Physical activity and sedentary behaviour of toddlers and preschoolers in child care centres in Alberta, Canada

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ABSTRACT

OBJECTIVE: To describe duration of physical activity and duration and bouts of sedentary behaviour during child care in a sample of toddlers and preschoolers (19–60 months) from Alberta, Canada, and to examine whether duration and bouts differed among sex, age and parental immigration status groups.

METHODS: One hundred and fourteen children aged 19–60 months from eight child care centres throughout Alberta participated. Data were collected at baseline of a study examining revised Alberta Child Care Accreditation Standards. Duration of physical activity (light (LPA), moderate-to-vigorous (MVPA)) and duration and bouts (1–4, 5–9, 10–14, and ≥15 minutes) of sedentary behaviour during child care were accelerometer-derived using 15-second epochs during October/November, 2013. Median [Interquartile ranges] and ANOVAs, accounting for the clustered nature of the data, were calculated.

RESULTS: Minutes/hour spent in sedentary behaviour, LPA and MVPA were 36.9 [32.9, 40.7], 18.4 [16.0, 20.9] and 4.2 [2.5, 5.6] respectively. Frequency/hour of sedentary bouts lasting 1–4, 5–9, 10–14 and ≥15 mins were 6.7 [6.1, 7.6], 0.9 [0.6, 1.1], 0.4 [0.2, 0.5] and 0.3 [0.2, 0.4] respectively. Preschoolers participated in less sedentary behaviour and more LPA and MVPA, and had fewer sedentary bouts lasting 10–14 and ≥15 mins compared to toddlers ($p < 0.05$).

CONCLUSION: This is the first Canadian study to report on the duration of physical activity and duration and bouts of sedentary behaviour among both toddlers and preschoolers attending child care centres. These findings suggest child care interventions are needed to increase MVPA and decrease total sedentary behaviour while continuing to promote short sedentary bouts.

KEY WORDS: Physical activity; child care; child; preschool

La traduction du résumé se trouve à la fin de l'article.

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Physical inactivity has been called the biggest public health problem of the 21st century.[1] Emerging research indicates that sedentary behaviour may have important implications on health, independent of physical activity.[2] Low physical activity and high sedentary behaviour are associated with all-cause mortality, cardiovascular disease, type 2 diabetes, excess adiposity, and other cardiometabolic health risks.[3,4]

The early years (≤4 years of age, as defined by national guidelines)[5,6] provide a window of opportunity to establish healthy habits of regular physical activity and minimal sedentary behaviour for healthy growth and development.[7] For instance, regular physical activity is associated with enhanced motor skill and cognitive development, psychosocial health, bone and skeletal health, cardiometabolic health, and decreased adiposity in the early years.[3] Conversely, increased sedentary behaviour is associated with unfavourable psychosocial health, cognitive development and adiposity in the early years.[4] Furthermore, the physical activity and sedentary behaviour patterns that are established in the early years have been shown to track moderately over time.[8] Taken together, these data suggest the possibility of an alarming future, given that only 15% of Canadian children aged 3–4 years are meeting both the national physical activity and the national sedentary behaviour guidelines.[9]

An important setting for physical activity promotion and sedentary behaviour reduction in the early years is child care centres, given the reachability of children in these settings. For example, 54% of Canadian children aged 0–5 years are in non-parental care for an average of 29 hours/week.[10] In Alberta, Canada, this equates to almost 70,000 children in 2012.[11] Of interest, children attending child care in Canada have been found to be at increased risk of becoming overweight or obese compared to children under parental care.[12] This risk could be associated with the low physical activity and high sedentary behaviour commonly reported in child care centres in a number of developed countries (e.g., the United States, the United Kingdom, Belgium and Sweden).[13]

There is currently little information on objectively measured physical activity and sedentary behaviour among preschool children (36–60 months of age) in Canadian child care settings.

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Vanderloo and colleagues measured 31 preschool children (mean age = 4.1 years, standard deviation (SD) = 0.9) in five child care centres in London, ON.[14] They reported the children spent 1.5 (SD = 1.4) minutes/hour (mins/hr) engaged in moderate-to-vigorous physical activity (MVPA) and 40.6 (9.1) mins/hr engaged in sedentary behaviour. However, in addition to the small sample size and limited geographical area observed, this study is also limited by the fact that children only wore the accelerometer for 1 day, which may not have captured habitual physical activity and sedentary behaviour.

Along with the limitations in the previous Canadian literature, there are several research gaps that need to be addressed. First, no study has examined objectively measured physical activity and sedentary behaviour among toddlers (19–35 months of age) within Canadian child care settings.[14] Internationally, evidence on the amount of objectively measured physical activity and sedentary behaviour toddlers participate in is also lacking.[15] Toddlers are an important population to study, in addition to preschool children, because this age group represents the beginning of ambulation.[15] Second, there is limited and conflicting evidence on the role of demographic factors (e.g., sex, age, parental immigration status) on physical activity and sedentary behaviour within child care centres. Further exploration of these demographic factors could be used for targeted interventions and initiatives to increase physical activity and decrease sedentary behaviour. Finally, no study to date has reported how sedentary behaviour is accumulated during child care among toddlers or preschoolers (e.g., short sedentary bouts or longer sedentary bouts). Emerging research indicates that the patterns of sedentary behaviour may have important implications on health independent of total sedentary behaviour.[16]

A better understanding of physical activity and sedentary behaviour within child care settings among toddlers and preschoolers can help inform future initiatives and interventions that aim to promote regular physical activity and minimal sedentary behaviour in child care centres. Therefore, the purposes of this paper were to: 1) describe objectively measured physical activity, sedentary behaviour and sedentary bouts during child care in a sample of toddlers and preschoolers aged 19–60 months from Alberta, Canada, and 2) examine whether duration and bouts differed among sex, age and parental immigration status groups in this sample.

METHODS

Participants

This study represents baseline data from the Supporting Active Living Behaviours in Alberta Child Care Settings study, which is examining the effects of revised Alberta Child Care Accreditation Standards. Child care centres in Alberta scheduled for initial accreditation during August to October, 2013 were eligible for the study. Of the 12 centres that were eligible, 8 (67%) agreed to participate. Seven centres were located in the cities of Edmonton (n = 4) and Calgary (n = 3), while one centre was located in a smaller city in Alberta.

All parents of children aged 19 to 60 months who attended the centre full time received a questionnaire package. Of the 270 eligible children, 145 (54%) had a parent agree to their child's participation by returning a signed consent form and completed questionnaire. The questionnaire assessed demographics and children's physical activity and sedentary behaviour outside of child care. Four children were excluded because they were older than 60 months when their parents received the package, leaving a sample of 141 children. Data were collected between September and November, 2013. Ethics approval was obtained from the University of Alberta Health Research Ethics Board. Parents/guardians of all participating children provided written informed consent.

Physical activity and sedentary behaviour

Calibrated waist-mounted accelerometers (Actical, Respironics, Bend, OR) were fitted by research staff at the very beginning of the first data collection day on a belt positioned on the child's right hip. Children continuously wore the accelerometer either under or over light clothing while at the child care centre for five consecutive weekdays. Early childhood educators were asked to attach the accelerometer belts each morning when a participating child arrived and to remove the accelerometer belt at the end of each day before the child went home. Data were collected in 15-second epochs. Sequences of consecutive zero counts ≥20 mins were deemed non-wear time and excluded from analyses.[17] Naps taken while wearing accelerometers were defined as non-wear time. Early childhood educators were given a log sheet to record each child's accelerometer on and off times, which was used to cross-reference non-wear time and to remove data points prior to the start time of the first data collection day. Consistent with previous studies in child care centres,[18,19] participants had to have ≥1 hr of wear time on ≥3 days to be considered valid and therefore included in the analyses.

Cut-points were defined based on national survey data from the Canadian Health Measures Survey[9] as follows: sedentary behaviour (<100 counts/minute (cpm) or <25 counts/15 seconds), light-intensity physical activity (LPA; 100 to 1149 cpm or 25 to <287.5 counts/15 seconds) and MVPA (≥1150 cpm or ≥287.5 counts/15 seconds). All variables were checked for outliers (≥ ±3 SD) and one participant had their MVPA truncated to the nearest score below 3 SD. Sedentary behaviour was further classified into continuous bouts of 1–4, 5–9, 10–14 and ≥15 mins. To account for variability in the duration each child spent at the child care centre, physical activity and sedentary behaviour variables were expressed as min/hr by dividing total minutes of physical activity and sedentary behaviour by total hours of wear time. All accelerometer data reduction was conducted and completed using SAS version 9.4 [SAS Institute Inc., Cary, NC].

Covariates

Sex, age and parent immigration status were assessed in the parental questionnaire.

Statistical analysis

Data analyses were completed using SPSS version 21.0 [IBM Corp., Armonk, NY]. Descriptive statistics were calculated, including median and interquartile ranges (IQR). Chi-square tests examined whether included and excluded participants differed among sex (male or female), age (toddler: 19–35 months or preschooler:

36–60 months) and parental immigration status (born in Canada or immigrated to Canada) groups. ANOVAs that took into account the clustered nature of the data were calculated to examine differences in sedentary behaviour, LPA, MVPA and sedentary bouts among sex, age and immigration status groups. The assumption of normality for the ANOVAs was assessed by examining residuals. Sedentary bouts of 10–14 minutes, and ≥15 minute bouts were square root-transformed to meet the assumption of normality for the ANOVA analyses. Statistical significance was set at $p < 0.05$ for all analyses.

RESULTS

Of the 141 children, valid accelerometer data were obtained for 114 (19 children were excluded due to invalid wear time, 8 due to faulty monitors). On average, participants' total wear time was 5.5 (1.6 SD) hrs/day. There were no significant differences in sex, age and parental immigration status between the included and excluded participants. The average age in the final sample was 38.0 months (12.4 SD), 47% were toddlers, 47% were females, and 29% had parents who had immigrated to Canada.

The median mins/hr spent in sedentary behaviour, LPA and MVPA were 36.9 [IQR: 32.9, 40.7], 18.4 [16.0, 20.9] and 4.2 [2.5, 5.6] respectively (Table 1). The percentage of time spent in sedentary behaviour, LPA and MVPA per hour was 61.5%, 30.6% and 7.0% respectively. Preschool-aged children accumulated significantly less sedentary behaviour and significantly more LPA and MVPA than toddlers, but no significant sex or parental immigration status differences were observed for sedentary behaviour, LPA or MVPA.

The median frequency/hour of sedentary bouts lasting 1–4, 5–9, 10–15 and >15 mins was 6.7 [6.1, 7.6], 0.9 [0.6, 1.1], 0.4 [0.2, 0.5] and 0.3 [0.2, 0.4] respectively (Table 2). Therefore, over the average 5.5-hr child care day it could be approximated that this sample would accumulate 37 bouts of sedentary behaviour lasting 1–4 mins, 5 bouts lasting 5–9 mins, 2 bouts lasting 10–14 mins and 2 bouts lasting ≥15 mins. Compared to toddlers, preschool-aged children had significantly less sedentary bouts per hour lasting 10–14 mins and ≥15 mins, but no other significant sex, age or parental immigration status differences were observed.

DISCUSSION

This study described objectively measured physical activity, sedentary behaviour and sedentary bouts and examined differences among sex, age and parental immigration status groups in a sample of toddlers and preschoolers aged 19 to 60 months attending licensed child care programs in Alberta. Children spent approximately 60% of their time being sedentary and the majority of their time spent being physically active consisted of LPA. However, sedentary behaviour was primarily accumulated in 1–4 minute bouts, with almost no engagement in sedentary bouts longer than 15 mins. Preschoolers participated in less sedentary behaviour and more MVPA compared to toddlers. Preschoolers also had fewer 10–14 and ≥15 minute sedentary bouts compared to toddlers. To our knowledge, this represents the youngest objectively measured sample of children in Canadian child care centres.

The current study's finding that low MVPA and high sedentary behaviour were prevalent among preschoolers within child care

Table 1. Median [Interquartile range] mins/hr of sedentary behaviour, LPA and MVPA within child care, stratified by sex and age of child and by parental immigration status groups

	Total (*n* = 114)	Sex (*n* = 114)		Age (*n* = 114)		Parental immigration status (*n* = 111)	
		Males	Females	Toddler (19–35 months)	Preschooler (36–60 months)	Born in Canada	Immigrated to Canada
Sedentary behaviour (mins/hr)	36.9 [32.9, 40.7]	36.5 [32.8, 40.1]	37.8 [34.1, 41.4]	38.7* [35.6, 41.5]	36.2* [31.2, 39.1]	37.5 [34.2, 41.2]	35.9 [31.2, 40.1]
LPA (mins/hr)	18.4 [16.0, 20.9]	18.7 [16.6, 21.6]	18.2 [16.0, 20.6]	17.5* [15.6, 20.0]	19.0* [16.7, 22.2]	18.3 [16.0, 20.8]	18.5 [16.5, 22.0]
MVPA (mins/hr)	4.2 [2.5, 5.6]	4.1 [2.4, 5.6]	4.2 [2.5, 5.5]	3.1* [2.0, 4.9]	4.6* [3.2, 7.1]	3.5 [2.3, 5.3]	5.0 [4.1, 7.2]

LPA = light intensity physical activity; MVPA = moderate-to-vigorous intensity physical activity; mins/hr = minutes/hour.
* Significant age difference in sedentary behaviour, LPA and MVPA.

Table 2. Median [Interquartile range] frequency/hour of sedentary bouts within child care, stratified by sex and age of child and by parental immigration status groups

	Total (*n* = 114)	Sex (*n* = 114)		Age (*n* = 114)		Parental immigration status (*n* = 111)	
Minutes/ hour		Males	Females	Toddler (19–35 months)	Preschooler (36–60 months)	Born in Canada	Immigrated to Canada
1–4	6.7 [6.1, 7.6]	6.5 [6.0, 7.1]	7.0 [6.2, 7.8]	6.3 [5.7, 7.4]	6.9 [6.2, 7.7]	6.6 [6.0, 7.6]	6.9 [6.3, 7.6]
5–9	0.9 [0.6, 1.1]	0.9 [0.6, 1.1]	0.9 [0.6, 1.2]	0.9 [0.7, 1.1]	0.9 [0.6, 1.2]	0.9 [0.7, 1.2]	0.9 [0.6, 1.1]
10–14	0.4 [0.2, 0.5]	0.4 [0.2, 0.5]	0.4 [0.2, 0.5]	0.4* [0.3, 0.5]	0.3* [0.2, 0.5]	0.4 [0.3, 0.5]	0.3 [0.2, 0.5]
≥15	0.3 [0.2, 0.4]	0.3 [0.2, 0.4]	0.3 [0.2, 0.4]	0.4* [0.2, 0.5]	0.2* [0.1, 0.3]	0.3 [0.2, 0.4]	0.3 [0.2, 0.4]

* Significant age difference in 10–14 and ≥15 minute bouts.

centres is consistent with a previous review.[13] All six studies included in this review that used accelerometers had less than 60 mins of MVPA during child care when extrapolated to a full day. Participants in the current study, who had an average 5.5-hr child care day, also had less than the 60 mins.

Only one previous study has reported on objectively measured physical activity and sedentary behaviour among preschoolers in child care centres in Canada, drawing similar conclusions of low MVPA and high sedentary behaviour.[14] However, the current study overcame previous limitations by objectively measuring physical activity and sedentary behaviour for at least 3 days in a larger sample size across a broad geographical area. The use of different cut-points makes comparisons of the specific duration of physical activity and sedentary behaviour observed across studies challenging. Pate and colleagues recommended that consensus needs to be reached for a standardized methodology in which accelerometer data are collected and interpreted in this young population.[20] Therefore, the cut-points chosen for the current study are aligned with national data from the Canadian Health Measures Survey.[9] Furthermore, a recent study has shown that the ≥1150 cpm is the most accurate Actical cut-point for classifying MVPA in young children.[21]

Currently, there are no Canadian guidelines for physical activity and sedentary behaviour within child care centres. However, there are Canadian Physical Activity and Sedentary Behaviour Guidelines for Children in the Early Years (aged 0–4 years) for the entire day.[5,6] For the physical activity guidelines, it is recommended that children 1–4 years of age accumulate at least 180 mins/day of total physical activity (LPA and MVPA) and progress to at least 60 mins of energetic play per day (i.e., MVPA) by age 5 years to meet the guidelines for school-aged children and youth (5 to 17 years). In this sample, physical activity was predominantly accumulated in the LPA category. Limited evidence exists on the health benefits associated with different intensities of activity in children of the early years.[3] However, in school-aged children, there is substantial evidence for the relationship between MVPA and health benefits, and these benefits have been observed to increase with intensity.[22,23] Thus future research is needed to explore the relationship between different intensities of physical activity and the health benefits for toddlers and preschoolers.

It is our understanding that this is the first study internationally to measure and describe physical activity and sedentary behaviour among toddlers within child care centres. Current evidence indicates that as school-age children become older, they engage in more sedentary behaviour and less physical activity.[24] In this sample, it was found that sedentary behaviour was lower and LPA and MVPA were higher in preschool-age children compared to toddlers. Preschoolers could represent a peak in physical activity before dropping off when transitioning to school. Therefore, this age range may be an optimal point to intervene to positively reinforce these behavioural trajectories; however, longitudinal cohort studies using objective measures are needed to confirm this.[7] While no sex differences were observed in the current study, one previous study involving 3–5 year old children attending preschool in the United States observed boys engaging in more MVPA than girls but equivalent LPA and sedentary behaviour.[18] As a result, further research is needed to determine when the well-known sex differences in MVPA among older children begin.[25] No study to our knowledge has examined the impact of immigration status on physical activity and sedentary behaviour during child care. While no differences were found in the current study, school-age children with immigrant parents have been shown to be at risk for physical inactivity and high sedentary behaviour as determined by questionnaires.[26] However, it cannot be determined whether the difference in findings compared to the current study are the result of methodological or age-group differences. Given the lack of evidence, further research around demographic differences in physical activity and sedentary behaviour during child care is needed to inform future interventions and initiatives aimed at promoting healthy active living behaviours in this environment for all children.

To our knowledge, no previous study has assessed or reported bouts of sedentary behaviour in toddlers and preschoolers. Similar to the children observed in the current study, school-aged children accumulate few longer sedentary bouts.[27] Longer sedentary bout lengths have been shown to be associated with increased BMI z-score, especially among children with lower MVPA.[27] Therefore, reinforcing the healthy habits of short sedentary bout length, such as the ones observed in this sample, with toddlers and preschoolers could be beneficial. However, the findings in the current study should be interpreted with caution, since accelerometers cannot capture posture changes, therefore some misclassification of sedentary bouts may exist when a child was in an upright posture (e.g., standing) but motionless, instead of a sedentary posture (e.g., sitting) and motionless. Future research examining sedentary patterns should use devices such as inclinometers[28] to minimize measurement error.

Overall, the findings of this study have important public health implications. More specifically, interventions and initiatives are needed to increase MVPA and to decrease total sedentary behaviour, while continuing to promote short bouts of sedentary behaviour, for toddlers and preschoolers within child care centres. Modest changes in physical activity and sedentary behaviour have been observed in previous child care interventions targeting various aspects of the child care environment.[29] Staff training and behaviour as well as physical activity and sedentary behaviour policies might be promising strategies to explore in future research.[30] This study represents the baseline findings to such a policy-level intervention. Future work will evaluate new accreditation standards recently introduced in Alberta that target physical activity and sedentary behaviour. Additionally, future work is also needed to create Canadian guidelines for physical activity and sedentary behaviour that are specific to the child care setting as well as curriculum and training to support these guidelines.

A main strength of the study is the objective measure of physical activity and sedentary behaviour. In addition, participating child care centres represented multiple cities, which increases the generalizability of the findings. The study also addressed gaps in the literature by including the toddler age group and examining sedentary bouts. Though there were strengths, this study also has limitations. For example, while accelerometers have many advantages over proxy-report measures of physical activity and sedentary behaviour, as stated

above, accelerometers cannot detect postural changes. This inability may have resulted in some measurement error of sedentary behaviour and sedentary bouts. Additionally, the cut-points used in the current study were for 1-minute epochs and have been validated in preschoolers but not in toddlers. Given the modest participation rate in the study, as well as the number of participants whose data were excluded from analyses, the possibility of selection bias cannot be eliminated. However, participation rates in the current study are similar or higher compared to other studies in this area.[14,18]

CONCLUSION

Children aged 19–60 months from licensed Alberta child care centres spent the majority of their time in child care engaging in sedentary behaviour and LPA. However, these children most frequently accumulated their sedentary behaviour in bouts lasting 1–4 mins. These findings suggest interventions are needed to increase MVPA and decrease total sedentary behaviour within child care centres for toddlers and preschoolers, while continuing to promote short sedentary bouts.

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RÉSUMÉ

OBJECTIFS : Décrire la durée de l'activité physique et la durée et les épisodes de comportement sédentaire pendant la garde d'un échantillon de tout-petits et d'enfants d'âge préscolaire (19 à 60 mois) de l'Alberta, Canada, et examiner si la durée et les épisodes diffèrent selon le sexe, l'âge et le statut d'immigrant des parents.

MÉTHODES : Cent quatorze enfants âgés de 19 à 60 mois de huit garderies de l'Alberta y ont participé. Les données ont été recueillies au départ d'une étude examinant les normes d'accréditation révisées des services de garde d'enfants de l'Alberta. La durée de l'activité physique (légère [APL], modérée à vigoureuse [APMV]) et la durée et les épisodes (1 à 4, 5 à 9, 10 à 14 et ≥ 15 minutes) de comportement sédentaire pendant la garde a été calculée avec un accéléromètre au moyen d'époques de 15 secondes en octobre et novembre 2013. On a calculé la médiane [intervalle interquartile] et les ANOVA qui tiennent compte de la nature en grappe des données.

RÉSULTATS : Les minutes et les heures de comportement sédentaire, d'APL et d'APVM étaient de 36,9 [32,9, 40,7], 18,4 [16,0, 20,9] et 4,2 [2,5, 5,6] respectivement. La fréquence et la durée des épisodes sédentaires qui allaient de 1 à 4, 5 à 9, 10 à 14 et ≥ 15 minutes étaient de 6,7 [6,1, 7,6], 0,9 [0,6, 1,1], 0,4 [0,2, 0,5] et 0,3 [0,2, 0,4] respectivement. Les enfants d'âge

préscolaire participaient à moins d'épisodes de comportement sédentaire et plus d'APL et d'APMV, et avaient moins d'épisodes sédentaires d'une durée de 10 à 14 et de ≥ 15 minutes comparés aux tout-petits ($p < 0,05$).

CONCLUSIONS : Il s'agit de la première étude canadienne à rendre compte de la durée de l'activité physique et de la durée et des épisodes de comportement sédentaire chez les tout-petits et les enfants d'âge préscolaire dans des garderies. Ces constatations suggèrent que les interventions en garderie sont nécessaires pour augmenter l'APVM et réduire le comportement sédentaire total tout en continuant de favoriser les courts épisodes sédentaires.

MOTS CLÉS : activité physique; garde d'enfant; enfant; préscolaire