# Prevalence and Correlates of Screen Time in Youth

## An International Perspective

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**Background:** Screen time (including TV viewing/computer use) may be adversely associated with metabolic and mental health in children.

**Purpose:** To describe the prevalence and sociodemographic correlates of screen time in an international sample of children aged 4–17 years.

**Methods:** Data from the International Children's Accelerometry Database were collected between 1997–2009 and analyzed in 2013. Participants were 11,434 children (48.9% boys; mean [SD] age at first assessment, 11.7 [3.2] years). Exposures were sex, age, weight status, maternal education, and ethnicity. The outcome was self- or proxy-reported screen time <2 or >2 hours/day. Analyses were conducted initially at study level and then combined using random-effects meta-analysis.

**Results:** Within each contributing study, at least two thirds of participants exceeded 2 hours/day of screen time. In meta-analytic models, overweight or obese children were more likely to exceed 2 hours/day of screen time than those who were non-overweight (OR=1.58, 95% CI=1.33,1.88). Girls (vs boys: 0.65; 0.54, 0.78) and participants with more highly educated mothers (vs <university level: 0.53; 0.42, 0.68) were less likely to exceed 2 hours/day of screen time. Associations of age and ethnicity with screen time were inconsistent at study level and non-significant in pooled analyses.

**Conclusions:** Screen time in excess of public health guidelines was highly prevalent, particularly among boys, those who were overweight or obese, and those with mothers of lower educational attainment. The population-attributable risk associated with this exposure is potentially high; further efforts to understand the determinants of within- and between-country variation in these behaviors and inform the development of effective behavior change intervention programs is warranted.
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## Introduction

The influence of sedentary behavior on physical and psychological well-being is an emerging issue in epidemiology.[1] Screen-based behaviors, such as TV viewing and computer use, may be adversely associated with body composition, cardiovascular disease risk factors, mental health, sleep quality, and academic performance in young people.[2,3] These behaviors are highly prevalent during children's leisure time, such that public health agencies recommend that screen time should be limited in this population.[4,5] Identification of population groups most at risk of accumulating excessive screen time enables the appropriate targeting of intervention programs. Pooled international data sets are particularly valuable in this regard, providing high statistical power and greater exposure heterogeneity than is typically possible in single-country studies. The aim of this study was to describe the prevalence and sociodemographic correlates of children's TV viewing and computer use in a large international data set.

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## Methods

Data were obtained from the International Children's Accelerometry Database, a pooled archive of accelerometer data and hypothesized determinants from 20 studies in children.[6] Data were collected in

1997–2009. All contributing studies obtained the relevant ethical approval. Data were extracted from nine studies that provided information on children's screen time: Children Living in Active Neighbourhoods (CLAN); Pelotas 1993 Birth Cohort; European Youth Heart Study (EYHS); Personal and Environmental Associations with Children's Health (PEACH); Iowa Bone Development Study (IBDS); and the National Health and Nutrition Examination Survey (NHANES).

TV viewing and computer use were assessed separately by self-report or parent proxy. Screen time was calculated as the sum of TV viewing and computer use and dichotomized as <2 or >2 hours/day.[4] The 2 hours/day threshold is supported by review evidence of the association between screen time and markers of body composition in this population.[2] The following exposure variables were examined: sex, age, weight status, maternal education, and ethnicity. Weight status was categorized as non-overweight versus overweight or obese, according to age- and sex-specific BMI reference values.[7] Maternal education was dichotomized as non-attendance versus attendance of university. Ethnicity was categorized as non-Hispanic white versus non-white. Exposures exhibiting minimal within-study heterogeneity (<5% of responses in one category) were not considered in study-level analyses.

Analyses were performed in 2013 using Stata, version 12.0. Study-level characteristics were summarized and the prevalence of exceeding 2 hours/day of screen time was calculated. Associations between exposures and the log odds of exceeding 2 hours/day of screen time were estimated using logistic regression, with a random effect at the participant level in studies that included multiple waves of assessment. Study-level estimates were combined using random-effects meta-analysis. Heterogeneity between studies was quantified using the $I^2$ statistic.

## Results

Characteristics of contributing studies are presented in Table 1. Outcome data were available for 11,434 participants (48.9% boys; mean [SD] age at first assessment, 11.7 [3.2] years), who contributed 14,124 observations on screen time. The percentage of participants providing one, two, three, and four observations was 64.6%, 19.7%, 7.1%, and 8.6%, respectively. At least two thirds of participants exceeded 2 hours/day of screen time across all included studies, and in most cases prevalence was greater than 50%. Results of the regression and meta-analytic modeling are presented in Table 2. Relative to their respective reference groups, girls and children with more highly educated mothers were less likely to exceed

**Table 1.** Descriptive characteristics of included studies

| Study | Country | Year | n: Boys | n: Girls | Age range (years) | Weight status (% overweight/obese) | Ethnicity (% white) | Mother education (% university+) | Screen time (% >2 hours/day) |
|---|---|---|---|---|---|---|---|---|---|
| **CLAN** | Australia | 2001 | 518 | 589 | 4–15 | 27.0 | –[a] | 36.0 | 59.3 |
| | | 2004 | 146 | 169 | 13–15 | 28.1 | –[a] | 40.8 | 51.8 |
| **Pelotas** | Brazil | 2006–07 | 238 | 219 | 12–14 | 23.0 | 67.0 | –[a] | 76.4 |
| **EYHS** | Denmark | 1997–98 | 403 | 454 | 8–16 | 13.1 | 94.3 | 26.4 | 34.3 |
| | | 2003–04 | 385 | 504 | 8–17 | 14.3 | 94.1 | 42.6 | 46.9 |
| | Estonia | 1998–99 | 290 | 362 | 8–17 | 9.4 | 97.6 | 37.9 | 62.4 |
| | Norway | 1999–00 | 190 | 182 | 8–10 | 12.2 | 83.3 | 52.6 | 48.7 |
| | Portugal | 1999–00 | 270 | 280 | 9–16 | 20.0 | 97.9 | 4.8 | 63.6 |
| **PEACH** | England | 2006–08 | 623 | 639 | 9–11 | 22.9 | 83.7 | 32.1 | 47.1 |
| | | 2007–09 | 423 | 469 | 11–12 | 24.0 | 86.2 | 34.6 | 58.5 |
| **IBDS** | USA | 1998–00 | 192 | 223 | 4–7 | 17.6 | 94.2 | 49.1 | 62.2 |
| | | 2000–04 | 247 | 250 | 7–11 | 29.8 | 94.6 | 50.0 | 58.4 |
| | | 2003–05 | 212 | 232 | 10–12 | 34.3 | 95.1 | 50.8 | 33.8 |
| | | 2005–07 | 199 | 200 | 12–14 | 33.2 | 94.7 | 50.4 | 38.9 |
| **NHANES** | USA | 2003 | 1,239 | 1,194 | 6–17 | 38.0 | 26.1 | –[a] | 78.7 |
| | | 2005 | 1,285 | 1,298 | 6–17 | 36.2 | 26.6 | –[a] | 72.5 |

[a]Data not collected.
CLAN, Children Living in Active Neighbourhoods; EYHS, European Youth Heart Study; IBDS, Iowa Bone Development Study; PEACH, Personal and Environmental Associations with Children's Health; NHANES, National Health and Nutrition Examination Survey.

**Table 2.** Study-level ORs (95% CIs) and pooled meta-analytic estimate for exceeding 2 hours/day of screen time

| Study | Sex (ref: boys) | Age (continuous) | Weight (ref: normal) | Maternal education (ref: <university) | Ethnicity (ref: white) |
|---|---|---|---|---|---|
| CLAN | **0.67 (0.50, 0.91)**** | —[a] | **1.61 (1.15, 2.25)**** | **0.41 (0.30, 0.56)**** | —[b] |
| Pelotas | 0.94 (0.60, 1.46) | **0.46 (0.22, 0.95)*** | 1.57 (0.90, 2.75) | —[b] | **0.60 (0.38, 0.95)*** |
| EYHS Denmark | **0.46 (0.36, 0.58)**** | **1.08 (1.04, 1.12)**** | **1.78 (1.29, 2.45)**** | **0.74 (0.58, 0.93)**** | 1.37 (0.84, 2.22) |
| EYHS Estonia | **0.69 (0.49, 0.98)*** | 1.04 (0.98, 1.10) | 1.68 (0.92, 3.10) | **0.70 (0.50, 0.99)*** | —[b] |
| EYHS Norway | **0.61 (0.39, 0.96)*** | 0.83 (0.41, 1.66) | 1.87 (0.92, 3.81) | **0.44 (0.27, 0.70)**** | 1.62 (0.86, 3.05) |
| EYHS Portugal | **0.64 (0.45, 0.92)*** | **1.15 (1.08, 1.22)**** | 1.06 (0.68, 1.66) | —[b] | —[b] |
| PEACH | 0.62 (0.37, 1.02) | **1.68 (1.21, 2.33)**** | **2.33 (1.24, 4.38)**** | **0.40 (0.23, 0.70)**** | 1.63 (0.70, 3.99) |
| IBDS | **0.50 (0.36, 0.71)**** | **0.81 (0.77, 0.85)**** | **2.08 (1.49, 2.91)**** | **0.49 (0.35, 0.68)**** | 0.88 (0.38, 2.02) |
| NHANES | **0.83 (0.73, 0.95)**** | —[a] | **1.27 (1.11, 1.46)**** | —[b] | **1.26 (1.09, 1.45)**** |
| Pooled estimate | **0.65 (0.54, 0.78)**** | 1.03 (0.89, 1.19) | **1.58 (1.33, 1.88)**** | **0.53 (0.42, 0.68)**** | 1.14 (0.84, 1.53) |
| Heterogeneity ($I^2$) | 68.8%, $p<$**0.01** | 94.9%, $p<$**0.01** | 46.1%, $p$=0.06 | 63.7%, $p$=**0.02** | 56.1%, $p$=**0.04** |

*Note:* Boldface indicates statistical significance (*$p<0.05$; **$p<0.01$). Regression models were mutually adjusted for all exposures available within each study.

[a]Association of age with screen time was non-linear. Results (OR [95% CI]) are presented with age categorized using study-specific quartiles (Q). CLAN: Q1 (ref), Q2, 1.85 (1.23, 2.78)**; Q3, 2.10 (1.38, 3.18)**; Q4 1.25 (0.85, 1.85). NHANES: Q1 (ref), Q2, 0.98 (0.82, 1.18); Q3, 0.78 (0.65, 0.94)**; Q4, 1.05 (0.87, 1.27).

[b]Data not collected or insufficient heterogeneity (<5% responses in one category).

CLAN, Children Living in Active Neighbourhoods; EYHS, European Youth Heart Study; IBDS, Iowa Bone Development Study; PEACH, Personal and Environmental Associations with Children's Health; NHANES, National Health and Nutrition Examination Survey.

2 hours/day of screen time. Compared to non-overweight children, those who were overweight or obese were more likely to exceed 2 hours/day of screen time. In pooled analyses, no significant associations with screen time were identified for age or ethnicity. Heterogeneity ranged from 46% to 94%.

## Discussion

Screen time in excess of current guidelines was highly prevalent, demonstrating widespread usage of screen-based media in young people. Viewed alongside burgeoning evidence linking TV viewing with adverse cardiometabolic health, the population-attributable risk associated with screen viewing in childhood is potentially substantial. Rapid advancements and increased ownership of information and communications technology in recent years has seen the variety of screen-based media available to young people expand significantly. Nonetheless, TV viewing in the traditional sense (watching live or time-shifted content on a TV set delivered by broadcast signal or paid TV subscription) remains the predominant source of children's electronic media use in the U.S.[5] Different screen-based behaviors may have differential impacts on health and well-being[8]; thus, in light of the established evidence base, TV viewing remains a key target for public health intervention in youth.

Children who were overweight or obese had greater odds of exceeding 2 hours/day of screen time than those of normal weight. This is consistent with much of the existing observational evidence on this topic, but the temporal sequence of this association, and whether it is in fact bidirectional, remains unclear.[9] The mechanisms that may underlie a causal sequence wherein screen time promotes excess adiposity also require further investigation. Despite these uncertainties, the evidence is sufficient to endorse continued efforts to limit screen time for the benefit of metabolic health in this population.

Girls and participants with more highly educated mothers had lower odds of exceeding 2 hours/day of screen time compared with their respective reference groups. Findings are largely consistent with previous research[10] and serve to highlight population groups that may be suitable for targeted intervention programs. The direction of associations was largely consistent across analyzed studies; variation in the magnitude of the associations, together with a small number of divergent findings, likely account for the larger $I^2$ values observed in some models.

Associations of age and ethnicity with screen time were notable in their variability. For example, the association between age and screen time was negative in the Pelotas and IBDS but positive in EYHS Denmark/Portugal and the PEACH study. Age-related trends in screen time may be country-specific or obscured by secular trends in media use that have accompanied recent technologic developments.

Examination of differences in screen time across ethnic groups may have been hindered by the relatively crude categories applied; this compromise, however, was necessary in order to facilitate data harmonization. In addition, the patterning of screen time across ethnic groups may vary between countries, as may related interactions with SES. This may account, in part, for the contrasting associations observed in the NHANES and Pelotas studies, for example. Further work exploring age- and ethnicity-related variability in screen time will help inform the timing and targeting of intervention programs.

The key strength of this study is the collation and harmonization of outcome and exposure assessments from a large, heterogeneous sample of children aged 4–17 years. Validity and reliability of items used to assess screen time likely varied between studies; this may have contributed to observed differences in prevalence. Bias in the reporting of screen-based behaviors may also have changed in concert with secular changes in electronic media availability.

Loss of information due to derivation of a binary screen time outcome is acknowledged as a limitation; however, this was necessary to facilitate data harmonization across contributing studies. Sensitivity analyses were conducted to examine correlates of TV viewing and computer use separately and results were largely unchanged (data not shown). Owing to the cross-sectional nature of the analysis, it is not possible to establish causality of the observed associations.

In this large international analysis, TV viewing and computer use were highly prevalent and patterned across sociodemographic factors. Continued work to inform the development of interventions to limit screen time is a public health priority.

The International Children's Accelerometry Database (ICAD) Collaborators include the ICAD Steering Committee: Ashley R. Cooper (Bristol University, United Kingdom [UK]); Ulf Ekelund (Norwegian School of Sport Sciences, Oslo, Norway, MRC Epidemiology Unit, University of Cambridge, UK); Dale W. Esliger (Loughborough University, UK); Angie S. Page (Bristol University, UK); Lauren B. Sherar (Loughborough University, UK); and Esther M.F. van Sluijs (MRC Epidemiology Unit, University of Cambridge, UK); and the following ICAD data contributors: Professor J. Salmon (Children Living in Active Neigbourhoods [CLAN], School of Exercise and Nutrition Sciences, Deakin University, Melbourne, Australia); Dr. K. Froberg (European Youth Heart Study [EYHS] Denmark, University of Southern Denmark, Odense, Denmark); Professor L.B. Sardinha (EYHS Portugal, Exercise and Health Laboratory, Faculty of Human Movement, Technical University of Lisbon, Lisbon, Portugal); Professor S. Anderssen, EYHS Norway, Norwegian School for Sport Science, Oslo, Norway); Professor K.F. Janz (Iowa Bone Development Study, Department of Health and Sports Studies, Department of Epidemiology, University of Iowa, Iowa City IA); CDC, National Center for Health Statistics (National Health and Nutrition Examination Survey [NHANES]); Professor A. Cooper (Personal and Environmental Associations with Children's Health [PEACH], Centre for Exercise, Nutrition and Health Sciences, University of Bristol, Bristol, UK); and Dr. P. Hallal (1993 Pelotas Birth Cohort, Postgraduate Program in Epidemiology, Federal University of Pelotas, Pelotas, Brazil).

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