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# Exploring parents' screen-viewing behaviours and sedentary time in association with their attitudes toward their young child's screen-viewing

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**ABSTRACT**

Sedentary time and screen-viewing (SV) are associated with chronic disease risk in adults. Parent and child sedentary time and SV are associated. Parents influence children's SV through parenting styles and role modelling. Understanding whether parents' attitudes toward child SV are associated with their own SV and sedentary time will aid development of family interventions to reduce sedentary behaviours. Cross-sectional data with 809 parents from Bristol, UK were collected in 2012-2013 and analysed in 2016. Parental total sedentary time was derived from accelerometer data. Parents self-reported daily television viewing, use of computers, games consoles, and smartphone/tablets (none, 1-59 mins, 1-2 hrs, >2 hrs) and attitudes toward child SV. Adjusted linear and logistic regression models were used to examine associations, separately for weekdays and weekend days. Having negative attitudes toward child SV was associated with lower weekend sedentary time (Coeff: -6.41 [95% CI: -12.37 to -0.45] mins/day). Limiting behaviours and having negative attitudes toward child SV were associated with lower weekday television viewing (OR: 0.72 [0.57-0.90] and 0.57 [0.47-0.70] respectively), weekend television viewing (0.75 [0.59-0.95] and 0.61 [0.50-0.75]), and weekend computer use (0.73 [0.58-0.92] and 0.80 [0.66-0.97]). Negative attitudes were also associated with lower smartphone use on weekdays (0.70 [0.57-0.85]) and weekends (0.70 [0.58-0.86]). Parent self-efficacy for limiting child SV and setting SV rules were not associated with sedentary time or SV. Reporting negative attitudes toward child SV was associated with lower accelerometer-assessed weekend total sedentary time and self-reported SV behaviours, while limiting child SV was also associated with lower self-reported SV.

## INTRODUCTION[1]

Sedentary behaviours are defined as any waking behaviours characterised by an energy expenditure of ≤1.5 METS, where sitting or lying is the dominant mode of posture (e.g., screen-viewing (SV), motorised transport, office work).[1,2] National data from England in 2012 suggest that adults spend approximately five hours daily being sedentary on both weekdays and weekend days.[3] Moreover, half of English adults in 2012 spent two or more hours watching television (TV) or other screens daily, and a third watched TV for over three hours,[4] with TV viewing the most prevalent leisure-time activity for UK adults in 2005.[5]

Sedentary time and SV (TV, computers, tablets, smartphones, video games) have been found to be associated with increased risk of obesity,[6-9] cardiovascular disease,[10-15] diabetes,[8] cancer,[16-17] all-cause mortality,[10,12-14] mental disorders,[4] and poor self-rated health[4] in adults. A study of Finnish adults found that each additional self-reported daily TV hour was associated with a 1.81±0.44cm larger waist circumference in women and 2.0±0.44cm in men (reference category: <1 hour; $p<0.0001$).[6] However, both cross-sectional and prospective studies in children and adults show little association between objectively-assessed time spent sedentary with adiposity or adverse cardio-metabolic health.[18-21] This lack of association suggests that reporting bias may explain some of the associations with adverse outcomes seen in studies that only use self-report. An alternative explanation may be that SV is more strongly associated with negative health, for example due to an increase in snack consumption during SV,[22] with measures of SV currently relying on self-reported data because objective SV measures for use in population studies do not exist. While some sedentary activities are associated with positive educational, mental and social

[1] Abbreviations: SV= screen-viewing, TV= television, IMD= indices of multiple deprivation

benefits (e.g., reading, connecting with loved ones, imaginative play),[23] the links with adverse health outcomes, at least from self-reported data, cannot be ignored. As such, there is a need to develop effective interventions to reduce SV and sedentary time for the whole family. While reductions in sedentary time at work are desirable, it is more likely that major reductions in sedentary behaviour will come from addressing leisure-time behaviours, such as SV, and shifts toward more active travel.[1]

To develop effective interventions to reduce SV and sedentary time among families, we must first understand how parent and child sedentary behaviours are associated, and how parents can influence their child's behaviours. Parent TV-viewing time has been found to be strongly associated with child TV-viewing across the week.[24,25] Parents who report low restriction of sedentary activities, low self-efficacy, and permissive parenting styles have children with greater levels of SV on average.[26,27] Findings from a previous study using the B-Proact1v dataset, found parental self-efficacy to limit child SV was associated with child weekday TV-viewing and mediated associations between parental control and child SV.[28] Beyond these observational studies, a RCT of a school-based intervention aimed at improving 9-10 year olds' physical activity and diet, reduced child-reported SV (though not their accelerometer-assessed sedentary behaviour or any of the primary outcomes) and this effect appeared to be mediated by an effect on child-reported maternal limitation of SV.[29,30]

These studies demonstrate that associations exist between parent and child SV time, and that parenting styles and preference for limiting child SV are associated with child SV. However, it is yet unknown whether parents' attitudes toward their child's SV are associated with their own SV

and sedentary time. For instance, if parents who report more negative attitudes toward their child's SV also report less SV and spend less time being sedentary themselves, there is potential to develop interventions to encourage parents to have negative attitudes toward their child's SV with the aim of reducing both parent and child SV and sedentary time. Therefore, it is important to understand which aspects of parents' attitudes toward child SV (e.g., self-efficacy for limiting SV, preference for limiting SV, negative attitudes toward SV, setting rules about SV) are associated to parents' own SV and sedentary behaviour.

The aim of this study was to examine whether parents' attitudes toward their young child's SV behaviour was associated with their (the parents) objectively-assessed total sedentary time and self-reported SV behaviours. Specifically, it is hypothesised that parents with a more restrictive attitude toward their young child's SV (i.e., higher preference and efficacy for limiting child SV, more rules and negative attitudes towards SV) would engage in less accelerometer-assessed sedentary time and self-reported SV themselves.

## METHODS

### *Study sample*

Data are from the cross-sectional B-Proact1v study, which aimed to identify factors associated with young children's (5-6 years) and parents' physical activity and SV. Details of the study design have been reported previously.[31] Between February 2012 and May 2013, data were collected from 57 primary schools in the greater Bristol area. In total, 1267 child-parent dyads wore and returned an accelerometer and were included in the final dataset. For the current study, we were interested in parent objectively-assessed sedentary time and self-reported SV

behaviours, and therefore only parents that both wore and returned an accelerometer and completed all the SV measures were included in the analyses (n=809). Figure 1 shows the study flow of participants. Ethical approval was granted by the School for Policy Studies research ethics committee at the University of Bristol, and written informed consent was obtained for all participants.[32]

**Figure 1.** ***Study flow of participants***

### *Measures*

#### *Sedentary time*

Participants were asked to wear an ActiGraph GT3X waist-worn accelerometer for five consecutive days, including two weekend days, during all waking hours. Data were recorded in 10-second epochs, and uniaxial data were processed using Kinesoft (v3.3.75; Kinesoft, Saskatchewan, Canada). Accelerometer data were considered valid if participants provided at least two weekdays and one weekend day of at least 500 minutes of data. Three days of monitoring have previously been demonstrated to produce reliable estimates of sedentary time in adults.[33] Accelerometer "non-wear" time was defined as periods of ≥60 minutes of consecutive zero values, with an allowance of up to 2 minutes of interruptions, and were removed from analyses.[34] Sedentary time was determined from accelerometer data using a threshold of <100 counts per minute.[35] Total sedentary time, including both work and leisure time, was analysed separately for weekdays and weekend days. A previous study by Clemes et al. found that objectively-assessed sedentary time was higher on workdays than non-workdays.[36]

***Self-report measures***

Parents completed a questionnaire about family characteristics, personal demographics, health aspirations, home media environment, SV time, and their attitudes towards their child's SV behaviour. The Index of Multiple Deprivation (IMD) scores, based upon the English Indices of Deprivation (http://data.gov.uk/dataset/index-of-multiple-deprivation), were assigned to each family based on their reported home postcode. Home media environment was assessed by parents indicating how many of each of 10 media devices they have within the home ('TV', 'DVD player', 'digital TV recorder', 'music player', 'desktop computer', 'laptop computer', 'tablet computer', 'games console', 'smartphone', 'handheld console'). The number of devices were summed to create a single score. Health aspirations were assessed on a five-item scale ('to be physically active'; 'to feel good about my level of physical fitness'; 'to keep myself healthy and well'; 'to be relatively free from sickness'; 'to have a physically healthy lifestyle'), where parents indicated the importance of each factor using a seven-point Likert scale, from 1 *'not at all'*, through 4 *'moderately'*, to 7 *'very'*.[37,38] Responses were combined and the mean score used in analyses. Parent SV time was assessed via separate questions for the following SV devices: TVs, computers/laptops, games consoles, and smartphones/tablets (except for the time spent talking or texting). For each device, parents reported the time they spent using it outside of work for; a) a normal weekday, and b) a normal weekend day, with response options: *'none'*; *'1-30 minutes'*; *'31 minutes – 1 hour'*; *'1-2 hours'*; *'2-3 hours'*; *'3-4 hours'*; and *'4 hours or more'*. This method of self-reporting SV time has previously been used to assess SV in parents and children.[26,39,40] A review found that self-reported measures of sedentary time generally showed moderate-to-high correlations for test-retest reliability and that validity correlations were higher in domain-specific measures (e.g., TV viewing, computer use) than for overall sedentary

measures across an entire day.[41] Weekday and weekend SV were assessed independently due to previous evidence that suggests parents report greater SV on weekends than weekdays.[42]

Parents' self-efficacy to limit their child's SV was assessed via three items (how much can you do to; a) 'control the time your child spends screen-viewing'; b) 'help your children have alternatives to screen-viewing'; c) 'reduce the time your child spends screen-viewing'), using a five-point Likert scale ranging from 1 *'nothing'* to 5 *'a great deal'*, adapted from Bandura's Self Efficacy Scale.[43] Parents' preference for limiting their child's SV time was measured via three items (I limit how long my child; a) 'plays video games'; b) 'can watch TV and DVDs each day'; c) 'can use the computer for things other than homework'), using a four-point Likert scale ranging from 1 *'strongly disagree'* to 4 *'strongly agree'*.[44] Parents' attitudes towards their child's SV were measured by asking their perspective on two statements 'children spending several hours per day watching television or playing video games' and 'children spending several hours per day during leisure time using a computer or surfing the Internet' by using four 5-point Likert scales (1-5) with anchor points: *'beneficial=>harmful,' 'healthy=>unhealthy,' 'useful=>of no use,'* and *'of no concern=>of concern'*.[45] Parental rules governing children's SV activities were determined by asking: 'limiting my child's amount of TV viewing, games console or computer use time is' (response options: 1 *'necessary'* to 5 *'unnecessary'*), and 'I let my child decide how much TV he/she watches' (response options: 1 *'never'* to 5 *'always'*).[45] For each of the four SV exposure variables, responses to items were combined and mean scores used for analyses.

***Statistical analysis***

Distributions of exposures, outcomes and co-variables were compared between participants included in this study and those who were excluded because of key missing data (e.g., not wearing or not having sufficient valid days of accelerometer data) using means, proportions and Chi Square statistics. To explore associations between objectively-assessed total sedentary time and index of multiple deprivation, parents' health aspirations, and home media environment Spearman's correlation coefficients were used. For the associations between SV behaviours and demographic variables means and one-way ANOVA statistics were used. The vast majority of parents did not use a games console on weekdays or weekend days (>90% and 83%, respectively), therefore this behaviour was not included in further analyses. The four exposure variables (self-efficacy for limiting child SV, preference for limiting child SV, negative attitudes towards child SV, and rules about child SV) were treated as continuous variables in all analyses. The responses to the 'rules about child SV' variable were flipped so that higher scores represented more restrictive parenting practices in line with the other exposure variables.

Two of the outcome variables (accelerometer-assessed total sedentary time on weekdays and weekend days) were continuous, as such multivariable linear regression models were used to examine the associations of the four exposure variables with these two sedentary time outcomes. Participant responses to the other six outcome variables (TV viewing, computer use, and smartphone/tablet use on weekdays and weekend days) were collapsed into four time categories: 'none', '1-59 minutes', '1-2 hours' and '2 hours or more'. As these variables were ordinal, multivariable ordered logistic regression models were used to examine the associations of the four exposure variables with each outcome variable. Ordered logistic regression assumes that the coefficients that describe the relationship between, for example, the lowest versus all higher

| | Included (N=809) | Excluded |
|---|---|---|

categories of the response variable are the same as those that describe the relationship between the next lowest category and all higher categories, known as the proportional odds assumption. To test for proportional odds, likelihood-ratio tests were conducted, and the margins command used. Any models that violated this assumption were analysed separately using generalised ordered logistic regression analyses.[46]

To take account of the parents being recruited via schools, robust standard errors were used. Adjusted models were adjusted for gender, IMD score, home media environment and health aspirations, as these have previously been associated with sedentary behaviours in adults.[47-49] Adjusted linear regression models with total sedentary time were also adjusted for accelerometer wear time. All analyses were performed in Stata version 14.0.[50]

## RESULTS

Descriptive statistics are shown in Table 1 for participants included and excluded from the dataset. Parents excluded due to missing data were more likely to be deprived, have lower health aspirations, spend less time sedentary, use computers less but smartphones/tablets more, and have lower self-efficacy for limiting child SV. Mean accelerometer wear-time for parents was 801.9 (SD=101.0) minutes on weekdays and 745.2 (111.6) minutes on weekend days.

| | Mean (SD) or % | N | Mean (SD) or % | *p* |
|---|---|---|---|---|
| Parent gender (% mothers) | 74.4% | 427 | 79.4% | 0.05 |
| Index of Multiple Deprivation[a] | 13.2 (11.1) | 359 | 18.9 (15.3) | <0.001 |
| Health aspirations | 5.9 (1.0) | 243 | 5.6 (1.2) | 0.002 |
| Number of media devices | 10.8 (4.6) | 231 | 10.9 (4.5) | 0.85 |
| Accelerometer-assessed total weekday sedentary time (mins/day) | 542.6 (91.7) | 337 | 490.0 (101.8) | <0.001 |
| Accelerometer-assessed total weekend sedentary time (mins/day) | 497.6 (94.1) | 207 | 453.4 (101.6) | <0.001 |
| Weekday television viewing | | 265 | | 0.09 |
| *None* | 3.5% | | 2.3% | |
| *1-59 minutes* | 27.7% | | 22.6% | |
| *1-2 hours* | 41.0% | | 40.0% | |
| *2+ hours* | 27.8% | | 35.1% | |
| Weekend television viewing | | 262 | | 0.05 |
| *None* | 2.2% | | 3.1% | |
| *1-59 minutes* | 13.6% | | 9.2% | |
| *1-2 hours* | 34.0% | | 29.0% | |
| *2+ hours* | 50.2% | | 58.8% | |
| Weekday leisure computer use | | 263 | | 0.006 |
| *None* | 11.4% | | 19.8% | |
| *1-59 minutes* | 48.2% | | 44.9% | |
| *1-2 hours* | 16.8% | | 13.3% | |
| *2+ hours* | 23.6% | | 22.1% | |
| Weekend leisure computer use | | 256 | | 0.001 |
| *None* | 17.3% | | 27.3% | |
| *1-59 minutes* | 51.9% | | 42.2% | |
| *1-2 hours* | 19.8% | | 16.0% | |
| *2+ hours* | 11.0% | | 14.5% | |
| Weekday smartphone use | | 262 | | <0.001 |
| *None* | 36.6% | | 34.4% | |
| *1-59 minutes* | 45.5% | | 41.6% | |
| *1-2 hours* | 13.5% | | 10.7% | |
| *2+ hours* | 4.5% | | 13.4% | |
| Weekend smartphone use | | 264 | | 0.001 |
| *None* | 36.8% | | 33.0% | |
| *1-59 minutes* | 42.3% | | 41.7% | |
| *1-2 hours* | 13.8% | | 10.2% | |
| *2+ hours* | 7.1% | | 15.2% | |
| Self-efficacy for limiting SV | 4.6 (0.5) | 258 | 4.5 (0.7) | 0.001 |
| Preference for limiting SV | 3.4 (0.6) | 251 | 3.3 (0.7) | 0.06 |
| Negative attitudes towards SV | 3.8 (0.7) | 191 | 3.7 (0.7) | 0.15 |
| Rules about SV | 4.1 (0.8) | 257 | 4.1 (0.9) | 0.45 |

**Table 1.** ***Descriptive characteristics of the study sample (N=809)***

[a] Index of multiple deprivation: a higher value indicates greater deprivation.

Table 2 displays how the outcome variables vary across demographic variables. For instance, compared to mothers, fathers spent more time being sedentary, reported more computer use on weekdays, and used smartphones/tablets for longer across the week. Participants who spent more time watching TV on weekdays or using computers across the week had lower health aspirations, while participants who spent more time watching TV or using smartphones/tablets across the week had more home media devices on average.

| | Index of Multiple Deprivation[b] | | Health Aspirations[b] | | Home media environment[b] | |
|---|---|---|---|---|---|---|
| | **Mean (SD)** | **r or F (*p*)** | **Mean (SD)** | **r or F (*p*)** | **Mean (SD)** | **r or F (*p*)** |
| **Accelerometer-assessed total weekday sedentary time (mins/day)** | | -0.07 (0.06) | | -0.01 (0.78) | | -0.002 (0.94) |
| **Accelerometer-assessed total weekend sedentary time (mins/day)** | | -0.01 (0.74) | | -0.01 (0.74) | | -0.02 (0.57) |
| **Weekday television viewing** | | 2.41 (0.07) | | 4.34 (0.005) | | 12.63 (<0.001) |
| *None* | 9.9 (6.4) | | 6.1 (0.9) | | 8.1 (4.7) | |
| *1-59 minutes* | 12.0 (9.5) | | 6.0 (0.9) | | 9.7 (4.3) | |
| *1-2 hours* | 13.6 (12.0) | | 5.9 (0.9) | | 11.1 (4.5) | |
| *2+ hours* | 14.2 (11.6) | | 5.7 (1.1) | | 11.8 (4.7) | |
| **Weekend television viewing** | | 0.92 (0.43) | | 1.83 (0.14) | | 11.55 (<0.001) |
| *None* | 14.7 (10.3) | | 5.7 (1.1) | | 7.4 (4.3) | |
| *1-59 minutes* | 12.7 (10.0) | | 6.0 (0.9) | | 9.5 (4.1) | |
| *1-2 hours* | 12.5 (11.0) | | 5.9 (0.9) | | 10.4 (4.6) | |
| *2+ hours* | 13.8 (11.5) | | 5.8 (1.0) | | 11.57 (4.5) | |
| **Weekday leisure computer use** | | 0.68 (0.56) | | 3.44 (0.02) | | 0.49 (0.69) |
| *None* | 14.4 (12.3) | | 6.1 (0.8) | | 10.8 (4.6) | |
| *1-59 minutes* | 13.1 (11.1) | | 5.9 (1.0) | | 10.6 (4.5) | |
| *1-2 hours* | 13.7 (10.7) | | 5.7 (1.0) | | 11.1 (4.6) | |
| *2+ hours* | 12.6 (10.9) | | 5.8 (0.9) | | 10.9 (4.7) | |
| **Weekend leisure computer use** | | 0.68 (0.57) | | 4.31 (0.005) | | 0.97 (0.41) |
| *None* | 13.4 (10.9) | | 6.1 (0.8) | | 11.0 (4.5) | |
| *1-59 minutes* | 12.9 (11.3) | | 5.8 (1.0) | | 10.8 (4.4) | |
| *1-2 hours* | 13.1 (10.0) | | 5.8 (1.0) | | 10.4 (4.4) | |
| *2+ hours* | 14.7 (12.5) | | 5.7 (0.9) | | 11.4 (5.6) | |
| **Weekday smartphone use** | | 0.58 (0.63) | | 1.79 (0.15) | | 19.41 (<0.001) |
| *None* | 13.3 (10.9) | | 5.9 (1.0) | | 9.3 (4.3) | |
| *1-59 minutes* | 13.2 (11.9) | | 5.9 (1.0) | | 11.5 (4.5) | |
| *1-2 hours* | 12.3 (9.1) | | 5.7 (0.9) | | 12.2 (4.4) | |
| *2+ hours* | 15.1 (10.5) | | 5.7 (1.0) | | 12.2 (4.5) | |
| **Weekend smartphone use** | | 0.17 (0.91) | | 1.38 (0.25) | | 22.28 (<0.001) |
| *None* | 13.4 (11.1) | | 5.9 (1.0) | | 9.2 (4.3) | |
| *1-59 minutes* | 12.9 (11.7) | | 5.9 (1.0) | | 11.4 (4.4) | |
| *1-2 hours* | 13.6 (10.6) | | 5.7 (1.0) | | 12.2 (4.7) | |
| *2+ hours* | 12.9 (9.2) | | 5.7 (0.9) | | 12.6 (4.1) | |

**Table 2.** ***Intercorrelations, means, proportions, and ANOVA statistics for the study outcome variables and adjustment variables***

[a] Mean sedentary minutes and T-test statistics presented for continuous outcome variables, proportions in each outcome category and $X^2$ statistics presented for categorical outcome variables.

[b] Intercorrelations presented for continuous outcome variables, and proportions in each outcome category and F-test statistics presented for categorical outcome variables.

Table 3 presents the associations between parents' attitudes toward their child's SV and their own accelerometer-assessed sedentary time. Having negative attitudes toward child SV was associated with a reduction in parents' weekend accelerometer-assessed total sedentary time, but there were no clear associations between the other three exposure variables and weekend sedentary time, and nor were there associations between any of the four exposures and weekday accelerometer-assessed total sedentary time.

| | **Unadjusted** | | **Fully adjusted[a]** | |
|---|---|---|---|---|
| **Accelerometer-assessed total weekday sedentary time (mins/day)** | ***Difference in mean sedentary time per 1 unit of each exposure [95% CI]*** | ***p*** | ***Difference in mean sedentary time per 1 unit of each exposure [95% CI]*** | ***p*** |
| Self-efficacy for limiting SV | 11.80 [-0.01 to 23.61] | 0.05 | 6.64 [-1.38 to 14.66] | 0.10 |
| Preference for limiting SV | 3.31 [-7.39 to 14.01] | 0.54 | -0.71 [-8.01 to 6.60] | 0.85 |
| Negative attitudes towards SV | -5.08 [-14.32 to 4.15] | 0.28 | -2.48 [-8.69 to 3.72] | 0.43 |
| Rules about SV | 1.16 [-6.81 to 9.12] | 0.78 | -0.33 [-5.70 to 5.04] | 0.90 |
| **Accelerometer-assessed total weekend sedentary time (mins/day)** | | | | |
| Self-efficacy for limiting SV | 5.68 [-6.47 to 17.84] | 0.36 | 3.86 [-3.86 to 11.58] | 0.33 |
| Preference for limiting SV | 5.48 [-5.48 to 16.45] | 0.33 | -0.41 [-7.45 to 6.62] | 0.91 |
| Negative attitudes towards SV | -8.50 [-17.95 to 0.94] | 0.08 | -6.41 [-12.37 to -0.45] | 0.04 |
| Rules about SV | -1.43 [-9.59 to 6.74] | 0.73 | -1.48 [-6.63 to 3.68] | 0.57 |

**Table 3.** ***Linear regression analyses showing associations between parents' attitudes toward child screen-viewing and their sedentary time***

[a] Adjusted for parent gender, index of multiple deprivation score, health aspirations, home media environment, and accelerometer wear-time on weekdays and weekend days respectively.

[b] The coefficients represent a per unit increase in the scores for each of the SV exposure variables. Categories for each of the SV variables were: None, 0-59 minutes, 1-2 hours, >2 hours.

All analyses take account of clustering at the school level by using robust standard errors.

The associations between parents' attitudes toward their child's SV and their own SV behaviours are presented in Table 4. Parental self-report of having a preference for limiting child SV and having negative attitudes towards their child's SV were both associated with lower levels of reported weekday and weekend TV viewing, and lower levels of weekend computer use; negative attitudes towards child SV were also associated with lower levels of reported weekday

and weekend smartphone/tablet use. Parental report of self-efficacy for limiting their child's SV and setting rules for child SV were not associated with parents' report of their own SV.

| | Unadjusted | | Fully adjusted[a] | |
|---|---|---|---|---|
| **Weekday television viewing** | ***OR for an increase in the level of the SV outcome variables per 1 unit of each exposure [95% CI]*** | ***p*** | ***OR for an increase in the level of the SV outcome variables per 1 unit of each exposure [95% CI]]*** | ***p*** |
| Self-efficacy for limiting SV | 0.91 [0.71 to 1.15] | 0.43 | 1.03 [0.81 to 1.32] | 0.80 |
| Preference for limiting SV | 0.63 [0.50 to 0.79] | <0.001 | 0.72 [0.57 to 0.90] | 0.005 |
| Negative attitudes towards SV | 0.54 [0.45 to 0.66] | <0.001 | 0.57 [0.47 to 0.70] | <0.001 |
| Rules about SV | 0.85 [0.72 to 1.01] | 0.06 | 0.93 [0.78 to 1.10] | 0.39 |
| **Weekend television viewing** | | | | |
| Self-efficacy for limiting SV | 0.95 [0.74 to 1.22] | 0.68 | 1.03 [0.80 to 1.34] | 0.80 |
| Preference for limiting SV | 0.67 [0.53 to 0.84] | 0.001 | 0.75 [0.59 to 0.95] | 0.02 |
| Negative attitudes towards SV | 0.58 [0.48 to 0.71] | <0.001 | 0.61 [0.50 to 0.75] | <0.001 |
| Rules about SV | 0.84 [0.71 to 0.99] | 0.05 | 0.91 [0.76 to 1.09] | 0.31 |
| **Weekday leisure computer use** | | | | |
| Self-efficacy for limiting SV | 0.95 [0.74 to 1.21] | 0.67 | 1.02 [0.79 to 1.31] | 0.89 |
| Preference for limiting SV | 0.84 [0.68 to 1.05] | 0.12 | 0.90 [0.72 to 1.13] | 0.37 |
| Negative attitudes towards SV | 0.83 [0.69 to 1.00] | 0.05 | 0.87 [0.72 to 1.05] | 0.15 |
| Rules about SV | 0.95 [0.81 to 1.12] | 0.56 | 0.98 [0.83 to 1.16] | 0.84 |
| **Weekend leisure computer use** | | | | |
| Self-efficacy for limiting SV | 0.78 [0.61 to 1.00] | 0.05 | 0.87 [0.67 to 1.11] | 0.26 |
| Preference for limiting SV | 0.68 [0.55 to 0.86] | 0.001 | 0.73 [0.58 to 0.92] | 0.009 |
| Negative attitudes towards SV | 0.75 [0.62 to 0.91] | 0.003 | 0.80 [0.66 to 0.97] | 0.02 |
| Rules about SV | 0.87 [0.73 to 1.02] | 0.09 | 0.88 [0.75 to 1.05] | 0.16 |
| **Weekday smartphone/tablet use** | | | | |
| Self-efficacy for limiting SV | 1.05 [0.81 to 1.34] | 0.73 | 1.14 [0.88 to 1.48] | 0.33 |
| Preference for limiting SV | 0.77 [0.62 to 0.96] | 0.02 | 0.89 [0.70 to 1.12] | 0.31 |
| Negative attitudes towards SV | 0.67 [0.55 to 0.81] | <0.001 | 0.70 [0.57 to 0.85] | <0.001 |
| Rules about SV | 0.98 [0.83 to 1.15] | 0.77 | 1.09 [0.92 to 1.29] | 0.31 |
| **Weekend smartphone/tablet use** | | | | |
| Self-efficacy for limiting SV | 1.03 [0.80 to 1.32] | 0.82 | 1.12 [0.86 to 1.45] | 0.40 |
| Preference for limiting SV | 0.80 [0.64 to 0.99] | 0.05 | 0.93 [0.74 to 1.17] | 0.53 |
| Negative attitudes towards SV | 0.67 [0.55 to 0.81] | <0.001 | 0.70 [0.58 to 0.86] | 0.001 |
| Rules about SV | 0.97 [0.82 to 1.14] | 0.69 | 1.09 [0.92 to 1.29] | 0.32 |

**Table 4.** ***Ordered logistic regression showing associations between parents' attitudes toward child screen-viewing and their SV behaviour***

[a] Adjusted for parent gender, index of multiple deprivation score, health aspirations and home media environment.

[b] The odds ratios represent the multiplicative change in the odds of belonging to a higher category of SV associated with a unit increase in each of the attitudes to SV variables. Categories for each of the SV variables were: None, 0-59 minutes, 1-2 hours, >2 hours.

All analyses take account of clustering at the school level by using robust standard errors.

***Testing of proportional odds assumption***

Five models violated the proportional odds assumption (weekend television viewing with negative attitudes towards SV; weekday smartphone use with preference for limiting SV; weekday smartphone use with negative attitudes toward SV; weekend smartphone use with self-efficacy for limiting SV; weekend smartphone use with negative attitudes toward SV), and thus the generalised ordered logistic regression results are presented in Table 5. For the majority of category-specific odds ratios, the associations were in the same direction as the main analysis. For parental report of negative attitudes toward child SV no associations were present with reported weekend television viewing for more than one hour compared with less than one hour, and with using smartphones for more than one minute during the week and weekend compared with no use. There was an inverse association between reported preference for limiting child SV and using a smartphone/tablet for more than one hour on a weekday, compared to less than one hour. Similarly, self-efficacy for limiting SV was inversely associated with using a smartphone/tablet for more than two hours on a weekend day, compared to using a smartphone for less than two hours.

| | *Unadjusted* | | *Fully adjusted*[a] | |
|---|---|---|---|---|
| | ***OR for each level of the SV outcome variables per 1 unit the exposure variable [95% CI]*** | ***p*** | ***OR for each level of the SV outcome variables per 1 unit the exposure variable [95% CI]*** | ***p*** |
| **Weekend television viewing & negative attitudes towards SV** | | | | |
| ≥1 minute vs. None | 0.26 [0.11 to 0.58] | 0.001 | 0.27 [0.12 to 0.61] | 0.002 |
| ≥1 hour vs. <1 hour | 0.75 [0.56 to 0.99] | 0.04 | 0.79 [0.59 to 1.05] | 0.11 |
| >2 hours vs. ≤2 hours | 0.54 [0.44 to 0.67] | <0.001 | 0.57 [0.46 to 0.71] | <0.001 |
| **Weekday smartphone use & preference for limiting SV**[b] | | | | |
| ≥1 minute vs. None | | | 1.01 [0.78 to 1.30] | 0.95 |
| ≥1 hour vs. <1 hour | | | 0.71 [0.52 to 0.97] | 0.03 |
| >2 hours vs. ≤2 hours | | | 0.84 [0.47 to 1.51] | 0.56 |
| **Weekday smartphone use & negative attitudes towards SV** | | | | |
| ≥1 minute vs. None | 0.78 [0.63 to 0.96] | 0.02 | 0.83 [0.67 to 1.04] | 0.10 |
| ≥1 hour vs. <1 hour | 0.56 [0.43 to 0.72] | <0.001 | 0.58 [0.44 to 0.76] | <0.001 |
| >2 hours vs. ≤2 hours | 0.32 [0.20 to 0.52] | <0.001 | 0.33 [0.20 to 0.54] | <0.001 |
| **Weekend smartphone use & self-efficacy for limiting SV** | | | | |
| ≥1 minute vs. None | 1.14 [0.87 to 1.48] | 0.34 | 1.25 [0.94 to 1.66] | 0.13 |
| ≥1 hour vs. <1 hour | 0.92 [0.67 to 1.27] | 0.62 | 1.01 [0.72 to 1.43] | 0.94 |
| >2 hours vs. ≤2 hours | 0.62 [0.43 to 0.89] | 0.01 | 0.67 [0.45 to 0.99] | 0.04 |
| **Weekend smartphone use & negative attitudes towards SV** | | | | |
| ≥1 minute vs. None | 0.82 [0.66 to 1.01] | 0.06 | 0.88 [0.71 to 1.10] | 0.27 |
| ≥1 hour vs. <1 hour | 0.55 [0.42 to 0.70] | <0.001 | 0.57 [0.44 to 0.74] | <0.001 |
| >2 hours vs. ≤2 hours | 0.35 [0.24 to 0.51] | <0.001 | 0.36 [0.25 to 0.53] | <0.001 |

**Table 5.** ***Generalised ordered logistic regression analyses for the variables that violated the proportional odds assumption.***

[a] Adjusted for parent gender, index of multiple deprivation score, health aspirations, and home media environment.

[b] Unadjusted analyses for weekday smartphone use and preference for limiting SV did not violate the proportional odds assumption.

## DISCUSSION

Parents who reported more negative attitudes toward their child's SV spent less time being sedentary on weekend days, but not on weekdays. One potential explanation for the null finding on weekdays is that parents with high sedentary time may be engaged in sedentary work, which could be indicative of higher levels of education, and thus confound the association between their attitudes toward child SV and their own weekday sedentary time. As sedentary time was measured via accelerometers, and parents were not asked to report their work hours or occupation, it is not possible to know what activities parents engaged in while being sedentary.

Parents, who had greater preferences for limiting child SV and more negative attitudes toward it, reportedly watched less TV throughout the week and used computers less on weekends. Additionally, parents with more negative attitudes toward child SV used their smartphone/tablet for less time across the week. The null finding for weekday computer use may be explained by the growing popularity of portable SV devices (tablets/smartphones) and thus computers may be more commonly used for more necessary tasks that may be less influenced by attitude beliefs.[51]

This is the first study to compare parents' attitudes towards child SV with parents' own sedentary time and SV behaviour, and so it was important to understand whether parents were adopting a 'Do as I say, not as I do' approach to parenting, or whether they also practice what they preach. Previous studies found that parents who place greater limitations on child SV also reported lower levels of child SV,[26] therefore, it seems logical that similar associations would exist with parent SV behaviour, given that parent and child SV are associated.[24,25] It may be that permissive parents do not limit their child's SV behaviour because they are unwilling to cut down their own SV or sedentary time, or because they are not concerned about SV, while more authoritative parents may engage in less SV and sedentary time themselves in order to role-model 'healthy behaviours' for their child, or because they have negative attitudes toward SV in regards to their own health, and thus have similar attitudes toward SV for their child.

This study found no association between parents' self-efficacy to limit their child's SV or setting SV rules with either parents' own sedentary time or self-reported SV. It is plausible that some

parents felt confident limiting child SV, while not even considering their own SV or sedentary time to be an issue (cognitive dissonance).[52] It is recommended that future studies explore this association further to examine whether parents' confidence for limiting child SV is associated with their concern and/or awareness of their own behaviours.

Five of the models assessing parents' attitudes with self-reported SV violated the proportional odds assumption, therefore, generalised ordered logistic regression analyses were conducted to provide a more comprehensive model of how associations differed across levels of SV.[53] For instance, parents' preference for limiting child SV was associated with lower weekday smartphone use for parents who used their smartphone for at least an hour per day (compared to less than an hour), a finding that was not present in the ordered logistic models. Similarly, parents' self-efficacy for limiting child SV was associated with lower reported weekend smartphone use for parents who used their smartphone for more than two hours per day (compared to less than two hours). These findings demonstrate that associations between these self-reported variables are complicated, and that more advanced models, such as generalised ordered logistic regression models, are necessary to tease out the differences across outcome levels.

The Family Ecological Model illustrates the processes by which parents influence children's diet, activity, and SV behaviours,[54] however other studies have shown that reciprocal reinforcing relationships exist among family members, and children can influence the health behaviours of their parents.[55-58] As such, the family can be a mutually reinforcing environment in which healthy behaviours can be introduced, accepted, and maintained.[59,60] Therefore, more family

models are needed that account for the complexities of the reciprocal relationship between parent and child health behaviours.

The findings in this study suggest that interventions to educate parents on the ill-effects of SV in order to instil negative attitudes towards child SV and limits for such behaviours could be a potential strategy to reduce both child and parent SV and sedentary time. Indeed, interventions to reduce sedentary behaviours in young people are more likely to be effective if they involve a family component;[61] therefore more family-based interventions to reduce SV and sedentary time are needed. One example of an intervention that successfully reduced sedentary behaviours was PACE+; a primary care-based goal-setting and counselling intervention for adolescents in the United States.[62] Parents were educated to encourage behaviour change attempts through active support, positive role modelling and praise. Self-reported sedentary time decreased from baseline to one-year follow-up to a greater extent in intervention participants versus control (-77.7 min/day; 95% CI: -105.8 to -49.5).[62] Therefore, a key target for future research would be to conduct similar interventions encouraging parents to have more negative attitudes toward their child's SV, to limit such behaviours, and be positive SV role models for their child.

***Strengths and limitations***

The strengths of this study are the availability of data from a reasonably-sized sample of parents, including both mothers and fathers, and that we collected data on both self-reported SV and objectively-assessed sedentary time across both weekdays and weekend days. This, in combination with questionnaire data on family demographics, parenting styles and attitudes

towards child SV allows the dataset to make a novel contribution to the literature. Limitations of the study include its cross-sectional nature so causality could not be examined. ActiGraph accelerometers are waist-worn, thus are unable to distinguish between sitting and standing still, therefore devices that utilise a thigh placement would be more accurate at recording key markers of sedentary behaviour (e.g., sitting or lying posture). 458 participants were excluded from the study due to missing data (N=458), which may have resulted in sampling bias, because these participants differed from included participants in terms of their time spent sedentary, use of screen devices and self-efficacy. The SV measures were self-reported, because there are no objective measures of SV available for use in large cohort studies, however this does means that reporting bias may explain some of the study findings, where parents who reported more negative attitudes towards their child's SV may have also felt obliged to report less SV behaviour for themselves (irrespective of their actual behaviour).[63] Additionally, the ordinal nature of the SV behaviour questionnaire enabled participants to report behaviours easily, however this also necessitated the use of more complex statistical analyses with less interpretable coefficients than a standard linear or logistic regression model. It also meant that it was not possible to calculate a combined SV score.

## CONCLUSIONS

Parental report of placing limitations on child SV and having negative attitudes towards it were associated with lower levels of reported TV viewing and weekend computer use among parents. Having negative attitudes towards child SV were also associated with lower levels of smartphone/tablet use and weekend total sedentary time among parents. However, parents' self-

efficacy for limiting child SV and setting SV rules were not associated with either self-reported SV or accelerometer-assessed sedentary time.

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