

Is Television Viewing a Suitable Marker of Sedentary Behavior in Young People?

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Abstract

Background Television (TV) viewing is a highly prevalent sedentary behavior in young people and has played a significant role in the assessment of sedentary behaviors. An important question to be addressed is to what extent TV viewing is a suitable indicator, or marker, of overall levels of sedentary behavior in children and adolescents. This has not yet been attempted in youth, but has already been attempted in Australian adults.

Purpose This study was conducted to test whether TV viewing in UK teenagers is a marker of sedentary behavior more broadly and to see if the results mirror those of Australian adults.

Methods Ecological momentary assessment time-use diaries were completed by 561 boys and 923 girls (mean age 14.67 years) in which weekday and weekend out-of-school time behaviors were recorded every 15 min.

Results TV viewing was negatively associated with other leisure-time sedentary behaviors for both boys and girls for weekdays and weekends. Higher levels of TV viewing were associated with less time in other key sedentary behaviors, such as computer use in boys and motorized transport in girls.

Conclusions TV viewing appears not to reflect additional time in other sedentary behaviors in British teenagers, in contrast to data from Australian women. Studies of sedentary behavior should encompass as wide a range of behaviors as possible.

Keywords Ecological momentary assessment · Gender · Sedentary behavior · TV viewing · Youth

Introduction

Interest in the physical activity of young people is currently high. However, there is now a growth in research addressing sedentary behavior in adults and youth [1, 2]. While television (TV) viewing is often the most prevalent sedentary behavior in young people [3], sedentary behavior is likely to be multifaceted, including other screen-based behaviors, sedentary socializing, homework, and motorized travel [4, 5]. Moreover, estimates show that, while some young people will watch a great deal of TV, there are many who have what might be considered “acceptable” levels [6, 7]. In addition, while some studies show a relationship between time spent watching TV and body fatness in youth [8], this relationship seems to be small [9].

Given the dominant role that TV has played in the assessment of sedentary behaviors, an important question to be addressed is to what extent TV viewing is a suitable or good indicator or marker of overall levels of sedentary behavior in children and adolescents. If it is a good marker, we might be better placed to screen individuals for sedentary behavior interventions based mainly on the extent of their TV viewing. Equally, if it is a poor marker, studies assessing only TV viewing are unlikely to be identifying those most at risk of a sedentary lifestyle.

There has been one study addressing this issue in adults [10]. Over 2,000 Australians aged between 20 and 65 years completed a questionnaire assessing TV viewing, as well as five other leisure-time sedentary behaviors and physical activity. Time spent in other sedentary behaviors and physical activity was compared across categories of TV

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viewing time. Results showed that, in women, time spent watching TV was associated positively with time in other sedentary behaviors and negatively with leisure-time physical activity. However, such associations were not observed in men. The purpose of the present study, therefore, was to test if the findings reported by Sugiyama et al. with adults were similar to those with adolescents and test whether TV viewing in 13- to 16-year-old boys and girls in the UK is a suitable marker of “sedentary behavior.”

Method

Sampling Design

Data were from a larger study of adolescent lifestyles (Project STIL—*Sedentary Teenagers and Inactive Lifestyles*) within the UK. Sampling took place between 2000 and 2002 across 15 regions stratified across England, Northern Ireland, Scotland, and Wales. Schools were randomly sampled from the largest local education authority in each region, stratified by the ratio of government-funded (“secondary”) schools to fee-paying (“independent”) schools in that local education authority. To control for seasonal variation in behavior as much as was possible, sampling occurred at all schools in two waves, 6 months apart (wave 1 predominantly March to May and wave 2 September to November). Sampling procedures were designed to ensure that separate students were sampled in each wave. To further increase sample size, an additional sample was recruited 6 months after wave 2 using the same procedures. At each school, a study coordinator randomly sampled one class from each of three year groups: year 9 (13–14 years old), year 10 (14–15 years old), and year 11 (15–16 years old). All students in the selected class were invited to participate in the study. Study procedures were approved by the ethical advisory committee of the first author’s institution and were in accordance with the ethical guidelines of the British Psychological Society. Informed consent was obtained from all parents/guardians and participants.

Participants

The sample comprised 1,484 (boys $n=561$, girls $n=923$) adolescents who returned completed diaries. The mean age of participants was 14.67 years ($SD=0.92$). The sample was predominantly white-European (87.7%), broadly reflecting the racial/ethnic make-up of this school-aged population in the UK [11]. Analysis of socioeconomic status (using mothers’ occupation) revealed that 43% of participants had mothers in senior or professional positions, 46.9% were in administrative or

skilled positions, 4.6% were in less skilled positions, and 5.6% were in other positions (e.g., unemployed, retired, or homemaker), reflecting a higher-than-average socioeconomic status.

Instrumentation

The principal data collection instrument was a pencil and paper self-report diary of “free time” that participants completed outside of school hours. Because the focus of our study involved behaviors that could be regarded as “volitional,” behaviors in school were not assessed. The self-report diary is based on principles of ecological momentary assessment and has been described in Gorely et al. [3]. The first part of the diary involved background questions about variables at the child, family, and environmental level that have been hypothesized to correlate with sedentary behavior and physical activity. Part 1 was answered once at the start of data collection. The second part was for recording the behaviors, locations, and social contexts that the young people engaged in each day. Participants completed part 2 of the diary for four randomly assigned days (three weekdays and one weekend day). At 15-min intervals, participants self-reported (free response) their main behavior and also responded to two closed-response items, “Where are you?” (location) and “Who’s with you?” (who). Only the behavior data are used in the current paper. For each weekday, 44 time samples were obtained (one every 15 min from 0700 to 0845 hours and from 1500 to 2345 hours). For the weekend day, 68 time samples were obtained (one every 15 min from 0700 to 2345 hours).

To assess the reliability of the ecological momentary assessment method, participants responded to a five-point categorical item estimating the average time lag between each interval prompt and actual diary entry (5, 15, 30, 60, or >60 min). Only 11% of respondents reported completing each diary entry within 5 min of the specified interval with 15% usually within 15 min, 17% within 30 min, 17% within 1 h, and 40% usually greater than 1 h. This suggests that most participants relied on some degree of retrospective recall for recording their behavior but the duration of recall and subsequent effects of memory distortion are likely to be minimized using this method relative to other forms of recall self-reports [12].

Data Analysis

The behaviors were first coded into 23 categories derived inductively from our own focus group research about how English youth spend their free time and described in Gorely et al. [3]. To estimate the time spent in each behavior category, the interval-level data were aggregated

for each individual (separately by weekday and weekend day) by multiplying the daily frequency of the event by 15 (1 interval=15 min). This makes an assumption that each episode of behavior occurred for the entire 15 min of the sampling period. Although this may not always be true, underestimation and overestimation errors are assumed to cancel out in interval-contingent sampling schedules and, when aggregated across the day or class, yield valid estimates of duration [13]. To address the current research question, behaviors that may not be considered truly volitional (e.g., personal care) and those with a mean less than 10 min were excluded. For boys, nine sedentary behaviors were included (TV time, listening to music, computer use, computer games, sitting and talking, hanging out, motorized transport, behavioral hobbies, and homework). For girls, ten sedentary behaviors were included (TV time, listening to music, computer use, using the phone, sitting and talking, hanging out, motorized transport, behavioral hobbies, reading, and homework). Behavioral hobbies included activities such as playing musical instruments, church, and looking after pets. Time spent in sports/exercise (e.g., after-school sport club, skateboarding) and active travel (e.g., walking to school) were also investigated.

As the sedentary behaviors included differed by gender, analyses were conducted separately for boys and girls. Weekday and weekend day data were also analyzed separately because of the greater discretionary time on weekends, which may influence behavior choice [14, 15]. All statistical analyses were carried out using STATA 8.0 (Stata Corporation, College Station, TX, USA). To account for cluster-based sampling, STATA *survey* commands were employed. Linear regression was employed to estimate the levels of association between TV viewing time category and time spent in other sedentary behaviors (excluding TV viewing). Within each regression analysis, the Wald test was used to test the joint null hypothesis for multicategory predictor variables, producing a single *p* value. Significance was set at an alpha level of 0.05. TV viewing time categories adopted were <2, 2–4, and >4 h/day, consistent with recommendations of the American Academy of Pediatrics [16].

Results

On average, boys reported 234 min in total leisure-time sedentary behavior per weekday, of which 131 min (56%) was TV viewing. On weekends, boys reported 527 min in total leisure-time sedentary behavior, of which 202 min (38%) was TV viewing. In contrast, girls reported 331 min in total leisure-time sedentary behavior per weekday, of which 105 min (32%) was TV viewing. On weekends, girls

reported 512 min in total leisure-time sedentary behavior, of which 148 min (41%) was TV viewing. Table 1 shows the gender-specific characteristics of the sample by TV viewing category and weekend and weekdays. There were no significant age or ethnicity differences between participants in the TV viewing categories.

Tables 2 and 3 show the time spent in TV viewing and other sedentary behaviors according to TV viewing category and weekdays/weekend days for boys and girls, respectively. Mean TV viewing time was significantly higher in boys for both weekdays and weekend days, consistent with prior data [6]. The TV viewing time category was significantly negatively associated with the total of other sedentary behaviors in both boys and girls. Figure 1 shows the means and confidence intervals for time spent in other sedentary behaviors according to TV viewing time category. On weekdays, for boys, the difference in time spent in other sedentary behaviors was 93 min/day between the low and high TV viewing time categories (232, 181, and 139 min/day in the low, medium, and high TV viewing categories, respectively). The difference was 154 min/day on weekend days (390, 359, and 236 min/day in the low, medium, and high TV viewing categories, respectively). On weekdays, for girls, the difference in time spent in other sedentary behaviors was 137 min/day between the low and high TV viewing time categories (250, 194, and 113 min/day in the low, medium, and high TV viewing categories, respectively). The difference was 154 min/day on weekend days (407, 377, and 253 min/day in the low, medium, and high TV viewing categories, respectively).

When looking at individual sedentary behaviors on weekdays, TV viewing time category was significantly negatively associated with computer use, sitting and talking, behavioral hobbies, and homework in boys and with motorized transport, sitting and talking, hanging out, using the phone, behavioral hobbies, and homework in girls. When looking at individual sedentary behaviors on weekend days, TV viewing time category was significantly negatively associated with motorized transport, behavioral hobbies, and homework in boys and with motorized transport, sitting and talking, hanging out, and behavioral hobbies in girls.

Time spent in sports/exercise was negatively associated with TV viewing time category in boys and girls on both weekdays and weekend days, although in boys the relationship on weekend days only approached significance ($p=0.059$). There was no relationship between active travel and TV viewing time category in boys on either weekdays or weekend days. In girls, a significant negative relationship was observed between active travel and TV viewing time category on weekend days, but not weekdays.

Table 1 Description of sample by gender, TV viewing category and weekday/weekend day

| | Boys—weekdays | | | Girls—weekdays | | | Boys—weekend days | | | Girls—weekend days | | | | | | |
|-----------------------------|--------------------------|--------------|--------------|--------------------------|--------------|--------------|--------------------------|--------------|--------------|--------------------------|--------------|--------------|--------------|--------------|--------------|--------------|
| | TV viewing time category | | | TV viewing time category | | | TV viewing time category | | | TV viewing time category | | | | | | |
| | <2h/day | 2–4h/day | >4h/day | <2h/day | 2–4h/day | >4h/day | <2h/day | 2–4h/day | >4h/day | <2h/day | 2–4h/day | >4h/day | | | | |
| Number | 566 | 293 | 230 | 43 | 925 | 597 | 308 | 20 | 527 | 143 | 214 | 170 | 854 | 335 | 326 | 193 |
| Age (years), mean (SD) | 14.64 (0.89) | 14.70 (0.96) | 14.58 (0.79) | 14.61 (0.93) | 14.67 (0.94) | 14.70 (0.95) | 14.61 (0.90) | 14.98 (0.94) | 14.63 (0.90) | 14.80 (0.93) | 14.61 (0.92) | 14.53 (0.83) | 14.69 (0.93) | 14.84 (0.93) | 14.68 (0.89) | 14.46 (0.94) |
| Ethnicity (% white British) | 87.14 | 82.11 | 92.63 | 90.34 | 87.59 | 86.36 | 89.02 | 95.53 | 86.91 | 86.52 | 84.90 | 89.61 | 88.94 | 88.83 | 88.26 | 90.38 |

None of the differences between TV viewing time groups are significant at $p < 0.05$

Table 2 Time spent in TV viewing and other sedentary behaviors (mean min/day (SE)) by TV viewing category and weekday/weekend day among adolescent boys

| Behavior | Weekday | | | Weekend day | | | <i>p</i> for trend | TV viewing time category | | | <i>p</i> for trend |
|--------------------------------|--------------------------|--------------|--------------|--------------------------|--------------|--------------|--------------------|--------------------------|--------------|---------|--------------------|
| | TV viewing time category | | | TV viewing time category | | | | TV viewing time category | | | |
| | <2h/day | 2–4h/day | >4h/day | <2h/day | 2–4h/day | >4h/day | | <2h/day | 2–4h/day | >4h/day | |
| TV time | 131.0 (3.8) | 73.3 (2.5) | 288.2 (15.7) | 202.5 (6.9) | 43.5 (4.3) | 179.2 (5.3) | <0.001 | 179.2 (5.3) | 349.9 (17.0) | <0.001 | |
| Other sedentary behaviors time | 202.7 (7.1) | 231.8 (10.2) | 139.2 (13.0) | 325.2 (11.5) | 390.0 (33.9) | 235.8 (13.2) | <0.001 | 359.0 (18.2) | 235.8 (13.2) | <0.001 | |
| Motorized transport | 39.8 (4.5) | 43.5 (5.3) | 35.1 (5.2) | 48.9 (6.8) | 61.3 (9.0) | 58.0 (13.2) | 0.263 | 58.0 (13.2) | 28.5 (5.7) | 0.004 | |
| Computer use | 17.6 (2.4) | 19.2 (2.6) | 7.6 (3.2) | 24.5 (3.6) | 31.9 (10.1) | 20.6 (4.9) | 0.002 | 23.1 (3.8) | 20.6 (4.9) | 0.635 | |
| Computer games | 25.1 (3.3) | 25.5 (3.8) | 17.8 (5.7) | 46.4 (8.1) | 32.0 (8.1) | 43.3 (8.2) | 0.514 | 58.1 (16.6) | 43.3 (8.2) | 0.315 | |
| Sitting and talking | 18.0 (4.1) | 25.3 (7.6) | 12.2 (1.4) | 47.1 (10.1) | 47.0 (10.5) | 34.8 (8.8) | <0.001 | 57.4 (19.0) | 34.8 (8.8) | 0.371 | |
| Hanging out | 22.1 (5.0) | 26.1 (7.2) | 16.1 (4.9) | 60.6 (9.4) | 88.3 (26.3) | 53.0 (13.9) | 0.411 | 49.7 (10.8) | 53.0 (13.9) | 0.403 | |
| Listening to music | 12.7 (2.2) | 15.5 (4.7) | 6.4 (2.8) | 13.7 (2.4) | 10.5 (3.4) | 12.6 (3.8) | 0.259 | 16.7 (5.1) | 12.6 (3.8) | 0.623 | |
| Behavioral hobbies | 13.1 (1.7) | 15.3 (1.9) | 6.6 (3.3) | 41.9 (5.4) | 64.9 (16.1) | 18.4 (4.1) | 0.045 | 47.0 (11.2) | 18.4 (4.1) | 0.003 | |
| Homework | 54.2 (5.6) | 61.3 (9.0) | 35.4 (14.8) | 42.1 (7.6) | 54.1 (11.9) | 24.7 (5.3) | <0.001 | 49.1 (13.0) | 24.7 (5.3) | 0.004 | |
| Active travel | 24.4 (2.3) | 27.1 (3.2) | 15.6 (3.9) | 12.7 (2.5) | 13.0 (3.3) | 9.2 (3.3) | 0.068 | 15.5 (3.9) | 9.2 (3.3) | 0.227 | |
| Sports and exercise | 29.6 (2.2) | 33.7 (3.7) | 6.6 (2.4) | 68.4 (1.9) | 92.5 (15.4) | 50.9 (7.8) | <0.001 | 67.8 (8.7) | 50.9 (7.8) | 0.059 | |

Table 3 Time spent in TV viewing and other sedentary behaviors (mean min/day (SE)) by TV viewing category and weekday/weekend day among adolescent girls

| Behavior | Weekday | | | Weekend day | | | <i>p</i> for trend |
|--------------------------------|--------------------------|-------------|--------------|--------------------------|--------------|--------------|--------------------|
| | TV viewing time category | | | TV viewing time category | | | |
| | <2h/day | 2–4h/day | >4h/day | <2h/day | 2–4h/day | >4h/day | |
| TV | 104.7 (4.5) | 156.1 (3.7) | 262.6 (4.9) | 147.9 (6.0) | 159.3 (2.8) | 330.9 (13.6) | <0.001 |
| Other sedentary behaviors time | 226.3(6.5) | 193.9 (6.2) | 113.2 (11.3) | 364.1 (13.1) | 407.0 (22.1) | 253.0 (11.4) | <0.001 |
| Motorized transport | 45.2 (4.1) | 37.4 (4.0) | 26.7 (7.0) | 52.8 (4.1) | 62.9 (6.3) | 40.0 (6.9) | 0.029 |
| Computer use | 10.3 (1.2) | 11.5 (2.4) | 4.3 (2.8) | 15.1 (1.5) | 11.3 (3.1) | 16.9 (4.0) | 0.303 |
| Sitting and talking | 29.9 (3.1) | 34.0 (3.8) | 25.0 (3.2) | 66.8 (6.0) | 80.2 (9.7) | 40.6 (8.1) | <0.001 |
| Hanging out | 20.3 (2.4) | 23.4 (3.0) | 3.6 (1.2) | 82.0 (5.4) | 101.2 (10.5) | 67.6 (7.6) | 0.033 |
| Listening to music | 14.5 (1.3) | 13.4 (1.5) | 21.6 (7.2) | 20.9 (1.6) | 16.3 (3.0) | 18.0 (3.1) | 0.117 |
| Reading | 10.2 (1.3) | 10.9 (1.6) | 4.4 (2.7) | 12.0 (1.8) | 9.0 (2.1) | 12.0 (3.1) | 0.101 |
| Phone | 13.1 (3.0) | 15.1 (4.5) | 4.9 (1.9) | 15.0 (1.8) | 14.2 (2.1) | 10.4 (2.4) | 0.261 |
| Behavioral hobbies | 20.6 (2.7) | 24.6 (3.8) | 9.6 (7.5) | 48.7 (5.4) | 69.1 (10.7) | 14.1 (2.5) | <0.001 |
| Homework | 62.3 (3.3) | 69.3 (4.2) | 35.4 (14.7) | 50.6 (7.3) | 42.6 (7.3) | 33.5 (5.1) | 0.051 |
| Active travel | 25.6 (2.2) | 25.9 (3.5) | 22.4 (5.4) | 17.5 (1.9) | 24.3 (3.4) | 9.9 (1.9) | 0.001 |
| Sports and exercise | 18.6 (2.8) | 22.7 (3.5) | 7.3 (3.5) | 35.9 (5.6) | 43.9 (9.8) | 17.0 (4.3) | 0.014 |

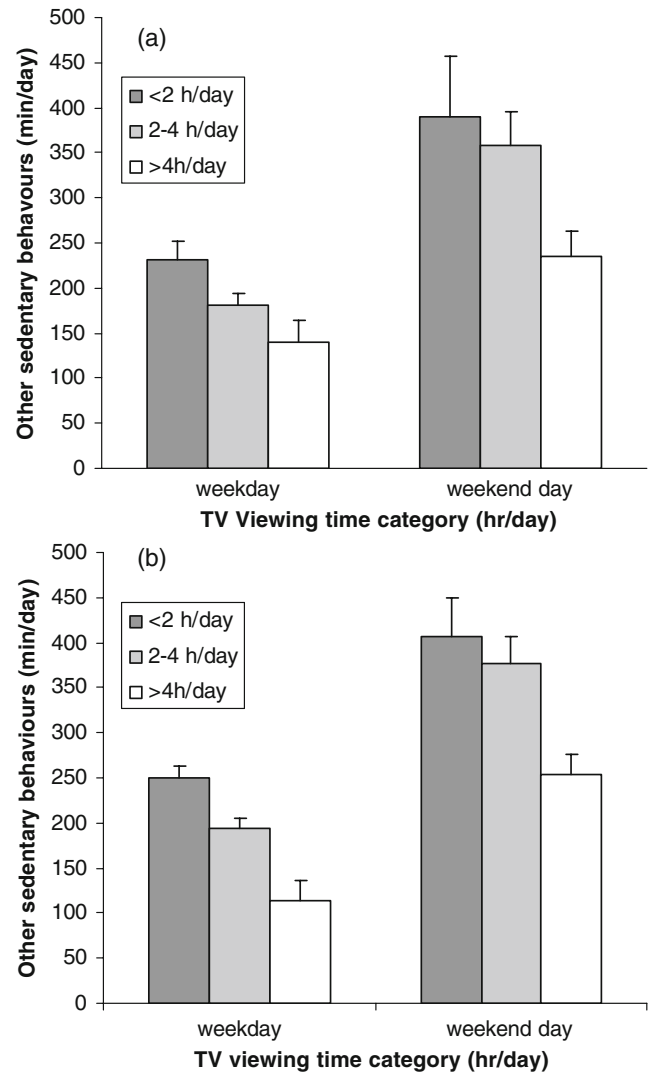


Fig. 1 Means (95% confidence intervals) for time spent in other sedentary behaviors by TV viewing category and weekday/weekend day for **a** boys and **b** girls (*p* for trend <0.001 in all cases)

Discussion

The purpose of this study was to test whether TV viewing was a marker of a broader pattern of sedentary behavior in young people and thereby compare our findings with those reported on adults by Sugiyama et al. [10]. Contrary to some of the findings reported by Sugiyama et al., we found that TV viewing was negatively associated with other leisure-time sedentary behaviors for both boys and girls for weekdays and weekends. Sugiyama et al. found a positive relationship for women and no association for men. In addition, we found that physical activity in the form of sports/exercise was also negatively associated with TV viewing categories. Previous research has generally shown that TV viewing is unrelated or only weakly associated with physical activity, usually when assessed as at least moderate in intensity [9, 17]. By analyzing this relationship

in the present study by using TV viewing categories rather than as a continuous variable and by capturing a wide range of physically active behaviors, the relationship may be more obviously revealed. Certainly, the association appears to be stronger than that reported in the meta-analysis of Marshall et al. [9]. Another reason could be that our method requires participants to note their main behavior at each time point, thus forcing interdependence between behaviors. The survey of Sugiyama et al., however, required a recall of behaviors and may lead to less dependency within the behaviors.¹ Nevertheless, while this may account for differences between the two studies, it can be argued that time-use diaries are superior over self-report questionnaires in capturing the range of sporadic behaviors studied in the present research. Indeed, Sugiyama et al. reported a correlation of only 0.3 between their survey measure of TV viewing and a measure derived from a 3-day behavior log, suggesting weak validity for their assessment of TV viewing.

The key research question being addressed, however, was whether TV viewing represented a wider pattern of sedentary behavior. Our results suggest that higher levels of TV viewing are associated with less time in other key sedentary behaviors, such as computer use in boys and motorized transport in girls. These findings, alongside the low-to-moderate proportion of “total” sedentary time that is occupied by TV viewing time (32–56%), suggest that TV viewing, while clearly an important and prevalent sedentary behavior, is not a good marker of “sedentary behavior” in young people. If, as our data show, TV is negatively associated with several other key sedentary behaviors, this suggests that some compensation effect may be in operation. That is, young people may switch between different sedentary behaviors rather than accumulating additional time in sedentary pursuits reflective of their TV viewing habits. This will require further testing, but some supportive evidence is provided by Marshall et al. [6] in their review of epidemiological trends in screen time for children and youth. These authors, in reviewing a large number of studies of screen use, concluded that “because secular data suggest that overall media use has remained relatively stable over the past 50 years, it might be hypothesized that a ‘substitution effect’ operates in which contemporary forms of screen-based entertainment (e.g., video game and computer use) have replaced more traditional media (reading comic books, listening to music, etc.)” (p. 344). Moreover, our findings are consistent with a “behavioral economics” approach to sedentary behaviors advocated by Epstein and colleagues [18] in which choices are made between behaviors. While we cannot say how these choices are made and what the role is for access,

availability, and value, as proposed in this approach, our findings do suggest that such an analysis is worthy of follow-up.

One limitation of the present study is that the high TV viewing category contained small numbers of young people. Moreover, the diary approach we adopted did not allow for the recording of multitasking in sedentary behaviors, and some behaviors (e.g., physical activity, homework) may be prone to socially desirable responding. This requires further research. We also had more girls responding than boys. The diary is a burdensome data collection method and girls appear to be more willing to complete this task. Another limitation is that we do not have health outcome data (e.g., body fat) to see if TV or other sedentary behaviors are associated with these kinds of variables.

In conclusion, and notwithstanding the fact that TV viewing is still the most prevalent sedentary behavior for young people, TV viewing appears not to be a good marker of sedentary behavior in UK teenagers. Focusing solely on TV viewing may be misleading as other important sedentary behaviors may not be captured. It is, therefore, recommended that studies of sedentary behavior encompass as wide a range of behaviors as possible.

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