Association of Trajectory and Covariates of Children’s Screen Media Time

Mai-Han Trinh, BS; Rajeshwari Sundaram, PhD; Sonia L. Robinson, PhD; Tzu-Chun Lin, MS; Erin M. Bell, PhD; Akhgar Ghassabian, MD, PhD; Edwina H. Yeung, PhD

IMPORTANCE Many children begin interacting with screen media as early as infancy. Although screen time is associated with negative developmental consequences, few longitudinal studies in the United States have examined covariates of screen time among children under 3 years of age.

OBJECTIVES To identify trajectories of screen time among children aged 1 to 3 years, to examine their association with screen use at 8 years of age, and to assess potential determinants of screen time.

DESIGN, SETTING, AND PARTICIPANTS This prospective birth cohort study included 3895 children (3083 singletons and 812 unrelated multiples) in New York State who had screen time data available for at least 1 time point from 1 to 3 years of age; 1156 children had data at 8 years. The study spanned September 4, 2007, through June 12, 2014, in the first phase, and August 29, 2014, through November 15, 2019, in the second phase. Data analysis for the present study was conducted from September 28, 2018, to July 15, 2019.

MAIN OUTCOMES AND MEASURES Maternal reports of children’s television, movie, and computer game times were summed for total daily screen time at 12, 18, 24, 30, and 36 months of age. Two screen time trajectories (low and increasing use) were classified by cluster analysis, and logistic regression was used to model risk factors for the increasing trajectory. Children exhibiting the highest 10th percentile of screen use at each point were examined, and linear mixed models were used to identify risk factors of this high exposure category.

RESULTS Among the 3895 children included in the analysis (2031 boys [52.1%] and 1864 girls [47.9%]), median daily screen time increased from 30 (interquartile range, 0-60) minutes at 12 months of age to 120 (interquartile range, 75-200) minutes at 36 months of age. Of 1045 children with complete data at all 5 time points, 279 (26.7%) had an increasing screen time trajectory. Female child sex (adjusted odds ratio [aOR], 0.90; 95% CI, 0.81-0.99) and graduate school levels of paternal (aOR, 0.73; 95% CI, 0.56-0.95) and maternal (aOR, 0.60; 95% CI, 0.47-0.77) education, compared with having completed college, were associated with lower risk of increasing trajectory. Maternal nulliparity was associated with higher risk of increasing trajectory (aOR, 1.14; 95% CI, 1.00-1.30). Children with an increasing trajectory from 1 to 3 years of age had an additional 22 (95% CI, 11-33) minutes per day of screen time at 8 years of age. Covariates associated with the highest 10th percentile of screen exposure included paternal graduate school education compared with college (aOR, 0.63; 95% CI, 0.39-0.99), maternal graduate school education compared with college (aOR, 0.55; 95% CI, 0.37-0.82), maternal nulliparity (aOR, 1.98; 95% CI, 1.50-2.61), twins compared with singletons (aOR, 1.41; 95% CI, 1.05-1.91), non-Hispanic black compared with non-Hispanic white race/ethnicity (aOR, 4.77; 95% CI, 2.25-10.10), and type of care (home-based care aOR, 2.17 [95% CI, 1.38-3.41]; parental care aOR, 2.11 [95% CI, 1.41-3.15]) compared with center-based care.

CONCLUSIONS AND RELEVANCE These findings suggest that a range of parental and child characteristics are associated with screen time. Screen time habits appear to track from as early as infancy, emphasizing the need for earlier interventions.
Concern about screen time of young children has grown in recent years. Screen media exposure for children younger than 2 to 3 years has been documented to negatively affect child health and development. As such, the American Academy of Pediatrics (AAP) discourages toddlers and infants younger than 18 months from being exposed to any digital media, after which screen media should be slowly introduced from 18 to 24 months of age. Children aged 2 to 5 years are recommended to limit screen time to 1 hour per day. Despite such recommendations, a nationally representative 2013 survey found that US children younger than 2 years spent approximately 1 hour per day with screen media, whereas those aged 2 to 4 years had a mean of nearly 2 hours per day.

In previous studies, higher screen time has been associated with racial/ethnic minority groups, maternal depression, and home-based vs center-based child care settings. However, inconsistencies in whether maternal age, parental educational level, and the presence of siblings are associated with higher screen time suggest that remaining determinants require further examination. Moreover, it is important to study screen time patterns using a longitudinal framework because children’s use may change over time. To date, most studies examining longitudinal trajectories of screen time begin at 5 years or older; however, behavior patterns may be established earlier in childhood. One study in Taiwan identified 3 distinct trajectories of low, increasing, and high television viewing among children aged 1.5 to 5.5 years. To our knowledge, no other studies have classified multiple trajectories of screen time starting in infancy. In addition, few studies have examined whether screen time habits in children younger than 3 years persist when the child enters school. Of these, a single measurement of early screen time is generally used, whereas repeated measures during the early years may provide a stronger indication of longitudinal screen habits.

Given these gaps in the literature, the aim of this study was to describe the trajectory and determinants of screen media use, including television, movie, and computer time, among children aged 1 to 3 years. We also investigated whether children’s screen time trajectory from 1 to 3 years of age was associated with screen time at 7 and 8 years of age.

**Trajectory and Covariates of Children’s Screen Media Time**

**Key Points**

**Question** What are the trajectories and covariates associated with screen time among children aged 3 years and younger?

**Findings** In this cohort study of 3895 children aged 1 to 3 years with screen media time classified into trajectories of low and increasing use, higher parental educational levels and female child sex were associated with a lower risk of increasing trajectory, whereas maternal nulliparity was associated with a higher risk. Increasing trajectory status was associated with greater screen time at 8 years of age compared with the low trajectory.

**Meaning** This study suggests that screen time patterns are associated with several sociodemographic characteristics and may persist over childhood starting from a young age.

**Outcome Measurements**

In questionnaires when children were aged 12, 18, 24, 30, and 36 months, mothers reported the mean number of hours or minutes per day their child spent watching television shows, watching movies, and playing computer games since the time of the previous questionnaire. In follow-up when children were aged approximately 7 and 8 years, mothers reported children’s time watching television or movies, playing video games on a game console (eg, Wii, PlayStation, or Xbox), and using a computer or the internet during the past week. For each time point, the 3 screen activities were summed to obtain total screen time.

**Covariates**

Maternal age, nulliparity, child sex, and child plurality were obtained from vital records. Maternal nulliparity refers to previously nulliparous (ie, first-time) mothers. Paternal and maternal educational levels, marital status, parental employment, and household use of a non-English language were maternally reported through questionnaires. Race/ethnicity and infertility treatment were obtained from maternal report, with vital records used when questionnaire data were unavailable. The Townsend index, a measure of economic deprivation, was calculated using census information. Maternal depression was measured longitudinally at 12, 24, and 36 months of age; child care, at 12, 18, 24, 30, and 36 months of age. Child care was coded as home based or center based if

**Methods**

**Study Design and Population**

The Upstate New York Infant Development Screening Program (Upstate KIDS) is a population-based, prospective cohort study created to examine the role of infertility treatments on child development. The study used the New York live birth registry to identify children born in New York State from January 1, 2008, through December 31, 2010. All mothers of infants whose birth certificates indicated use of infertility treatment were invited to participate. Infants conceived by infertility treatment were frequency matched by birth region and plurality in a 1:3 ratio to those not conceived by infertility treatment. In total, 5034 mothers (27.2% of 18 479 approached) and 6171 children were recruited. The first phase spanned September 4, 2007, through June 12, 2014. The study launched a second phase of data collection on children’s development and behavior at 7 to 8 years of age August 29, 2014, through November 15, 2019.

The New York State Department of Health and the University at Albany institutional review boards approved the study, serving as the institutional review board designated by the National Institutes of Health under a reliance agreement. Parents provided written informed consent. This study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guidelines.

**Covariates**

Maternal age, nulliparity, child sex, and child plurality were obtained from vital records. Maternal nulliparity refers to previously nulliparous (ie, first-time) mothers. Paternal and maternal educational levels, marital status, parental employment, and household use of a non-English language were maternally reported through questionnaires. Race/ethnicity and infertility treatment were obtained from maternal report, with vital records used when questionnaire data were unavailable. The Townsend index, a measure of economic deprivation, was calculated using census information. Maternal depression was measured longitudinally at 12, 24, and 36 months of age; child care, at 12, 18, 24, 30, and 36 months of age. Child care was coded as home based or center based if
children spent more than 20 hours per week at that respective care location; otherwise, care type was coded as parental care. Time-varying models included maternal depression and child care at all measured time points, whereas time-invariant models used only the first measurement at 12 months of age.

Statistical Analysis
Data were analyzed from September 28, 2018, to July 15, 2019. The study included all singletons and 1 randomly selected child from each multiple set. Discordant screen time by twin status was not observed (mean [SD] difference in screen time between twins, 6.15 [31.60] min/d). Analyses were restricted to participants with screen time data available for at least 1 point from 1 to 3 years of age (n = 3895). eTable 1 in the Supplement compares baseline characteristics between included and excluded participants. To account for children excluded owing to missing data, inverse probability weights were generated from a multivariate logistic regression model in which the outcome was having information on screen time for at least 1 point (yes or no). Covariates in the model included paternal educational level; maternal age, nulliparity, educational level, and marital status; parental race/ethnicity; child sex, plurality, and conception by infertility treatment; and household economic deprivation. Sampling weights, used to correct for the oversampling of infants conceived by infertility treatment, were then multiplied to inverse probability weights. Sampling weights were derived using New York State birth certificate data on infertility treatment, birth region, and plurality for all infants born during the recruitment period.34 Missing data on covariates and screen time at 1 to 3 years of age within the analytic sample were then completed with multiple imputation by chained equations using the mice package in R, version 3.5.1 (R Project for Statistical Computing), to create 20 imputed data sets with 5 iterations.

First, screen time trajectories from 1 to 3 years of age were identified with cluster analysis using the traj package in R, version 3.5.1.37 The optimal number of clusters was selected identified with cluster analysis using the traj package in R, version 3.5.1.38

Contrary to the trajectory analyses, which clustered children into distinct groups for the duration of observation (ie, 1-3 years of age), this time-varying model allows for comparisons between children at each observation period, thus allowing for changes in screen time use between observational points. This model addresses the factors associated with children having higher use than their peers at any point from 1 to 3 years of age. The cluster trajectory analyses also answer the question of why certain children's screen use adheres to a distinct pattern (ie, increasing over time) but may not necessarily be higher at any single point compared with their peers. Because most children (3373 [86.6%]) did not adhere to AAP guidelines for at least 1 point, we established a study-specific cutoff point examining the highest 10th percentile of screen time, using age groups set by AAP guidelines (ie, $\geq$3 hours per day for children aged <24 months and $\geq$4 hours per day for those aged $\geq$24 months).

Results
Among 3895 children, 2031 (52.1%) were boys and 1864 (47.9%) were girls; 2973 of 3861 (77.0%) were non-Hispanic white (Table 1). Approximately one-third of mothers completed graduate school (1229 [31.6%]). At 1 year of age, 1988 of 3016 children (65.9%) were primarily cared for by parents, decreasing to 1294 of 2134 (60.6%) by 3 years of age.

Mean daily screen time rose from nearly 1 hour (mean [SD], 53.45 [80.81] minutes; median, 30 [range, 0-60] minutes) at 1 year of age to more than 2 hours (mean [SD], 150.65 [99.84] minutes; median, 120 [range, 75-200] minutes) at 3 years of age (Figure 1). At 7 years of age, screen exposure decreased to less than 1.5 hours (mean [SD], 76.99 [61.22] minutes; median, 60 [range, 30-90] minutes), presumably owing to time displaced by school-related activities. This decline from 3 to 7 years of age was unlikely to be owing to differential loss to follow-up because the same trend was present among children (n = 398) with complete screen time data for all 7 points (eFigure in the Supplement).

Children with complete follow-up at all 5 points (n = 1045) were classified into 2 distinct clusters based on their trajectory of screen time from 1 to 3 years of age (Figure 2). The low trajectory (766 [73.3%]) was characterized by a relatively stable amount of screen time, starting at a mean (SD) of 50.58 (80.55) minutes (median, 30 [range, 0-60] minutes) at 1 year of age and leveling off at 106.87 (62.77) minutes (median, 120 [range, 60-135] minutes) by 3 years of age (eTable 2 in the Supplement). The increasing trajectory (279 [26.7%]) had a lower mean (SD) of 36.94 (50.25) minutes (median, 20 [range, 0-60] minutes) at 1 year of age but exhibited a much sharper increase over time, resulting in a mean (SD) of 235.62 (88.81) minutes (median, 240 [range, 180-300] minutes) at 3 years of age. eTable 3 in the Supplement provides descriptive comparisons of sociodemographic characteristics by screen time trajectory.

In adjusted logistic regression (Table 2), attainment of graduate school vs college levels for paternal (adjusted odds ratio [aOR], 0.73; 95% CI, 0.56-0.95) and maternal (aOR, 0.60; 95% CI, 0.47-0.77) educational level and female child sex (aOR, 0.90; 95% CI, 0.81-0.99) were associated with lower risk of children's classification in the increasing trajectory.
Maternal nulliparity (aOR, 1.14; 95% CI, 1.00-1.30) was associated with a greater risk of increasing trajectory. Children's trajectory from 1 to 3 years of age was also associated with later school-aged screen use. Increasing trajectory status was associated with an additional 15.73 (95% CI, 5.37-26.10) minutes per day of screen time at 7 years of age and 22 (95% CI, 11-33) minutes per day at 8 years of age (Table 3).

High screen exposure, defined by the highest 10th percentile of screen time, was associated with a broad range of factors (Table 2). Compared with having completed college, a paternal educational level of less than high school (aOR, 2.46; 95% CI, 1.41-4.29) and maternal educational level of high school or General Educational Development (aOR, 2.25; 1.42-3.58) were associated with a greater risk of children's high screen exposure at any point from 1 to 3 years of age. Maternal nulliparity was also associated with a higher risk of high screen use (aOR, 1.98; 95% CI, 1.50-2.61). Twin compared with singleton plurality (aOR, 1.41; 95% CI, 1.05-1.91) was associated with a greater risk of children's high screen exposure at any point from 1 to 3 years of age. Maternal nulliparity (aOR, 1.14; 95% CI, 1.00-1.30) was associated with a greater risk of increasing trajectory. Children's trajectory from 1 to 3 years of age was also associated with later school-aged screen use. Increasing trajectory status was associated with an additional 15.73 (95% CI, 5.37-26.10) minutes per day of screen time at 7 years of age and 22 (95% CI, 11-33) minutes per day at 8 years of age (Table 3).

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Discussion

Key Findings

In the Upstate KIDS cohort, most children (86.6%) did not adhere to AAP screen time recommendations. Children's screen time trajectories from 1 to 3 years of age were clustered into 2 distinct patterns of stable low vs increasing use, with 26.7%...
of children in the increasing trajectory. Paternal and maternal educational levels, maternal nulliparity, and child sex were associated with children's classification in the increasing trajectory. Increasing trajectory status was associated with an additional 15 to 20 minutes of daily screen time at 7 to 8 years of age. When modeling the top 10th percentile of screen time, paternal educational level, maternal educational level and nulliparity, and child plurality, race/ethnicity, and child care type were associated with children having higher use than their peers at any given time point from 1 to 3 years of age.

Screen Time Trends
Consistent with previous work, our study observed poor adherence to the AAP guidelines. For instance, a 2005 study of 412 children aged 0 to 2 years observed 70% not adhering to AAP guidelines. Similar to the trend we found, a cross-sectional 1999 survey indicated that total media consumption rapidly increases until preschool age, declines from 3 to 7 years of age, and increases again from 8 to 11 years of age. However, a longitudinal 1990-1998 study found that television viewing levels off, rather than declining, from 3 to 7 years of age. At 7 and 8 years of age, the mean screen time of children in the present study was almost 1.5 hours less than that in the 2012 National Health and Nutrition Examination Survey (n = 491). Our findings of lower screen time among older children may be owing to the higher socioeconomic status of this cohort compared with the general population, along with differences in the wording of survey questions and time frame assessed. However, screen time at an early age and among older children clearly appears to maintain a role in children's daily lives.

Screen Time Trajectories and Covariates
To our knowledge, no other US study has classified longitudinal trajectories of screen time among children younger than 3 years. The Taiwan Birth Cohort Study followed up infants born in 2005 to 18, 36, and 66 months of age. Three trajectories of consistently low (20%), increasing (47%), and consistently high (34%) television viewing were identified among more than 18,000 children. The increasing trajectory identified is similar to the one observed in Upstate KIDS, although we found higher mean screen times at 18 and 36 months of age. Differences may be owing to a period effect of increased screen media availability by the time of the present investigation. Nevertheless, similar to the Taiwanese study, we identified lower parental educational level and male child sex as factors associated with the increasing trajectory vs low trajectory. The authors of the Taiwan study also observed that home-based child care settings were associated with the increasing trajectory. Although we did not find a significant association between child care type and screen time trajectory, we instead identified an association with first-time mothers (ie, previously nulliparous).

Covariates of High Screen Time
Child factors associated with high screen time included care type and twin plurality. Although results are mixed, most studies examining differences in child care type similarly found that children who had private home care or no formal care had greater television use than those in center-based programs. Twin plurality, a factor not previously examined as a covariate of screen time in young children, was associated with greater risk of high screen use; this finding may be owing to caretakers using screens to easily occupy multiple children at once. Last, consistent with most studies of children younger than 3 years, we observed no association between child sex and screen use.

Of the maternal factors assessed, only nulliparity was positively associated with children's screen time. This finding is comparable to that of a previous study identifying a negative association between children's screen time and number of siblings. Having other children to interact with, such as older siblings, may explain this protective association. Previously linked to higher child screen time, maternal depression was not a significant covariate in this study, perhaps owing to the lower prevalence (23% [7.8%]) of women with postpartum depression herein compared with previous reports and differences in timing of measurement.
Table 2. Adjusted Odds for the Increasing and High Screen Time Exposure, According to Parental, Child, and Household Characteristicsa

<table>
<thead>
<tr>
<th>Covariate</th>
<th>Screen Exposure, aOR (95% CI)</th>
<th>Increasing Trajectoryb</th>
<th>Top 10th Percentilec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paternal educational level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than high school</td>
<td>0.99 (0.67-1.45)</td>
<td>2.46 (1.41-4.29)</td>
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<tr>
<td>High school or GED</td>
<td>1.10 (0.87-1.40)</td>
<td>1.81 (1.15-2.84)</td>
<td></td>
</tr>
<tr>
<td>Some college</td>
<td>1.32 (1.03-1.68)</td>
<td>1.91 (1.33-2.75)</td>
<td></td>
</tr>
<tr>
<td>College</td>
<td>1 [Reference]</td>
<td>1 [Reference]</td>
<td></td>
</tr>
<tr>
<td>Graduate school</td>
<td>0.73 (0.56-0.95)</td>
<td>0.63 (0.39-0.99)</td>
<td></td>
</tr>
<tr>
<td>Maternal age</td>
<td>1.02 (0.99-1.05)</td>
<td>1.00 (0.97-1.02)</td>
<td></td>
</tr>
<tr>
<td>Nulliparity</td>
<td>1.14 (1.00-1.30)</td>
<td>1.98 (1.50-2.61)</td>
<td></td>
</tr>
<tr>
<td>Maternal educational level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than high school</td>
<td>1.20 (0.87-1.65)</td>
<td>1.43 (0.73-2.79)</td>
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<tr>
<td>High school or GED</td>
<td>1.53 (1.21-1.95)</td>
<td>2.25 (1.42-3.58)</td>
<td></td>
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<tr>
<td>Some college</td>
<td>1.07 (0.91-1.27)</td>
<td>1.57 (1.06-2.31)</td>
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<tr>
<td>College</td>
<td>1 [Reference]</td>
<td>1 [Reference]</td>
<td></td>
</tr>
<tr>
<td>Graduate school</td>
<td>0.60 (0.47-0.77)</td>
<td>0.55 (0.37-0.82)</td>
<td></td>
</tr>
<tr>
<td>Moderate to severe maternal depression present</td>
<td>1.07 (0.91-1.27)</td>
<td>1.39 (0.87-2.21)</td>
<td></td>
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<tr>
<td>Married</td>
<td>1.05 (0.85-1.30)</td>
<td>0.90 (0.60-1.36)</td>
<td></td>
</tr>
<tr>
<td>No maternal employment</td>
<td>1.04 (0.91-1.19)</td>
<td>1.00 (0.71-1.42)</td>
<td></td>
</tr>
<tr>
<td>Child age, mo</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>NA</td>
<td>1 [Reference]</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>NA</td>
<td>2.28 (1.71-3.03)</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>NA</td>
<td>2.05 (1.53-2.76)</td>
<td></td>
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<tr>
<td>30</td>
<td>NA</td>
<td>2.72 (2.02-3.66)</td>
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<tr>
<td>36</td>
<td>NA</td>
<td>5.44 (3.86-7.67)</td>
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<tr>
<td>Female child sex</td>
<td>0.90 (0.81-0.99)</td>
<td>0.78 (0.61-1.01)</td>
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</tr>
<tr>
<td>Child race/ethnicity</td>
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<td>Non-Hispanic white</td>
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<tr>
<td>Non-Hispanic black</td>
<td>0.95 (0.53-1.70)</td>
<td>4.77 (2.25-10.10)</td>
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<tr>
<td>Asian</td>
<td>1.32 (0.70-2.49)</td>
<td>1.58 (0.62-4.03)</td>
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</tr>
<tr>
<td>Hispanic</td>
<td>0.91 (0.64-1.30)</td>
<td>2.64 (1.49-4.69)</td>
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</tr>
<tr>
<td>Mixed race or other</td>
<td>1.04 (0.72-1.51)</td>
<td>2.19 (1.52-3.15)</td>
<td></td>
</tr>
<tr>
<td>Child plurality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Singleton</td>
<td>1 [Reference]</td>
<td>1 [Reference]</td>
<td></td>
</tr>
<tr>
<td>Twin</td>
<td>1.09 (0.22-5.32)</td>
<td>1.41 (1.05-1.91)</td>
<td></td>
</tr>
<tr>
<td>Triplet</td>
<td>0.71 (0.03-15.41)</td>
<td>0.44 (0.12-1.56)</td>
<td></td>
</tr>
<tr>
<td>Conceived with infertility treatment</td>
<td>0.95 (0.73-1.23)</td>
<td>1.19 (0.87-1.61)</td>
<td></td>
</tr>
<tr>
<td>Child care type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Center-based</td>
<td>1 [Reference]</td>
<td>1 [Reference]</td>
<td></td>
</tr>
<tr>
<td>Parental</td>
<td>1.13 (0.95-1.34)</td>
<td>2.11 (1.41-3.15)</td>
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<tr>
<td>Home-based</td>
<td>1.16 (0.98-1.38)</td>
<td>2.17 (1.38-3.41)</td>
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<tr>
<td>Townsend index</td>
<td>1.01 (0.94-1.08)</td>
<td>1.07 (0.98-1.16)</td>
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<tr>
<td>Non-English language spoken</td>
<td>0.96 (0.78-1.18)</td>
<td>0.96 (0.64-1.44)</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: aOR, adjusted odds ratio; GED, General Educational Development.

a Indicates coefficient for linear regression models of screen time at 7 and 8 years of age, where a change in the covariate (ie, changing from the low to increasing screen time trajectory) is associated with a corresponding change in β, holding all other variables constant.

b Adjusted for paternal educational level, maternal age, educational level, marital status, employment, moderate/severe depression, and nulliparity; child age at follow-up, race, sex, plurality, conception by infertility treatment, and care type, and household Townsend index and non-English language.

c Based on a generalized linear mixed model with logit link function; covariates included all variables presented.

Overall, markers of higher socioeconomic status were inversely associated with high screen time. Our findings of associations between minority race/ethnicity and high screen time align with previous research.14,17,18,47 In past studies, however, associations of screen time with maternal and paternal educational levels have been mixed.14,16-22,25 Herein, we found an inverse association between parental educational level and screen use. As a potential explanation, research among older children has linked lower parental educational level to parental modeling behavior of higher screen time and increased television exposure during meals.48 Further, parents with higher educational attainment and income are less likely to believe that educational television programs have positive effects, which may mediate the association between socioeconomic status and screen time.49 We did not have information on parental views.

Tracking of Screen Time

We found that the increasing trajectory was associated with an additional 22 minutes of daily screen time at 8 years of age, which supports previous reviews suggesting that television behaviors track from early to middle childhood.50,51 However, most studies reviewed reported correlation coefficients, which do not consider confounding factors that may bias the association. Studies using analytic methods comparable to ours found similar results.15,31-33 Using nationally representative data of 1354 US children from the 1997 and 2002 waves of the Child Development Supplement, Lee et al15 found that children's television viewing time at 0 to 4 years of age was associated with television time 5 years later. Another study of Canadian children born from 1997 to 1998 (n = 1985) found that each additional hour of television at 2 years of age was associated with a 9-minute increase in screen time at 13 years of age.33

Strengths and Limitations

Despite its strengths, including the use of a large, well-characterized cohort and repeated reporting of several screen time measures, this study had limitations. Screen time data were based on maternal report rather than direct observation or parental 24-hour recall diary.52 Admittedly, children may be exposed to back-
ground television or movies instead of directly watching a screen for long periods, making direct observation more accurate. However, the burden of these methods prohibits their use in population-level longitudinal studies. In addition, the sample in this study consisted predominantly of white families with high socioeconomic status; results may not be generalizable to more diverse populations that likely have higher screen time.16

Conclusions

Adding the strength of longitudinal analysis in this cohort study, we identified parental educational level, maternal nulliparity, and child race/ethnicity, sex, plurality, and care type as covariates of screen time from 1 to 3 years of age. Although screen time decreases after children commence school, the amount of exposure was still associated with habits set at a much earlier age. These results suggest possible target groups for interventions on children's screen media use. For instance, although New York has implemented policies prohibiting infants’ screen exposure in daycare centers, these regulations are not yet present nationwide and may aid in decreasing children’s screen time. Future prospective studies among this age group are needed to confirm our classification of children’s screen time trajectories and their determinants.

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REFERENCES


