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Objectively Measured Physical Activity of Young Canadian Children Using Accelerometry

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Abbreviations: CHMS – Canadian Health Measures Survey; LPA – light physical activity; MVPA: moderate-to-vigorous physical activity; PA – physical activity.

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Abstract

Objectives: To describe objectively measured physical activity (PA) and sedentary time of infants, toddlers, and preschoolers and determine the proportion meeting Canadian age-specific physical activity guidelines.

Methods: Ninety children (47 girls, 43 boys; mean age 32 (range, 4–70) months) attending scheduled health supervision visits and in the TARGet Kids! cohort wore an Actical accelerometer for 7 days. Participants with 4 or more valid days were included in the analysis. Time, in mean minutes per day (min/d), spent sedentary, and in light physical activity (LPA), moderate-to-vigorous physical activity (MVPA) and total PA was determined using published cut-points; age groups were compared using ANOVA.

Results: Twenty-three percent of children < 18 months (n = 28) and 76% of children 18 – 59 months (n = 45) met the guideline of 180 min/d of total PA; 13% of children ≥ 60 months (n = 17) met the guideline of 60 min/d of MVPA. Children < 18 months spent more of their waking time per day engaged in sedentary behaviours (79%; ~7.3 hours) compared to children 18 – 59 months (63%; ~6.6 hours) and children ≥ 60 months (58%; ~6.6 hours).

Conclusions: Most children aged 18 – 59 months met the Canadian physical activity guidelines for children 0-4 years, whereas few younger than 18 months met the same guidelines. Only 13% of children ≥ 5 years met their age-specific physical activity guidelines. Further research is needed to develop, test and implement effective strategies to promote physical activity and reduce sedentary behaviour in very young children.

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Introduction

Increased physical activity in early childhood is associated with improvements in bone health, psychosocial health, cardiometabolic health, adiposity and cognitive and motor skill development (Timmons et al. 2012).

National organizations have attempted to translate the research on health benefits into specific activity guidelines. The National Association for Sport and Physical Education from the United States recommends at least one hour of structured and one or more hours of unstructured physical activity every day for children from birth to age 59 months (American Alliance for Health, Physical Education, Recreation and Dance 2002). Canadian and Australian guidelines recommend that children aged 0-59 months accumulate 180 minutes per day (min/d) of physical activity at any level of intensity (Australian Government, The Department of Health 2009; Tremblay et al. 2012a). The Canadian guidelines also recommend a progression towards 60 min/d of more energetic play by 60 months of age to align with the 60 min/d of moderate-to-vigorous physical activity (MVPA) recommendation for the 5-17 year age group (Tremblay et al. 2011a). Age-specific physical activity guidelines provide clinicians with a framework for making specific activity recommendations and allow researchers to compare physical activity levels against a standard.

Direct measurement of physical activity using valid instruments can be used to assess adherence with these guidelines and to provide health care professionals and governmental bodies with information to guide interventions and policies for this age group. Accelerometers are activity monitors that measure motion in multiple dimensions and provide valid objective estimates of intensity, duration, and frequency of physical activity (Hnatiuk et al. 2012; Oliver et al. 2007). Accelerometers can provide objective estimates of the amount of time children usually spend sedentary and in light physical activity (LPA) and MVPA. Accelerometer measurements are valid, reliable and feasible for quantifying physical activity at all intensities

in preschool-aged children (i.e., ages 36 – 59 months) (Adolph et al. 2012; Cliff et al. 2009; Pate et al. 2006; Pfeiffer et al. 2006). In studies assessing the validity of accelerometers in children less than 36 months of age, two demonstrated that accelerometers can accurately distinguish sedentary time from LPA in this age group (Costa et al. 2014; Van Cauwenberghe 2011), and another demonstrated valid estimates of MVPA when compared with direct observation of physical activity (Trost et al. 2012).

The majority of the accelerometer-based physical activity studies in young children have focused on preschool children (Hnatiuk et al. 2014). These studies reported considerable variability in total time spent in physical activity at all intensities and the proportion of children meeting physical activity guidelines (ranging from 5 to 99.5%) (Beets et al. 2011; Colley et al. 2013; Hinkley et al. 2012; Hnatiuk et al. 2014). These large discrepancies, partially explained by differences in devices used to measure physical activity, cut-points assigned to LPA and MVPA, and guidelines employed, make it difficult to accurately describe physical activity levels of preschool children (Hnatiuk et al. 2014).

To the best of our knowledge, there are only two published studies that objectively measured physical activity levels in children less than 36 months of age, neither of which included Canadian children; the results are also inconsistent (Hnatiuk et al. 2012; Wijtzes et al. 2013). Thus, the aim of this study was to describe objectively measured physical activity and sedentary time of a Canadian sample of infants, toddlers, and preschoolers and assess their adherence with the recently published physical activity guidelines for their corresponding age groups (Tremblay et al. 2011a; Tremblay et al. 2012a).

Materials and methods

Study design

This was a cross-sectional study of healthy children who attended scheduled health supervision visits at a TARGet Kids! participating pediatric or family medicine primary care practice in Toronto, Canada between January, 2013 and April, 2014.

Study population and recruitment

TARGet Kids! (The Applied Research Group for Kids) is a primary care practice-based research network in Toronto, Canada. It was created to examine growth and developmental trajectories of infants, toddlers and preschool-aged children (Carsley et al. 2014). Trained research personnel at two primary care practices approached parents of healthy children less than 6 years of age to participate in our accelerometry study during regularly scheduled well-child physician visits. Children with chronic condition(s) (except for asthma), health conditions affecting growth (e.g., cystic fibrosis), severe developmental delay, and children whose families were not able to complete questionnaires in English were excluded from the study. This study was granted ethics approval by The Hospital for Sick Children Research Ethics Board. All parents of participating children consented to participation in the study.

Parents completed questionnaires on sociodemographic information, health, and health related behaviours. Trained research personnel obtained height and weight, for each participant. Body mass index (BMI) was calculated as weight in kilograms divided by the height in meters squared. For growth status, centiles were assigned to each participant using the 2006 World Health Organization (WHO) Child Growth Standards (World Health Organization 2006). Centile was determined using weight-for-length for children under 2 years of age and BMI-for-age for children 2 years of age and older. Children aged 0 to 5 years were characterized as underweight if in the < 3rd centile and overweight if in the > 97th centile. Children 5 years and older were characterized as underweight if in the < 3rd centile and

overweight if in the > 85th centile.

Measurement of physical activity

Parents were instructed to attach the Actical™ accelerometer (Phillips – Respironics, Oregon, USA) over their right hip of their child with a Velcro belt, 24 hours/d for 7 consecutive days. While they are water resistant, accelerometers were removed during bathing or swimming as they are not waterproof. The Actical™ (small size: 28 × 27 × 10 mm; light weight: 17 g) is an omnidirectional accelerometer most sensitive to movement in the vertical plane, capable of detecting both sedentary and high energy movements (sensitivity range: 0.5-3.0 Hz). While accelerometers were set to collect digitized values in 2 second epochs, the data were aggregated and analysed in a count value per minute (cpm). The Actical™ has been validated for use in preschool aged children (Adolph et al. 2012; Pfeiffer et al. 2006). Accelerometers were initialized to start collecting data at midnight following their physician visit. Parents returned the accelerometers to the TARGet Kids!-affiliated practice in a prepaid envelope.

Statistical analysis

The data were reduced using a SAS-based macro consistent with the Canadian Health Measures Survey (available at <http://www.haloresearch.ca/accel/>) (Colley et al. 2011; Colley et al. 2012b; Colley et al. 2013). Participants with 4 or more valid days were included in the analysis (Colley et al. 2011; Colley et al. 2012b; Colley et al. 2013). A valid day was defined by at least 5 hours of wear time (Pfeiffer et al. 2009). To minimize the impact of wear-time variation (Katapally and Muhajarine 2014) and to not overestimate sedentary time with sleep time, we defined wear time as waking hours between 8:00am and 8:00pm. Actual wear time was calculated by subtracting non-wear time from this 12-hour period. Non-wear time was defined by at least 60 minutes of consecutive movement counts of 0, allowing for up to 2 minutes of movement counts between 0 and 100 (Colley et al. 2013).

To reduce measurement error from parental motion, the participants were divided into

emerging ambulation (< 18 months) and ambulatory (≥ 18 months) groups. We based our 18 month age threshold on the normal developmental milestone for gross motor that 95% of children can walk; it is considered a red flag if a child is not walking at 18 months (Council on Children With Disabilities and Bright Futures Steering Committee, 2006). We wished to characterize the physical activity of children in these 2 groups, recognizing that some of the movement detected in children < 18 months may be parental motion.

The ambulatory group was subdivided into two groups to correspond with the Canadian physical activity guidelines (i.e., 18 – 59 months; ≥ 60 months). The 18 – 59 month age group was further divided into 18-35 month and 36-59 month age groups to facilitate direct comparisons with results of previous studies (Colley et al. 2013; Hnatiuk et al. 2012; Wijtzes et al. 2013). Time spent at different levels of movement intensity was based on published cut-points. Sedentary behaviour was defined as all movement intensity less than 100 cpm (Wong et al. 2011). LPA and MVPA were characterized by 100 – 1149 and ≥ 1150 cpm, respectively (Adolph et al. 2012; Wong et al. 2011). Total PA was the sum of LPA and MVPA.

The mean daily minutes spent sedentary, and in LPA, MVPA and total PA for all valid days were reported by age group and sex. Comparisons of time spent at different levels of movement intensity were made according to age group and sex using ANOVA with pairwise contrasts. To determine the proportion of children meeting age-specific physical activity guidelines, we used the analytical approach used in the CHMS analyses (Colley et al. 2011; Colley et al. 2012b; Colley et al. 2013). For children aged 0 – 59 months, guideline adherence was defined as the probability of accumulating at least 180 minutes of daily physical activity at any intensity. For children ≥ 60 months, guideline adherence was defined as the probability of accumulating at least 60 minutes of MVPA at least 6 days a week. Given that some children will not have at least 6 valid days of data, a Bayesian approach is utilized to

incorporate information from individuals with 4 or more valid days to estimate an individual's probability of being active at least 6 out of 7 days. The proportion of children meeting the guidelines was the average of these individual probabilities. For further details, please see Colley et al. (2012b). Statistical significance was defined as $P < 0.05$; all statistical tests were two-sided. All analyses were conducted using SAS Version 9.3. (SAS Institute Inc., Cary, NC, USA).

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Results

Population

In total, 117 children participated in this accelerometry study. Of these, 90 were included in the final analysis as 27 children did not have 4 valid days of wear time (Table 1). The mean age was 32 months (range, 4 – 70 months), and 48% were male. Maternal ethnicity was predominantly White European (59%); for the remaining children, maternal ethnicity was Asian (14%), Other (17%), or missing (10%). The majority of children (83%) were at a normal weight. The average number of days that children wore the accelerometer was 6.1 (range, 4.0 – 7.0) days.

Average daily physical activity and sedentary time

Children < 18 months were significantly less active than children in the two older age groups ($p < 0.001$). On average, they accumulated 118 daily minutes of total PA and spent 79% (~7.3 hours) of their waking time per day engaged in sedentary behaviours, 21% (~1.9 hours) engaged in LPA and <1% (~4 mins) of their day engaged in MVPA (Table 2). On average, children 18 – 59 months accumulated 232 daily minutes of total PA and spent 63% (~6.6 hours) of their waking time per day engaged in sedentary behaviours, 32% (~3.4 hours) engaged in LPA and 5% (~29 mins) of their day engaged in MVPA. On average, children ≥ 60 months accumulated 282 daily minutes of total PA and spent 58% (~6.6 hours) of their waking time per day engaged in sedentary behaviours, 33% (~3.7 hours) engaged in LPA and 9% (~58 mins) of their day engaged in MVPA. The average accelerometer wear time for all children in the sample was approximately 10.2 (range, 7.7 – 12.0) hours per day. There were no significant differences in boys compared to girls in overall mean (95% CI) daily minutes of sedentary time: 407 (392 – 422) vs. 408 (391 – 424); $p = 0.99$, LPA: 179 (157 – 200) vs. 180 (162 – 197); $p = 0.93$; or MVPA: 29 (21 – 37) vs. 25 (17 – 33); $p = 0.54$ for any age group.

Proportion meeting physical activity guidelines

Twenty-three percent (95% CI: 9.1 – 36.6) of children < 18 months, and 76 percent (95% CI: 67.6 – 84.8) of children 18 – 59 months met the guideline of at least 180 minutes of physical activity at any intensity on at least 4 days per week (the operational definition of meeting the guideline of 180 minutes of total PA every day) (Figure 1). Thirteen percent (95% CI: 1.2 – 24.1) of children $\geq$ 60 months met the guideline of at least 60 minutes of MVPA on at least 6 days per week (the operational definition of meeting the guideline of 60 minutes of MVPA every day).

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Discussion

The majority of children aged 18 – 59 months in our study met the Canadian physical activity guidelines of at least 180 minutes of total physical activity every day, whereas only 13% of children 5 years and older met the recommended 60 minutes of daily MVPA. Our findings on children over the age of 3 years are in line with the adherence to physical activity guidelines reported by the 2009-2011 Canadian Health Measures Survey (Colley et al. 2013). To the best of our knowledge, this is the first Canadian study to objectively measure physical activity in children less than 3 years and the first study to use accelerometers to objectively measure crawling and non-ambulatory movement in children less than 18 months. We found that 23% of children less than 18 months met the guideline of 180 minutes of daily physical activity at any intensity. Because our results are consistent with CHMS data for the same age groups, we likely have a good estimate of minutes at varying levels of movement intensity for children less than 3 years. However, accelerometer cut-points used to define different levels of intensity can have an important impact on estimates of physical activity. The MVPA cut-point we used was developed for Actical™ accelerometer data collected in 3–5 year old children (Adolph et al. 2012). The sedentary cut-point we used was developed in adults (Wong et al. 2011) and may have underestimated the time spent in light physical activity, supporting the need for accelerometer count cut-points specifically for children less than 3 years of age. Had we used the sedentary cut-point identified by Adolph and colleagues (2012) of 25 cpm, we would have reported a higher average daily minutes of total physical activity in children less 3 years.

We report very low activity levels for children in the < 18 month age group. Our sample included a large number of young infants (mean age of 9 months for this age group). While there are accelerometer validation studies in children less than 36 months of age (Costa et al. 2014; Van Cauwenberghe 2011), there are no validation studies involving children less

than 12 months of age. Our presentation of physical activity in children less than 3 years is exploratory and therefore our results should be interpreted with caution. We recognize that some of the movement detected in children < 18 months may be parental motion. In future studies of this age group, we recommend collecting data on ambulation and categorizing children into one of 3 categories (a. not crawling or walking; b. crawling or bum shuffling; c. walking). As we explore determinants of physical activity and sedentary time in infants, it may be useful to reconsider time-based recommendations for this age group. For example, physical activity guidelines in Australia encourage physical activity, focusing on supervised floor-based play in safe environments, for infants < 12 months without specific time-based recommendation (Australian Government, The Department of Health 2009).

The majority of children aged 18-59 months appear to be meeting the Canadian physical activity guidelines with a guideline adherence rate of 76% and a mean total PA of 232 min/d. Our results for the proportion of children meeting the guidelines are consistent with the previously published national sample of children (Colley et al. 2013). In the national sample of 3-4 year olds, 84% met the guideline of at least 180 minutes of daily total PA; 84% of our children in the 3-4 year age group met the same standard (see Table 3). However, the mean total PA for our sample was more than 100 min/d lower than those reported by Colley et al. (2013). Our 36-59 month age group accumulated 245 min/d of total PA and 31% (~3.4 hours) of their day engaged in LPA and 7% (~43 mins) of their day engaged in MVPA versus 352 min/d of total PA and 41% (~4.8 hours) of their day engaged in LPA and 9% (~66 mins) of their day engaged in MVPA reported by Colley et al. (2013). Both studies used the Actical™ accelerometer with the same activity cut-points and definitions for a valid day of wear time, so it is unlikely that inconsistent methodologies account for the lower physical activity levels we report. One possible explanation is that our sample was limited to an urban population recruited from primary care. Another possible explanation is that it may reflect

changes over time as our data were collected from 2013-2014 versus 2009-2011. However, both studies draw a similar conclusion – the majority of children aged 3-4 years are meeting the Canadian physical activity guidelines.

In contrast, our results are inconsistent with other studies that reported very low proportions of children meeting the guidelines for the same age group (Hinkley et al. 2012; Wijtzes et al. 2013). For example, Wijtzes et al. (2013) and Hinkley et al. (2012) reported that 0% and 5% of the children aged 18-59 months in their studies met the guideline of 180 min/d of total PA, respectively. The Actigraph™ accelerometer was used in these studies with an LPA cut-point of 1208 cpm, which may have underestimated total PA. Studies have demonstrated that an LPA cut-point of approximately 100 cpm for the Actigraph™ is better at distinguishing LPA from sedentary time (Janssen et al. 2013; Van Cauwenberghe et al. 2011). When these lower cut-points were adopted in other studies using the Actigraph™, the proportion of children meeting guidelines is similar to what we have reported (Hnatiuk et al. 2012; Obeid et al. 2011). While supporting that the majority of children in the 18-59 month age group meet the guidelines when appropriate cut-points are used, these results emphasize the importance of establishing a standard methodology using the best evidence for age-appropriate cut-points.

The average daily minutes of MVPA and proportion of children meeting the physical activity guidelines for the ≥ 60 months age group in our sample were similar to those reported by Colley et al. (2013). Children in our sample averaged 10 min/d less MVPA than those reported in the CHMS study (see Table 3) (Colley et al. 2013), though, like the CHMS, they spent 9% of their day engaged in MVPA. However, because they spent a greater percentage of their day engaged in sedentary behaviours and a lower percentage of their day engaged in LPA, this suggests that the children in our study were somewhat less active than a previously published national sample of children (Colley et al. 2013).

The apparent decline in physical activity adherence after age 5 is partly due to the changes in physical activity guidelines when children transition from 0-4 years to the 5-17 year age group, rather than a decrease in activity level. In our sample, there was a trend towards increased LPA and MVPA for children in the ≥ 60 -month age group compared to the 18-59 month group, despite a large decline in the proportion meeting guidelines. A similar increase in physical activity was found with increasing age within the 18-59 month age group, with the older group more active and with more MVPA than the younger group. However, while the majority of children in the 18-59 month age group met the physical activity guidelines, the large majority of that time was spent in LPA, as demonstrated in other studies (Colley et al. 2013; Hnatiuk et al. 2014). Thus, many children aged 18-59 months are not progressing towards 60 minutes of MVPA; this may explain why only 13% of children ≥ 60 months met their age-specific guidelines.

Canadian sedentary behaviour guidelines do not specify a total daily sedentary time target. Rather, guidelines only specify time restrictions on screen time: that children under age 2 do not engage in screen time (American Academy of Pediatrics Committee on Public Education 2001), and screen time be limited to less than 1 hour per day in 3 to 4 year old children (Tremblay et al. 2012b), and to no more than 2 hours per day in 5 year old children (Tremblay et al. 2011b). While our data show that children aged < 18 months, 18-59 months and ≥ 60 months spend 79% (~7.3 hours), 63% (~6.6 hours), 58% (~6.6 hours) of their day, respectively, engaged in sedentary behaviours, we do not know how much of that time was screen time. A higher proportion of waking hours was spent in sedentary time, particularly for the two youngest age groups, when compared with CHMS data (Colley et al. 2013). What specific behaviours the youngest children are engaging in during sedentary time may be best explored using parent-report or direct observation (Colley et al. 2012).

Study limitations include using the Actical™ model of accelerometer. While its use in the preschool age group is supported by the literature (Adolph et al. 2012; Cliff et al. 2009; Pfeiffer et al. 2006), no studies have validated the Actical™ accelerometer for children aged < 36 months. In addition, the cut-point used to distinguish sedentary time from LPA was derived from data validated in adults (Wong et al. 2011). We chose this cut-point to allow a direct comparison with the results from the national sample (Colley et al. 2013), but appreciate that the validity of our results could be strengthened by age-specific cut-points. Despite this limitation, our results are consistent with previous studies that used similar cut-points validated in young children for the Actigraph™ accelerometer (Hnatiuk et al. 2012; Obeid et al. 2011). Further, Straker and Campbell (2012) created translation equations to compare the Actigraph™ and Actical™ accelerometer and our LPA cut-point aligns with the cut-point range that has been validated for the Actigraph™ in toddlers and preschool children (Janssen et al. 2013; Pate et al. 2006; Trost et al. 2012; Van Cauwenberghe et al. 2011). We also acknowledge that with the Actical™ not being waterproof and removed during swimming, we may have underestimated physical activity. In addition, seasonal variation could not be assessed in our sample nor could differences in physical activity and sedentary time between normal weight and overweight children because of sample size; both are areas of future research. Finally, we acknowledge the limitation of a cross-sectional design and recognize that longitudinal studies are needed to better understand physical activity trajectories of children from an early age.

Conclusions

The majority of children aged 18 – 59 months in our study met the Canadian physical activity guidelines for children 0-4 years, whereas few younger than 18 months met the same guidelines. Despite a trend towards increasing MVPA in the older age groups, only 13% of

children ≥ 60 months of age met the guidelines of 60 min of daily MVPA. While children under 18 months appeared relatively inactive, further research is needed to validate accelerometer-based physical activity measurement and develop accelerometer count cut-points in this age group. This will aid in the development of effective strategies to promote physical activity and reduce sedentary behaviours in very young children.

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Authors' contributions

Cornelia M. Borkhoff: Dr. Borkhoff participated in study conception and design, carried out the analyses, revised and finalized the manuscript, and approved the final manuscript.

Liane D. Heale: Dr. Heale participated in data analysis and interpretation, wrote the first draft of the manuscript, and approved the final manuscript. Dr. Liane Heale is the person who wrote the first draft of the manuscript; we would ask that she be acknowledged as the co-first author. No honorarium, grant, or other form of payment was given to anyone to produce the manuscript.

Laura N. Anderson: Dr. Anderson coordinated and supervised data collection, critically reviewed the manuscript, and approved the final manuscript.

Mark S. Tremblay: Dr. Tremblay participated in data interpretation, critically reviewed the manuscript, and approved the final manuscript.

Jonathon L. Maguire: Dr. Maguire designed the data collection instruments, coordinated and supervised data collection, critically reviewed the manuscript, and approved the final manuscript.

Patricia C. Parkin: Dr. Parkin designed the data collection instruments, coordinated and supervised data collection, critically reviewed the manuscript, and approved the final manuscript as submitted.

Catherine S. Birken: Dr. Birken participated in study conception, designed the data collection instruments, coordinated and supervised data collection, critically reviewed the manuscript, and approved the final manuscript as submitted.

All authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Table 1. Descriptive characteristics of participants, by age group and sex

Characteristics	Total	Age group					
		<18 months		18-59 months		≥60 months	
		Boys	Girls	Boys	Girls	Boys	Girls
Sample size, n	90	13	15	18	27	12	5
Mean age, months	32.4 (4.0-70.0)	8.9 (6.0-12.0)	10.0 (4.0-15.0)	37.9 (18.0-58.0)	34.1 (18.0-51.0)	62.2 (60.0-70.0)	61.2 (60.0-63.0)
Mean height, cm*	90.8 (62.0-117.2)	73.0 (65.0-79.4)	72.0 (62.0-83.0)	95.5 (78.0-114.0)	93.6 (75.5-116.5)	111.1 (102.7-117.2)	111.8 (108.0-115.4)
Mean weight, kg	13.4 (5.9-23.0)	9.2 (7.3-12.9)	8.2 (5.9-10.2)	15.0 (9.3-21.7)	13.7 (8.1-21.4)	18.7 (15.9-20.8)	20.1 (16.9-23.0)
Mean BMI, kg/m ²	15.9 (13.1-20.5)	17.1 (14.1-20.5)	15.8 (13.3-18.5)	16.3 (13.5-20.0)	15.5 (13.1-18.3)	15.2 (14.0-16.3)	16.0 (14.5-17.4)
Growth status, n (%)**							
Underweight	3 (3)	1 (8)	1 (7)	1 (6)	0 (0)	0 (0)	0 (0)
Normal Weight	83 (92)	10 (77)	14 (93)	16 (89)	27 (100)	12 (100)	4 (80)
Overweight	4 (4)	2 (15)	0 (0)	1 (6)	0 (0)	0 (0)	1 (20)
Mean number of valid days of accelerometry	6.1 (4.0-7.0)	5.7 (4.0-7.0)	5.9 (4.0-7.0)	6.1 (4.0-7.0)	6.2 (5.0-7.0)	6.3 (4.0-7.0)	6.2 (6.0-7.0)
Mean wear time per day in hours***	10.2 (7.7-12.0)	9.0 (7.9-10.6)	9.4 (7.7-10.6)	10.5 (8.6-11.8)	10.4 (8.7-12.0)	11.2 (9.6-12.0)	11.5 (11.0-11.8)

Values are presented as means (range) *Mean length for children under 2 years of age**For growth status, percentile was first determined using weight-for-length for children under 2 years of age and BMI-for-age for children 2 years of age and older. Children aged 0 to 5 years were characterized as underweight if in the < 3rd centile and overweight if in the > 97th centile. Children 5 years and older were characterized as underweight if in the < 3rd centile and overweight if in the > 85th centile.

Proportion of children overweight or obese is defined as BMI-for-age >97th percentile *** Wear time between 8:00am and 8:00pm

Table 2. Average daily minutes of activity at various levels of movement intensity, by age group and sex

Sex / Age group	Intensity of activity, average minutes per day							
	Sedentary		Light		Moderate-to-vigorous		Total	
	min/d	95% CI	min/d	95% CI	min/d	95% CI	min/d	95% CI
All participants	407	396 – 418	179	166 – 193	27	21 – 33	206	189 – 223
<18 months	435	413 – 456	114	90 – 138	4	3 – 6	118	94 – 142
18-59 months	395	381 – 409	203	192 – 214	29*	23 – 36	232*	218 – 246
≥60 months	396	371 – 421	224	203 – 244	58*	44 – 72	282*	252 – 312
Boys	407	392 – 422	179	157 – 200	29	21 – 37	208	180 – 235
<18 months	444	417 – 471	94	63 – 126	3	2 – 5	97	66 – 129
18-59 months	393	371 – 415	206	191 – 222	30	19 – 42	236	218 – 255
≥60 months	389	363 – 416	229	202 – 256	54	40 – 69	283	247 – 319
Girls	408	391 – 424	180	162 – 197	25	17 – 33	205	183 – 227
<18 months	427	392 – 462	131	94 – 168	5	2 – 8	136	100 – 173
18-59 months	396	377 – 415	201	185 – 217	29	20 – 38	230	209 – 250
≥60 months	413	331 – 495	211	172 – 250	68	22 – 114	279	194 – 363

*Significantly more active than children in the < 18 month age group ($p < 0.001$).

Table 3. A comparison of the TARGet Kids! and CHMS cohorts for mean daily minutes of sedentary time and total, light and moderate-to-vigorous physical activity and proportion of children meeting the guidelines by age group

Age	Study	Sedentary time min/d (95% CI*)	LPA min/d (95% CI)	MVPA min/d (95% CI)	Total PA min/d (95% CI)	Proportion meeting guidelines** (95% CI)
36-59 months	TARGet Kids!	407 (389 – 426)	202 (189 – 215)	43 (35 – 50)	245 (229 – 261)	83.8% (75.4 – 92.3)
	CHMS	348 (332 – 365)	285 (275 – 296)	66 (61 – 72)	352 (340 – 364)	83.8% (77.7 – 90.0)
≥ 60 months	TARGet Kids!	396 (371 – 421)	224 (203 – 244)	58 (44 – 72)	282 (252 – 312)	12.6% (1.2 – 24.1)
	CHMS	381 (361 – 400)	275 (261 – 289)	68 (62 – 74)	343 (325 – 361)	13.7% (9.4 – 18.0)

*CI, Confidence Interval

**For children 36-59 months, the proportion meeting 180 min/d of total PA on at least 4 days;
for children ≥ 60, the proportion meeting 60 min/d of MVPA on at least 6 days

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Figure 1. Proportion of children meeting the Canadian physical activity guidelines by age group

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