



Adherence to Canadian physical activity and sedentary behaviour guidelines among children 2 to 13 years of age

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ABSTRACT

Active living is relevant for healthy child development and disease prevention. In 2011–2012 new Canadian Physical Activity and Sedentary Behaviour Guidelines were developed for children under four and 5–17 years of age. This cross-sectional study assessed children's adherence to the national guidelines, using a large sample of Alberta children ages 2–4 and 5–13 years in 2013.

The proportions of children achieving the average daily duration of physical activity and screen time recommended were determined, and child and parental predictors of non-achievement were identified. Participants were 631 parent and child dyads. Data were collected by parental reports of physical activity and screen time during weekdays, and analysed using univariate and multivariate techniques ($p < 0.05$). Logistic regression models were used to examine factors associated with children's non-achievement of physical activity and screen time recommendations while adjusting for covariates.

Sixty-two percent of children aged 2–4 and 26% of children aged 5–13 did not meet physical activity time recommendations, and 64% of children aged 2–4 and 23% of children aged 5–13 exceeded the maximum screen time recommendation. Several associations between parental age and education with non-achievement were observed but associations were not consistent across age groups or behaviours. Among preschoolers, those with middle-age parents were more likely to not achieve physical activity recommendations.

Evidence of high non-achievement of the recommendations among children 2–4 years highlights the need for increased programming targeting preschool children. Further research is required to identify modifiable risk factors that may inform future health promotion efforts.

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Introduction

Physical activity (PA) is a key component of healthy child development and prevention of disease. PA in children is associated with a decreased risk of several chronic diseases including cardiovascular disease, metabolic syndrome, osteoporosis, and also with overall improved physical, cognitive and psychosocial wellbeing (Hills et al., 2007; Lees and Hopkins, 2013; Maximova et al., 2009; Timmons et al., 2012). Research shows that PA levels are declining among children and time spent in sedentary behaviours is becoming more common (Leatherdale and Ahmed, 2011; Shields and Tremblay, 2008). Increased sedentary behaviours, and in particular screen-based sedentary behaviours (including TV, computer, and other electronic devices), have been

associated with unfavourable growth and development (Hills et al., 2007; Marshall et al., 2004). For example, increased screen time (ST) has been related to poor diet, overweight and obesity, and lower measures of psychosocial and cognitive development (Christakis, 2009; Hancox et al., 2004; LeBlanc et al., 2012).

In 2011, the Canadian Society for Exercise Psychology revised the Physical Activity and Sedentary Behaviour Guidelines for children (5–11 years of age) and youth (12–17 years of age), and in 2012 released the first ever guidelines for younger children (0–4 years of age) (Tremblay et al., 2012; Tremblay et al., 2011a; Tremblay et al., 2011b). The guidelines are evidence-informed and include recommendations for daily PA at different ages that offer substantial health benefits, and the maximum daily amount of sedentary behaviour at different ages (including ST) that reduces health risks (The Canadian Society for Exercise Physiology, 2012). PA recommendations are: for children under 1 year of age “several times a day,” for 1–4 year-olds at least 180 min/day (any intensity), and for 5–17 year-olds at least 60 min/day (moderate to vigorous intensity); ST recommendations are: for children younger than 2 years of age “not recommended,” for 2–4 year-olds

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under 1 h/day (less is better), and for 5–17 year-olds under 2 h/day (less is better) (Tremblay et al., 2012; Tremblay et al., 2011a). The guidelines were endorsed by the Canadian Paediatric Society and extensively promoted and disseminated to the public (Tremblay et al., 2014; Tremblay et al., 2011a; Tremblay et al., 2011b). The effort to raise awareness and educate the public included a strong media engagement and initiatives to work closely with a number of professional groups in different sectors such as government, education, health, and recreation (LeBlanc et al., 2015).

Despite promotion and dissemination efforts, there are limited PA and ST data to assess adherence to the guidelines. National data available from 2012–2013 indicated that 70% of preschoolers and 9% of school-aged Canadians accumulated the recommended 180 and 60 min respectively of daily PA (ParticipACTION, 2015). Levels declined since 2007–2009 for preschoolers when 84% met daily recommendations, and remained stable for school-age children when 7% met daily recommendations (Active Healthy Kids Canada, 2013; Colley et al., 2013). National data further indicated that 15% of preschool children and 24% of school-aged children limit their daily ST to less than 1 h and 2 h a day, respectively (ParticipACTION, 2015). Given the extensive efforts to promote and disseminate the most recent guidelines, an updated assessment of adherence to the guidelines among children, and a better understanding of the factors associated with non-achievement of the recommendations are needed. Parental predictors of children's non-achievement are relevant because parents have considerable influence on their children's active living behaviours (Smith et al., 2010; Trost et al., 2003). A discourse analysis of PA promotion in children (Alexander and Coveney, 2013) identified parents as key stakeholders for supporting children's meeting the recommendations. Characterisation of children who are least likely to follow PA and sedentary behaviour recommendations based on both child and parent factors may identify children at risk of negative health outcomes, and help guide targeted active living promotion activities.

The aim of this study was to determine the proportion of children 2–4 and 5–13 years of age achieving the average daily duration recommended for both PA and ST and to identify child and parental predictors of non-achievement of the updated guidelines in a large population sample from Alberta, Canada. The distinction between children 2–4 and 5–13 years of age is important because these two age groups have distinct guidelines with different recommendations, and have different correlates associated with PA and sedentary behaviour participation (Hinkley et al., 2008; Van der Horst et al., 2007).

Methods

Survey

The study is a secondary analysis of the 2013 Provincial Benchmark Survey, Alberta (Pujadas Botey et al., 2014). The survey followed a cross-sectional study design. It explored both parents and non-parents' knowledge of child development and opinions about child-related issues including breastfeeding and childcare. For parents, the survey also inquired about active living, parental confidence, parental supports, and use of childcare. Participants were adults (18 years of age or older), residents of Alberta, contacted by direct dialling of residential numbers, and had interacted with a child under the age of 14 in the past six months under one of the following categories: parent (including guardians and foster parents), grandparent, other relative, through their job (e.g., childcare provider, teacher, nurse) or volunteer role. Participants were selected using a random-digit dialling approach. Only one adult living in each household dialled was eligible to participate. If more than one adult of a household was eligible, the adult who most recently celebrated his or her birthday was selected. The sample was stratified such as the first 1200 participants were equally distributed between the two large urban centres (Calgary and Edmonton, population approximately one million each) and other areas of the

province (population approximately one million) to represent the distribution of the Alberta population. Participants were selected so that approximately 25% were male, and 50% were non-parents. The total number of participants was 1451. The survey was administered weekdays and weekends, using Computer Assisted Telephone Interviewing by trained interviewers. Data were collected between March and May 2013 (Pujadas Botey et al., 2014). Ethical approval was granted by the University of Alberta Research Ethics Board.

Participants

Participants included in the present analysis were Albertan adults who were parents of children 2–13 years old. If the parent had more than one child within the age range, he or she was asked to report on the child who most recently celebrated their birthday (Salmon and Nichols, 1983). A total of 631 parent and child dyads participated (100% of parents and their children aged 2–13 years).

Measures

Potential child and parental factors related to PA and ST were based on demographic and other available data. Factors related to the child included: age (continuous variable, 2–13 years); gender (male, female); special needs (yes, no); in childcare (attending, not attending; children ≤ 4 years); and, in kindergarten or school (attending, home-schooled; children ≤ 6 years). Factors related to the parent included: gender (male, female); age (≤ 35 , 36–41, ≥ 42 years); family structure (with partner, single); education level (high school or lower, technical school or some university/college, college or higher); born in Canada (yes, no); aboriginal status (yes, no); annual income ($< \$40,000$, $\$40,000$ – $\$99,999$, $\geq \$100,000$); and residence (Calgary/Edmonton, other areas). Additional parental factors included: parenting confidence (“strongly agree”/“agree,” “neutral”/“disagree”/“strongly disagree” with “I have confidence in my parenting skills”); level of knowledge of child development (≥ 13 responses correct to 26 milestone questions, < 13 correct); and, emotional health (“very poor”/“poor,” “fair,” “good”/“excellent” in a 5-point scale).

To determine children's PA and ST, parents were asked to identify the approximate number of minutes per day that their child is physically active and engages screen-based behaviours on a typical weekday. Respondents were provided the definition of PA and screen-based behaviour presented in the guidelines' main dissemination products, together with age-specific examples also taken from main dissemination products. In order to account for total ST, it was clarified that both child-centred and non-intentional viewing (e.g., sitting with a parent while the parent watches an adult show) had to be considered. Responses were captured in time segments (< 15 min, 15–29 min, 30–59 min, 1 h to 1 h 59 min, and 2 h to 2 h 59 min for PA; ≤ 15 min, 16–30 min, 31–60 min, 1 h 1 min to 2 h, 2 h 1 min to 3 h, > 3 h for ST) and then categorised into “not achieving” or “achieving” times recommended based on the age of the child.

Data analysis

Descriptive statistics were used to describe the demographics of parents and children, and to explore the number of children in each age group not meeting PA and ST recommendations. Logistic regression analysis was used to examine factors associated with children's non-achievement of the recommendations. Variables eligible for inclusion in the regression models were identified at the bivariate level if $p < 0.2$. Regression models were created by entering variables hierarchically. Four separate models were created for PA and ST, with children in age groups of 2–4 and 5–13 years. Significance was set at $p < 0.05$. Analyses were based on all available data. SPSS for Windows, version 20 was used for all analyses.

Results

Study sample characteristics

The sample included 631 parents and their children. Less than one-third of parents (27%; Table 1) and approximately half of children (52%) were males. The mean age was 40 years (standard deviation (SD) = 7) for parents, and 8 years (SD = 4) for children. Most parents had two or more children (63%), were married or common-law (86%), and had completed more than high school (78%). Most parents were born in Canada (81%) and a minority were Aboriginal (7%). Two-thirds of families (66%) had a household annual income of \$80,000 or more, which reflects the parenting population of Alberta (McDonald et al., 2013). Over half (55%) resided in Alberta's largest cities (29% Calgary, 26% Edmonton).

Non-achievement of physical activity time recommendations

Of children in the 2–4 age range, more than half (62%) did not achieve the daily duration of PA recommended in the guidelines. Of children in the 5–13 age range, one quarter (26%) did not achieve the daily duration of PA recommended in the guidelines (Table 2).

Table 3 presents bivariate associations between child and parent characteristics related to non-achievement of the daily duration of PA recommended in the guidelines. Children 2–4 years of age with parents aged 36–41 years were almost 3 times more likely to be non-achievers compared to children of parents younger than 36 years (aOR 2.88, 95% CI 1.35, 6.16; Table 4). For children 5–13 years of age, those whose parents had technical school or some college/university were more likely to be non-achievers than children with parents with lower level of education (high school or lower level) (aOR 2.00, 95% CI 1.08, 3.72). Children in this same age range residing in large cities (i.e., Calgary or Edmonton) were more likely to be non-achievers compared to those residing in the rest of the province (aOR 1.61, 95% CI 1.04, 2.51).

Table 1

Characteristics for parent respondents and children 2–13 years of age in the 2013 Provincial Benchmark Survey, Alberta, Canada.

Demographics	Parents N = 631 n (%)	Children N = 631 n (%)
Gender: male	173 (27)	323 (52)
Age [mean, SD]	40, 7	8, 4
<i>Number of children</i>		
1	232 (37)	–
2	283 (45)	–
3 or more	116 (18)	–
<i>Family structure</i>		
Shared parenting (i.e., married, common-law)	537 (85)	–
Single parent	93 (15)	–
<i>Highest level of education attained</i>		
High school or lower	137 (22)	–
Technical school or some college/university	234 (37)	–
College or higher	257 (41)	–
Born in Canada	511 (81)	–
Aboriginal status	41 (7)	–
<i>Annual household income</i>		
Less than \$40,000	36 (7)	–
\$40,000 to \$79,999	151 (28)	–
\$80,000 to \$99,999	80 (15)	–
\$100,000 or \$179,999	189 (35)	–
\$180,000 or more	90 (16)	–
<i>Place of residence</i>		
City of Calgary	183 (29)	–
City of Edmonton	163 (26)	–
Other Alberta	285 (45)	–

Denominators vary due to missing values.

Table 2

Achievement of physical activity and screen time recommendations among children 2–13 years of age in the 2013 Provincial Benchmark Survey, Alberta, Canada.

Age (years)	Physical activity achievement N = 623		Screen time achievement N = 623		Physical activity and screen time achievement ^a N = 343	
	Yes n (%)	No n (%)	Yes n (%)	No n (%)	Yes n (%)	No n (%)
2	23 (45)	28 (55)	26 (50)	26 (50)	11 (22)	13 (26)
3	22 (36)	39 (64)	15 (24)	47 (76)	6 (10)	30 (49)
4	21 (34)	40 (66)	22 (35)	40 (65)	7 (11)	25 (41)
5	28 (65)	15 (35)	33 (75)	11 (25)	20 (48)	3 (7)
6	34 (83)	7 (17)	26 (65)	14 (35)	22 (55)	3 (7)
7	38 (83)	8 (17)	37 (82)	8 (18)	31 (69)	2 (4)
8	37 (79)	10 (21)	40 (85)	7 (15)	31 (66)	1 (2)
9	34 (71)	14 (29)	28 (58)	20 (42)	20 (42)	6 (13)
10	49 (80)	12 (20)	37 (61)	24 (39)	31 (51)	6 (10)
11	34 (76)	11 (24)	22 (50)	22 (50)	16 (36)	5 (11)
12	30 (61)	19 (39)	26 (53)	23 (47)	14 (29)	7 (14)
13	51 (73)	19 (27)	32 (46)	37 (54)	23 (33)	10 (14)
Total ages 2–4	66 (38)	107 (62) ^b	63 (36)	113 (64) ^b	24 (14)	68 (39)
Total ages 5–13	335 (74)	115 (26) ^b	281 (63)	166 (37) ^b	208 (47)	43 (10)
Total all ages	401 (64)	222 (36)	344 (55)	279 (45)	232 (38)	111 (18)

^a Refers to achievement of both physical activity and screen time, and non-achievement of either physical activity or screen time.

^b Differences between age groups were significant ($p < 0.000$).

Non-achievement of screen time recommendations

Over half (64%) of children in the 2–4 age range exceeded the maximum ST recommendation. Over one-third (37%) of children in the 5–13 age range exceeded ST recommendations (Table 2).

Two to four year old children of parents 42 years or older were more likely to meet the recommendation for ST compared to children of parents aged 35 or younger (aOR 0.40, 95% CI 0.16, 0.98; Table 4). Among children within the 5–13 age range, the likelihood to be non-achievers increased with age (aOR 1.21, 95% CI 1.11, 1.42). Male children as opposed to female children were more likely to be non-achievers (aOR 1.61, 95% CI 1.04, 2.51). Also, children whose parents had completed college or had a higher education level were more likely to meet the recommendations compared to those whose parents had completed high school or had a lower education level (aOR 0.45, 95% CI 0.27, 0.77).

Discussion

This study assessed children's adherence to the active living national guidelines in Canada, which has been paid limited attention since the release and extensive promotion of the updated guidelines. Findings suggest that over 60% of children aged 2–4 are not achieving the recommended amount of PA and are exceeding the recommended amount of ST. In contrast, over 70% of children aged 5–13 are achieving the recommended amount of PA, and over 60% are adhering to ST recommendations. Parental age and education, as well as residence, and child age and gender had some influence on guideline achievement but results were inconsistent across age groups and behaviours.

In our study, the prevalence of children 2–4 years of age who did not reach the daily duration of PA recommended (62%) was higher than previously reported data. For instance, a study in Hamilton, Ontario (2009–2011 data) found that 27% of children aged 1–4 years (Gabel et al., 2013), and a national study found that 30% of 3–4 year old Canadian children (2012–2013 data) (ParticipACTION, 2015) did not meet the 180 min a day of PA recommended. Little is known about appropriate strategies for stimulating active living among preschoolers (Flynn et al., 2006; T. Hinkley et al., 2012). More recently, a pan-Alberta Advisory Committee came together to tackle low levels of PA

Table 3

Unadjusted logistic regression of risk factors of non-achievement of physical activity and screen time recommendations among children 2–4 and 5–13 years of age in the 2013 Provincial Benchmark Survey, Alberta, Canada.

Characteristic	Category	Physical activity		Screen time	
		Age 2–4 N = 173	Age 5–13 N = 450	Age 2–4 N = 176	Age 5–13 N = 447
		Unadjusted OR (95% CI)	Unadjusted OR (95% CI)	Unadjusted OR (95% CI)	Unadjusted OR (95% CI)
Child's age		1.19 (0.82–1.73)	1.04 (0.95–1.13)	1.42 (0.97–2.08)	1.22 (1.12–1.31)^a
Child's gender	Female (referent)				
	Male	0.59 (0.31–1.12)	0.71 (0.46–1.09)	1.18 (0.63–2.22)	1.49 (1.01–2.20)^a
Child special needs	No (referent)				
	Yes	0.34 (0.08–1.49)^a	1.40 (0.78–2.53)	1.63 (0.32–8.33)	1.42 (0.82–2.47)
Child in childcare	No (referent)				
	Yes	0.67 (0.36–1.27)	1.32 (0.78–2.23)	1.11 (0.58–2.10)	0.79 (0.47–1.28)
Child in kindergarten or school	No (referent)				
	Yes	–	#	–	0.20 (0.02–1.95)
Parent's gender	Female (referent)				
	Male	1.18 (0.59–2.35)	1.25 (0.78–1.99)	1.07 (0.54–2.13)	1.16 (0.76–1.78)
Parental age	35 or younger (referent)				
	36–41	2.88 (1.35–6.16)^a	0.72 (0.38–1.36)	0.71 (0.35–1.45)	1.12 (0.62–2.04)
	42 or older	1.18 (0.48–2.92)	0.93 (0.52–1.67)	0.40 (0.16–0.98)^a	1.52 (0.87–2.68)
Family structure	Single (referent)				
	With partner	2.32 (0.77–7.02)	0.82 (0.47–1.41)	1.44 (0.51–4.10)	0.60 (0.36–0.99)^a
Parental education	High school or lower (referent)				
	Technical school or some college/university	0.67 (0.29–1.55)	2.04 (1.11–3.78)^a	1.15 (0.49–2.70)	0.61 (0.37–1.01)
	College or higher	1.27 (0.54–2.74)	1.63 (0.87–3.04)	0.91 (0.41–2.03)	0.44 (0.26–0.74)^a
Parent born Canada	No (referent)				
	Yes	1.28 (0.60–2.72)	0.60 (0.36–1.00)	1.49 (0.71–3.12)	1.40 (0.84–2.35)
Parent Aboriginal status	No (referent)				
	Yes	0.49 (1.43–1.68)	0.71 (0.28–1.79)	1.52 (0.39–5.96)	0.97 (0.45–2.10)
Annual income	<\$40,000 (referent)				
	\$40,000–\$99,999	1.27 (0.31–5.19)	0.73 (0.28–1.86)	0.87 (0.20–3.81)	0.96 (0.40–2.32)
	≥\$100,000	1.30 (0.32–5.20)	1.06 (0.42–2.67)	0.92 (0.21–3.93)	1.17 (0.49–2.79)
Residence	Other (referent)				
	Calgary or Edmonton	1.28 (0.69–2.41)	1.58 (1.03–2.44)^a	1.14 (0.61–2.15)	0.94 (0.64–1.38)
Parent high parenting confidence	No (referent)				
	Yes	0.75 (0.36–1.52)	0.66 (0.41–1.04)	0.96 (0.48–1.95)	0.87 (0.57–1.34)
Parent high knowledge child development	No (referent)				
	Yes	0.77 (0.35–1.71)	0.77 (0.37–1.60)	0.81 (0.36–1.80)	1.06 (0.57–1.97)
Parental emotional health	Poor (referent)				
	Fair	1.89 (0.43–8.23)	0.75 (0.29–1.96)	0.19 (0.02–1.72)	0.79 (0.31–2.01)
	Good	1.63 (0.45–5.92)	0.56 (0.24–1.31)	0.19 (0.02–1.51)	0.60 (0.26–1.40)

Variables in bold were eligible for inclusion in the models ($p < 0.2$).

^a $p < 0.05$ compared to reference category.

in preschool childcare settings in Alberta and raised the need for increased and improved understanding of physical literacy and physical activity through the development of standards (Armitage et al., 2012). It is possible that the lack of evidence-based approaches combined with the lack of caregiver information about the importance of PA accounts for the high proportion of children who are not achieving the guidelines. Furthermore, the preschool guidelines include light-intensity physical activity. This is more difficult to capture with parental-report questionnaires compared to objective measures, which were used in previous studies (Gabel et al., 2013; ParticipACTION, 2015).

For children 2–4 years of age the proportion of those exceeding the 1 h daily of ST recommended (64%) was the same as the proportion reported for 2- to 4-year-olds from Kingston, Ontario (64%; 2009 data) (Carson et al., 2013). However, it was lower than national data reported for children ages 3–4 years in recent years (82%, 2009–2011 data; 85%, 2012–2013 data) (Bilinski et al., 2005; Colley et al., 2013), which in turn was comparable to results from other countries with similar ST time targets such as Australia (Trina Hinkley et al., 2012). Overall, findings across studies suggest excessive ST use is a problem for preschool children.

The high levels of achievement of the daily average of PA recommended among children 5–13 years of age (74%) in the present study exceeded those previously reported from national data. Canadian values reported for school-aged children were only 9% of 5- to 17-year-olds

(data 2012–2013) (ParticipACTION, 2015), which remained unchanged from earlier reporting periods (Active Healthy Kids Canada, 2013; Colley et al., 2013). Disparities between our data and the national levels may be explained by different methodologies. While national PA data were obtained from objective measures and captured both duration and intensity of PA, the current study used subjective measures and captured exclusively duration of PA. Furthermore, assessment of meeting the guidelines using national data has been operationalised as participating in 60 min of moderate- to vigorous-intensity physical activity (MVPA) six days of the week. However, our study looked at a PA in a typical weekday. National data indicated that, on average, children and youth participate in 47–61 min of MVPA per day and 35–53% meet the guidelines at least 3 days of week (Colley et al., 2011), which is closer to our estimates of PA in a typical weekday.

The proportion of children 5–13 years of age meeting ST recommendations (63%) was also higher than what was previously reported. Information from 2008 suggested that 59% of 10 year old Albertan children met ST recommendations (Carson et al., 2010). National studies found that 49% of children aged 10–17 years (data 2008–2009) (Leatherdale and Ahmed, 2011), and 24% of children aged 5–11 years (data 2012–2013) (LeBlanc et al., 2012) were meeting ST recommendations. These lower levels of achievement might be due to the fact that these studies, as opposed to our study, included ST during weekends, which tends to be higher than on weekdays (Compte et al., 2013).

Table 4
Adjusted logistic regression of risk factors of non-achievement of physical activity and screen time among children 2–4 and 5–13 in the 2013 Provincial Benchmark Survey, Alberta, Canada.

	Risk factor	Category	Adjusted OR (95% CI)
PA among children 2–4 ^a	Parental age	35 or younger (referent)	
		36–41	2.88 (1.35–6.16)^e
		42 or older	1.18 (0.48–2.92)
PA among children 5–13 ^b	Parental education	High school or lower (referent)	
		Technical school or some college/university	2.00 (1.08–3.72)^e
		College or higher	1.47 (0.78–2.77)
ST among children 2–4 ^c	Parental age	Other (referent)	
		Calgary or Edmonton	1.61 (1.04–2.51)^e
		35 or younger (referent)	
ST among children 5–13 ^d	Child's age	36–41	0.71 (0.35–1.45)
		42 or older	0.40 (0.16–0.98)^e
		Child's gender	
	Parental education	Female (referent)	
		Male	1.61 (1.04–2.51)^e
		High school or lower (referent)	
		Technical school or some college/university	0.66 (0.39–1.12)
		College or higher	0.45 (0.27–0.77)^e

^a Adjusted for other predictor variables. Number of observations included in final model $n = 171$. Model fit: $\chi^2 = 8.20$, $df = 2$; p -value = 0.02; Nagelkerke $R^2 = 0.06$; overall percentage: 62%.

^b Adjusted for other predictor variables. Number of observations included in final model $n = 447$. Model fit: $\chi^2 = 10.12$, $df = 3$; p -value = 0.02; Nagelkerke $R^2 = 0.03$; overall percentage: 74.3%.

^c Adjusted for other predictor variables. Number of observations included in final model $n = 174$. Model fit: $\chi^2 = 4.15$, $df = 2$; p -value = 0.126; Nagelkerke $R^2 = 0.03$; overall percentage: 64.9%.

^d Adjusted for other predictor variables. Number of observations included in final model $n = 436$. Model fit: $\chi^2 = 36.72$, $df = 4$; p -value = 0.00; Nagelkerke $R^2 = 0.11$; overall percentage: 67.4%.

^e $p < 0.05$ compared to reference category.

The foundations of health behaviours are developed before adulthood and understanding correlates of active living may be crucial (Gordon-Larsen et al., 2004). In the present study, important parent and children predictors of non-achievement of PA and ST recommendations were identified. Results showed that children 2–4 years of age with middle-age parents (36–41 years) may be at increased risk of not reaching PA recommendations, and those with older parents (≥ 42 years) may be at lower risk of exceeding ST recommendations. Consistent with two recent reviews (Hinkley et al., 2010; Hoyos Cillero and Jago, 2010), these findings suggest that children of younger parents might be more active and spend more time in screen-based activities. This can be explained by the fact that younger parents might be able to better support PA, and might be more technology advocates, open to involving new media in family activities, and provide environments with greater access to media sources. Earlier studies have reported that parents have an important influence on preschool children's PA and screen-behaviour engagement (Smith et al., 2010), and parental levels of PA are an important predictor of preschool children's PA (Adamo et al., 2012; Hinkley et al., 2008). Other parental factors influencing preschool children's ST include parental levels of concerns around viewing time (Carson et al., 2014), perceiving screen-based resources as having educational benefits (De Decker et al., 2012), and using screens as an opportunity for parents to complete household chores more easily (He et al., 2005).

For older children, our study suggested that parental education may be a factor associated with non-achievement of both PA and ST recommendations. In particular, children 5–13 years of age with parents with middle education level (technical school or some college/university) were more likely to not be active enough, and those with parents with high education level (college or higher) were less likely to exceed ST recommendations. These results did not provide a clear trend about non-achievement, but align with previous research reporting that children of parents in the lower educational group are likely to be higher screen-viewers (Hoyos Cillero and Jago, 2010), which has been related to less parental screen-viewing rules, and greater access to media sources (Carlson et al., 2010). However, in terms of PA, our results contradicted previous research that indicated that children of parents

in the lower education level are less active. Differences between studies may be due to differences in measurement methodologies.

Our study also suggested that residence in Alberta's largest cities was a predictor for non-achievement of the average daily duration of PA recommended for children aged 5–13 years. While some studies found no differences (Plotnikoff et al., 2004), others aligned with our findings (Pampalon, 1991) or suggested the opposite (Bilinski et al., 2005; Comte et al., 2013). Discrepancies might be due to the exclusive focus on school-based activities (Bilinski et al., 2005), the inclusion or not of suburban populations (Damore, 2002; Pampalon, 1991), and the season of the year in which data were collected. We also found that age and gender of the child were predictors for non-achievement of ST recommendations among 5- to 13-year-olds. As consistently reported in the literature, older (Carlson et al., 2010; Hoyos Cillero and Jago, 2010; Leatherdale and Ahmed, 2011; Mark et al., 2006; Van der Horst et al., 2007) and male (Carlson et al., 2010; Leatherdale and Ahmed, 2011; Liwander et al., 2014; Mark et al., 2006; Van der Horst et al., 2007) children were more likely to engage in higher levels of ST and therefore more likely to exceed ST guidelines.

Strengths and limitations

The strengths of the study include a relatively large and randomly selected sample of parents of 2–4 and 5–13 year old children. Limitations of the study included that PA and ST were assessed by proxy reports completed by a parent. Although this approach has been typically used and accepted in the literature (Bryant et al., 2007; Tucker, 2008) it has also been reported to be prone to overestimations by parents (Corder et al., 2010). In addition, a limited interaction between parent participants and their child may account for bias. However, given that our participants were 13 years and younger it is likely that they interact with their parents more frequently than do older youth. Another limitation was the random-digit dialling technique that restricted participants to land-line phone owners potentially biasing representativeness. Findings also reflected the views of English-speaking parents willing to participate in a half-hour survey, and may not reflect those who are less comfortable in English. Non-achievement of the

recommendations could be underestimated for PA since questions were related to the average daily time spent in PA and did not include other indicators such as frequency or intensity. Similar to previous work (Compte et al., 2013; Hoyos Cillero and Jago, 2010), achievement was restricted to weekdays and did not consider weekends. For ST, we included intentional and non-intentional viewing. While both intentional and non-intentional viewing account for total amount of time spent watching a screen they can be different constructs. Further research is required to address the implications of the two. This study identified child and parental factors associated with non-achievement of PA and ST recommendations. Future research to understand other covariates is required.

Conclusions

Findings demonstrated that a majority of preschool-aged children in our sample did not reach PA and ST thresholds for positive health outcomes suggesting the need for increased efforts to promote active living. Results further suggested that it would be beneficial to design particular strategies targeting middle-age parents, and acknowledging both the home context and the childcare/preschool context. These strategies may consider increasing awareness among parents and caregivers of the health benefits of limiting ST, and the promotion of alternatives to sedentary activities such as outdoor play. In the case of the childcare/preschool context, agreement of what are acceptable levels of PA (and ST) for accreditation in the different settings may be required. The finding that the majority of children 5–13 years of age are achieving PA and ST recommendations is reassuring. However, efforts to increase these rates remain warranted because of the long-term positive outcomes associated with adoption of a healthy lifestyle. Further research is required to identify modifiable risk factors to inform and target future health promotion efforts.

Conflict of interest statement

The authors declare that there are no conflicts of interest.

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