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Associations between parent and child sedentary behaviour and physical activity in early childhood

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Abstract

Background: Parents are central to healthy development in early childhood. Study objectives were to examine the associations between parent and child sedentary behaviour and physical activity in a large representative sample of Canadian 3-5-year-olds, and to determine if associations differed between sons and daughters and mothers and fathers.

Data and methods: Participants were 1,116 children aged 3-5 years and one of their biological parents from cycles 2-5 (2009-2017) of the repeated cross-sectional Canadian Health Measures Survey. Sedentary time, light-intensity physical activity (LPA), and moderate- to vigorous-intensity physical activity (MVPA) were objectively-measured in both parents and children with Actical accelerometers. Average minutes/day for all valid days, valid weekdays, and valid weekend days (n=935) were calculated. Screen time of both parents and children was parent-reported, and average hours/day were calculated. Pearson correlations and linear regression models with interaction terms were conducted.

Results: In the overall sample, all of the parental physical activity and sedentary behaviours were significantly correlated with children's behaviours (r=0.08-0.20). No significant parental or child sex interactions were observed in linear regression models so models were not stratified by parent or child sex. Significant associations with small effect sizes were observed between all of the parental behaviours and children's behaviours. For accelerometer data this was consistent for total days, weekdays, and weekend days.

Interpretation: Parental sedentary behaviour and physical activity may be intervention targets in early childhood. This appears consistent regardless of the sex of the parent or child. Given the small effect sizes observed, additional intervention targets should also be considered.

Keywords: Preschool children; Parents; Sedentary behaviour; Physical activity; Accelerometer
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Physical activity has numerous physical, social, and cognitive health benefits in early childhood.[1] Conversely, sedentary behaviour, in particular screen time, is detrimentally associated with healthy growth and development in this age group.[2] The behavioural patterns formed in early childhood have implications throughout childhood.[3] More specifically, physical activity has been found to be moderately stable from early childhood to middle childhood, whereas, over the same time period, moderate to large stability has been observed for sedentary behaviour.[3] At present, only 15% of Canadian preschoolers (3-4-year-olds) meet both physical activity (≥180 minutes/day of total physical activity, including ≥60 minutes/day of energetic play) and screen time (≤1 hour/day) recommendations, within 24-Hour Movement Guidelines.[4] A similar pattern has been observed in a regional sample of toddlers in Edmonton, Canada.[5]

From an ecological perspective, children's sedentary behaviour and physical activity can be influenced by several correlates across multiple levels, such as intrapersonal, interpersonal, organizational, environmental, and policy.[6] The interpersonal level, which includes parental correlates (e.g., behaviours and practices), is thought to be particularly important for children's physical activity and sedentary behaviours.[7] Specifically, parents profoundly influence children's development and are gatekeepers for children's participation in both sedentary behaviour and physical activity.[7] This is particularly true for young children who have less independence from their parents, compared to older children.[8] Therefore, identifying key parental correlates of sedentary behaviour and physical activity can inform interventions designed to increase the proportion of early years children who meet guidelines.

One potential mechanism to explain how parents influence children's sedentary behaviour and physical activity is role modeling.[7] Previous literature focusing on role modeling has typically examined the associations between sedentary behaviour and physical activity of parents and children.[7,9] However, robust conclusions on parental role modeling of sedentary behaviour and physical activity are difficult to make in early childhood due to gaps and limitations in the current evidence base. For example, previous research is limited by convenience samples, small sample sizes, and/or subjective measures of sedentary behaviour and physical activity.[10] Additionally, few studies have examined whether associations between parent and preschoolers' sedentary behaviours and physical activity differ by child sex, parental sex, or day of the week (e.g., weekdays, weekend days).[9,11] Thus, the objectives of this study were to: 1) examine the associations between total days, weekday, and weekend objectively-measured sedentary time and physical activity as well as total parent-reported screen time among parents and children in a large representative sample of Canadian 3-5-year-olds, 2) determine if associations differed between sons and daughters, and 3) determine if associations differed between mothers and fathers.

Authors: Valerie Carson (vlcarson@ualberta.ca) is with the Faculty of Kinesiology, Sport, and Recreation at the University of Alberta in Edmonton, Alberta. Kellie Langlois and Rachel Colley are with the Health Analysis Division at Statistics Canada in Ottawa, Ontario.

Methods

Participants

Participants were children aged 3 to 5 years and their biological parent from cycles 2 (2009–2011), 3 (2012–2013), 4 (2014-2015) and 5 (2016-2017) of the Canadian Health Measures Survey (CHMS).[12] The CHMS uses a repeated cross-sectional design and a three-stage sampling procedure to collect data from a sample representing 96% of Canadian 3- to 79-year-olds living in the provinces.[13] At each collection site, a respondent was selected from each dwelling, and when the respondent was aged 3-11 years, an older member from that dwelling was also selected (12-79 years).[13] Data was not included from cycle 1 in this analysis because the age group was not within scope (only 6- to 79-year-olds were sampled).

Data collection included a computer-assisted in-person interview at each dwelling and a physical health examination collected at a mobile examination centre (MEC). At the MEC, each participant was given an accelerometer with specific wear instructions. A total of 2,181 children aged 3-5 at the MEC visit participated in the CHMS along with an older member of their dwelling, and 1,792 of these pairs were deemed eligible for this study because the older participating member was a biological parent. Ethics approval for the CHMS was obtained from Health Canada and the Public Health Agency of Canada Research Ethics Board.[14] Written informed consent was obtained from the parent and assent was obtained from the child.[15] Detailed information about the CHMS is available elsewhere.[13]

Sedentary Behaviour and Physical Activity

Sedentary time, light-intensity physical activity (LPA), and moderate- to vigorous-intensity physical activity (MVPA) were objectively-measured in both parents and children with Actical accelerometers (Philips Respironics, Bend, OR, USA). Both parents and children wore the device over their right hip on an elasticized belt for 7 consecutive days. Data was collected in 60 second epochs for parents across all cycles. However, for children data was collected in 60 second epochs for cycle 2 and 15-second epochs for cycles 3-5. Due to the smaller epochs used in cycles 3-5, only 5.6 days of data was recorded due to the memory capacity of the device. Therefore, only the first 5 days were used for children in cycles 3-5. Accelerometer non-wear time in both parents and children were defined as ≥60 consecutive minutes of zero counts (or ≥240 intervals of 15 seconds of zero counts), with allowance for 2 minutes of counts between zero and 100 (or 30 seconds of counts between 0 and 25).[16,17] To be included in the analyses, parents were required to have ≥4 valid days, defined as ≥10 hours of wear time, and children were required to have ≥4 valid days in cycle 2 and ≥3 valid days in cycles 3-5, defined as ≥5 hours of wear time.[16,18-20] For children, sedentary time was defined as <100 counts per minute (cpm, or <25 counts per 15 seconds),[21] LPA as 100–1149 cpm (or 25-278 counts per 15 seconds), and MVPA as ≥1150 cpm (or ≥288 counts per 15 seconds).[22] In adults, sedentary time was defined as <100 cpm,[21] LPA as 100–1534 cpm, and MVPA as ≥1535 cpm.[23] Average minutes/day of sedentary time, LPA, and MVPA were calculated for parents and children for all valid days, valid weekdays, and valid weekend days. Correction factors were applied to children's minutes/day data in cycle 2 so the data was comparable to cycles 3-5.[24] Finally, to adjust for wear time, standardized sedentary time and LPA variables were calculated for both parents and children.[25] MVPA was not adjusted for wear time because it was not highly correlated with wear time in children (r=0.28) or parents (r=0.17).

Average daily screen time of children and parents were assessed as part of the household interview. Parents reported the average hours per day their child spends 1) watching TV or videos or playing video games, and 2) on a computer. The response categories were slightly different between cycle 2 (none, <1, 1 to 2, 3 to 4, 5 to 6, ≥7) and cycles 3–5 (none, <1, 1 to <3, 3 to <5, 5 to <7, ≥7) for children. However, the same mid-points could be applied across cycles (i.e., 0, 0.5, 1.5, 3.5, 5.5 and 7). Children's average daily screen time was calculated by summing the mid-points of the two screen time questions. For cycles 2-4, parents also reported the average time in a typical week outside of work or school (leisure time only) during the past three months they have spent: 1) watching television, DVDs or videos, 2) playing video games, and 3) on a computer. In cycle 5, parents reported the time during the last 7 days outside of work or school (leisure time only) they have spent: 1) watching TV, DVDs, movies, or internet videos, 2) playing video or computer games, 3) on a computer, tablet or smart phone. Across all cycles, parental average daily screen time was calculated by summing the three screen time questions and dividing by seven.

Covariates

Covariates included child and parent sex, child and parent age, single-child household, parental education, and survey cycle. Parental education was coded into two categories, post-secondary graduate and less than post-secondary graduate. A single-child household was defined as a dwelling with no other children younger than 18 living in it.

Statistical analyses

All statistical analyses were performed using SAS version 9.4 (SAS Institute, Cary, NC, USA) and SUDAAN version 11.0.3, using DDF=46 (denominator degrees of freedom) in the SUDAAN procedure statements. Descriptive statistics were calculated for the total sample and separately for males and females. T-tests were conducted to compare participant characteristics between those in the final sample and those with valid (child) accelerometer data but deemed ineligible because the older member selected from the dwelling was not a biological parent, the biological parent was pregnant or did not have valid accelerometer data, or the dyad was excluded due to missing covariate information (non-study sample;

n=511). Sex differences in descriptive information were also examined using t-tests. To address objective one, correlations between child and parent sedentary behaviour and physical activity variables were performed, followed by linear regression models adjusted for child and parent sex, child and parent age, parental education, single-child household, and survey cycle. Separate models were run for each of the sedentary behaviour and physical activity variables. To address objectives two and three, correlations were conducted for child and parent sex sub-groups. To determine if sex-stratified analyses were needed, child sex or parent sex by parent sedentary behaviour or physical activity interaction terms were added to the linear regression models separately. To meet the assumption of normality for linear regression models, child MVPA was log transformed. The analyses were weighted using CHMS survey weights assigned to the child for combined cycles, 2-5.[26] Survey weights accounted for non-response and incomplete accelerometer data, to ensure the sample was representative of Canadian children aged 3-5 years. To account for survey design effects, 95% confidence intervals and significance testing were estimated with the bootstrap technique.[27,28] Statistical significance was set a priori at $p < 0.05$.

Results

Of the 1,792 eligible parent-child pairs, 51 pairs were excluded because the parent was pregnant, 621 pairs were excluded because of a lack of valid accelerometer data for both the parent and the child, and 4 were excluded because of missing covariate data. Therefore, the final sample for this study was 1,116 parent-child pairs, and for analyses involving weekend days, the sample was 935 parent-child pairs. No significant differences in child age, sex, sedentary time, LPA, MVPA and proportion of single-child households were observed between those in the final sample and those in the non-study sample. However, children in the final sample had lower screen time compared to children in the non-study sample. Also, adults in the final sample were older compared to adults in the non-study sample, and there was a higher proportion of university/college graduates in the final sample compared to the non-study sample (data not shown).

Participant characteristics, stratified by sex, are provided in Table 1. The average age of children was 4 years and approximately half (49%) were female. Average screen time and sedentary time among children was 1.8 hr/day and 452 min/day, respectively, whereas average LPA and MVPA for total days was 208 min/day and 73 min/day, respectively. Regardless of the day of the week, female children engaged in significantly more sedentary time and significantly less MVPA than male children. The average age of parents was 36.6 years and approximately half (52%) were female. Among parents, average screen time and sedentary time was 2.3 hr/day and 567 min/day, respectively; average LPA and MVPA for total days was 259

Table 1
Description of sample, by child and biological parent characteristics, by sex, household population, Canada excluding territories, 2009 to 2017

	All				Males†				Females			
			95% confidence interval				95% confidence interval				95% confidence interval	
Characteristic	Sample Size	Mean or %	from	to	Sample Size	Mean or %	from	to	Sample Size	Mean or %	from	to
Children						Sons				Daughters		
Age (years)	1,116	4.0	4.0	4.1	543	4.0	3.9	4.1	573	4.1	4.0	4.2
Sex (%)												
Male	543	50.9	48.2	53.6	…	…	…	…	…	…	…	…
Female	573	49.1	46.4	51.8	…	…	…	…	…	…	…	…
Number of valid days	1,116	5.3	5.2	5.3	543	5.2	5.1	5.4	573	5.3	5.2	5.4
Average wear time												
Total	1,116	12.1	11.9	12.3	543	12.1	11.8	12.4	573	12.1	12.0	12.3
Weekday	1,116	12.2	12.1	12.4	543	12.2	11.9	12.5	573	12.3	12.1	12.4
Weekend	935	11.9	11.7	12.1	452	12.0	11.7	12.4	483	11.8	11.5	12.0
Screen time (hours/day)	1,116	1.8	1.7	1.9	543	1.8	1.7	2.0	573	1.8	1.6	1.9
Sedentary time (minutes/day)‡												
Total	1,116	452	446	458	543	445	437	452	573	459*	451	467
Weekday	1,116	456	449	462	543	449	441	457	573	463*	454	471
Weekend	935	442	435	449	452	433	423	443	483	451*	442	461
LPA (minutes/day)‡												
Total	1,116	208	204	212	543	210	205	215	573	207	201	212
Weekday	1,116	211	206	215	543	212	206	218	573	209	203	215
Weekend	935	205	200	209	452	208	201	214	483	201	194	208
MVPA (minutes/day)												
Total	1,116	73	70	75	543	78	74	82	573	67*	64	70
Weekday	1,116	73	70	77	543	78	74	82	573	68*	64	72
Weekend	935	71	68	74	452	76	72	81	483	65*	61	69

Table 1
Description of sample, by child and biological parent characteristics, by sex, household population, Canada excluding territories, 2009 to 2017

	All				Males†				Females			
			95% confidence interval				95% confidence interval				95% confidence interval	
Characteristic	Sample Size	Mean or %	from	to	Sample Size	Mean or %	from	to	Sample Size	Mean or %	from	to
Parents						Fathers				Mothers		
Age (years)	1,116	36.6	36.0	37.2	560	38.1	37.2	39.0	556	35.2*	34.5	35.9
Sex (%)												
Male	560	48.1	42.9	53.3	…	…	…	…	…	…	…	…
Female	556	51.9	46.7	57.1	…	…	…	…	…	…	…	…
Parental Education (%)												
Less than post-secondary graduate	220	21.7	18.1	25.8	121	23.6	19.1	28.9	99	20.0	15.2	25.8
Post-secondary graduate	896	78.3	74.2	81.9	439	76.4	71.1	80.9	457	80.0	74.2	84.8
Single-child household (%)												
Yes	242	18.6	14.4	23.8	111	19.1[E]	13.3	26.6	131	18.2	13.8	23.6
No	874	81.4	76.2	85.6	449	80.9	73.4	86.7	425	81.8	76.4	86.2
Number of valid days	1,116	6.2	6.1	6.3	560	6.2	6.1	6.3	556	6.2	6.1	6.4
Average wear time (hours/day)												
Total	1,116	14.2	14.0	14.3	560	14.4	14.2	14.6	556	14.0*	13.8	14.1
Weekday	1,116	14.3	14.1	14.5	560	14.5	14.3	14.7	556	14.1*	13.9	14.3
Weekend	935	13.8	13.6	14.0	468	13.9	13.7	14.2	467	13.7	13.4	13.9
Screen time (hours/day)	1,116	2.3	2.2	2.5	560	2.4	2.2	2.6	556	2.3	2.1	2.5
Sedentary time (minutes/day)‡												
Total	1,116	567	560	574	560	562	552	573	556	571	563	579
Weekday	1,116	575	568	582	560	569	557	580	556	581	574	589
Weekend	935	542	533	552	468	542	532	553	467	542	528	556
LPA (minutes/day)‡												
Total	1,116	259	253	265	560	261	251	271	556	257	250	264
Weekday	1,116	257	250	263	560	261	250	272	556	253	247	260
Weekend	935	266	258	275	468	265	255	274	467	268	256	280
MVPA (minutes/day)												
Total	1,116	23	20	26	560	26	23	29	556	20*	17	24
Weekday	1,116	25	22	28	560	28	25	32	556	22*	18	26
Weekend	935	17	14	19	468	18	16	21	467	15	11	20

… not applicable

[E] use with caution

* Significantly different from reference category (p<.05)

† Reference category

‡ Standardized for wear time

LPA = light-intensity physical activity

MVPA = moderate- to vigorous-intensity physical activity

Source: 2009 to 2011, 2012 to 2013, 2014 to 2015, and 2016 to 2017 Canadian Health Measures Survey (CHMS), combined.

min/day and 23 min/day, respectively. Male parents had significantly higher average total and weekday wear time and engaged in significantly more total and weekday MVPA than female parents.

Correlations between parent-child screen time, sedentary time, and physical activity are displayed in Table 2. In the overall sample, all of the parental behaviours were significantly correlated with the children's behaviours. For the accelerometer data, this was consistent for total days, weekdays, and weekend days. However, correlations were small in magnitude,[29] ranging from 0.08-0.20. The strength of correlation differed across the various sex combinations of the parent-child dyads. For instance, the MVPA of fathers tended to have stronger correlations with children's MVPA compared to mothers. The same findings were observed for sedentary time for sons only. In most instances, correlations tended to be stronger for same sex parent-child dyads compared to opposite sex parent-child dyads.

The linear regression associations between parent-child screen time, sedentary time, and physical activity are displayed in Table 3. Child sex by parent physical activity or sedentary behaviour interaction terms and parent sex by parent physical activity or sedentary behaviour interaction terms were not significant so sex-stratified analyses were not conducted. All of the parental behaviours were significantly associated with the children's behaviours. For the accelerometer data, this was consistent for total days, weekdays, and weekend days. However, for sedentary time and LPA, beta coefficients were larger on the weekend days compared to total days and weekdays. Overall the effect sizes were small. For example, every additional hour of parental screen time was associated with approximately 8 minutes higher screen time in children. For total

Table 2
Pearson correlations between parent and child screen time, sedentary time, and physical activity, by parent-child pair, household population, Canada excluding territories, 2009 to 2017

	Parent-child		Parent-son		Parent-daughter	
	r-value	p-value	r-value	p-value	r-value	p-value
Screen time (hours/day)	**0.18**	<.0001	**0.20**	<.0001	**0.16**	0.0002
Sedentary time (minutes/day)†						
Total	**0.17**	<.0001	**0.16**	0.0002	**0.18**	<.0001
Weekday	**0.13**	<.0001	**0.14**	0.0009	**0.12**	0.0044
Weekend	**0.20**	<.0001	**0.18**	0.0002	**0.23**	<.0001
LPA (minutes/day)†						
Total	**0.19**	<.0001	**0.20**	<.0001	**0.18**	<.0001
Weekday	**0.16**	<.0001	**0.19**	<.0001	**0.13**	0.0026
Weekend	**0.18**	<.0001	**0.16**	0.0006	**0.20**	<.0001
MVPA (minutes/day)						
Total	**0.11**	0.0002	**0.11**	0.0096	**0.11**	0.0060
Weekday	**0.09**	0.0015	**0.11**	0.0112	0.08	0.0503
Weekend	**0.08**	0.0096	0.06	0.2160	**0.12**	0.0087
	Mother-child		**Mother-son**		**Mother-daughter**	
Screen time (hours/day)	**0.20**	<.0001	**0.16**	0.0066	**0.24**	<.0001
Sedentary time (minutes/day)†						
Total	**0.11**	0.0119	0.06	0.2859	**0.15**	0.0115
Weekday	0.07	0.1238	0.06	0.3211	0.07	0.2503
Weekend	**0.14**	0.0025	0.07	0.2762	**0.22**	0.0007
LPA (minutes/day)†						
Total	**0.16**	0.0002	**0.15**	0.0110	**0.16**	0.0085
Weekday	**0.12**	0.0035	**0.16**	0.0070	0.09	0.1302
Weekend	**0.16**	0.0007	0.09	0.1566	**0.22**	0.0007
MVPA (minutes/day)						
Total	0.04	0.3141	0.04	0.4602	0.02	0.6773
Weekday	0.01	0.7282	0.03	0.6642	-0.02	0.7636
Weekend	**0.10**	0.0393	0.08	0.2063	0.11	0.0991
	Father-child		**Father-son**		**Father-daughter**	
Screen time (hours/day)	**0.16**	0.0001	**0.23**	0.0001	0.08	0.1606
Sedentary time (minutes/day)†						
Total	**0.22**	<.0001	**0.23**	0.0001	**0.20**	0.0005
Weekday	**0.18**	<.0001	**0.19**	0.0013	**0.16**	0.0070
Weekend	**0.28**	<.0001	**0.29**	<.0001	**0.25**	0.0001
LPA (minutes/day)†						
Total	**0.22**	<.0001	**0.23**	0.0002	**0.20**	0.0007
Weekday	**0.18**	<.0001	**0.19**	0.0016	**0.16**	0.0077
Weekend	**0.21**	<.0001	**0.23**	0.0004	**0.17**	0.0081
MVPA (minutes/day)						
Total	**0.17**	<.0001	**0.17**	0.0040	**0.21**	0.0004
Weekday	**0.16**	0.0001	**0.19**	0.0016	**0.17**	0.0044
Weekend	0.06	0.1614	0.01	0.9060	**0.15**	0.0180

† Standardized for wear time

Statistically significant correlations ($p < 0.05$) are highlighted in bold.

LPA = light-intensity physical activity

MVPA = moderate- to vigorous-intensity physical activity

Source: 2009 to 2011, 2012 to 2013, 2014 to 2015, and 2016 to 2017 Canadian Health Measures Survey (CHMS), combined.

What is already known on this subject?

- Physical activity has numerous health benefits in early childhood, whereas excessive sedentary behaviour, particularly screen time, has unfavourable health implications.
- Less than one in six Canadian preschoolers meet both the physical activity and screen time recommendations.
- Parental correlates of sedentary behaviour and physical activity are especially important to consider in early childhood because young children have limited autonomy from their parents.
- The importance of parental modeling on sedentary behaviour and physical activity in early childhood is unclear due to evidence gaps and limitations.

What does this study add?

- Parent-child associations for sedentary behaviour and physical activity were observed among a representative sample of Canadian 3 to 5 year olds.
- Higher parental moderate- to vigorous-intensity physical activity and light-intensity physical activity was associated with higher moderate- to vigorous-intensity physical activity and light-intensity physical activity among children.
- Every additional hour of parental screen time and sedentary time was associated with approximately 8 minutes higher screen time and 7 minutes sedentary time among children, respectively.
- Unlike older age groups, associations between parental sedentary behaviour and physical activity and children's behaviours did not differ by day of the week (weekday versus weekend day), parental sex (mothers versus fathers), or child sex (sons versus daughters).

days, every additional 60 minutes per day of parental sedentary time and LPA was associated with approximately 7 minutes higher sedentary time and 6 minutes higher LPA in children. After back-transforming MVPA on total days from the log scale, every additional 20 minutes per day of parental MVPA was associated with approximately 4% higher MVPA in children (equivalent to approximately 3 minutes per day).

Discussion

The objectives of this study were to examine the associations between parent and child sedentary behaviour and physical activity in early childhood, and determine if associations differed by the sex of the parent or child. Higher parental screen time, sedentary time, LPA and MVPA was significantly associated with higher screen time, sedentary time, LPA, and MVPA in this large representative sample of Canadian 3-5-year-olds. However, effect sizes were small. Additionally, associations did not differ between weekdays and weekend days, sons and daughters or mothers and fathers.

In line with the present study, a meta-analysis published in 2015 on the parental correlates of physical activity in children and adolescents between the ages of 2.5 and 18 years reported that parental modeling, operationalized as parental physical activity, was weakly associated with children's physical activity.[9] Age group (i.e., 2-5.4, 5.5-12.4, 12.5-19 years) was not a significant moderator in this meta-analysis, though point estimates in random effect models were larger for younger age groups,[9] supporting the notion that parents have stronger influences on younger children compared to older children.[8] Overall, the present study strengthens the evidence base on the association between parental role modeling and physical activity in early childhood by addressing previous limitations, including small sample sizes and subjective measures.[9] Additionally, associations were not only observed for MVPA but also for LPA, which has rarely been examined in any group.[9]

Table 3
Multiple linear regression coefficients for the associations between parent and child screen time, sedentary time, and physical activity, household population, Canada excluding territories, 2009 to 2017

Behaviour	Beta	P-value
Screen time (hours/day)	**0.128**	0.0002
Sedentary time (minutes/day)†		
Total	**0.124**	0.0016
Weekday	**0.079**	0.0309
Weekend	**0.170**	0.0003
LPA (minutes/day)†		
Total	**0.096**	0.0001
Weekday	**0.067**	0.0030
Weekend	**0.103**	0.0003
MVPA (minutes/day)‡		
Total	**0.002**	0.0070
Weekday	**0.002**	0.0134
Weekend	**0.002**	0.0432

† Standardized for wear time
‡ Log-transformed
Statistically significant beta coefficients ($p < 0.05$) are highlighted in bold.
LPA = light-intensity physical activity
MVPA = moderate- to vigorous-intensity physical activity
Note: The child behaviour is the outcome variable in all models and all models were adjusted for child and parent sex, child and parent age, single-child household, parental education, and survey cycle.
Source: 2009 to 2011, 2012 to 2013, 2014 to 2015, and 2016 to 2017 Canadian Health Measures Survey (CHMS), combined.

Compared to physical activity, little is known on the association between parent and child objectively measured sedentary time in early childhood, highlighting another novel aspect of the present study.[30,31] Study findings are consistent with a previous study in a representative sample of Canadian 6-11-year-olds from the CHMS, where parental sedentary time was also found to be weakly associated with children's sedentary time.[32] More research has examined the association between parent and child screen time in early childhood. For example, a systematic review published in 2012 on correlates of energy balance-related behaviours reported a positive association between parental television viewing and children's screen time in both of the included studies.[33] Since that review was published, two Canadian studies with regional samples have also reported an association between higher parental screen time and higher screen time among children aged 0-5 years[11] and 1-2 years.[34] However, effect sizes were stronger in these previous studies compared to the present study. Overall, the findings of this study confirm that parental role modeling is a consistent correlate of screen time in early childhood.

The present study made an important contribution to the literature base on parental modeling of sedentary behaviour and physical activity in early childhood by examining the moderating effects of sex in both children and parents. In contrast to the present study, the meta-analysis on parental correlates of physical activity found that parental sex moderated the association between parental and children's physical activity in boys only.[9] Specifically, effect sizes were larger among father-son dyads compared to mother-son dyads.[9] However, none of the studies included in this sub-analyses focused on young children.[9] Correlations in the present study were also stronger for father-son dyads compared to mother-son dyads for MVPA, however in linear regression models, interaction terms were not found to be statistically significant. In the previous study of 6-11-year-olds from the CHMS, it was also found that parental sex did not moderate the association between parental and children's sedentary behaviour and physical activity.[11,32] However, some child sex differences were observed. For instance, parental MVPA was associated with girls' MVPA but not boys' MVPA for total days.[32] In line with the

present study, children's sex was also not a significant moderator in the previous study of 0-5-year-olds.[11] Therefore, it is possible that the moderating effects of parent and child sex is not as strong in younger age groups compared to older age groups.

Parental modeling is thought to be an important correlate of children's physical activity, in particular for younger age groups, because of the social norms that it creates within the family unit.[9] A similar rationale can apply to sedentary behaviour. Additionally, for younger children, in particular, parental modeling is thought to also encompass co-participation in sedentary behaviour and physical activity.[9] One potential reason for the small effect sizes observed in the present study and others[9] could be the crude measures used. For example, while average durations of parental and children's behaviours are likely capturing habitual levels,[19] it is not possible to know from these measures when parental and children's behaviours are occurring independently or concurrently. Therefore, future research examining parental modeling of sedentary behaviour and physical activity should consider methodologies that provide more detailed information on parental modeling. For example, some newer models of accelerometers have proximity tagging features where sedentary time and physical activity can be objectively measured in multiple people while simultaneously recording when they are in close proximity.[35,36] This feature has been validated in parent-young child dyads.[36] To date, a study using this method in a small sample of mother-young child dyads has found dyads mostly spend their time together engaged in sedentary time or LPA but rarely MVPA.[35] This proximity tagging method could be expanded to include multiple caregivers (e.g., mother and father) along with siblings to better understand behavioural influences of the entire family unit.

The present study had a number of strengths including the large representative sample and the objective measures of sedentary time and physical activity in both parents and children. Additionally, the examination of whether associations differed by the sex of the child and the parent addressed a gap in the evidence base for this age group. The study also had some limitations. Given the repeated cross-sectional design of the CHMS, observed associations cannot be interpreted as causal. Some differences (screen time, parental education) were noted between children included in the analysis (i.e., that had a biological parent and complete data) and those excluded from the analysis due to ineligibility. These differences would be accounted for in the survey weights; however, some bias could still exist in the findings observed. Screen time was parent-reported and therefore more prone to biases (e.g., recall and social desirability). Data was only available for one biological parent, however the participating parent was randomly selected by study personnel based on the dwelling roster and not by the family. Some methods differed between cycles, however, survey cycle was adjusted for in linear regression models. Finally, residual confounding may have occurred. For instance, it was not possible to adjust for children's childcare status because this variable was not available in all cycles. In addition, children are influenced by other adults in addition to their parents (e.g., childcare providers, grandparents) and there was no mechanism within the present analysis to address this. Though analyses were stratified by weekdays and weekend days, with the weekend typically being when children are with their parents, regardless of their childcare status.

Conclusions

Findings from this large representative sample of Canadian 3-5-year-olds and their biological parent suggest that parental behaviours may be one target for family-based sedentary behaviour and physical activity interventions and public health messaging in early childhood. This appears relevant regardless of the sex of the parent or child. Given the small effect sizes observed, future research using more detailed measures of parental modeling is needed, along with the consideration of additional intervention targets.

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