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More Than Just Screen Time: Children's Sedentary Behaviors at Home and the Interplay of Home Environment Factors

Apoorva Rathod
Jerry Olsson
University of Gothenburg

Tim Schwanen
University of Oxford

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Abstract

Children's sedentary behavior (SB) is associated with various negative health outcomes. Because the home is an important site of children's SB, it is essential to study the correlations between different kinds of SBs in which children engage and home environment factors. This paper studies 7-12-year-old children's home-based SB in a Swedish municipality to understand the amount and correlates of different kinds of SBs, using logistic regression. Results show that children engage in both non-screen and screen-based SBs, all with multiple yet different correlates. The amount of non-screen and screen-based SBs differed by age and gender.

Keywords: sedentary behavior, home environment, screen time

Introduction

Concerns about children's health and well-being, notably related to overweight and obesity, have brought attention to children's activity behaviors. Increasingly, it is understood that studying only physical activity is not enough; children's sedentary behavior (SB) must also be taken into account (Tremblay et al., 2011). SB is understood in this context as "any waking behavior characterized by an energy expenditure ≤1.5 metabolic equivalents (METs), while in a sitting, reclining, or lying posture" (Sedentary Behaviour Research Network, 2012, p. 540). Across the planet, children are sedentary for an average of 8.6 hours per day (LeBlanc, Katzmarzyk, et al., 2015), with most of this occurring at home (Liao, Intille, Wolch, Pentz, & Dunton, 2014). Most studies on children's SB tend to focus on screen time— television (TV) watching, computer use, and using other forms of electronic media (Anderson, Economos, & Must, 2008). Screen time is, however, not an adequate marker of total sedentary time (Hoffmann et al., 2019) since motorized travel, homework, hobbies, and socializing are also prominent SBs comprising sedentary time (Biddle, Gorely, Marshall, & Cameron, 2009; Olds, Maher, Ridley, & Kittel, 2010). Moreover, Marshall and colleagues (2004) investigated the relationship of body fatness with forms of screen time among children and youth in a meta-analysis, and concluded that "relationships between sedentary behavior and health are unlikely to be explained using single markers of inactivity such as TV viewing or video/computer game use" (p. 1244).

The identification of strategies for reducing SB and increasing physical activity are high on the research agenda. It has been suggested that removing media devices from children's bedrooms, increasing access to play equipment in the home and using devices for controlling and monitoring screen time can reduce sedentary time (Tandon et al., 2012; Todd et al., 2008). However, in a trial, Epstein and colleagues (2005) found that the reduction of specific screen time behaviors had little effect on children's physical activity, perhaps due to children choosing other sedentary pursuits instead. Thus, the formulation of effective health-improving interventions demands a better understanding of multiple SBs, especially non-screen SBs (Atkin, Gorely, Biddle, Marshall, & Cameron, 2008; LeBlanc, Broyles, et al., 2015; Olds et al., 2010).

Furthermore, the correlates of different SBs are shown to differ, which highlights the need to study multiple SBs along with their different correlates among children (LeBlanc, Broyles, et al., 2015; Pate, Mitchell, Byun, & Dowda, 2011; Salmon, Tremblay, Marshall, & Hume, 2011; Stierlin et al., 2015). Informed by the socio-ecological model, this paper seeks to contribute to a more holistic understanding of children's SB by studying the different SBs in which children engage at home along with the potential personal, familial and neighborhood correlates of these behaviors. This study uses data from a questionnaire about the SBs of children aged 7-12 in the Swedish municipality of Partille. The focus is on this age bracket since there are few studies on SB that explicitly consider pre-adolescent children, although research has demonstrated that SB tends to track from childhood to adolescence and beyond (Janssen et al., 2016; Olds et al., 2009; Ortega et al., 2013).

Studying Children's Sedentary Behavior at Home

Correlates of Sedentary Behavior among Children

Previous studies have shown that children's SB has various correlates found at the personal, familial, and neighborhood levels (Pate et al., 2011; Salmon et al., 2011; Stierlin et al., 2015). However, few studies have looked at these multiple levels of correlates comprehensively. It has also been suggested that these correlates differ according to SB type; for example, using accelerometer and questionnaire data, LeBlanc, Broyles and colleagues (2015) demonstrated that correlates of total sedentary time and screen time differ. Further, review papers have noted few common correlates between different forms of SBs (Pate et al., 2011; Salmon et al., 2011; Stierlin et al., 2015).

The socio-ecological model (SEM; Owen, Leslie, Salmon, & Fotheringham, 2000) provides a suitable framework with which to understand children's SB. This model posits that health behaviors have multiple levels of influence—ranging from personal factors such as age, gender and ethnicity, to environmental factors such as architectural features, socio-cultural milieu, neighborhood design and community planning—in successive, nested levels (Sallis, Owen, & Fisher, 2008; Stokols, 1992). The specific factors to be considered in the model depend upon the nature and scope of the study undertaken, and the flexibility of the model enables it to be applied to a wide range of health behaviors in various settings. The next section briefly considers the literature on children's SB at home before moving onto a discussion of how the SEM can be used to study children's home-based SB.

Children's Sedentary Behavior and the Home Environment

Studies about the physical context of children's SB show that children are most sedentary at home, as compared to school, recreational facilities, outdoors, or someone else's house (Bürgi, Tomatis, Murer, & De, 2016; Liao et al., 2014). This makes the home environment critical to understanding children's SB (Biddle, Marshall, Gorely, & Cameron, 2009; Liao et al., 2014; Maitland, Stratton, Foster, Braham, & Rosenberg, 2014). Significantly, the home environment is also considered amenable to change in order to modify children's SB, such as by rearranging furniture to make space for active play or installing devices to limit TV viewing (Maitland et al., 2013; 2014).

The literature on children's SB and the home environment has highlighted various significant correlates of SB, such as access to electronic media devices, parental concerns related to TV watching, as well as parenting styles, role-modelling and rules related to electronic media use (Bjelland et al., 2015; Granich, Rosenberg, Knuiman, & Timperio, 2011; Pearson, Salmon, Crawford, Campbell, & Timpiero, 2011; Quarmby, Dagkas, & Bridge, 2011; Ramirez et al., 2011; Rey-López et al., 2010; Sirard, Laska, Patnode, Farbakhsh, & Lytle, 2010). However, most of these studies have focused on screen behaviors, particularly TV watching, and there is little knowledge about the correlates of other non-screen SBs, such as homework or hobbies (Arundell, Fletcher, Salmon, Veitch, & Hinkley, 2015; Stierlin et al., 2015).

Along with the presence of media devices and parental factors, exploratory studies by Granich, Rosenberg, Knuiman, and Timperio (2010) and Maitland and colleagues (2014) have shown how the physical characteristics of the home environment such as type of dwelling, size, and design may have an effect on SB. While both of these studies used qualitative methods, there is a dearth of research with quantitative data on how the physical home environment is associated with SB among children.

In addition to parental factors and the physical environment of the home, SB also varies according to personal and household factors, such as age, gender, family structure, household income and parental education (Arundell et al., 2015; Pate et al., 2011; Quarmby et al., 2011; Salmon et al., 2011). The factors of the home environment associated with children's SB therefore need to be studied in terms of personal, familial, and physical environment factors along with their interactions (Maitland et al., 2013; Roemmich, Epstein, Raja, & Yin, 2007).

In order to investigate children's SB at home using the SEM, the study organized the various correlates of children's SB into the three levels of personal factors (age, gender, participation in organized activities), social environment (household characteristics, parenting, access to media devices), and physical environment (dwelling characteristics) identified by the SEM.

Methodology

Questionnaire Development and Distribution

As the study's aim was to determine both the amount and correlates of children's SB at home, the researchers determined that a questionnaire to be answered by the parents was the most appropriate method, despite its limitations of recall and response bias (Atkin et al., 2012; Hardy et al., 2013). The questionnaire posed questions about children's time spent on various screen and non-screen SBs, as well as different personal, familial and environmental characteristics. While the energy expenditure of different activities cannot be determined with questionnaires and hence their classification as SB might not be entirely accurate, the study adopted the approach used by Olds and colleagues (2010) of including activities most commonly conducted while sitting.

The non-screen SBs listed in the questionnaire were homework, reading, socializing, playing with board games or toys (indoor play), and playing musical instruments or doing artwork (hobbies). The non-screen activities were short-listed based on previous studies using Ecological Momentary Assessment in order to include the widest range of activities possible (Biddle, Gorely, et al., 2009; Olds et al., 2010). The screen-based activities listed were: watching TV/videos, using social media, searching on the internet, and playing computer games.

The questions inquiring about the time children spent on different non-screen and screen activities were posed as "Approximately how much time does your child spend on the following activities at home on a typical weekday," with eight time-use response categories: 0 minutes, 1-30 minutes, 30-60 minutes, 60-90 minutes, 90 minutes-2 hours, 2-3 hours, 3-4 hours, and ≥4 hours.

The variables considered at the personal level were the child's age, gender and participation in organized activities; social-level variables included household characteristics, parental perceptions, and access to media devices; and physical-level variables were the dwelling characteristics. To identify household characteristics, the questionnaire included questions on family type (single- or dual-parent), language(s) spoken at home, presence of siblings, household income, number of cars at home, and education and employment status of parents. The study inquired about parental views about media, as well as their rules regarding use of media (Sanders, Feng, Fahey, Lonsdale, & Astell-Burt, 2015). Additionally, parental rules concerning children's outdoor play could potentially affect children's behaviors, so were also included (Roemmich et al., 2007). Specifically, the parental opinion questions were posed as "Please indicate your opinion regarding the following statements: Digital media is an important educational tool for my child; My child's time spent with digital media is strictly controlled; My child's digital media content is strictly controlled; My child is allowed to go out alone and play freely in the neighborhood." The parents were asked to indicate their responses on a 5-point Likert scale ranging from "strongly agree" to "strongly disagree." Finally, to gain insight about the children's physical environment, the study posed questions about the physical features of the dwelling, namely typology, size, design (open-plan or not), presence of backyard, and the presence of play area and activity equipment.

The questionnaire was intended to be answered by the child's parent or legal guardian, while the questions on time spent in different SBs were to be answered in consultation with the child. We made both a paper version and online version of the questionnaire available to the parents, and they could choose which to answer.

Because of limited resources, pilot-testing of the questionnaire had to be limited to four parents and took a qualitative approach, with in-depth one-to-one discussions focusing on the ease of understanding and answering questions from other studies that had been translated into Swedish. This choice was deemed acceptable as questions on parental beliefs and the proxy-reporting of children's media usage and presence of media devices in the home have provided acceptable reliability in previous studies (Pearson et al., 2011; Rosenberg et al., 2010). It became clear during the testing that many children used devices at home that had been given to them by their school, and that the parents had not included these when answering questions on the number of media devices at home. Therefore, a question on the child's personal access to media devices was added in the questionnaire. Additionally, the parents found the questions about children's time spent on specific screen-based activities difficult to answer, and instead suggested framing the question based on device usage. The questionnaire was thus modified to ask about children's time spent using a mobile phone, tablet, TV, computer, laptop, and gaming console. While previous studies have asked questions about children's SB on weekdays and weekends, the parents in the pilot study indicated that answering questions about weekdays was simpler as the children followed a more-or-less fixed schedule, and there was a great deal of variation between the weekends. Therefore, the questionnaire referred to weekdays only. The revised questionnaires were

returned to the same parents and discussed again. The parents' responses during this two-stage pilot testing did not raise concerns over the validity and reliability of the included questions.

The questionnaire was intended to be distributed through schools to children living in different areas of the city of Gothenburg, Sweden with different income levels, family structures, and house typologies. All principals of the 25 schools in the stratified random sample of four areas (two high-income and two low-to-high income areas)[1] were contacted through e-mail and letters to help distribute the surveys in their schools. Six indicated their willingness to participate, however, none responded when followed up with attempts to arrange meetings and distribute the surveys to the school. The poor response may reflect that communication with principals was through e-mail and letters, intended to allow them to respond at the most convenient time for them. Subsequently, we chose two schools in Partille municipality (see below) and approached their principals again in person, because they were known to the researchers; these principals were willing to help personally with distribution of the surveys among parents. Although introducing coverage error, this convenience sampling strategy was the most efficient and effective way of conducting the survey.[2]

At the two participating schools, an envelope containing an information letter, the survey, and a stamped reply envelope was distributed to all the children in grades 1-6 (aged 7-12 years) in October 2016. Both the schools were public schools located in the same locality, approximately 1.2 kilometers from each other. School 1 had 466 students in Grades 0-9 while School 2 had 181 students in Grades 0-6 at the time of the survey. Less than 10 percent of the students in both the schools had parents who were born outside of Sweden. A total of 175 questionnaires out of 450 were returned between October 2016 and February 2017, yielding a response rate of 38.8 percent.

Study Area[3]

The study was conducted in Partille municipality, Sweden. Partille is a small municipality located less than 10 kilometers from the city of Gothenburg, the second largest city in Sweden. Most of the people in Partille commute to neighboring municipalities for work. The population of Partille in 2017 was 37,880, with a density of 667 persons per square kilometer. There were 14,850 dwellings in the municipality, of which 44 percent were self-owned, 18 percent community-owned, and 30 percent rented. Children under 18 formed 24 percent of the population; the corresponding figure for Sweden was 21 percent. There are 12 primary schools located in Partille. The average income for those living in the municipality was 340,200 Swedish kronor (SEK) in 2016, higher than the average of 300,000 SEK in Sweden (approximately $33,000 USD). The education level in

[1] Income, the share of rented apartment housing, and ethnic diversity are closely correlated in Gothenburg.

[2] The study was approved by the regional chapter of the National Ethical Review Board (Dnr 154-17).

[3] All statistics derived from the official website of Partille municipality (Partille Kommun, n.d.), unless otherwise stated.

Partille is higher than average as well, with 32.3 percent of the population of Partille in the age group of 25-64 university educated according to the 2016 statistics, compared to 19 percent in Sweden. The unemployment rate was 3.9 percent, compared to 6.7 percent in Sweden. These statistics show that Partille is an area with high income and education and low unemployment as compared to the rest of Sweden.

Sample Characteristics

The sample characteristics are summarized in Tables 1a and 1b. While a total of 175 questionnaires were returned, only those with complete demographic information about the child were included in the analysis, for a total of 173 responses.

The sample was evenly distributed in terms of gender (86 girls, 87 boys), but there were more children aged 7 and 8 in the sample than ages 9 through 12. Most children in the sample (93.6 percent) had at least one sibling, while only-child families are the majority in Partille. The majority (82.6 percent) of participating families spoke only Swedish at home, although 16.8 percent of families spoke more than one language. There were only 11 single-parent families in the sample, which is very different from Partille overall, which has almost 40 percent single-parent households. The sample was in line with Partille being a high-income area. However, the sample itself was concentrated in one of several particularly high-income areas within Partille, with most families (86 percent) earning more than 55,000 SEK (gross) per month, and a majority (54 percent) earning more than 75,000 SEK (gross) per month. Both parents worked full-time in most families, while mothers worked part-time in 24.8 percent of the families and fathers worked part-time in 5.8 percent of the families. Most parents were university educated—74.5 percent of the mothers and 67.6 percent of the fathers, much higher than the average for Partille. A large majority (71.7 percent) of participating families lived in villas, 18 percent in row houses and 10.4 percent in apartments, and the average dwelling size was 147.6 square meters, higher than the average of 97.7 square meters for Partille. Overall, the sample represents a specific group of families—ethnically homogenous, high-income and highly educated dual-parent households with more than one child. The specificity of the sample must be borne in mind while interpreting the results. Nevertheless, the data from the sample is valuable for investigating the interplay of various factors occurring at the personal, social, and environmental levels of the SEM and contributing towards our understanding of children's SB at home.

Table 1a. Sample characteristics from survey of 173 households in Partille municipality, Sweden

Variable	Category	Sample		Partille municipality[1] (%)
		n	%	
Age of child	7	41	23.7	19.3
	8	32	18.5	17.4
	9	28	16.2	16.4
	10	29	16.8	16.1
	11	21	12.1	16.4
	12	22	12.7	14.3
Gender of child	Female	86	49.7	47.5*
	Male	87	50.3	52.5*
Family type	Single-parent household	11	6.4	38.8
	Dual parent household	162	93.6	54.2
Language(s) spoken at home	Only Swedish	143	82.6	n/a
	Swedish + others	29	16.8	n/a
Presence of siblings	Yes	162	93.6	47.4*
	No	11	6.4	52.6*
Monthly household gross income (in SEK)	15 000-<25 000	1	0.6	
	25 000-<35 000	1	0.6	
	35 000-<45 000	12	6.9	
	45 000-<55 000	10	5.8	
	55 000-<65 000	24	13.9	
	65 000-<75 000	26	15.0	
	75 000-<85 000	27	15.6	
	85 000-<95 000	24	13.9	
	≥95 000	43	24.9	
Median net monthly household income (SEK)				38 791
Maternal education	High/vocational school	36	20.7	38.6¤
	University	129	74.5	47.6¤
Paternal education	High/vocational school	46	26.6	44.3¤
	University	117	67.6	38.6¤
Maternal employment status	Employed	160	96.5	82.9
	Not employed	6	3.5	17.1
Paternal employment status	Full time employed	165	97.7	85.0
	Not employed	4	2.3	
Type of dwelling	Villa	124	71.7	50.1
	Row house	31	17.9	n/a
	Apartment	18	10.4	44.9

[1] All statistics from Kolada (2017)
* Statistics are for all children aged 0-18 in Partille.
¤ Statistics are for all adults aged 16+ in Partille.

Table 1b. Selected characteristics of survey participants and population of Partille municipality, Sweden

	Sample Mean (SD)	Whole municipality Mean
Child's age	9.13 (1.7)	-
Number of people living in household	4.14 (0.68)	2.5
Weekly participation in number of organized leisure activities outside school	2.59 (1.5)	-
Dwelling size (square meters)	147.56 (40.6)	97.7

Data Analysis[4]

The researchers undertook basic statistical analysis of the time spent on the five non-screen SBs and six screen-based SBs. We identified statistically significant correlates of the different SBs using ordinal regression analysis with each type of SB as the dependent variable (except homework where we used binary logistic regression). The dependent variables were re-categorized so that there were at least 15 observations in each category. We first grouped together the independent variables in blocks based on the SEM—personal, social and physical environment variables. For the statistical analysis, we further sub-divided the social environment level into 3 blocks—household characteristics, parental beliefs, and access to media devices. The final blocks used in the statistical analysis were (i) personal, (ii) household characteristics, (iii) parental beliefs, (iv) access to electronic devices, and (v) physical features of the dwelling. We tested each of these independent variable blocks against the dependent variables. The independent variables that were Yes or No responses (such as presence of playground in neighborhood) were coded as No=0 and Yes=1. Where needed, we collapsed the independent variables with more than two outcome categories so that there were at least 15 observations in each response category. Monthly household income was thus re-categorized as <55,000 SEK, 55,000-75,000 SEK, 75,000-95,000 SEK and ≥95,000 SEK; both maternal and paternal education were re-categorized as those who had university education and "other." We re-coded the parental belief responses into three categories, combining the categories "agree" and "strongly agree" into "agree," and combining "disagree" and "strongly disagree" into "disagree." In the case of parental belief regarding their child's neighborhood play, we collapsed the option "not sure" into "agree" due to low response in the original "not sure" category. Multicollinearity tests were performed for each of the blocks and where variables were highly correlated, one or more were dropped. The blocks with the remaining set of variables were then tested for significance using regression analysis. All the variables found significant at $p \leq 0.10$ were included in a combined model, and the variables that remained significant at $p \leq 0.05$ were listed in the final outcome. We

[4] We carried out the analysis using IBM SPSS Statistics 25.

also tested possible interactions between the independent variables. As very few children (less than 25) were spending more than 30 minutes on reading and use of computer and laptop, these three SBs were excluded from the regression analysis. Wherever the assumption of proportional odds was not met, we performed separate binary logistic regression analyses (O'Connell & McCoach, 2008), and as the estimated coefficients in the binary models were all of the same sign and similar magnitudes as those from the ordinal regression analysis, the results from the final model were retained.

Results

Children's time spent on different non-screen SBs at home on weekdays is shown in Figure 1. The most common SB was socializing, followed by indoor play, homework and hobbies, while very few children spent time reading.

Figure 1. 7 to 12-year-old children's time spent on different non-screen sedentary behaviors at home on a weekday (percent)

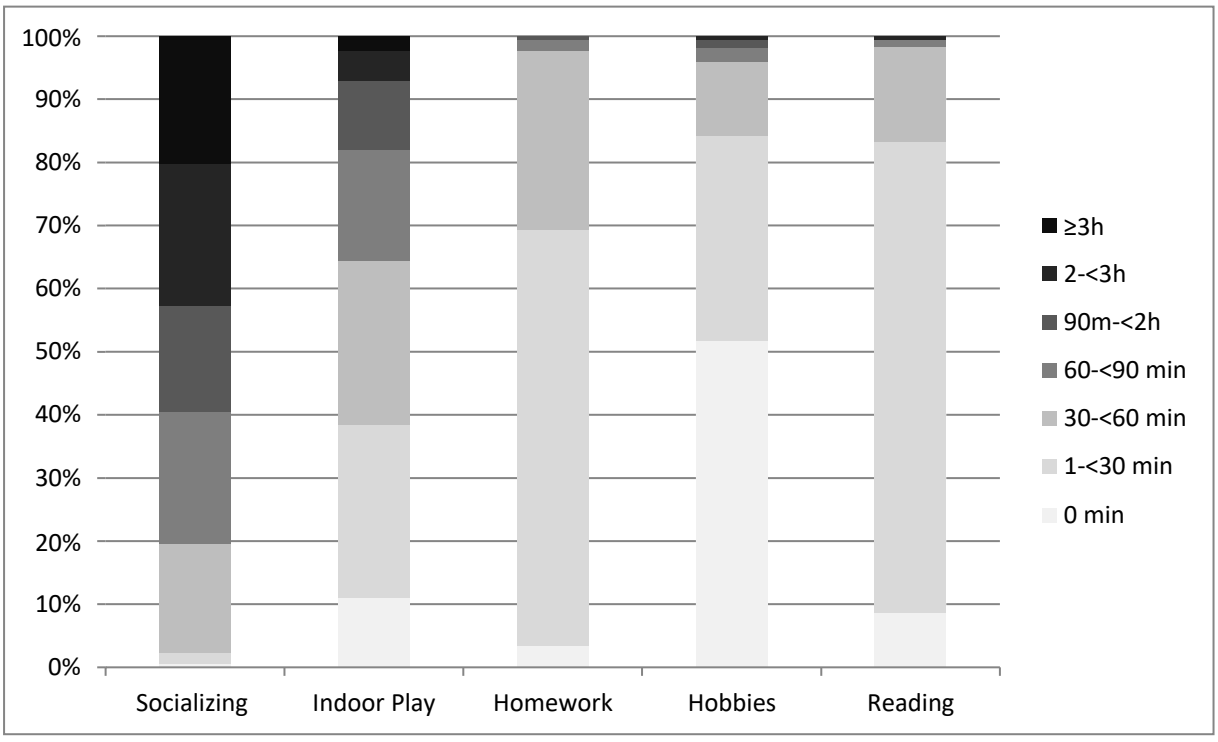
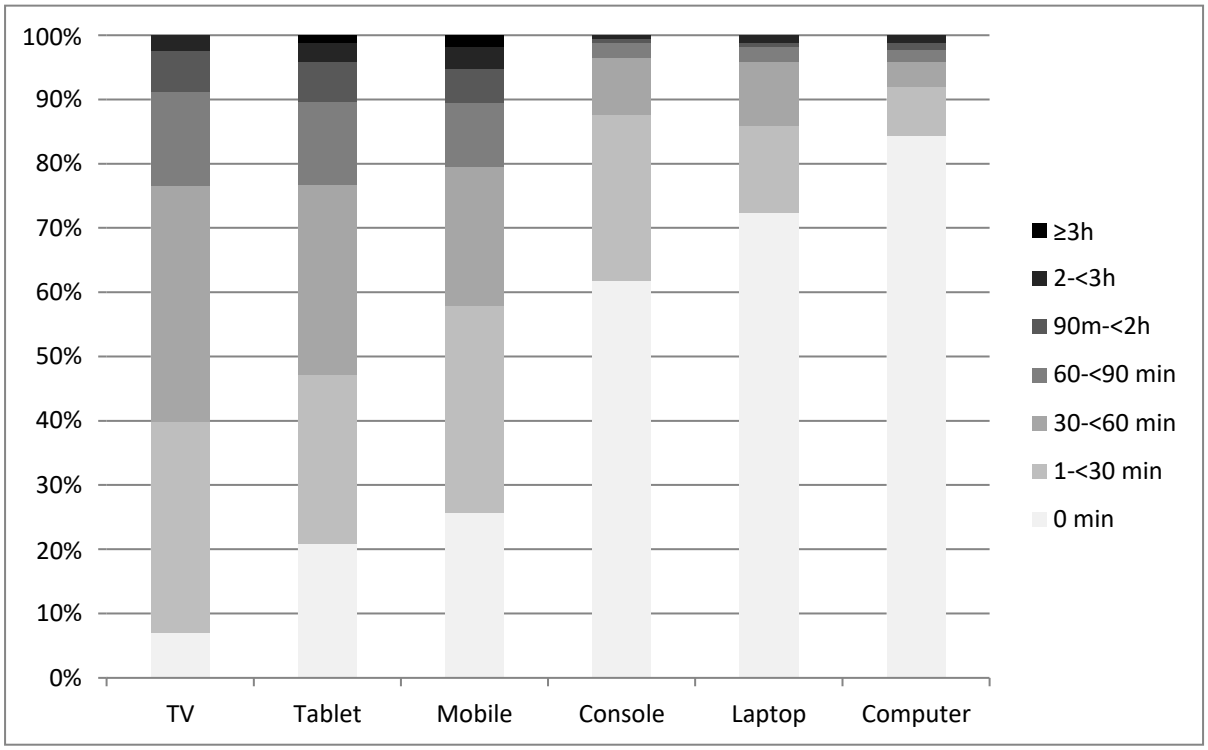


Figure 2 shows the children's time spent on screen-based SBs. TV watching was the most common, followed by tablet and mobile use. Very few children spent time using the computer or laptop.

Figure 2. 7 to 12-year-old children's time spent on different screen-based sedentary behaviors at home on a weekday (percent)



As seen in Figures 1 and 2, except for socializing, indoor play, tablet use and watching TV, most children in the study did not spend more than 30 minutes on the other activities listed here. This is significant when it comes to concerns about children spending much of their time at home on media devices. In the case of non-screen time, socializing and indoor play were the only activities on which most children spent time more than 30 minutes. Most children spent less than 30 minutes on homework, hobbies, and reading. For the media devices themselves, children spent more time on more recent devices (tablet, mobile phone) than a personal computer or laptop. Nonetheless, TV watching remained popular.

Correlates of Non-Screen Sedentary Behaviors

The results from the final models of the regression analyses for non-screen SBs are shown in Table 2. As the table shows, there were few common correlates for the different behaviors investigated.

In the final model, the only variable with a statistically significant association for socializing was the presence of a common play area, with those who had a common play area more likely to spend more time socializing. Children who were more likely to spend more time on indoor play were those who were younger, whose parents disagreed about allowing their child freedom of outdoor movement, or those who had a common play area in their neighborhood. The strongest association was found for the variable on parental beliefs, followed by the presence of an outdoor

play area. Children who were more likely to spend more time on homework were older children, those whose mothers were not university educated, who were in households with nil or one car, those whose parents agreed with the importance of media as an educational tool, or those who had a common play area in their neighborhood. In this case too, the most strongly associated variable was parental opinion. Those who spent the largest amounts of time on hobbies were likely to be girls, children without their own gaming console, or those without a TV in their bedroom. The effect of parental belief about the importance of controlling media time is complex, suggesting that children whose parents who were not sure about this spent the lowest amount of time on hobbies. The variables most strongly associated with time spent on hobbies were parental beliefs about media time and the presence of a TV in the child's bedroom.

Correlates of Screen-Based Sedentary Behaviors

The results from the final models of the regression analyses for screen-based SBs are shown in Table 3. For the screen behaviors also, very few common correlates were found.

In the final model for TV watching, children who belonged to households where the income ranges were 55,000-75,000 SEK and 75,000-95,000 SEK/month were more likely to spend more time watching TV compared to those who belonged to households with income ≥95,000 SEK/month, as were children who owned a mobile phone. The strongest association was found for household income in the range of 55,000-75,000 SEK/month. Children who were more likely to be high tablet users were those whose parents agreed with the importance of media as an educational tool, or who disagreed with controlling their child's media time, or those children who had their own or shared a tablet with their sibling(s). The variable with the strongest statistical association was tablet ownership. The likelihood for being in higher categories of mobile phone use increased with the child's age, those whose fathers had not studied at university, those whose parents disagreed or were not sure about controlling their child's media time, those who owned a mobile phone, or those who did not have a trampoline at home. Mobile phone ownership was most strongly associated with mobile phone use, followed by parental belief about controlling media time. More intensive game console use was associated with gender and console ownership; girls were less likely to be high console users than boys, while children with their own console or those sharing one with their sibling(s) were more likely to spend greater amounts of time on console use. Console ownership was very strongly associated with console use.

Table 2. Results from final models of regression analyses for non-screen SBs

		Socializing			**Indoor Play**			**Homework**			**Hobbies**		
		< 60m (19.8%) 60-90m (20.9%) -1.09 90m-2h (16.9%) -0.04 2-3h 22.7%) 0.66 ≥3h (19.8%) 1.79			0m (11.2%) 1-30m (26.6%) -7.01 30-60m (26.6%) -5.07 60-90m (17.2%) -3.65 ≥90m (18.3%) -2.62			< 30m (68.1%) ≥ 30m (31.9%)			0m (51.8%) 1-30m (32.5%) -0.65 ≥30m (15.7%)1.25		
Categories	**Threshold Values**	*B*	95% CI LL[1]	95% CI UL[2]	*B*	95% CI LL	95% CI UL	*B*	95% CI LL	95% CI UL	*B*	95% CI LL	95% CI UL
Child's age					-0.55**	-0.70	-0.37	0.44**	0.21	0.66			
Gender	M=0, F=1										1.09**	0.43	1.75
Maternal education	Other=0, University=1							-1.05*	-1.93	-0.17			
Number of cars at home	No or 1 car=0 ≥ 2 car=1							-1.08*	-1.92	-0.25			
Parents' belief about digital media being an important educational tool	Disagree Not Sure Agree							-1.01 -1.81* 0	-2.15 -3.41	0.12 -0.21			
Parents' belief about importance of controlling children's media time	Disagree Not Sure Agree										-0.29 -1.18** 0	-1.03 -2.04	0.45 -0.33
Parents' belief about allowing free of outdoor movement	Disagree=1 Agree/ not sure=0				0.86* 0	0.15	1.57						
Console ownership	Own console Shared w/sibling No										-0.76 -1.18** 0	-1.64 -1.96	0.13 -0.41
TV in child's bedroom	No=0; yes=1										-1.19*	-2.22	-0.16
Common outdoor play area	No=0; yes=1	0.72**	0.18	1.26	0.68*	0.12	1.24	0.90 *	0.13	1.68			
Constant								-3.83					
N observations			172			169			163			166	
-2 Log Likelihood	Null model[3] Final model		41.9 34.9			249.2 192.4						144.3 108.8	
Chi-square			7.0			56.8			43.1			35.4	
McFadden ρ^2			0.013			0.108			0.211			0.107	

[1] 95% confidence interval, lower limit; [2] 95% confidence interval, upper limit

[3] This model contains a constant for homework but none for socializing, indoor play and hobbies

* $p<0.05$; ** $p<0.01$

Table 3. Results from final models of regression analyses for screen-based SBs

		TV			Tablet			Mobile Phone			Gaming Console		
		<30m (40.4%) 30-60m (36.1%) 0.96 ≥60m (23.5%) 2.66			0m (21%) 1-30m (25.7%) 0.69 30-60m (30.5%) 0.76 ≥60m (22.8%) 2.36			0m (26.3%) 1-30m (32.5%) 2.35 30-60m (21.9%) 5.15 ≥60m (19.4%) 6.85			0m (60.7%) 1-30m (25.4%) 1.85 ≥30m (12.1%) 3.64		
Categories	**Threshold Values**	*B*	95% CI LL[1]	95% CI UL[2]	*B*	95% CI LL	95% CI UL	*B*	95% CI LL	95% CI UL	*B*	95% CI LL	95% CI UL
Child's age								0.33**	0.09	0.56			
Gender	M=0, F=1										-1.42**	-2.12	-0.71
Paternal education	Other=0, University=1							-1.37**	-2.11	-0.62			
Household income per month	< 55k SEK 55k-75k SEK 75k-95k SEK ≥ 95k SEK	0.33 1.12** 1.00* 0	-0.64 0.31 0.20	1.30 1.93 1.80									
Parents' belief about digital media being an important educational tool	Disagree Not Sure Agree				-1.24** 0.69 0	-2.05 -0.16	-0.44 1.55						
Parents' belief about importance of controlling children's media time	Disagree Not Sure Agree				0.74* -0.38 0	.062 -1.10	1.42 0.35	1.91** 1.68** 0	1.08 0.84	2.75 2.52			
Mobile ownership	None=0 Own=1	0.97**	0.31	1.62				2.79**	1.79	3.79			
Tablet ownership	Own tablet Shared w/sibling No				1.42** 0.91* 0	0.68 0.15	2.17 1.66						
Console ownership	Own console Shared w/sibling No										2.69** 2.37** 0	1.39 1.10	3.99 3.63
Trampoline at home	No=0; yes=1							-0.85*	-1.53	-0.18			
N observations			166			167			160			170	
-2 Log Likelihood	Null model (Final model)		76.2 59.6			198.1 155.1			352.9 222.0			90.3 40.1	
Chi-square			16.6			42.9			130.9			50.2	
McFadden ρ^2			0.047			0.093			0.299			0.163	

[1] 95% confidence interval, lower limit; [2] 95% confidence interval, upper limit

* $p<0.05$; ** $p<0.01$

Discussion

The purpose of the current study was to investigate the kinds of SBs in which children engage at home, and the correlates associated with these behaviors. The findings indicate that children engage in a variety of both non-screen and screen-based SBs at home, and these behaviors are correlated with multiple but mostly different indicators at the personal, social and physical environment levels.

Amount of Screen- and Non-Screen-Based Sedentary Behaviors

The SBs that children undertook most commonly were socializing, followed by TV watching and indoor play. Previous studies investigating both screen and non-screen behaviors found that homework was a rather common non-screen SB (Biddle, Gorely, et al., 2009; Olds et al., 2010), while this study found socializing to dominate. The difference could be due to the fact that both the other studies were with older children, or that they were conducted in Scotland and Australia, respectively, countries where students spent more time doing homework than Sweden (OECD, 2013).

There were also notable differences according to age and gender in the amounts of time dedicated to specific SBs. Both homework and mobile phone use increased with age, while indoor play declined. Correlation analysis further revealed that time spent on indoor play and mobile use had negative associations with each other (*Spearman's Rho* =-.38, *p* =.009), suggesting that mobile phone use might be replacing indoor play among older children. A review of the correlates of after-school SBs by Arundell and colleagues (2015) found that overall after-school SB increased with age, although they could not conform the same finding for TV viewing. Investigating different types of screen and non-screen SBs in the future could help us understand the nature of age-related differences in children's SB and could help target specific activities among different age groups for reducing SB.

The gender differences found in gaming in this study concur with earlier research (Houghton et al., 2015; Totland et al., 2013). Moreover, this study also noted negative associations between time spent in hobbies and console use (*Spearman's Rho* =-.20, *p* =.009), possibly due to girls and boys spending their time on different kinds of home-based SBs. As previous studies focused largely on screen time, the gender differences in hobbies and console use shown here is an important insight that could help explain the differences in sedentary time among boys and girls. Interestingly, Biddle and colleagues (2009) also noted gender differences in time spent socializing, while the current study did not. Again, this could be due to age-related differences in the samples.

In terms of recommendations to reduce SB, the differences in which behavior(s) dominates are important since the energy requirements of different behaviors, as well as their "acceptability," differ. The energy requirements of non-screen SBs such as indoor play are generally shown to be higher than those of screen SBs, depending on posture and way of performance (Olds et al., 2010; Ridley, Ainsworth, & Olds, 2008). However, more insight is needed into the extent to which children engage in screen vs. non-screen SBs, and how these may be associated with their physical activity and health. Secondly, these behaviors are also viewed differently by parents, with many non-screen behaviors such as homework, reading and hobbies considered desirable (Bentley, Jago, & Turner, 2015; Carson, Clark, Berry, Holt, & Latimer-Cheung, 2014). How other non-screen behaviors such as socializing and indoor play are viewed remains unclear and deserves further scrutiny. More knowledge about the extent, health associations, and place of non-screen behaviors with regards to children's overall sedentary time is therefore required. It should also be noted that the time spent on the different behaviors

investigated here implicitly assumes that children spend their time dedicated to one activity at a time, while it is more likely that children multi-task, especially when it comes to screen time (Jago, Sebire, Gorely, Cillero, & Biddle, 2011). Current methods of studying SB are limited in their ability to account for multi-tasking and future studies should therefore look at more novel methods of investigating how children undertake different activities.

Correlates of Screen- and Non-Screen-Based Sedentary Behaviors

The results from the regression analyses show few common correlates between screen and non-screen SBs, reasserting the findings from previous works (LeBlanc, Broyles, et al., 2015; Stierlin et al., 2015). In fact, there were few common correlates even within the various screen and non-screen SBs, again highlighting that each behavior is distinct and must be investigated separately. This is a crucial finding when it comes to designing interventions, suggesting that different SBs need to be targeted in different ways.

Olds and colleagues (2010) studied both screen and non-screen SBs among adolescents in Australia and found that key socio-demographic factors such as sex, age, household income and parental education showed opposite directions of association with screen and non-screen behaviors. The results from the present study also show opposing patterns for the child's age for mobile phone use and indoor play, and for gender in the case of hobbies and console use. Opposing patterns were also found in this study in relation to parental beliefs about media-time control with the child's time spent on devices as compared to hobbies. These opposing patterns could be due to what Olds and colleagues (2010) call compensatory effects, meaning that when allocating time for different activities, adolescents choose from within different sedentary activities. As mentioned in the introduction, others have also posited that children might not necessarily decrease their sedentary time if their screen time is limited, instead choosing other sedentary pursuits (Epstein, Roemmich, Paluch, & Raynor, 2005; Maitland et al., 2013; Roemmich et al., 2007). In this respect, investigating non-screen SBs and their correlates becomes crucial.

The model fit statistics are low for most models, with the exception of those for mobile phone use (p^2=0.299), gaming (p^2=0.163) and homework (p^2=0.211). This means that most of the variation in different SBs, and especially for socializing and TV watching, is not accounted for by variables considered in the modeling; future research should try to identify other correlates of different kinds of SBs.

Personal, Social and Physical Environment Correlates of Non-Screen-Based Sedentary Behaviors

With regard to the specific variables investigated for non-screen behaviors, parental beliefs and the presence of a common outdoor play area were each significant in three of the four behaviors investigated. Also, the strength of associations found were strongest for parental beliefs, alluding to the importance of the social environment in shaping children's non-screen behaviors, which has previously been found to be the case for screen activities (Bjelland et al., 2015; Pate et al., 2011).

Notably, the correlation between parental opinions on control of media time and hobbies, and control of outdoor movement and indoor play suggest that children could be choosing non-screen, home-based sedentary activities due to parental beliefs, questioning the extent to which parental rules about media time can actually reduce overall sedentary time. Furthermore, statistically significant results were found for beliefs regarding not only media time but also outdoor movement. Both these points suggest that future work should look at parental beliefs on a variety of aspects that could influence both screen and non-screen time among children. Further support for studying parental beliefs can be seen in the correlation found between homework and parental opinions about media as an educational tool, perhaps due to parental beliefs about education in general influencing their particular beliefs about media devices.

Curiously, the presence of a neighborhood playground was associated with more time spent on homework, socializing, and indoor play. One reason for this might be that sharing a neighborhood playground was not desired by children and instead resulted in more SB (Stierlin et al., 2015). Another possible reason could be that the children who did not have a neighborhood playground participated in more organized activities or were driven to play spaces further away from home, thus reducing the total time they spent at home. That said, this finding certainly merits further investigation, in terms of the actual use of the play area, its features and quality, distance from homes, and the presence of playmates. More reflection is also warranted in the case of homework, given that the amount of time spent on homework is seen to vary based on socio-economic status, type (public vs. private) and location (urban vs. rural) of school attended (OECD, 2014). While school-based differences in time spent on homework could not be explored in this study given that both schools were public schools located in the same municipality, the association of number of cars at home and maternal education levels with children's homework time seem to suggest that children from more advantaged socio-economic status spent less time on homework, a finding contradictory to previous surveys (OECD, 2014). More work is needed in the future to try and understand differences in time spent on homework among children, in terms of both familial and school-based factors.

For the other variables investigated, the lack of associations as well as the model fit statistics for socializing suggest that the SEM as operationalized in this study is not effective in capturing the variation in the amount of time children in the sampled households spent socializing. Overall, non-screen SBs appear to be distinct behaviors and investigating variables associated with screen activities to try and explain non-screen behaviors is not adequate.

Personal, Social and Physical Environment Correlates of Screen-Based Sedentary Behaviors

For screen-based SBs, access to devices and parental beliefs showed strong associations with the different types of media use, which is in line with previous studies (Bjelland et al., 2015; Dumuid, Olds, Lewis, & Maher, 2016; Ramirez et al., 2011; Rey-López et al., 2010). For mobile phone, tablet and console use, device ownership was very strongly correlated with use. Not surprisingly, this study too

found that possession of media devices is associated with their use. In fact, it was only in the case of TV watching that having a TV in the bedroom was not associated with more TV watching, a variable that has previously shown mixed results (Cillero & Jago, 2010). Interestingly, mobile phone ownership was significantly associated with TV watching, while presence of TV in the bedroom was found to be significant for hobbies. Future work should try to understand the reasons and situations under which such findings emerge.

It is also noteworthy that none of the physical features of the dwelling were associated with any of the screen-based behaviors. While this could be due to the homogeneity of the sample as there was not much variation in the dwelling typology, there was considerable variation in dwelling size and design, and even these were not statistically significant (at $p \leq 0.05$) in the final model.

During the modelling process it became clear that access to media devices and parental beliefs were more directly linked to time spent on screens than the physical features of the dwelling. Therefore, by studying variables across multiple levels of the SEM, it becomes clear that some domains may be more important for specific SBs than others (see also Granich et al., 2010; Maitland et al., 2014).

As compared to the non-screen behaviors investigated, the models for screen behaviors performed better, most likely due to the strength of associations noted with the device ownership and parental belief variables. In the case of mobile phone and console ownership especially, these were both very strongly correlated with mobile phone use and console use, respectively, and generated the best fitted models. This could perhaps also explain why TV watching did not perform as well as the other models, as TV watching was not associated with access to one's own TV. Interestingly, both TV watching and socializing—the SBs that were most common among this sample—also showed the models with the lowest strengths, suggesting that more context-based, exploratory work is needed in the future to understand the correlates of different SBs.

Conclusions

This paper has shown how children engage in a wide range of screen-based and non-screen-based SBs at home, of which socializing, indoor playing, TV watching and using a tablet are the most common. Age and gender differences have also been observed in the time devoted to specific behaviors. There are, however, few common correlates for these behaviors. These findings stress an important point with regards to future studies—it is necessary to know children's specific activities and their correlates in order to devise strategies to reduce children's SBs. While studies noting children's overall sedentary time are useful for highlighting the extent of SB among children, they are of little use when it comes to targeting children's SB since they give no information about the actual activities in which children engage. As seen in this paper, while subjective methods can capture both children's activities and their possible correlates, more exploratory studies are needed first to identify possible correlates of children's SBs, especially non-screen behaviors. Novel study approaches using mixed methods that can ascertain the

energy expenditure and time spent in different activities, along with identifying correlates of different SBs, can further our knowledge in this area.

This study also shows that most of the strongly associated correlates of children's SB at home lie at the social level of the SEM. Future work employing qualitative methods and in-depth studies is needed to understand how parental beliefs and rules are shaped and implemented at home, how they might intersect with media device acquisition and access, and how these different factors actually play out to shape both screen and non-screen behaviors. This is crucial especially for understanding the extent to which rules may be effective in reducing overall sedentary time. Also, children's social environment can be shaped by siblings, friends, as well as their own preferences and motivations. Future work should look more closely at this domain in the study of children's SB.

Some of the strengths of this research were the inclusion of non-screen activities, and newer devices, along with their correlates in the study of children's SB. The paper also investigated these correlates at multiple levels using the SEM. The limitations of the study were the use of self-reported data for measurement of SB, small sample size, overrepresentation of a high-education and high-income group, and the cross-sectional nature of the data. Further, the investigation of correlates of non-screen SBs based on a priori associations with screen SBs possibly contributed to the limited findings in this area. As noted earlier, more mixed methods research on children's SB can overcome some of these limitations and help deepen our knowledge about this research area.

Apoorva Rathod *is a Ph.D. candidate at the Unit for Human Geography, University of Gothenburg, Sweden. Her Ph.D. research investigates the role of the home environment in shaping children's sedentary behaviors at home.*

Jerry Olsson *is Associate Professor in Human Geography at the Unit of Human Geography, University of Gothenburg, Sweden. He holds a Ph.D. (2007) from University of Gothenburg, and besides research also holds a position as senior lecturer at the University of Gothenburg since 2012.*

Tim Schwanen *is Professor of Transport Studies and Geography and Director of the Transport Studies Unit (TSU) at the School of Geography and the Environment, University of Oxford. He is also Fellow in Geography at St Anne's College, Oxford. He holds a Ph.D. (2003, cum laude) from Utrecht University, the Netherlands and held various researcher and lecturer position before taking up the TSU Directorship in 2015.*

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