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Associations between indicators of screen time and adiposity indices in Portuguese children ☆

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ABSTRACT

Objectives. To examine associations between three types of screen time (TV, electronic games (EG), and personal computer (PC)) and two proxies of adiposity (body mass index (BMI) and sum of skinfolds) in children.

Design. The sample comprised 17,509 children aged 2–13 years who participated in the 2009/10 Portuguese Prevalence Study of Obesity in Childhood.

Methods. Complex samples generalised linear models, using school as a cluster variable were ran separately for each combination of ST predictor and adiposity-related outcome, adjusting for covariates including age, sex, physical activity, diet, and parental factors. Missing values in predictors and covariates were imputed.

Results. Watching TV for >2 h/day compared to <1 h/day was associated with higher age- and sex-specific BMI standard deviation score (coefficient: 0.06, 95% CI: 0.01 to 0.12, linear trend p = 0.008) and sum of skinfolds (logged and back transformed 0.04, 0.02 to 0.07, p = <0.001). We also found weak evidence for an inverse association between PC and BMI.

Conclusions. Associations between ST and adiposity differ by both type of ST and type of adiposity marker. Only TV viewing was consistently associated with adiposity. Studies using a single adiposity marker looking at total screen time or total sedentary behaviour time may miss or confound type-specific associations.

Introduction

Childhood is when physical activity (PA) and sedentary behaviour (SB) habits begin to form (Hills et al., 2007). Screen-related indicators of SB may be associated with adiposity in children and adolescents, independent of physical activity (Crespo et al., 2001; Ekelund et al., 2006; Lioret et al., 2007).

Screen time (ST) (e.g. TV viewing, playing electronic games, and time spent using a computer), is one of the most prevalent forms of SB. Over 45% of boys and 47% of girls in England spend more than 2 h a day watching TV on weekdays (The Health and Social Care Information Centre, 2009). In Portugal the proportion of children watching more than 2 h of TV a day on weekdays is 28% of boys and 26% of girls, rising to 75% and 74% at weekends (Jago et al., 2012). TV viewing constitutes about half of the total SB (The Health and Social Care Information Centre, 2009). There are indications that TV viewing may have stronger associations with health outcomes than other types of SB (Fulton et al., 2009; Martinez-Gomez et al., 2009; Rey-López et al., 2008; Wake et al., 2003), but many studies focus either on TV viewing alone (Ekelund et al., 2006; Gortmaker et al., 1996), or on an aggregate measure of SB (Elgar et al., 2005; Mitchell et al., 2009) making it possible that type-specific associations between SB and adiposity are being obscured (Wake et al., 2003).

Abbreviations: BMI, Body mass index; CSGLMs, Complex samples generalised linear models; EG, Electronic games; MI, Multiple imputation; PA, Physical activity; PC, Personal computer; SB, Sedentary behaviour; SDS, Standard deviation score; ST, Screen time; TV, Television.

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Common adiposity proxy measures include body mass index (BMI), hip to waist ratio, fat free body mass, and skinfolds. Inconsistencies between studies in measurement of both SB and adiposity may be behind null associations reported in two relatively recent studies (Fulton et al., 2009; Mitchell et al., 2009). For this reason, it is important that SB studies use multiple indices of adiposity, when possible.

The aim of the present study was to examine the associations between different types of ST and markers of adiposity in a large population sample of Portuguese schoolchildren. To our knowledge this is the first study to examine associations between childhood (type-specific) ST and adiposity in Portugal.

Methods

The full unabridged methods section can be found in Appendix B.

Sample

Data are from the Portuguese Prevalence Study of Obesity in Childhood which is a cross sectional study conducted between March 2009 and January 2010 in mainland schools in Portugal. Details on sampling and response rates can be found elsewhere (Jago et al., 2012). Briefly, schools were randomly selected from the Ministry of Education database. Sampling was based on a sex- and age-specific proportionate stratified random design with district as the primary sampling unit. A total of 17,509 2–13 year old children were recruited. Response rate was 57.4%. Ethical approval was given by Direcção Geral de Inovação e Desenvolvimento. Parental informed consent was obtained prior to data collection.

Measurements

The screen-viewing behaviour of the children was assessed by proxy parental questionnaires. Specifically, parents were asked to report the average number of hours per day that the child spent watching TV, using a personal computer (PC) and playing electronic games (EG) on a weekday, on a Saturday and on a Sunday. Response options were none, up to 1 h, 1, 2, 3, 4 h and 5 h or more. Anthropometric measurements (skinfold thickness, height, weight) were taken at school by a trained technician. The questionnaires also inquired about weekday and weekend active play (running, jumping, playing football and cycling), which was recorded using the same categories as TV viewing.

Other information collected in the questionnaire included contextual factors (consumption frequency of unhealthy foods including sodas, iced tea, cakes, chocolate, hamburgers and pizza; number of fruit portions eaten per day; parental weight and height; number of hours of sleep per night; birth weight and breastfeeding duration); parental socioeconomic indicators (parental education; parental employment status) and parental perception of crime in the neighbourhood.

Data handling

Body mass index (BMI = kg/m^2) was calculated for all children and converted to an age- and sex-specific standard deviation score (SDS) using the Cole formula as detailed in Vidmar et al. (2004). The sum of skinfold outcome variable was calculated by taking the sum of the mean of the two readings for each skinfold (triceps, subscapular and suprailiac). For TV, PC, EG and active play time, the original categories were recoded into a proxy continuous variable: none was coded as 0, up to 1 h as 0.5, 1 h as 1, 2 h as 2, and so on. 5 h or more was coded as 5. These proxy continuous variables were then weighted such that weekdays accounted for 5/7ths, and Saturdays and Sundays each accounted for 1/7th of the variable.

For our analyses, the proxy continuous daily TV viewing time variable was re-categorised into three categories: <1 h/day, 1–2 h/day, and >2 h/day. Due to lower per day volumes, different cut-offs were used for PC and EG times (<0.5 h/day, 0.5–1 h/day, >1 h/day). An unhealthy food consumption score was created with higher numbers indicating higher frequency of consumption of unhealthy foods (range from 6 to 36).

Multiple imputation

No predictor variable had more than 17.6% of values missing. However because listwise deletion of cases with missing values led to >50% exclusion, we performed multiple imputation (MI) of missing values in predictor variables using the MI procedure in SPSS (version 18), with linear regression as the type of imputation model. Main results are presented using the pooled outcomes of five imputed datasets while key analyses using the original dataset with listwise deletion can also be found in Appendix A.

Analyses

The association between each ST variable and each of the two adiposity indicators was examined using generalised linear models and multiple linear regression to determine the trend p value. Before analysis, regression assumptions were checked. We used the complex samples generalised linear model (CSGLM) procedure in SPSS 18 to produce results with robust standard errors that take into account clustering of participants by school. To improve normality the sum of skinfolds was logged and outliers outside 4 standard deviations of the mean were removed (114 cases).

Models were adjusted: 1) for age and sex; 2) additionally for all contextual, socioeconomic and parental covariates (average hours of sleep per night, birth weight, duration of breastfeeding, unhealthy diet score, number of pieces of fruit per day, perception of crime in the local area, mother's education and BMI, and father's education and BMI); and 3) additionally for time spent in active play per week. CSGLM coefficients indicate mean differences (in values for each adiposity indicator) between the reference category and each of the other screen viewing categories. The lowest category (<1 h/day for TV and total ST, <0.5 h/day for PC and EG) is the reference category for the mean difference in the outcome (and associated confidence interval for the difference) in all CSGLMs.

As we found little appreciable evidence of age or sex interactions, all analyses were age- and sex-adjusted, but not stratified. All of the above models were mutually adjusted for TV, EG and PC times in the 3rd model.

Results

Sample characteristics

A larger proportion of respondents were in the lowest TV, EG and PC categories than in the highest category (37% compared to 26% for TV time, 58% compared to 4% for EG time, and 48% compared to 7% for PC time). Table 1 presents the sample characteristics by level of TV viewing (prior to MI and exclusion of outliers) with case-wise deletion of missing values. Participants who watched TV >2 h per day were more likely to be male, to be older, to have parents with <9 years of education, and to have parents who were more likely to consider the local area unsafe due to crime than participants who watched TV ≤2 h per day. They were also more likely to have a higher BMI and sum of skinfolds, eat unhealthy food more frequently, and eat fewer pieces of fruit per day. TV viewing was also directly associated with active play.

Appendix Table A.2 compares characteristics of participants with and without missing values. Participants with a missing value for one or more predictor variables on average spend more time watching TV, and on EG and PC use, have lower parental education, and spend more time on active play non-than participants with no missing values ($p<0.001$ for all observations). Participants without missing values had higher BMI and sum of skinfolds (difference in mean BMI 0.22, $p<0.001$ difference in mean sum of skinfolds 0.69, $p=0.002$). These differences imply that missing values are not missing at random, supporting the use of MI rather than listwise deletion.

TV, EG and PC times and adiposity

Table 2 shows the results from the models with TV as the main exposure. Higher levels of TV viewing per day (1 to 2 and >2 h) compared to lower TV viewing levels (<1 h) were associated with both higher BMI SDS and sum of skinfolds in all models. EG time was not associated with BMI SDS or with sum of skinfolds in any model (Table 3). Higher levels of PC time (0.5 to 1 and >1 h) compared to lower PC time (<0.5 h) were weakly positively associated with lower BMI SDS, but not with sum of skinfolds (Table 4).