Tanita 700-TBF300GS Body Fat Analyzer w/Goal Setter scale. Waist circumference (starting at the navel; to the nearest 0.1 cm) was collected using a measuring tape. Height and weight data were used to format the accelerometers and calculate BMI. Standardized BMI (BMI-z) will also be calculated as BMI does not account for age and growth and research supports the effectiveness of using BMI-z to assess adiposity among children on a single occasion.[25–27]

Child temperament

The Child Temperament Questionnaire was developed based on the Colorado Child Temperament Inventory (CCTI) by Rowe and Plomin.[28] Typically used with children between the ages of 1 and 6 years, the Child Temperament Questionnaire was used to assess child temperament via parent/guardian report.[28] Specifically, this 30-item tool seeks to evaluate the following six subscales: reaction to food, soothability, attention span, activity, sociability, and emotionality. Previous research has found that items within the *activity* subscale assess the vigour and intensity of gross motor movement among young children.[29] As such, the *activity* subscale will be used to compare with Actical-measured PA of participating preschoolers.

Additional measures

In addition to the measures discussed above, demographic information was gathered from participants' parents/guardians. A survey was also completed by teachers/ECEs which captured PA-related data (*e.g.,* training/education, caregiver/teacher habits, modelling behaviours, etc.) in addition to demographic characteristics.

Sample size estimation

A cluster sampling strategy was used in an effort to distribute participants as evenly as possible across the FDK classrooms, childcare centres, and home-based childcare sites. Given the primary objective of this study was to assess preschoolers' PA level within three different early learning environments, statistical power for this study was based on the estimation of population mean.[30] Based on previous research assessing Canadian preschoolers' PA via accelerometry, the mean number of minutes per hour of MVPA was 2.08 (SD=0.60).[20] Using this work as the basis for our sample size calculation, while allowing for a 10% margin of error (0.208), a sample size of 32 preschoolers from each of the three early learning environments was required (n=96). We targeted early learning centres as units (clusters); therefore, the sample size was adjusted to account for a clustering effect. Given the lack of published literature related to the intra-cluster correlation (r) of PA among preschoolers, we utilized 0.05. Therefore, the design effect for an average cluster size of 10 children was $[1+0.05(10-1)]=1.45$. Thus, the sample size of each group needed to be inflated to $32\times1.45=47$. Anticipating that some preschoolers would not adhere to the five days of accelerometer data collection (*e.g.*, if a child was sick on one of these five days), we further adjusted the sample size within each group to account for loss to follow-up (20%), bringing the sample size to 57 children per group. Therefore, the final targeted sample size was 171 preschoolers.

Data analysis

Data analysis will commence in Summer 2013. To address the primary objective of this study, an independent groups ANOVA will be used to quantify differences in PA level among preschoolers attending the three early learning arrangements. Following this, linear regression analyses will be undertaken to identify which EPAO subscales predict PA. Additionally, regression analyses will be undertaken to explore child temperament as a predictor of activity participation. Finally, independent sample t-tests will be completed to identify if differences in PA level exist based on sex and/or weight status. Because this research used a clustered sampling strategy, the analyses will include *type of early learning centre* as a random factor to account for clustering effect. Children's movements skills differ dramatically during this age, and as such, analyses will control for age where possible (*i.e.*, through the use of covariates in ANOVA calculations, through the inclusion of age as a predictor in regression analyses).

Expected impact on public health

There are limited Canadian data assessing PA levels among preschoolers, particularly with regard to the pivotal role of the early learning environment. To facilitate lifelong active living, young children need to develop the skills, knowledge, appreciation for, and norm of PA; affording these opportunities in school and childcare settings is an important option to consider. Documenting the current study's protocol is important not only for the translation of research into practice, but also to ensure that other researchers interested in undertaking similar studies can use the detailed methodology provided to inform their work.

The current research will garner an in-depth understanding of the role that early learning environments play on PA behaviours of preschoolers and thus, will certainly provide support and knowledge to inform evidence-based interventions aimed at improving activity behaviours in young children. Given that the early learning setting is considered responsible for approximately half the variation in preschoolers' activity behaviours,[22] it is important that we gain a greater understanding of what attributes within these facilities best encourage active behaviours. Additionally, this research will highlight if discrepancies exist in activity behaviours of children attending various types of early learning environments, so that interventions can be targeted and tailored appropriately to those venues which warrant attention.

Data collection has provided valuable information about the challenges of recruiting home-based childcare centres (*e.g.,* data collection transpires in their home). Moreover, as a result of a work-to-rule job action among teachers in one of the London school boards, our data collection in FDK classrooms was compromised. Specifically, although five centres were contacted in the public school board during year two of data collection, we were not able to connect with any before data collection had to be stopped.

Despite these challenges, the results of this research program will support the: design of future early learning programs, policies, and regulations; identification of essential elements of early learning centres' infrastructure and staff training and education; and provision of research-informed guidance for future health promotion programs implemented in these venues. Moreover, this research may highlight variations in PA levels of preschoolers based on sex, weight status, and temperament as well as highlight the need for tailored interventions based on such factors (*i.e.*, personality-dependent activities or activities which encourage activity for boys and girls separately). Each of these potential outcomes is an important step in promoting and creating environments that are supportive of healthy active lifestyles among young children.

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