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Electronic media time and sedentary behaviors in children: Findings from the Built Environment and Active Play Study in the Washington DC area

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ABSTRACT

An objective of the Built Environment and Active Play (BEAP) Study was to examine whether home built environment, bedroom electronic presence, parental rules and demographics predicted children's sedentary behavior (SB). In 2014, BEAP Study questionnaires were mailed to 2000 parents of children (7–12 years) within the Washington DC area. SB-Duration (hours/day) and SB-Frequency (days/week) were assessed by two questions with multiple subparts relating to SB activity type (e.g. car riding) and SB companionship (e.g. friends). Built environment, bedroom electronic presence, parental rules and demographic data were obtained through questionnaire items and ordered logistic regression models were used to examine whether these variables were associated with SB. Study sample included 144 children (female (50%); average age (9.7 years); White (56.3%); Black/African-American (23.7%); Asian-Americans (10.4%)). Nearly 40% of the sample reported daily solitary SB with car riding being the most frequently reported type of SB. Children living on streets without a dead-end/cul-de-sac exhibited a higher odds in SB-Duration using electric media [2.61 (CI: 1.31, 5.18)] and having no television in a child's bedroom was associated with a lower odds in SB-Frequency [0.048 (CI: 0.006, 0.393)] and SB-Duration [0.085 (CI: 0.018, 0.395)]. Non-Hispanic/Latino children were also found to have higher odds in solitary SB-Frequency when parental rules of electronic use were modeled [8.56 (CI: 1.11, 66.01)]. Based on results from this cross-sectional study, home neighborhood built environment, bedroom electronic presence and absence of parental rules can significantly predict children's SB.

1. Introduction

Sedentary behavior (SB), including watching television (TV), playing video games, and other screen time activities, is a primary contributor to the decreasing physical activity trend present in youth across the United States. The combination of increased SB and decreased physical activity puts youth at an increased risk for becoming overweight or obese. On average, children and adolescents spend 8 h per day engaging in SB (Lou, 2014). Children who watch TV for more than 3 h a day have a 65% higher chance of being obese compared to children who watch less than 1 h of TV per day (Singh et al., 2008). Furthermore, SB is not distributed uniformly across ethnic and socioeconomic groups. Black/African American and low-income family children report more SB compared to White children and children from higher-income families (Lou, 2014). While sedentary behavior is often measured or classified as being with or without screen time or electronics, the Active Living Research consortium of experts published a research review, which stated the need for additional research examining "other sedentary behaviors, including sitting time during school, socializing with friends, and riding in a car" (ALR, 2014). With regard to SB and companionship, a very recent study found that friendship network characteristics were associated with SB and screen time in late childhood/early adolescence, but emphasized that additional research was warranted (Marks et al., 2015).

Various features within the home and neighborhood can contribute to children's SB. Children's access to TVs may vary based on the location of the device throughout the house as well as parental rules regarding viewing time. The presence of a TV, computer, or video game device in the child's bedroom increases SB (Tandon et al., 2014; Tandon et al., 2012; Maitland et al., 2013; Atkin et al., 2013). Although, multiple

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studies have compared parental rules to physical activity behavior, few have examined SB as the outcome variable (Crawford et al., 2010). Rules concerning safety (e.g. "stay close/within sight of the house/parent") and electronic usage (e.g. "no more than two hours of TV per day") are examples of what previous studies have assessed (Tandon et al., 2014; Tandon et al., 2012; Spurrier et al., 2008). One study found that rules limiting electronic media usage significantly decreased SB by roughly 8 min per day, and significantly decreased screen time by nearly 38 min per day (Tandon et al., 2014).

Home built environment features including access to yard space and equipment should also be considered when reviewing determinants of youth's SB. Previous studies have examined the presence of fixed and portable play equipment, such as basketball hoops, swing sets, and sports equipment, and their impact on children's activity levels (Tandon et al., 2014; Spurrier et al., 2008; Maitland et al., 2014). For example, in one study, the presence of a basketball hoop decreased SB by 10 min per day (Tandon et al., 2014). Yard size, another important built environment factor related to activity, has been researched minimally and within a narrow scope (Spurrier et al., 2008; Maitland et al., 2014; Carson et al., 2014). In particular, research of preschool children found that greater backyard size was significantly associated with increased outdoor playtime, yet the influence of yard size on older children has not been extensively examined even though they may not be restricted to physical activity spaces within close proximity of their home (Spurrier et al., 2008). While current studies have primarily assessed yard size for physical activity outcomes, studies comparing yard size with SB have not yet been conducted (Maitland et al., 2013). Moreover, few studies have considered the association of home size and comparisons of specific home types (e.g. apartment, town home, single-family home) with SB (Maitland et al., 2014).

Home neighborhood design, such as grid structure and cul-de-sac, are also associated with children's activity or SB (Laxer and Janssen, 2013; Handy et al., 2008; Veitch et al., 2011; Carver et al., 2008). One study reported that children who lived in a cul-de-sac spent less time using computer/e-games compared with children who did not live in a cul-de-sac (Veitch et al., 2011). Additionally, youth living in neighborhoods within the lowest two quartiles of cul-de-sac density had a 28–32% increased risk of physical inactivity compared to youth in neighborhoods with the highest density of cul-de-sacs (Laxer and Janssen, 2013). This finding suggests that physical activity promoting neighborhood designs and those that reduce SB may be dependent on age since research has demonstrated that higher residential density and increased street connectivity designs are more conducive for adult physical activity while the converse is true for youth (Sallis et al., 2009; Tappe et al., 2013).

Sociodemographics may also impact factors influencing SB. Children who are overweight, live in an urban area, or are from low socioeconomic families are more likely to have a TV in their bedroom (Atkin et al., 2013). In a study comparing the homes of obese families to healthy weight families, 37.1% of obese families had electronic media devices in the child's bedroom, compared to 12.8% of healthy weight families (Boles et al., 2013). Another study found that 52% of children from lower income households had TVs in their bedroom, compared to only 14% of children from higher income households; however, parents in the middle income category had fewer rules regarding media use compared to lower and higher income families (Tandon et al., 2012).

While research regarding the built environment and youth's physical activity is an expanding field, it is also important to consider the built environment and youth's SB, as both sedentarism and physical activity fall within the physiological movement continuum and are not mutually exclusive behaviors (Wong and Leatherdale, 2009; Tremblay et al., 2010). Accordingly, the Built Environment and Active Play (BEAP) Study, an explorative study that focused on children's active play, also examined the association of children's SB in the Washington, D.C. metropolitan area [Washington, D.C.; Maryland; Virginia (DMV)] with features of the home neighborhood built environment, bedroom electronic presence, parental rules, and demographics (Roberts et al., 2016; Roberts et al., 2015). The BEAP Study is a valuable addition to the scientific literature on children's SB because this research investigated types of behaviors not related to screen time as well as SB with friends, siblings and parents. Likewise, this is the first study of its kind to be conducted in the DMV, an area of unique racial, ethnic, income, educational, and origin of birth diversity. As an example of DMV's unique heterogeneity in a population of approximately six million, census data reported a median household income of $93,294 (25% households under $50,000; 28% households $50,000–$100,000; 32% households $100,000–$200,000; 15% households over $200,000), a racial/ethnic composition of 46% White, 25% Black/African-American, 15% Hispanic/Latino and 10% Asian American, and among the foreign-born population, the most common places of birth were Latin American (41%), Asia (36%) and Africa (14%) (US.CensusReporter, 2015). Furthermore, the level of education attainment ranged from no degree (10%), high school (19%), some college (22%), bachelor's (25%), to post-graduate (24%) (US.CensusReporter, 2015).

2. Methods

2.1. Sampling method and study setting

In September–December 2014, the BEAP Study questionnaire was sent by mail delivery to the parents of 2000 children between the ages of 7–12 years living within the DMV. To ensure adequate inclusion of diverse built environments within nine DMV areas (Washington, DC (District of Columbia); Fairfax County, VA; Arlington County, VA; Loudon County, VA; Fairfax City, VA; Alexandria City, VA; Montgomery County, MD; Prince George's County, MD; and Frederick County, MD), a stratified sampling strategy was executed. Within the entire BEAP Study setting of these nine DMV areas, there were 2901 block groups (statistical divisions of U.S. census tracts containing between 600 and 3000 people) (US.Census, 2012). Depending on the population densities and land area sizes for each of the block groups, one to three street location(s) within each block group were randomly selected using latitude and longitude coordinates and assigned a median Street Smart Walk Score® (Roberts et al., 2015). Thus, Street Smart Walk Score® was used as a stratified sampling tool by classifying and stratifying each block group into one of five built environment strata using the classification scheme developed by Walk Score®: (1) walker's paradise (90–100 score); (2) very walkable (70–89 score); (3) somewhat walkable (50–69); (4) car-dependent (25–49); and (5) very car-dependent (0–24) (StreetSmartWalkScore, 2007). Lastly, addresses were purchased per built environment strata proportional to the population of households with children aged 7–12 years as estimated by the U.S. Census Bureau (US.Census, 2013). A total of 2000 DMV addresses were purchased from Alesco Data Group, a direct marketing services company (ADG, 2013). Additional details on the sampling methodology have been previously published (Roberts et al., 2015).

2.2. Study participants

The BEAP Study questionnaire, a $10 gift card, and a postage-paid self-addressed envelope with instructions to return the completed questionnaire were mailed to potential study participants. In the mailing, potential participants were also provided with a secure and encrypted web address, unique access code and the option of completing an identical online version of the BEAP Study questionnaire via Qualtrics.com. The BEAP Study questionnaire underwent several iterations of reliability and validity testing and was originally adapted from a survey used in the Neighborhood Impact on Kids project (Roberts et al., 2016; Roberts et al., 2015; NIK, 2013a, b). The questionnaire collected data on child active play, child SB, parental physical activity, home and neighborhood built environment features, parental neighborhood perceptions, parental rules, and demographic characteristics of child

and parent including child weight, height and pre-existing health conditions (Roberts et al., 2016). A response rate of 10% was obtained, however, questionnaires with incomplete demographic data were deleted from analysis. This resulted in 144 (72 girls and 72 boys) responses entered into the analysis. Implicit informed consent was obtained through the return of the completed BEAP Study questionnaire. The Institutional Review Board at The University of Maryland at College Park approved the study protocol (UMCP, 774586-1).

2.3. Independent variables

Data on home neighborhood built environment, bedroom electronic presence, parental rules, and demographics were collected with the BEAP Study questionnaire. Built environment, bedroom electronic presence, and parental rules were assessed with 14 questions (Table 1). All questions elicited yes/no responses, with the exception of the following question: "What type of building is your home/your child's home?" For this question, participants were required to mark "detached single family home"; "townhouse"; "condominium or apartment building" or "other". Both child and parent demographics were assessed with questions on age, gender, race, ethnicity and origin of birth.

2.4. Dependent variables

Children's SB was estimated with two BEAP Study questionnaire items. The first question (SB-Frequency (days/week)) asked "During a typical week, how many days does your child sit and watch TV, play videogames on the computer, or with other electronic devices [alone]; [with siblings]; [with parent or guardian]; [with friends]?" with responses ranging from never, 1–2 days, 3–4 days, 5–6 days and everyday. The second question (SB-Duration (hours/day)) asked about SB again, but on an hourly scale. Respondents were instructed to "Please indicate how much time on a typical weekday your child does the following activities, when he or she is mostly sitting, and not moving around. Please think about the time from when your child wakes up until he or she goes to bed. Please do not include time when your child is in school during regular hours." The sedentary activities included: a) "watching television/videos/DVDs"; b) "playing sedentary computer or video games (e.g. Xbox, cell phone)"; c) "using Internet, e-mailing, or other electronic media for fun or relaxation"; d) "doing homework (including reading, writing, or using the computer)"; e) "reading a book or magazine not for school (including comic books)"; and f) "riding in a car". Responses for this question ranged from none, 15 min/day, 30 min/day, 1 h/day, 2 h/day, 3 h/day to 4 or more hours/day.

Table 1
BEAP Study questionnaire items for independent variables.

Home Neighborhood Built Environment
1. What type of building is your home/your child's home?
2. Does your home/your child's home have a front yard?
3. Does your home/your child's home have a back yard?
4. Does your home/your child's home have a side yard?
5. Does your home/your child's home have a driveway?
6. Does the part of your/your child's street that you live on have sidewalks?
7. Do the streets connected to the street of your home/your child's home have sidewalks?
8. Do you rent or own your/your child's home?
9. Is your street/your child's street in a cul-de-sac or dead-end?
Bedroom Electronic Presence
1. Please indicate whether the following are currently or have been in your child's bedroom or the room in which he or she sleeps.
a. TV
b. VCR or DVD player
c. Computer
d. Video game system (non-handheld) (Playstation, Xbox, etc.)
a. Cell phone or 2-way radio
b. Hand held videogame players (Game Boy, Sony PSP, etc.)
c. Tablet (iPad, Kindle, etc.)
d. Portable music players (radio, MP3 or iPod)
2. Does your child have the following for his/her own use?
a. Cell phone or 2-way radio
b. Hand held videogame players (Game Boy, Sony PSP, etc.)
c. Tablet (iPad, Kindle, etc.)
d. Portable music players (radio, MP3 or iPod)
Parental Rules
1. In your family, do you enforce doing homework before going outside?
2. In your family, do you enforce no television/DVD/computer before homework?
3. In your family, do you enforce maximum number of hours/day of television/DVD/computer?

2.5. Statistical analysis

For each SB outcome, SB-Frequency and SB-Duration, univariate ordered logistic regression was conducted to determine if individual variables within each independent variable category of built environment, bedroom electronic presence, parental rules, or demographics predicted SB independently. Significant independent variables (p-value < 0.05) for each independent variable category of built environment, bedroom electronic presence, and parental rules were further analyzed using multivariate ordered logistic regression whereby all models were adjusted for demographic variables. Since one of the assumptions underlying ordered logistic regression is the proportional odds assumption or rather the parallel regression assumption, this assumption was confirmed with a likelihood ratio test for each model. The proportional odds assumption states that the relationship between each pair of outcome groups is the same (e.g. assumes that the coefficients that describe the relationship between the lowest versus all higher categories of the response variable are the same as those that describe the relationship between the next lowest category and all higher categories, etc.) (UCLA, 2016). By failing to reject the null hypothesis of this test (e.g. there is no difference in the coefficients between models), it was confirmed that there was no violation to the proportional odds assumption. Statistical analyses were carried out using STATA/MP 14.1 (StataCorp, 2015).

3. Results

Questionnaires with demographic data resulted in a sample of 144 (72 females and 72 males) responses entered into the analysis; however some respondents did not answer all questions (Table 2). The average age of the sample was 9.7 years (SD = 1.6). Over one-third of the BEAP Study population was Black/African American (23.7%) or Asian American (10.4%). Nearly a quarter of the children were in the fifth grade (23.8%) or approximately 10 or 11 years old. Over half (53%) of the children in the study lived in households where the annual income was over $100,000. Even though only 7.9% of the parents indicated that their children were diagnosed as overweight/obese, the calculated overweight/obesity rate was 25.5% using parent reported weights and heights of their children.

Our results found that 38.1% of the sample reported solitary SB everyday of the week (Fig. 1). Similarly high proportions of SB were with a friend (38.4%) or parent (36.3%) 1–2 days/week. Car riding, followed by homework were the most frequently reported types of SB (Fig. 2). For television watching, it was determined that 27.5%, 22.5%, 7.0%, and 5.5% spent 1, 2, 3, 4 h/day engaged in this type of SB, respectively. Among the 53 children whose parents reported solitary SB everyday of the week, the highest proportions per parameter were found among children living in Montgomery County, diagnosed with asthma, ADHD/ADD or overweight/obesity, older children in 4th–6th grades as well as White children (Table 2). Additionally, within the annual household income parameter a high proportion of daily solitary SB was identified among children from households with annual incomes of $100,001–$150,000.

Table 2
BEAP Study child participant demographics.

Parameter	Total N (%)	Solitary sedentary behavior – 0 days N = 18 n (%)	Solitary sedentary behavior – 7 days N = 53 n (%)
Gender			
Male	72 (50.0)	8 (44.4)	26 (49.1)
Female	72 (50.0)	10 (55.6)	27 (50.9)
Ethnicity/race			
Hispanic/Latino	7 (4.9)	1 (5.6)	2 (3.9)
Black/African American	32 (23.7)	5 (29.4)	12 (24.0)
American Indian/Alaska Native	1 (0.7)	0	0
Asian American	14 (10.4)	3 (17.7)	8 (16.0)
White	76 (56.3)	9 (52.9)	28 (56.0)
Other	12 (8.9)	0	2 (4.0)
Highest grade completed			
1st grade	14 (9.8)	1 (5.6)	6 (11.3)
2nd grade	24 (16.8)	4 (22.2)	7 (13.2)
3rd grade	21 (14.7)	5 (27.8)	3 (5.7)
4th grade	24 (16.8)	5 (27.8)	9 (17.0)
5th grade	34 (23.8)	2 (11.1)	15 (28.3)
6th grade	17 (11.9)	0	9 (17.0)
>6th grade	9 (6.3)	1 (5.6)	4 (7.6)
Annual household income			
≤$30,000	6 (4.4)	1 (5.9)	2 (3.9)
$30,001–$50,000	14 (10.3)	1 (5.9)	6 (11.8)
$50,001–$75,000	12 (8.8)	0	7 (13.7)
$75,001–$100,000	20 (14.7)	4 (23.5)	7 (13.7)
$100,001–$150,000	27 (19.9)	5 (29.4)	11 (21.6)
$150,001–$250,000	29 (21.3)	1 (5.9)	7 (13.7)
$250,001–$500,000	13 (9.6)	2 (11.8)	4 (7.8)
>$500,000	3 (2.2)	0	3 (5.9)
Doctor diagnosed illness			
Anxiety	9 (6.5)	0	5 (9.4)
Asthma	25 (17.6)	1 (5.9)	9 (17.0)
ADHD/ADD	17 (12.0)	2 (11.1)	9 (17.0)
Depression	2 (1.4)	0	1 (1.9)
High blood pressure	1 (0.7)	0	1 (1.9)
High cholesterol	3 (2.1)	0	2 (3.8)
Overweight/obese	11 (7.9)	1 (5.9)	7 (13.2)
Child weight status[a]			
Underweight	12 (13.3)	0	6 (18.9)
Healthy weight	55 (61.1)	7 (58.3)	18 (56.3)
Overweight	12 (13.3)	1 (8.3)	4 (12.5)
Obese	11 (12.2)	4 (33.3)	4 (12.5)
Born in United States			
Yes	134 (95.0)	18 (100.0)	51 (96.2)
No	7 (5.0)	0	2 (3.8)
County residence			
Montgomery County	38 (27.1)	5 (29.4)	19 (36.5)
Fairfax County	39 (27.9)	4 (23.5)	10 (19.2)
Loudoun County	19 (13.6)	3 (17.7)	6 (11.5)
Prince George's County	20 (14.3)	2 (11.8)	8 (15.4)
Frederick County	10 (7.1)	1 (5.9)	1 (8.3)
Washington, DC	14 (10.0)	2 (11.8)	1 (8.3)

[a] Calculated based on parent reported child weight and height.

For this explorative study, univariate analysis identified associations between built environment, bedroom electronic presence, parental rules and SB (SB-Frequency and SB-Duration). Multivariate analysis either strengthen or attenuated these results. Having no television in a child's bedroom was associated with a lower odds in solitary SB-Frequency [0.048 (CI: 0.006, 0.393)] (Table 3) and a lower odds in SB-Duration [0.085 (CI: 0.018, 0.395)] (Table 7). The lack of some bedroom electronic devices (e.g. VCR/DVD player, portable music player) predicted a lower odds in SB-Frequency with friends, yet, this was the converse for other devices (e.g. hand-held video game player, bedroom video game player) (Table 4). Girls demonstrated a lower odds in SB-Frequency with friends compared to boys [0.291 (CI: 0.110, 0.772)] (Table 4). When parental rules of electronic use were modeled, non-Hispanic/Latino children exhibited a higher odds in solitary SB-Frequency [8.56 (CI: 1.11, 66.01)] (Table 5). Additionally, when built environment factors were regressed on SB, it was shown that children living on streets that did not have a dead-end or cul-de-sac presented a higher odds in SB-Duration using electronic media [2.61 (CI: 1.31, 5.18)] (Table 6). With this model, child age was also directly proportional to SB-Duration. For example, for each increase in year of age, the odds in SB-Duration using electronic media significantly increased [1.43 (CI: 1.17, 1.74)] (Table 6).

4. Discussion

The DMV area represented a highly optimal setting for conducting the BEAP Study due to its unique racial, ethnic, income, educational, and origin of birth diversity. Dissimilar to other youth built environment research, the BEAP Study consisted of over 34% Black/African and Asian Americans. With this research that examined the relationship of children's SB with features of the home built environment, bedroom electronic presence, parental rules, and demographics, we demonstrated that these independent variables were associated with SB-Frequency and SB-Duration. Furthermore, the predictability through these

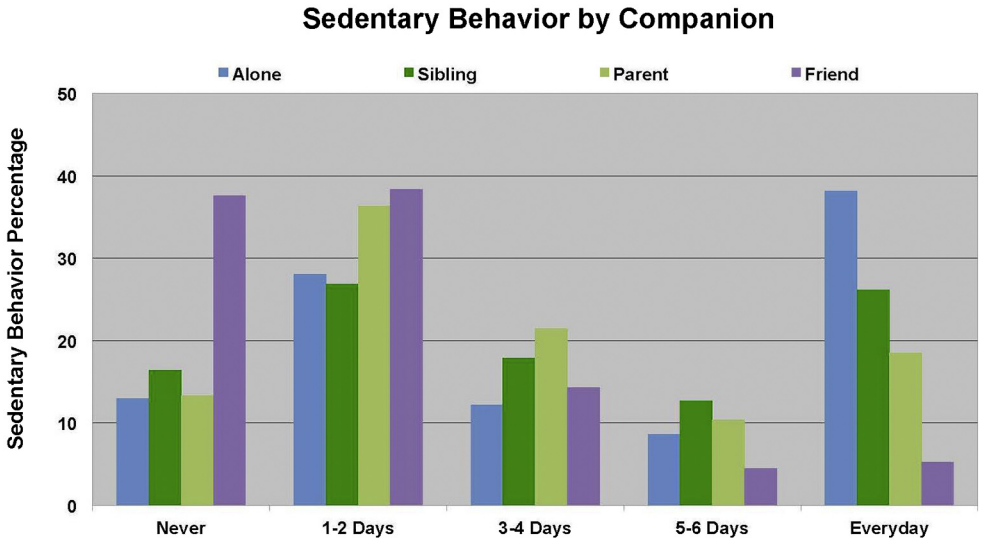

Fig. 1. Sedentary behavior frequency by companion.

independent variables varied between solitary SB-Frequency versus SB-Frequency with friends.

This cross-sectional study demonstrated that having no television in a child's bedroom was associated with a lower odds in SB-Frequency and SB-Duration, which was similar to other research identifying increased SB with the presence of a TV, computer, or video game device in a child's bedroom (Tandon et al., 2014; Tandon et al., 2012; Maitland et al., 2013; Atkin et al., 2013). Our findings indicated that there was a decreased odds in SB, ranging from one-third of a day in a week to approximately 2 h in one day, even when other bedroom electronic devices, parent's education, child's age, gender, race and age were controlled. BEAP Study findings on children's SB and bedroom electronic presence are consistent with current research while also contributing to gaps in the existing literature (Tandon et al., 2014; Tandon et al., 2012; Maitland et al., 2013; Atkin et al., 2013). For example, unlike the BEAP Study, most of the prior research on children's SB has been conducted outside the U.S. and/or in more homogeneous study populations (Tandon et al., 2014; Tandon et al., 2012; Maitland et al., 2013; Atkin et al., 2013).

Apart from a few other research studies examining the relationship between SB and parental rules, this study also investigated this relationship (Tandon et al., 2012; Bounova et al., 2016; Pearson et al., 2011; Gingold et al., 2014; Salmon et al., 2005). The BEAP Study found that the absence of parental rules regarding screen time was associated with a higher odds of solitary SB-Frequency. Specifically, non-Hispanic/Latino children were found to have a statistically significant higher odds in solitary SB-Frequency when parental rules of electronic use were modeled. Given that both child bedroom electronic presence and parental rules are related to SB, additional nuanced research conceptualizing and measuring technology or electronic media time would provide a greater understanding of the bi-directionality among these variables. Essentially, video games, computers, technology and electronic media have been viewed as the culprit for sedentary lifestyles and lack of physical activity, however, there has been some very recent evidence that mobile phone technology can actually increase physical activity and decrease SB in adults due to the receipt of activity reminders (Kendzor et al., 2016). While the use of mobile phone reminders in children may not have the same motivating effect as with adults, research has demonstrated that cell phones play a significant role in youth communication and can function as a catalyst in the coordination of play dates with their friends (Lenhart et al., 2010). Therefore, parental monitoring through parental rules as compared to complete restriction of

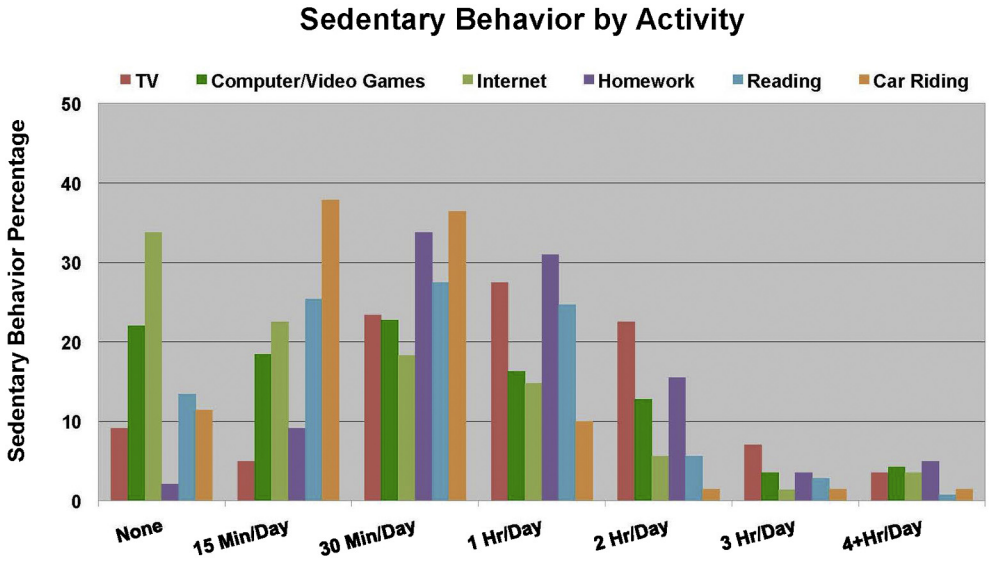

Fig. 2. Sedentary behavior duration by activity.

Table 3
Ordered logistic regression analysis of the influence of electronics and demographics on children's number of sedentary behavior days alone.

Model Predictors	Unadjusted	Adjusted			
	Odds ratio	Odds ratio	95% CI		p-Value
			Lower	Upper	
No child's bedroom television	0.503	0.048	0.006	0.393	0.005*
No child's bedroom VCR/DVD player	0.344	0.418	0.073	2.39	0.327
No child's bedroom computer	0.454	1.28	0.338	4.85	0.716
No child's bedroom video game system	1.68	19.78	3.45	113.22	0.001*
No child's cell phone	0.810	0.652	0.193	2.21	0.491
No child's cell hand-held video game player	0.493	0.940	0.384	2.30	0.893
No child's tablet	0.610	0.692	0.239	2.00	0.496
No child's portable music player	0.609	0.474	0.169	1.33	0.155
Parent education (some high school)					
Some college/vocational	2.35	0.088	0.006	1.30	0.077
Completed bachelor's degree	4.51	0.166	0.013	2.13	0.168
Completed graduate/professional degree	2.66	0.113	0.009	0.141	0.090
Child's age	1.18	1.11	0.800	1.55	0.526
Child's gender (male)					
Female	1.08	0.755	0.296	1.92	0.556
Child's race (African American)					
Asian American	1.94	1.84	0.262	13.02	0.534
White	1.44	1.77	0.373	8.41	0.472
Other	0.994	0.425	0.064	2.96	0.395
Child's ethnicity (Hispanic/Latino)					
Non-Hispanic/Latino	1.19	5.44	0.797	37.17	0.084

Within the multivariable ordered logistic regression model, the odds ratios reported for each independent variable are adjusted as they account for the other variables in the model.
* Statistically significant (p-value ≤ 0.05).

Table 4
Ordered logistic regression of the influence of electronics and demographics on children's number of sedentary behavior days with friends.

Model Predictors	Unadjusted	Adjusted			
	Odds ratio	Odds ratio	95% CI		p-Value
			Lower	Upper	
No child's bedroom television	0.304	0.314	0.067	1.47	0.142
No child's bedroom VCR/DVD player	0.326	0.211	0.044	1.00	0.051*
No child's bedroom computer	0.394	0.712	0.210	2.42	0.586
No child's bedroom video game system	0.452	1.72	0.447	6.60	0.431
No child's cell phone	0.486	0.6412	0.124	1.37	0.148
No child's cell hand-held video game player	0.828	2.59	1.02	6.57	0.045*
No child's tablet	0.576	0.726	0.253	2.08	0.551
No child's portable music player	0.466	0.363	0.136	0.970	0.043*
Parent education (some high school)					
Some college/vocational	0.055	0.191	0.019	1.93	0.161
Completed bachelor's degree	0.093	0.274	0.030	2.50	0.251
Completed graduate/professional degree	0.052	0.141	0.015	1.32	0.086
Child's age	1.19	1.01	0.728	1.40	0.960
Child's gender (male)					
Female	0.627	0.291	0.110	0.772	0.013*
Child's race (African American)					
Asian American	0.418	1.18	0.173	8.03	0.867
White	0.690	1.95	0.482	7.85	0.350
Other	0.403	0.370	0.046	2.94	0.347
Child's ethnicity (Hispanic/Latino)					
Non-Hispanic/Latino	0.539	0.616	0.091	4.17	0.619

Within the multivariable ordered logistic regression model, the odds ratios reported for each independent variable are adjusted as they account for the other variables in the model.
* Statistically significant (p-value ≤ 0.05).

electronics may indeed be a more favorable approach to increasing physical activity and thus reducing SB in youth.

Again, while several studies have examined the relationship of home built environment features, such as backyard size or home neighborhood design, with physical activity in children, research comparing built environment features with SB have been limited (Maitland et al., 2013; Laxer and Janssen, 2013; Handy et al., 2008; Veitch et al., 2011; Carver et al., 2008). Similar to another study identifying an inverse association between children's cul-de-sac residence and time using computer/e-games, our study also demonstrated that children living on streets lacking a dead-end or cul-de-sac exhibited a higher odds in SB-Duration using electric media (Veitch et al., 2011). Comparisons of specific home types (e.g. apartment, town home, single-family home) and SB had not been examined previously. However, the BEAP Study did examine this association. Although a statistically significant finding was not identified, a nearly four-fold higher odds of SB-Duration using electric media was found among children who lived in a condominium or apartment compared to the children who lived in a detached single family home. The plausibility of this association is underpinned by the visible and undeniable availability of yard space with many detached single family homes, which not only allows for play areas for children, but also creates a "protected space" perception for parents.

These findings represent a valuable contribution to the childhood SB research field. As mentioned previously, the BEAP Study was composed of an exceptionally diverse population of children and interesting racial/ethnic trends were observed. In our study, the parents of all non-White children (Hispanic/Latino (28.6%); Black/African-American (37.5%); Asian American (57.1%)) reported higher levels of weekly SB compared to the parents of White (36.8%) children. Considering that Black/African-American and Hispanic/Latino children have been found to spend far more time with media than White children, this BEAP Study finding may be a function of a trend found in prior research where time spent watching television was the underlying determinant of SB (Babey et al., 2013). Or, perhaps this finding is due to the higher income level of the BEAP Study sample whereby the affordability of screen time technology is greater (KFF, 2010). Approximately 53% of the sample's children were from households with annual incomes of $100,000 or more. Although, it has been identified that the shared number of household computers increases with increasing income, the relationship between other types of media (e.g. television vs. computer) and income can also illustrate a different relationship (Princeton-Brookings, 2008).

Another valuable contribution of this research was the examination of multiple types of SB behaviors and SB companionship. In previous SB research, a common approach has been to focus on the highly visible and most common SB activities (e.g. TV/screen-based media use) (Nelson et al., 2005; Schmitz et al., 2002). However, this approach fails to capture the diversity and variability of SB patterns in youth that may be dependent on factors unique to the sample or area being studied (Marshall et al., 2002). In our research, car riding was the most frequently reported type of SB, which may have provided some explanation to the high proportions of SB with a parent. This particular BEAP Study finding is very relevant as the DMV has the third highest commute time among U.S. metropolitan cities and more than a quarter (27.4%) of District of Columbia workers travel 60 min or longer to work (Rapino and Fields, 2013). While the trend of commuting by car in the U.S. has significantly increased since the 1960s from approximately 40 million to over 120 million drivers and the commuting time has steadily increased as well, it can only be expected that travel SB has also increased for the youth riding in these cars (McKenzie and Rapino, 2011). If only focusing on screen-based or the most commonly researched SB activities, other types of SB activities, such as car riding, would have been overlooked as a significant, substantial and unique

Table 5
Ordered logistic regression of the influence of parental electronic rules and demographics on children's number of sedentary behavior days alone.

Model Predictors	Unadjusted	Adjusted			
	Odds ratio	Odds ratio	95% CI		p-Value
			Lower	Upper	
No enforcement of television/computer before homework rule	2.47	1.69	0.659	4.34	0.274
No enforcement of maximum hours/day television/computer rule	1.98	1.56	0.730	3.34	0.251
Parent education (some high school)					
Some college/vocational	2.35	0.158	0.015	1.67	0.125
Completed bachelor's degree	4.51	0.227	0.022	2.36	0.215
Completed graduate/professional degree	2.66	0.141	0.141	1.40	0.095
Child's age	1.18	1.21	0.965	1.52	0.097
Child's gender (male)					
Female	1.08	1.00	0.491	2.04	0.999
Child's race (African American)					
Asian American	1.94	1.08	0.254	4.62	0.913
White	1.44	1.10	0.405	3.00	0.847
Other	0.994	0.657	0.153	2.83	0.573
Child's ethnicity (Hispanic/Latino/Latino)					
Non-Hispanic/Latino	1.19	8.56	1.11	66.01	0.039*

Within the multivariable ordered logistic regression model, the odds ratios reported for each independent variable are adjusted as they account for the other variables in the model.
* Statistically significant (p-value ≤ 0.05)

contributor to the overall SB of DMV youth as well as other youth residing in similar car dependent areas.

Whereas this study demonstrated unique strengths, such as the diverse study population and examination of overlooked home built environment measures, types of SB and SB companionship, there were a few limitations to consider. For example, the relatively low response rate yielded a small sample size albeit within the size necessitated by pre-study power calculations that were intended for this analysis and not the construction of a playability index as referenced in the study protocol (Roberts et al., 2015). The BEAP Study population was still fairly representative of the overall DMV population and the participant composition was demographically representative of all potential study participants in all the geographic areas of the study (US.CensusReporter, 2015). Nonetheless, multiplicity or performing multiple analyses on such a small sample size may warrant some degree of pause when interpreting the study findings. Another possible limitation was the collection and use of subjective parent-reported data. Attempts were made to ask about "typical week" SB which may have limited any recall and response bias. Future research incorporating both subjective and objective home built environment and SB data could further increase the understanding of the relationship between built environment, parental rules, demographics and SB among children. Finally, associations were identified with this BEAP Study, but causality could not be established due to the cross-sectional design and explorative nature of this study. Yet, with this research design, the investigation of multiple SB behaviors generating additional research hypotheses became a possibility, which granted the discovery of research findings unique to the DMV as well as other similar metropolitan areas.

Table 6
Ordered logistic regression of the influence of built environment and demographics on children's number of hours using electronic media leisurely.

Model Predictors	Unadjusted	Adjusted			
	Odds ratio	Odds ratio	95% CI		p-Value
			Lower	Upper	
Home structure (detached family home)					
Townhouse	0.544	0.750	0.256	2.20	0.600
Condominium/apartment	1.68	3.96	0.693	22.62	0.122
No home front yard	1.40	1.31	0.459	3.74	0.613
No home back yard	0.897	0.721	0.224	2.32	0.583
No home side yard	0.671	0.696	0.328	1.48	0.344
No home driveway	0.847	0.752	0.291	1.94	0.587
No home street dead-end/cul-de-sac	1.99	2.61	1.31	5.18	0.006*
Child's age (7 years)	1.37	1.43	1.17	1.74	0.001*
Child's gender (male)					
Female	1.36	1.12	0.580	2.09	0.769

Within the multivariable ordered logistic regression model, the odds ratios reported for each independent variable are adjusted as they account for the other variables in the model.
* Statistically significant (p-value ≤ 0.05).

Table 7
Ordered logistic regression of the influence of electronics and demographics on children's number of hours using electronic media leisurely.

Model Predictors	Unadjusted	Adjusted			
	Odds ratio	Odds ratio	95% CI		p-Value
			Lower	Upper	
No child's bedroom television	0.154	0.085	0.018	0.395	0.002*
No child's bedroom VCR/DVD player	0.194	0.956	0.211	4.32	0.954
No child's bedroom computer	0.731	1.05	0.350	3.18	0.925
No child's bedroom video game system	0.451	4.06	0.978	16.83	0.054*
No child's cell phone	0.683	0.546	0.186	1.60	0.270
No child's cell hand-held video game player	0.708	1.09	0.450	2.63	0.852
No child's tablet	0.487	0.626	0.244	1.61	0.331
No child's portable music player	0.644	0.292	0.118	0.723	0.008*
Parent education (some high school)					
Some college/vocational	<0.001	1.00	0.137	7.34	0.997
Completed bachelor's degree	<0.001	0.604	0.095	3.83	0.593
Completed graduate/professional degree	<0.001	0.427	0.071	2.56	0.352
Child's age	0.909	0.795	0.581	1.09	0.151
Child's gender (male)					
Female	0.771	0.638	0.264	1.54	0.319
Child's race (African American)					
Asian American	0.241	1.12	0.181	6.97	0.902
White	0.188	0.397	0.112	1.40	0.152
Other	0.202	0.271	0.046	1.57	0.146
Child's ethnicity (Hispanic/Latino)					
Non-Hispanic/Latino	0.737	0.974	0.141	6.71	0.978

Within the multivariable ordered logistic regression model, the odds ratios reported for each independent variable are adjusted as they account for the other variables in the model.
* Statistically significant (p-value ≤ 0.05).

5. Conclusions

Based on BEAP Study results, home neighborhood built environment, bedroom electronic presence and absence of parental rules are significantly associated with the number of hours and days of children's sedentary behavior.

Competing interests

The authors have declared that no competing interests exist.

Transparency document

The Transparency document associated with this article can be found, in online version.

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