Prevalence of high screen time in English youth: association with deprivation and physical activity

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ABSTRACT

Background Physical activity (PA) and deprivation are major determinants of health. We estimated the prevalence of high screen time (ST) among English youth and examined whether deprivation mediated the relationship between ST and PA.

Methods It is a cross-sectional study of 6240 participants (53% boys, aged 10–15 years) enrolled in the East of England Healthy Hearts study. The participants were categorized into three groups based on daily ST: <2, 2–4 or >4 h. Participants were classified as ‘active’ or ‘inactive’ based on PA z-scores.

Results Prevalence of >2 h ST was 36%. Participants reporting <2 h daily ST were more likely to be active than those reporting 2–4 h (adjusted OR: 1.51, 95% CI: 1.26–1.82, P < 0.001) or >4 h (adjusted OR: 2.26, 95% CI: 1.91–2.67, P < 0.001). Analysis of covariance demonstrated a significant main effect for ST on PA (F = 85.7, P < 0.001) with lower PA in each ascending ST group (P < 0.001). Deprivation was not significantly associated with PA and did not mediate the relationship between ST and PA.

Conclusions There is high prevalence of >2 h ST in English schoolchildren. PA is lower in children reporting 2–4 versus <2 h daily ST and lower still in those classified as heavy users (>4 h) independent of deprivation.

Keywords deprivation, physical activity, schoolchildren, screen time, sedentary behaviour

Introduction

A sedentary lifestyle is a major risk factor for chronic disease.1,2 Physical inactivity costs the English economy £8.2 billion a year including the direct costs of treating lifestyle-related diseases and the indirect costs of sickness-related absence from work.2 These costs are also predicted to rise.

Screen time (ST), a common sedentary behaviour, includes television viewing, games console, computer or smartphone usage. In addition to physical activity (PA), ST is independently associated with increased adiposity,3–5 metabolic risk,6,7 and metabolic syndrome8 in children and adolescents.

The prevalence of sedentary behaviours is increasing in the general population3,9 while PA is decreasing. These changes have coincided with the development of new labour-saving devices and sedentary leisure technologies. The displacement hypothesis5 suggests that high ST reduces the time available for children to engage in PA. Marshall et al.10 suggested that this hypothesis should be viewed with caution as results from studies are inconsistent. Overall, Marshall et al.10 found a significant inverse association between television viewing and PA in young people but deemed the association too small to be clinically relevant. The authors suggested that a direct link between ST and PA was difficult to determine due to the large number of unmeasured confounding variables also related to PA in youth. The majority of studies including those in Marshall et al.’s10 meta-analysis assessed only television viewing. Those that have also assessed computer and game console use have done so with considerable methodological

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variation. Notwithstanding inconsistencies in the literature, the recognition of ST as a correlate of health has led the USA\textsuperscript{11} and Australia\textsuperscript{12} to recommend that children be exposed to no more than 2 h daily ST. No such guidelines exist in England.

Deprivation is associated with higher television viewing in adults,\textsuperscript{13} lower PA levels and more sedentary behaviour in children.\textsuperscript{14} Lower parental income is associated with an increased likelihood of children exceeding ST recommendations.\textsuperscript{15} How deprivation interacts with sedentary behaviours and PA patterns in children and adolescents is, however, not fully established. The aim of this study was, therefore, to assess the association between PA and ST and determine if deprivation mediates this relationship in a large cross-sectional sample of English children and adolescents.

**Methods**

After ethical approval by the university of Essex ethical review committee, we recruited 8053 (10.0–15.9 year olds) from a structured convenience sample of 23 state schools. All data collection occurred between 2007 and 2009. Only state-run, comprehensive schools were sampled. We sent letters to schools in the East of England region inviting them to participate in this study and then purposefully selected a representative mix of volunteer schools to take part in the study. The sample was selected to ensure that it had characteristics similar to the East of England in terms of rural (30\%) or urban location (70\%) and area-level deprivation. In England, 80\% of the population live in urban areas, whereas the East has more rural areas. The East of England itself is also relatively affluent with a deprivation score of $\sim 10\%$ below the national average. Physical education (PE) is compulsory for all English school pupils until age 16. All pupils normally attending PE were potentially included in the study; exclusion criteria were the presence of known illness (such as underlying cardiomyopathy) and lack of parental or pupil consent. Schools provided consent for pupils to be tested and we used an additional opt-out approach to parental consent. Finally, verbal consent was required from each participant at a point of testing. This approach resulted in response rate of 98.2\%.

Participants’ mass and stature were measured (to the nearest 0.1 kg and 0.1 cm, respectively) with light clothing (T-shirts and shorts) and without shoes. Body mass index (BMI) of each participant was calculated in kilograms per square metre and $\zeta$-scores generated using the UK 1990 Growth Reference which adjusts for age, sex and skewness.\textsuperscript{16} We categorized BMI twice to determine the effect of our categorization. In the first analysis, BMI was categorized as underweight, normal weight, overweight and obese according to the International Obesity Task force (IOTF) criteria,\textsuperscript{17} which are less arbitrary criteria than the 85th and 95th percentile cut-off points\textsuperscript{16} used by the UK’s National Obesity Observatory.\textsuperscript{18} We grouped underweight and normal weight together, to create three groups based on BMI scores: normal and underweight, overweight and obese.

Each participant completed the Physical Activity Questionnaire for Adolescents (PAQ-A) or Children (PAQ-C). Participants of high school age ($>$11 years) completed the PAQ-A and primary schoolchildren ($<$11 years) completed the PAQ-C.\textsuperscript{19} This instrument has been previously validated.\textsuperscript{20} Age- and sex-standardized PAQ scores ($\zeta$-scores) were dichotomized, by median split, to create physically active and inactive groups.

We obtained an area-level measure of deprivation for each participant using their individual home postcode. The English Index of Multiple Deprivation 2007 (IMD 2007) is measured based on the small-area geographical units known as lower super output areas (LSOAs); each LSOA contains between 1000 and 3000 inhabitants with an average population of 1500 people allowing identification of small pockets of deprivation in an area.\textsuperscript{21} There are 32 482 LSOAs in England and these are ranked from 1, the most deprived to 32 482, the least deprived. These areas are also given scores ranging from 0.37 to 85.46. A lower score indicates low area-level deprivation, with a high score indicating higher deprivation. Within the present data, the lowest IMD 2007 score was 1.96, while the highest was 62.51. Quintiles of deprivation were generated from the ranked IMD 2007 scores in which the first quintile (1) represented the least deprived and last quintile (5) the most deprived.

Participants self-reported daily ST by answering the following question: ‘How much time do you spend on average each day watching television, watching DVDs or videos, using a computer or games console’. Answers were given on a 0–5 point scale with the following answers: none, 0–30 min, 30–60 min, 1–2, 2–4 and $>$4 h. We have determined good ($r > 0.8$) reliability for this question ($n = 38$; age $13.1 \pm 0.9$ years) and answers show good agreement with ST assessed by same day interview (Sandercoc, unpublished work). Participants were grouped according to whether they reported $<$2 h ST as recommended,\textsuperscript{11,12} 2–4 or $>$4 h. The latter value is proposed as another important threshold representing heavy use.\textsuperscript{22,23}

Schools represent natural clusters of participants who may share similar characteristics. We calculated the intracluster correlation coefficient (ICC) for the dependent variable (PAQ $\zeta$-scores). The ICC was 0.022, which resulted in an...
average variance inflation factor of 1.030. Such small values indicate very low levels for clustering of PA levels within schools and similarly low levels of colinearity among independent variables. We did not, therefore, control for clustering in our regression analyses but school was entered as a random factor when PAQ $z$-scores were treated as a continuous variable.

Multilevel logistic regression model with random intercept and random slope in ‘XTMELOGIT’ programme, each school representing a cluster, was carried out to identify the predictors of PA in schoolchildren. The associations of PA with individual predictors were examined first, before adjusting for other variables. Adjusted and unadjusted odds ratios for the explanatory variables (ST, sex, deprivation, age and BMI) were obtained.

To identify more subtle differences in PA levels, we performed an analysis of covariance controlling for sex, IMD score (deprivation), age and BMI $z$-score with school treated as a random factor, ensuring *a priori* that low ($\leq 2$ h) and high ($>2$ h) ST do not significantly differ on IMD score by $t$-test. Statistical analyses were performed using PASW Statistics 18 for windows (SPSS, Inc.: an IBM Company, Chicago, IL, USA), except multilevel modelling which was performed using Stata 10.1 (StataCorp, TX, USA).

**Results**

After excluding participants with missing data for any of the variables of interest, 6240 participants (77.5% of the whole sample, 53% males) were included in the analysis. Descriptive statistics are presented in Table 1. The mean PAQ $z$-scores by ST group are shown in Fig. 1.

Table 1 shows that overall, 36% of participants reported $>2$ h daily ST (38% of boys and 33% of girls). Age-specific prevalence for $>2$ h daily ST increased at around 13 years of age (Table 1).

When multilevel modelling was conducted to analyse the variability in PA, both at the individual and school levels, PA was higher in males than in females in all ST categories. PA was negatively associated with ST, but showed no significant association with deprivation (Table 2). Participants reporting $>2$ h daily ST were more likely to be physically inactive compared with those reporting $>4$ h daily ST. Those who reported $<2$ h daily ST were more than twice as likely to be physically active than those reporting $>4$ h (unadjusted OR: 2.21, 95% CI: 1.87–2.62), while those who reported 2–4 h daily ST were about 50% likely to be active than those who reported $>4$ h (unadjusted OR: 1.51, 95% CI: 1.25–1.82). The odds of being physically active, after adjusting for sex, age, deprivation and BMI, were 2.30 (95% CI: 1.94–2.73) times higher in the $<2$ h group compared with those who reported $>4$ h of daily ST.

In the adjusted model, normal/underweight participants were more likely to be active than obese participants (OR: 1.63, 95% CI: 1.30–2.06). Overweight participants were also more physically active than obese participants (the relationship between PA and BMI was modified by different weight strata). These differences were similar when BMI was divided into four categories (Table 2).

The likelihood of being active was actually lowest in the fourth quintile of deprivation. Despite a trend towards higher odds, schoolchildren in the three least deprived quintiles (Table 2) were not significantly likely to be classified as more physically active than those in the most deprived quintile. Table 2 also contains the adjusted and unadjusted odds ratios demonstrating that ST, sex and BMI were all strong predictors of PA in schoolchildren. The inclusion of random effect for each participant’s school (cluster) in the multilevel modelling improves significantly over a fixed effects logistic model ($P < 0.0001$).

When controlling for school as a random factor, there was a significant main effect for ST on PAQ $z$-scores ($F = 15.2, P < 0.001$). In a second model, additionally controlling for age, sex, BMI and deprivation, the main effect for ST on PAQ $z$-scores was larger ($F = 85.7, P < 0.001$). Post hoc analysis showed significant differences in the estimated marginal means (95%CI) of all ST groups: $<2$ h, 0.22 (0.16–0.28); 2–4 h, 0.02 (−0.05–0.09) and $>4$ h, −0.29 (−0.37 to −0.20). Within this second model, there was no significant difference in PAQ $z$-scores between quintiles of deprivation ($F = 2.1, P = 0.15$). The random factor ‘school’ did show a significant main effect ($F = 7.3, P < 0.001$) as did BMI ($F = 14.6, P < 0.001$) and age ($F = 11.8, P = 0.001$).

**Discussion**

**Main findings of this study**

The primary aim of this study was to determine if deprivation mediated the relationship between ST and PA in youth. We found that schoolchildren who reported $>2$ h of daily ST were less physically active than those who reported lower ST (Fig 1). We found no evidence, however, for an association between ST and deprivation or any evidence that deprivation mediated the association between ST and PA. Given the negative dose–response relationship between ST and PA, limiting ST in schoolchildren to at least $<4$ h, if not $<2$ h daily may be important in a broader effort to increase PA in this age group.
What is already known on this topic?
Sedentary behaviour may impact on health. The recognition of ST as a prevalent sedentary behaviour has led the American Academy of Pediatrics\(^\text{11}\) and Australia’s Department of Health and Ageing\(^\text{12}\) to recommend no more than 2 h daily ST for children and adolescents. The recent Chief Medical Officer’s report has, however, not yet given a 2 h limit for daily ST.\(^\text{24}\)

In agreement with the results from previous studies, males were more likely to be classed as physically active than females.\(^\text{25}\) Regardless of sex, underweight, normal weight and overweight schoolchildren were all more likely to be physically active than obese children.\(^\text{9,25}\) The relationship between BMI and PA showed a positive dose–response relationship, which was independent of ST. Such results should be viewed with caution, as reverse causality between PA and obesity is still being debated. Physical inactivity may lead to obesity as opposed to obesity leading to physical inactivity, but a large reliance on cross-sectional evidence makes it difficult to disentangle this association.\(^\text{26}\)

Longitudinal data in 200 pre-pubescent children show no relationship between PA and change in BMI,\(^\text{27}\) suggesting that physical inactivity is the result of fatness rather than its cause. These findings lead the researchers to conclude that reverse causality may explain why attempts to tackle childhood obesity by promoting PA have largely been unsuccessful.

### Table 1
Descriptive statistics of participants including PA assessed by PAQ and the prevalence of school children who exceed two hours of daily ST

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Total (%)</th>
<th>Active (%, &lt;2 h ST)</th>
<th>Inactive (%, &lt;2 h ST)</th>
<th>Mean PAQ z-score (± SD)</th>
<th>Prevalence of daily ST &gt;2 h</th>
<th>95% Confidence limit (Fisher’s exact)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>288 (4.62)</td>
<td>145 (71.72)</td>
<td>143 (61.54)</td>
<td>3.14 (0.65)</td>
<td>33.33</td>
<td>27.91–39.10</td>
</tr>
<tr>
<td>11</td>
<td>1220 (19.55)</td>
<td>592 (74.83)</td>
<td>628 (67.83)</td>
<td>2.95 (0.67)</td>
<td>28.77</td>
<td>26.24–31.31</td>
</tr>
<tr>
<td>12</td>
<td>1645 (26.36)</td>
<td>797 (74.91)</td>
<td>848 (64.44)</td>
<td>2.93 (0.66)</td>
<td>31.00</td>
<td>28.77–33.30</td>
</tr>
<tr>
<td>13</td>
<td>1372 (21.99)</td>
<td>675 (67.11)</td>
<td>697 (52.80)</td>
<td>2.80 (0.68)</td>
<td>40.16</td>
<td>37.55–42.81</td>
</tr>
<tr>
<td>14</td>
<td>1107 (17.74)</td>
<td>546 (63.00)</td>
<td>561 (52.05)</td>
<td>2.76 (0.70)</td>
<td>42.55</td>
<td>39.61–45.46</td>
</tr>
<tr>
<td>15</td>
<td>608 (9.74)</td>
<td>300 (66.33)</td>
<td>308 (47.08)</td>
<td>2.68 (0.72)</td>
<td>43.42</td>
<td>39.44–47.47</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Deprivation (quintile)</th>
<th>Total (%)</th>
<th>Active (%, &lt;2 h ST)</th>
<th>Inactive (%, &lt;2 h ST)</th>
<th>Mean PAQ z-score (± SD)</th>
<th>Prevalence of daily ST &gt;2 h</th>
<th>95% Confidence limit (Fisher’s exact)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (least deprived)</td>
<td>1254 (20.10)</td>
<td>620 (70.97)</td>
<td>634 (61.51)</td>
<td>2.89 (0.67)</td>
<td>33.81</td>
<td>31.19–36.51</td>
</tr>
<tr>
<td>2</td>
<td>1241 (19.89)</td>
<td>614 (70.68)</td>
<td>627 (59.33)</td>
<td>2.86 (0.66)</td>
<td>35.05</td>
<td>32.40–37.78</td>
</tr>
<tr>
<td>3</td>
<td>1237 (19.82)</td>
<td>621 (68.60)</td>
<td>616 (56.98)</td>
<td>2.86 (0.69)</td>
<td>37.19</td>
<td>34.49–39.95</td>
</tr>
<tr>
<td>4</td>
<td>1233 (19.76)</td>
<td>587 (72.06)</td>
<td>646 (56.66)</td>
<td>2.82 (0.70)</td>
<td>36.01</td>
<td>33.33–38.76</td>
</tr>
<tr>
<td>5 (most deprived)</td>
<td>1275 (20.43)</td>
<td>613 (68.03)</td>
<td>662 (57.10)</td>
<td>2.87 (0.72)</td>
<td>37.65</td>
<td>34.98–40.37</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BMI categories (IOTF)</th>
<th>Total (%)</th>
<th>Active (%, &lt;2 h ST)</th>
<th>Inactive (%, &lt;2 h ST)</th>
<th>Mean PAQ z-score (± SD)</th>
<th>Prevalence of daily ST &gt;2 h</th>
<th>95% Confidence limit (Fisher’s exact)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>287 (4.60)</td>
<td>134 (73.13)</td>
<td>153 (64.71)</td>
<td>2.76 (0.68)</td>
<td>31.36</td>
<td>26.03–37.07</td>
</tr>
<tr>
<td>Normal</td>
<td>4272 (68.46)</td>
<td>2191 (69.74)</td>
<td>2081 (57.57)</td>
<td>2.89 (0.70)</td>
<td>36.19</td>
<td>34.75–37.65</td>
</tr>
<tr>
<td>Overweight</td>
<td>1337 (21.43)</td>
<td>597 (71.36)</td>
<td>740 (60.27)</td>
<td>2.82 (0.65)</td>
<td>34.78</td>
<td>32.22–37.40</td>
</tr>
<tr>
<td>Obese</td>
<td>344 (5.51)</td>
<td>133 (66.17)</td>
<td>211 (54.03)</td>
<td>2.70 (0.62)</td>
<td>41.28</td>
<td>36.03–46.68</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sex</th>
<th>Total (%)</th>
<th>Active (%, &lt;2 h ST)</th>
<th>Inactive (%, &lt;2 h ST)</th>
<th>Mean PAQ z-score (± SD)</th>
<th>Prevalence of daily ST &gt;2 h</th>
<th>95% Confidence limit (Fisher’s exact)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>2931 (46.97)</td>
<td>1398 (72.60)</td>
<td>1533 (61.51)</td>
<td>2.70 (0.63)</td>
<td>33.20</td>
<td>31.49–34.94</td>
</tr>
<tr>
<td>Male</td>
<td>3309 (53.03)</td>
<td>1657 (67.89)</td>
<td>1652 (55.33)</td>
<td>3.00 (0.71)</td>
<td>38.38</td>
<td>36.72–40.06</td>
</tr>
<tr>
<td>Total</td>
<td>6240 (100.00)</td>
<td>3055 (70.05)</td>
<td>3185 (58.30)</td>
<td>2.86 (0.69)</td>
<td>35.95</td>
<td>34.75–37.15</td>
</tr>
</tbody>
</table>

*Age- and sex-specific PAQ z-scores were dichotomized to create a physically active (>0) and inactive group (<0).
What this study adds

Melkevik et al. reported data from 200,615 (11–15-year-old) schoolchildren from 39 North American and European countries and estimated that 41% of children and adolescents accumulate ≥2 h daily ST. This figure is broadly comparable with our prevalence of ≥2 h ST, 36%. We also observed significant sex- and age-related differences in ST. Higher reported ST in boys than in girls is consistent with previous studies but directly opposes the displacement hypothesis, since boys are generally more physically active than girls. Table 1 shows that the proportion of schoolchildren with daily ST ≥2 h rises sharply at 13 years of age but increases little thereafter. Melkevik et al. reported a similar increase in ST at this age, possibly due to an increase in computer use for educational purposes at this age. Such increases may, however, also be associated with 13 years being the lower age limit for registration on a number of the world’s most popular social networking websites including Facebook. The negative association between ST and PA shown here is consistent with the results from previous studies. Most of these studies report weaker associations than in the present study, which might be due to our detailed examination of PA and our more comprehensive definition of ST.

Our results regarding deprivation are contrary to those reported in adults and children from other countries. In adults, lower socioeconomic position and greater deprivation are both associated with higher daily ST. Grund et al. found that low socioeconomic status (SES) was associated with high television viewing (n = 60; aged 5–11 years). More recently, Drenowatz et al. found that 8–11-year-old children from low SES families spent more time watching television and had lower PA levels than high SES children. Gorely et al. also found that lower SES was associated with higher ST and more sedentary behaviour, although only in girls.
The discrepancy in findings could be due to geographical location, as these are the first data on this topic from the UK. There are also potential methodological explanations. The current study used an area-level deprivation index, whereas most other studies have measured SES via parental education, employment or household income alone.\textsuperscript{14,33,35} A full discussion of the relative merits of self-reported SES and deprivation index measures is available elsewhere.\textsuperscript{36,37} Both classification systems have advantages, but area-level deprivation is recommended for use in populations in which it is difficult to assign a socioeconomic position such as the elderly, some women, students and as here, schoolchildren.\textsuperscript{37} The present study used the English IMD. This is a more detailed measure than simple or proxy estimates of SES based on education or employment as it covers many aspects of neighbourhood-level deprivation. The measure has 37 indicators in seven domains, including income, living environment, education, employment, housing, health and crime levels.\textsuperscript{38} Such indices may be more valid for health-related studies as they provide greater insight to health inequalities than using routine estimates of SES.\textsuperscript{36}

England currently has no national guidance regarding daily ST in youth. The results of this study suggest that daily ST for children should be limited to <2 h, allowing children and adolescents sufficient time to engage in levels of PA capable of incurring benefits to health. The recommended ST for children in the USA\textsuperscript{11} and Australia\textsuperscript{12} is 2 h, with US recommendations that children <2 years view no television at all.\textsuperscript{11} Our data show significantly lower PA in youth who exceed the recommended daily exposure, participants reporting 2–4 h daily ST were still more likely to be active than those reporting >4 h, which was previously classified as heavy users.\textsuperscript{22,23}

From a public health perspective, it seems that there may be some initial benefit from discouraging heavy use (>4 h) even if this means small reductions in ST. Eventually, reaching <2 h ST should be a target, but small reductions may appear more achievable to heavy users. We know little of the potential dose–responses below the 2 h level and further investigation is warranted. A small proportion (1.1\%) of our sample reported no ST. It might be of interest to know what characterizes this particular group has; as according to the displacement hypothesis, these individuals would naturally be assumed to be the most active group. Our limited descriptive data on this group, however, suggest that they were somewhat unremarkable. They represented participants from every deprivation category, age group and sex.

The current sample represents the East of England well, and is broadly comparable with much of England. This sample has a wide age range and a large sample size compared with many previous studies.\textsuperscript{14,33} This quality allowed a robust analysis within which we could adjust for potential confounding variables (age, sex and BMI) and is the first study of its size examining how ST and deprivation interact to affect children PA.

**Limitations of this study**

Our chosen measure of PA has the normal limitations associated with self-report scales such as recall bias, inaccurate estimation of PA intensity or day-to-day variations in PA and differing interpretation of scale items. Self-report was the only practicable tool for the simultaneous assessment of a sample this size. A more complete discussion of advantages and disadvantages of self-report assessments of PA in school-aged children is available in several reviews.\textsuperscript{39,40}

While the PAQ is well validated for use in such samples,\textsuperscript{41} it has no agreed cut-off point to define individuals as active or inactive. PAQ-A/C results also do not allow the user to determine whether children achieve current PA guidelines. The arbitrary nature of the median split used here to define active/inactive is a limitation, and criterion-based PAQ-A/C scores related to objective measures of health would be of value.

The region of England studied is less deprived than most, and we cannot exclude the notion that deprivation interacts differently with ST and PA in less affluent areas. We did not separate educational ST from other sources. Educational ST is becoming an increased necessity and recommendations to govern overall levels of this behaviour should pay attention to this fact.

Our measure of sedentary behaviour (including television viewing, PC usage and game console usage) improves on those assessing only TV use,\textsuperscript{31,33} yet this measure remains inadequate as it does not assess chatting, reading, mobile phone use including I-pads, blackberries and other hybrid devices. Constant advances in small-screen media technology mean that any such measurements are almost instantaneously obsolete. Frequent studies using objective data collection methods such as Ecological Momentary Assessment\textsuperscript{42} would be used to frequently update the increasingly sedentary habits of young people. From our results it appears that, in young people at least, further research is needed on the effect of deprivation on children’s PA levels, as this relationship may differ from that observed in adults. These data should be collected in more deprived areas. Further work should also encompass a greater variety of locations and be carried out at different times of year to assess regional and seasonal variations.
Conclusions

Sedentary behaviours and their associations with physical inactivity and childhood obesity are recognized as major public health problems. Constant advances in technology continue to increase the availability of television, games consoles, social networking websites and multiple other sedentary pastimes for young people. ST does seem to displace PA in schoolchildren and this association may be independent of deprivation. Given this, greater ST was associated with lower PA in our sample. The Department of Health in England should adopt guidelines similar to those in the USA and Australia which recommended daily ST in children and adolescents. Local guidance is important since a recent cross-national study concluded that the guidelines implemented in the USA and Australia may be inappropriate for increasing PA of the adolescents in other regions. We would add to the recommendation of <2 h daily ST a warning that, an absolute upper limit of 4 h should be set as it seems, from the dose–response relationship shown here, that this threshold may also be important. Research to determine a ‘safe’ lower limit <2 h is warranted.

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References

21 Department, for Communities and, Local Government. The English Indices of Deprivation 2007. London: Department for Communities


27 Metcalf BS, Hosking J, Jeffery AN et al. Fattness leads to inactivity, but inactivity does not lead to fattness: a longitudinal study in children (EarlyBird 45). Arch Dis Child 2010; Published Online 23 June 2010. doi:10.1136/adc/2009.175927.


