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Title: Accelerometer and self-reported measures of sedentary behaviour and associations with adiposity in UK youth.

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Running title: Sedentary time, screen time, and adiposity

Keywords: Youth; sedentary time; screen time; adiposity; measurement.

Abstract

This study used accelerometer and self-report measures of overall sedentary time (ST) and screen time behaviours to examine their respective associations with adiposity among UK youth. Participants (Year groups 5, 8, and 10; n=292, 148 girls) wore the SenseWear Armband Mini accelerometer for eight days and completed the Youth Activity Profile, an online report tool designed to estimate physical activity and ST. Stature, body mass and waist circumference were measured to classify adiposity outcomes (overweight/obese and central obesity). One-way between groups ANOVA and adjusted linear, logistic and multinomial logistic regression analyses were conducted. There was a significant main effect of age on total ST across the whole week ($F(2, 289)=41.64$, $p\leq0.001$). ST increased monotonically across Year 5 (581.09±107.81 $min\cdot d^{-1}$), 8 (671.96±112.59 $min\cdot d^{-1}$) and 10 (725.80±115.20 $min\cdot d^{-1}$), and all pairwise comparisons were significant at $p\leq0.001$. A steep age-related gradient to mobile phone use was present ($p\leq0.001$). ST was positively associated with adiposity outcomes independent of moderate-to-vigorous intensity physical activity (MVPA; $p\leq0.001$). Engaging in >3 hours of video gaming daily was positively associated with central obesity (OR=2.12, $p\leq0.05$) but not after adjustment for MVPA. Results further demonstrate the importance of reducing overall ST to maintain healthy weight status among UK youth.

Keywords: Youth; sedentary time; screen time; adiposity; obesity; measurement

Introduction

There is considerable public health interest in understanding the correlates and health implications of sedentary behaviour (i.e., activities that involve sitting or reclining while expending little energy) and standardised approaches and definitions have been proposed to advance this work (Tremblay et al., 2017). The issue is germane to all segments of the population, but there are unique considerations and challenges when studying this behaviour in youth (Welk and Kim, 2016). Studies have documented that sedentary behaviour is associated with increased risk of poor health among youth, including adiposity (Marshall & Ramirez, 2011; Saunders, Chaput, & Tremblay, 2014); however, results depend on the nature of the study design and how sedentary behaviour is measured (Welk and Kim, 2016). Recent evidence also suggests that the sedentary behaviour and adiposity relationship is partly mediated by cardiorespiratory fitness (Santos et al., 2018). Thus, the associations are more complex than previously thought.

Part of the challenge is due to the many different forms of sedentary behaviour. These include educational activities such as homework, travelling passively (i.e., motorized transport), seated hobbies (e.g., reading and talking with friends), and screen time behaviours (e.g., TV viewing, video games, etc.), with screen time behaviours being the most common form of leisure-time sedentary behaviours among youth (Biddle, Marshall, Gorely & Cameron, 2009; Kenney & Gortmaker, 2017). Prominent reviews have highlighted the high overall prevalence of sedentary behaviours, especially during leisure-time (Arundell, Fletcher, Salmon, Veitch & Hinkley, 2016), but less is known about the breakdown of the different types of sedentary behaviour.

In the UK, many youths spend more than 2 hours per day engaged in screen time behaviours (Coombs & Stamatakis, 2015; Sandercock, Ogunleye & Voss, 2012). While current evidence suggests that sedentary time increases with age (Janssen et al., 2016; Ruiz et al., 2011; Santos et al., 2018), it is unknown whether these age-related differences are reflected in specific screen time behaviours among UK youth. Moreover, to date, very few UK studies have used self-reported measures alongside device-based measures to provide contextual understanding of a range of youth sedentary behaviours (Coombs & Stamatakis, 2015). The use of parallel measures of sedentary behaviour and investigation of these sedentary behaviours across age groups can highlight specific sedentary behaviours during youth that may benefit from age-targeted interventions.

Although a positive association between overall screen time and youth adiposity has been shown (Bai et al., 2016), few studies have examined the influence of specific types of screen time behaviours on youth adiposity. Indeed, a recent systematic review of reviews highlighted the limited number of studies reporting data on mobile screen use in particular (Stiglic & Viner, 2019). Traditionally, time spent watching TV has been treated as a representative measure of screen time (Eisenmann, Bartee, Smith, Welk & Fu 2008; Steffen, Dai, Fulton & Labarthe, 2009; Zhang, Wu, Zhou, Lu & Mao 2016), leading to the consistent finding that youth who watch high levels of TV are more likely to be overweight or obese (Carson et al., 2016a; Tremblay et al., 2011a; 2011b). However, TV time alone is no longer adequate as a representative measure of screen time, since other devices (e.g., computers, games consoles, tablets, mobile phones) have become prominent elements of youth lifestyle (Ofcom, 2017).

Therefore, a greater level of specificity is necessary when assessing sedentary behaviour, and particularly screen time among youth. To address this need, the aims of this study were to 1) assess age-related differences in youth sedentary time, screen time behaviours and adiposity, and 2) examine associations between parallel measures of youth sedentary behaviour (i.e., accelerometer measured sedentary time and self-reported screen time behaviours) and adiposity.

Methods

Participants

Eleven schools (four primary and seven secondary) situated in North West England were provided with information regarding the study and were invited to participate. Four primary (100%) and five secondary schools (71%) agreed to take part. Participating schools received project and consent information and were scheduled for data collection. Informed parental consent and child assent was obtained from 401 students (209 boys) in Year groups 5 (aged 9 - 10 years, *n* = 133), 8 (aged 12 - 13 years, *n* = 132), and 10 (aged 14 - 15 years, *n* = 136). Ethical approval was granted from Liverpool John Moores Research Ethics Committee (14/SPS/012). A financial incentive of £700 was provided to each participating school and each participant received a £10 retail voucher for taking part. Data collection took place on school sites during school-term time between March and July 2017.

Measures

Adiposity

Trained researchers measured stature to the nearest 0.1 cm using a portable stadiometer (Leicester Height Measure, Seca, Birmingham, UK), and body mass to the nearest 0.1 kg using the same calibrated scales (Seca, Birmingham, UK). Body mass index (BMI) was calculated from stature and body mass (kg/m^2), and BMI z-scores were assigned to each participant (Cole, Freeman & Preece, 1995). Age- and gender-specific BMI cut-points were used for normal weight or overweight/obese classifications (Cole, Bellizzi, Flegal & Dietz 2000). Waist circumference was measured at the midpoint between the bottom rib and the iliac crest to the nearest 0.1 cm using a non-elastic measuring tape (Seca, Birmingham, UK). Waist-to-height ratio (WHtR) was used as a measure of central obesity, with a WHtR ≥ 0.5 indicating the presence of central obesity (McCarthy & Ashwell, 2006; Mokha et al., 2010).

Device-based sedentary time

Each participant wore a SenseWear Armband Mini (SWA) (BodyMedia, Inc., Pittsburgh, PA) wireless pattern-recognition device on their upper non-dominant arm. The SWA estimates energy expenditure by integrating data from multiple sources, including a bi-axial accelerometer, physiological sensors (e.g. capturing heat flux and galvanic skin response), and demographic information (i.e., the wearer's age, gender, and weight) (Arvidsson, Slinde, Larsson & Hulthén, 2007). The SWA has been validated in youth (Calabro, Welk & Eisenmann, 2009; van Loo et al., 2017), and has been shown to provide accurate estimates of sedentary time (Ridgers, Hnatiuk, Vincent, Timperio, Barnett & Salmon, 2016). A key advantage of the SWA for fieldbased research is its ability to accurately detect non-wear time. The SWA is able to detect whether the device is in contact with skin, which provides a more refined estimate of non-wear time and consequently reduces the error within the measure of sedentary time (Andre et al., 2006).

The SWA devices were initialized with default 1-minute epochs using the SenseWear Pro v.8.0 software. Each participant was provided with verbal and written instructions detailing how to wear the SWA. They were asked to wear the device continuously for 8-days, removing only for water-based activities and contact sports. On return of the SWA devices, data were downloaded using the SenseWear Pro software (v.8.0), and files were converted to .xls format to enable initial data screening. Subsequent data processing was conducted in R (R Core Team, 2017) using custom-written code. To be included in the analysis, participants needed to wear the SWA for a minimum of 960 minutes per day on at least 3 days (Fairclough et al., 2017; Rowlands et al., 2018; Slootmaker et al., 2009). SWA data were expressed as METs, which were then converted to minutes of sedentary time and moderate-to-vigorous intensity physical activity (MVPA) during waking hours (7am to 11pm) using age- and gender-specific thresholds (Welk, Morrow & Saint-Maurice, 2017).

Self-reported screen time

Participants completed an online physical activity and sedentary behaviour survey under the supervision of researchers and teachers. We used a UK-specific version of the Youth Activity Profile (YAP). The YAP is a 7-day recall tool that consists of 15 items relating to in-school activity (five items), out-of-school physical activity (five items), and sedentary behaviours (five items). Among US youth, YAP estimates of weekly physical activity and sedentary time have previously demonstrated agreement with estimates derived from objective monitors (Saint-Maurice & Welk, 2015; Saint-Maurice, Kim, Hibbing, Oh, Perna, & Welk, 2017). Participants answered each item using a 5-point Likert scale representing the frequency of the behaviour. A critical aspect of the items that addressed sedentary behaviour was the presence of separate items inquiring about time spent in the following screen time behaviours: watching TV, playing video games, using computers or tablets, and using a mobile/cell phone. Participants were asked to indicate how much time in the previous 7-days they had spent engaging in each screen time behaviour. The survey does not distinguish between school and leisure screen time. Response choices were: no use, less than 1-hour per day, 1-2 hours per day, 2-3 hours per day, and more than 3 hours per day. Responses were clustered, so we collapsed the responses, and created two dichotomized variables for each screen time behaviour representing > 2 hours per day and > 3 hours per day engagement. Only data from these four questions are reported in this study. On completion of the survey, researchers checked the responses with the participants before they were submitted. Each participant's electronic YAP responses were collated in school- and class-specific .csv files, which were subsequently cleaned and merged with the other data.

Covariates

Potential confounding factors were selected *a priori* based on previous evidence (Coombs, Shelton, Rowlands & Stamatakis, 2013; LeBlanc et al., 2016; Saunders & Vallance, 2017). Participant age, gender and home postcode were self-reported. Arealevel deprivation was calculated from home postcodes using the 2015 Indices of Multiple Deprivation (IMD; Department for Communities and Local Government, 2015). The IMD is a UK Government measure comprising seven areas of deprivation including income, employment, health, education, housing, environment and crime. Home postcodes were entered into the GeoConvert (http://geoconvert.mimas.ac.uk/) application (MIMAS, 2018) to generate deprivation scores. Higher deprivation scores represented higher deprivation. Missing responses were imputed with the variable mean score (n = 26) to prevent further data loss. This imputation approach has been used previously in physical activity studies involving children (Corder et al., 2010). MVPA measured from the SWA was also included as a covariate as MVPA is known to be associated with adiposity in youth (Schwarzfischer et al., 2017).

Analyses

All analyses were conducted using SPSS v. 24 (SPSS Inc; Chicago, IL) and statistical significance was set at $p \leq 0.05$. Descriptive statistics were calculated for all measured variables.

Research aim 1 was to assess age-related differences in youth sedentary time, screen time behaviours and adiposity. To address this aim, a one-way between groups analysis of variance (ANOVA) with Bonferroni post-hoc test was performed to examine differences in device-based measured sedentary time between Year groups. Multinomial logistic regression analyses examined differences in adiposity outcomes and self-reported screen time behaviours between Year groups. The Year 5 group was chosen as the reference category. Analyses were adjusted for gender, deprivation and MVPA.

Research aim 2 was to examine associations between parallel measures of youth sedentary behaviour (i.e., accelerometer measured sedentary time and self-reported screen time behaviours) and adiposity. To address this aim, linear and logistic regression analyses assessed associations between device measured sedentary time and adiposity outcomes, and self-reported screen time behaviours and adiposity outcomes, respectively. Analyses were adjusted for gender, Year group, deprivation, and MVPA.

Results

Forty-nine participants were absent on data collection days or did not provide all required data for the analyses, which meant YAP, IMD, and SWA data were available from 353 participants. Fifty-two participants did not achieve the SWA wear time criteria, and a further nine participants had incomplete questionnaire data. These participants were subsequently removed from analyses, which resulted in a final analytical sample of 292 participants (148 girls) (72.8% response rate). The descriptive characteristics of the sample are presented in Table 1.

[TABLE 1 NEAR HERE]

Research aim 1

Daily SWA wear time (mean ± SD) for Year 5, 8 and 10 children was 1225.10 ± 150.44 min·d^{-1}, 1271.84 ± 126.70 min·d^{-1}, and 1289.45 ± 110.86 min·d^{-1}, respectively. There was a significant main effect of age on total sedentary time across the whole week ($F(2, 289) = 41.64$, $p < 0.001$). Bonferroni post-hoc testing showed a monotonic increase in sedentary time with increasing age, and all pairwise differences were significant with $p < 0.001$. The most dramatic increase occurred between Year 5 (581.09 ± 107.81 min·d^{-1}) and Year 8 (671.96 ± 112.59 min·d^{-1}), whereas the increase was more modest between Year 8 and Year 10 (725.80 ± 115.20 min·d^{-1}).

Compared to Year 5 children, Year 10 children were more likely to engage in > 3 hours of video gaming (Odds Ratio, OR = 3.34; $p \leq 0.05$; Table 2), > 2 hours of computer/tablet time (OR = 5.02; $p \leq 0.001$), > 3 hours of computer/tablet time (OR = 29.81; $p \leq 0.001$), > 2 hours of mobile phone use (OR = 11.73; $p \leq 0.001$), and > 3 hours of mobile phone use (OR = 10.71; $p \leq 0.001$). Compared to Year 5 children, Year 8 children were more likely to engage in > 2 hours of mobile phone use (OR = 2.90; $p \leq 0.001$), and > 3 hours of mobile phone use (OR = 2.54; $p \leq 0.01$).

[TABLE 2 NEAR HERE]

Research aim 2

Adjusted linear regression analyses revealed a positive association between sedentary time and BMI z-score (B = 0.01, $p \leq 0.001$; Table 3) and waist circumference (B = 0.03, $p \leq 0.001$). Associations between sedentary time and BMI z-score and waist circumference remained significant at $p \leq 0.01$ after adjustment for MVPA.

[TABLE 3 NEAR HERE]

Table 4 presents OR for associations between screen time behaviours and adiposity. Children who reported engaging in more than 3 hours of video gaming daily (OR = 2.28, 95% CI = 1.04 – 5.02) were more likely to be classified as centrally obese compared with children who reported engaging in less than 3 hours of video gaming daily, respectively. However, the association was attenuated after adjustment for MVPA.

[TABLE 4 NEAR HERE]

Discussion

This study represents the first in the UK to use device-based and self-report measures of youth sedentary behaviour to assess age-related differences and associations with adiposity. The study revealed significant age-related differences in device measured sedentary time and self-reported computer/tablet time and mobile phone use. Device measured sedentary time was positively associated with adiposity independent of MVPA, but none of the self-reported screen time behaviours were associated with adiposity outcomes after adjustment for MVPA.

Consistent with prior UK (Janssen et al., 2016) and European research (Ruiz et al., 2011) this study evidenced an age-related gradient to device measured sedentary time. Here we extend beyond earlier studies by revealing an age-related gradient to some self-reported screen time behaviours, namely computer/tablet time and mobile phone use. One possible explanation for this finding is that adolescents often have more autonomy on how they spend their free time (Haberstick et al., 2014) in comparison to younger children, and this unstructured time is often spent engaged in video gaming, computer/tablet time and/or mobile phone use. Moreover, adolescents may spend more time on computers in their leisure-time compared to younger children because they are completing homework (Sheldrick et al., 2018). Such productive screen time behaviours can be perceived as positive for development and wellbeing (e.g., academic attainment, school functioning; Carson et al., 2016b), and may not necessarily displace more ‘healthy behaviours’ such as physical activity (Sheldrick et al., 2018). Further work exploring age-related variability in screen time behaviours will help inform the timing and targeting of sedentary behaviour and wellbeing interventions. Moreover, although age-related differences were observed for device-based and self-report measures of sedentary behaviour, we found no statistically significant differences in adiposity outcomes between young and older youth, which is consistent with previously reported English population level data (Conolly, 2016).

In this study, device measured sedentary time was positively associated with adiposity in UK youth. This finding is consistent with a recent systematic review of reviews (Stiglic & Viner, 2019), and some individual studies (De Bourdeaudhuij et al., 2013), but not all (Atkin et al., 2013; Marques et al., 2016). Notably, the strength of associations between sedentary time and adiposity outcomes were small, which is consistent with the findings of a 2017 review of reviews and analysis of causality (Biddle, García Bengoechea, Wiesner, 2017). Such modest associations may be attributable to the varied methodological approaches employed. For example, different measurement methods influence the observed strength of association between sedentary time and youth adiposity. Moreover, the combined effect of sedentary time, physical activity, dietary behaviour and sleep on adiposity is currently not well understood (Leech, McNaughton & Timperio, 2014). For example, health enhancing behaviours (i.e., regular physical activity and healthy food intake) may compensate for unhealthy behaviours (i.e., high sedentary time) which would offer some explanation for the inconsistency across the literature (Grgic et al., 2018; Sheldrick et al., 2018). Further research examining the concurrent effect of sedentary time, physical activity, diet and sleep behaviour on adiposity in youth is warranted.

A novel aspect of this study was the examination of associations between a range of screen time behaviours and youth adiposity. Almost all associations between screen time behaviours and adiposity were in a positive direction, but few were statistically significant. Again, this finding may be primarily reflective of the complexity of youth adiposity but may also be due to the low prevalence of excessive screen time behaviour when TV viewing was included (> 2 hours daily; 18.90%, 36.20% and 23.40% of Year 5, 8 and 10 youth, respectively) compared to previous European (57.2%-85.8%; Jago et al., 2008) and US research (29% to 35%; Fulton et al., 2009). Furthermore, the increased availability of 'on demand' TV options means that youth may also be watching television programmes online using computers or tablet devices. Such modes of screen use require further exploration in future studies. Although TV viewing is currently the most widely studied screen behaviour associated with youth adiposity (Carson et al., 2016a; Tremblay et al., 2011a), future research should continue to work towards differentiating the health impact of different screen time behaviours. This is especially the case with video gaming, since playing video games for more than 3 hours per day in this study was associated with central obesity risk.

Strengths and limitations

This study represents the first in the UK to use device-based and self-reported measures of total sedentary time and screen time behaviour to assess age-related differences and associations with adiposity. We considered multiple measures of adiposity, measured sedentary time using a validated device, and adjusted the analyses for known confounding factors. There were also limitations in this study. We used validated measures to assess screen time behaviours, but the data derived from these self-report measures may have been prone to some forms of measurement error, such as social desirability bias from participants. To protect against this, surveys were completed independently under the supervision of researchers and teachers, and participants verified their responses before submitting. Our self-report measure was unable to capture whether youth engaged in concurrent sedentary behaviours (i.e., screen stacking) which may influence associations with adiposity. The SWA 1-minute epoch may not have been sensitive enough to capture short episodes of higher intensity activity and thus may have biased MVPA estimates (Edwardson & Gorely, 2010). The study design was cross-sectional, and we are therefore unable to determine causality.

Conclusion

This study evidences an age-related gradient to device measured sedentary time and some self-reported screen time behaviours among UK youth. The results highlight the importance of limiting total sedentary time in youth to reduce risk of adiposity. None of the self-reported screen time behaviours were associated with adiposity outcomes after adjustment for MVPA. Given the complexity of youth adiposity it is important for future research to explore the concurrent effect of a range of lifestyle behaviours including multiple modes of sedentary behaviour.

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Disclosure statement

No potential conflict of interest was reported by the authors.

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Table 1. Descriptive characteristics of sample

Variable	Year 5 (n = 93) Mean (SD) or %	Year 8 (n = 94) Mean (SD) or %	Year 10 (n = 105) Mean (SD) or %
Gender			
Boy	50.50	40.40	56.20
Girl	49.50	59.60	43.80
Age (years)	10.18 (0.33)	13.17 (0.34)	15.23 (0.33)
Stature (cm)	141.37 (6.20)	157.16 (9.10)	167.61 (8.59)
Body mass (kg)	36.08 (7.81)	51.04 (11.44)	63.26 (12.15)
BMI (kg/m^2)	17.93 (2.91)	20.69 (4.62)	22.55 (4.22)
BMI z-score	0.46 (1.08)	-0.12 (8.03)	0.85 (1.13)
Overweight/obese	26.90	27.70	33.30
WC (cm)	64.38 (7.23)	72.61 (9.66)	76.80 (9.83)
WHtR	0.46 (0.05)	0.46 (0.07)	0.46 (0.06)
WHtR >0.50	15.10	22.30	21.90
Sedentary time (min/day)	581.09 (107.81)	671.96 (112.59)	725.80 (115.20)
MVPA (min/day)	158.50 (70.77)	137.29 (64.77)	138.74 (64.39)
Deprivation score	16.26 (10.20)	20.55 (14.21)	19.63 (13.72)

BMI, body mass index; WC, waist circumference; SD, standard deviation; WHtR, waist-to-height-ratio; MVPA, moderate-to-vigorous physical activity.

Table 2. Multinomial logistic regression associations between Year group and adiposity outcomes and screen time behaviours.

Variable	Year 5 Odds ratio (95% CI)	Year 8 Odds ratio (95% CI)	Year 10 Odds ratio (95% CI)
Adiposity outcomes			
Overweight/obese	(Ref)	1.37 (0.72 - 2.61)	1.02 (0.53 - 1.95)
Central obesity	(Ref)	0.92 (0.46 - 1.87)	1.20 (0.55 - 2.58)
Screen time behaviours			
TV > 2 hrs/day	(Ref)	0.61 (0.32 - 1.14)	1.13 (0.56 - 2.26)
TV > 3 hrs/day	(Ref)	0.92 (0.31 - 2.66)	0.80 (0.29 - 2.22)
Video > 2 hrs/day	(Ref)	0.58 (0.30 - 1.13)	1.52 (0.77 - 3.03)
Video > 3 hrs/day	(Ref)	0.85 (0.39 - 1.87)	3.34 (1.28 - 8.71) **
Computer > 2 hrs/day	(Ref)	1.58 (0.88 - 2.85)	5.02 (2.43 - 10.40) ***
Computer > 3 hrs/day	(Ref)	1.54 (0.75 - 3.15)	29.81 (3.93 - 46.37) ***
Phone > 2 hrs/day	(Ref)	2.90 (1.60 - 5.26) ***	11.73 (5.81 - 23.69) ***
Phone > 3 hrs/day	(Ref)	2.54 (1.39 - 4.6) **	10.71 (4.50 - 25.47) ***

Adjusted for gender, deprivation and MVPA in all analyses; Year 5 group were reference category; CI, confidence interval; ** $p \leq 0.01$; *** $p \leq 0.001$.

Table 3. Adjusted linear regression associations between device assessed sedentary time and adiposity outcomes.

Variable	Model 1 †				Model 2 ††			
	B (95% CI)	SE	β	*p*	B (95% CI)	SE	β	*p*
BMI z-score	0.01 (0.00 – 0.01)	0.00	0.19	0.005	0.01 (0.00 – 0.01)	0.00	0.21	0.008
Constant	-2.50 (-5.79 - 0.80)	1.68		0.14	-3.32 (-8.09 - 1.44)	2.42		0.17
Waist circumference	0.03 (0.02 - 0.03)	0.00	0.30	>0.001	0.02 (0.01 - 0.03)	0.01	0.22	>0.001
Constant	46.23 (40.10 - 52.35)	3.11		>0.001	54.22 (45.46 - 62.97)	4.45		>0.001

† Analyses adjusted for gender, Year group and deprivation; † Analyses adjusted for gender, Year group, deprivation and MVPA; B, unstandardised β coefficient; β, standardised β coefficient; BMI, body mass index; CI, confidence interval; SE, Standard error.

Table 4. Adjusted logistic regression associations between screen time behaviours and adiposity outcomes.

Variable	Overweight/obese † Odds ratio (95% CI)	Overweight/obese †† Odds ratio (95% CI)	Central obesity † Odds ratio (95% CI)	Central obesity †† Odds ratio (95% CI)
TV > 2 hrs/day	1.08 (0.60 - 1.93)	1.10 (0.60 - 2.02)	1.20 (0.62 - 2.29)	1.26 (0.64 - 2.48)
TV > 3 hrs/day	0.65 (0.23 - 1.85)	0.63 (0.21 - 1.88)	0.83 (0.27 - 2.56)	0.81 (0.25 - 2.64)
Video > 2 hrs/day	1.31 (0.72 - 2.38)	1.24 (0.67 - 2.31)	1.64 (0.84 - 3.19)	1.55 (0.78 - 3.08)
Video > 3 hrs/day	1.39 (0.67 - 2.90)	1.21 (0.56 - 2.61)	2.28 (1.04 - 5.02) *	1.99 (0.87 - 4.55)
Computer > 2 hrs/day	1.41 (0.80 - 2.47)	1.27 (0.71 - 2.29)	1.61 (0.86 - 3.01)	1.44 (0.75 - 2.77)
Computer > 3 hrs/day	1.55 (0.76 - 3.17)	1.30 (0.62 - 2.74)	1.66 (0.76 - 3.62)	1.37 (0.61 - 3.07)
Phone > 2 hrs/day	1.45 (0.82 - 2.58)	1.43 (0.79 - 2.58)	1.14 (0.60 - 2.17)	1.12 (0.57 - 2.19)
Phone > 3 hrs/day	1.36 (0.75 - 2.46)	1.25 (0.68 - 2.31)	1.36 (0.70 - 2.63)	1.25 (0.63 - 2.48)

† Adjusted for gender, Year group, deprivation; †† Adjusted for gender, Year group, deprivation and MVPA; Year 10 children were the reference group; CI, confidence interval; * $p \leq 0.05$.