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Contemporary Screen Time Modalities and Disruptive Behavior Disorders in Children: A Prospective Cohort Study

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Abstract

Background: Cross-sectional studies have demonstrated associations between screen time and disruptive behavior disorders (conduct disorder and oppositional defiant disorder); however, prospective associations remain unknown. This study's objective was to determine the prospective associations of contemporary screen time modalities with conduct and oppositional defiant disorder in a national cohort of 9–11-year-old children.

Methods: We analyzed data from the Adolescent Brain Cognitive Development (ABCD) Study (N=11,875). Modified Poisson regression analyses were conducted to estimate the associations between baseline child-reported screen time (total and by modality) and parent-reported conduct or oppositional defiant disorder based on the Kiddie Schedule for Affective Disorders and Schizophrenia (KSADS-5) at one-year follow-up, adjusting for potential confounders.

Results: Participants reported an average of 4.0 hours of total screen time per day at baseline. Each hour of total screen time per day was prospectively associated with 7% higher prevalence of conduct disorder (95% CI 1.03–1.11) and 5% higher prevalence of oppositional defiant disorder

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Supporting information

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(95% CI 1.03–1.08) at one-year follow-up. Each hour of social media per day was associated with a 62% higher prevalence of conduct disorder (95% CI 1.39–1.87). Each hour of video chat (prevalence ratio [PR] 1.21, 95% CI 1.06–1.37), texting (PR 1.19, 95% CI 1.07–1.33), television/movies (PR 1.17, 95% CI 1.10–1.25), and video games (PR 1.14, 95% CI 1.07–1.21) per day was associated with a higher prevalence of oppositional defiant disorder. When examining thresholds, exposure to >4 hours of total screen time per day was associated with a higher prevalence of conduct disorder (69%) and oppositional defiant disorder (46%).

Conclusion: Higher screen time was prospectively associated with higher prevalence of new-onset disruptive behavior disorders. The strongest association was between social media and conduct disorder, indicating that future research and interventions may focus on social media platforms to prevent conduct disorder.

Keywords

Screen time; television; social media; conduct disorder; oppositional defiant disorder

Introduction

Digital media and screen use have become increasingly ubiquitous with increased advancements in and accessibility of technology (LeBlanc et al., 2017). While multiple benefits of screen time have been identified, recent studies have linked excessive screen time with adverse physical and psychological outcomes, although these findings are based mostly on cross sectional data, have focused on adults, and have reported mixed findings (Hill et al., 2016a; Lissak, 2018; Nagata et al., 2021; Odgers & Jensen, 2020; Ponti et al., 2017; Viner et al., 2019). The effects of screen time may be nuanced, depending on factors such as level of interaction and engagement (Orben & Przybylski, 2019; Przybylski et al., 2020a). Further investigation is necessary to better understand how interacting with digital media and screens impact child development.

One particular area of interest is the relationship between screen time and disruptive behavior disorders, including conduct disorder and oppositional defiant disorder. Conduct disorder is diagnosed in children and adolescents with a persistent pattern of behavior violating major societal rules or norms or the basic rights of others (American Psychiatric Association, 2013). Oppositional defiant disorder is diagnosed in children and adolescents exhibiting patterns of angry or irritable mood, argumentative or defiant behavior, and vindictiveness (American Psychiatric Association, 2013). These disorders may interfere with day-to-day functioning and lead to difficulties transitioning into adulthood (Burke, 2012; Burke et al., 2014). Therefore, it is important to understand the modifiable risk factors associated with the development of disruptive behavior disorders. Previous studies have described associations between higher screen time and more externalizing behaviors, such as violence and rule breaking in children, though findings have been mixed, mostly limited to television and video games, and effect sizes were generally small (Carson et al., 2016; Christakis & Zimmerman, 2007; Eirich et al., 2022; Pagani et al., 2016; Willoughby et al., 2012). Exposure to aggressive, inappropriate, or violent content online may lead to similar behaviors offline or further reinforce externalizing behaviors (David, 2015; Ellis et al., 2020). The rise of social media, video chatting, and texting warrants additional studies

focused on the role of these contemporary screen time modalities on child development. For instance, social media sites may allow for cyberbullying (Hamm et al., 2015), which can be perpetrated anonymously, often with limited consequences, and children maybe exposed to unwanted content (e.g., violent or sexually explicit material) through advertisements or videos (Madigan et al., 2018; Radesky et al., 2020).

Prior cross-sectional studies indicate potential associations between screen time and conduct disorder or oppositional defiant disorder. A study of adolescents in mainland China found a cross-sectional association between screen time and oppositional defiant disorder in females but not males (Liu et al., 2016). The study found particular associations with video game or computer use and conduct and oppositional defiant disorder, but did not examine other screen modalities. A study of pediatric emergency department visits in the US found that higher screen time was associated with conduct disorder, but did not examine specific types of screen use (Shenoi et al., 2022). Examining various types of screen modalities separately may help to identify the specific modalities that may need to be limited to prevent disruptive behavior disorders. Finally, a cross-sectional analysis of baseline data from the Adolescent Brain Cognitive Development Study found associations among screen time and a wide range of mental health, academic, and social outcomes, including conduct and oppositional defiant disorder (Paulich et al., 2021). This analysis adjusted for race and income and stratified findings by sex but did not consider other potential confounding variables, such as parent education, parent marital status, major depressive disorder, or family history of psychopathology. These studies indicate potential linkages between screen time and disruptive behavior disorders; however, these investigations could be strengthened with a prospective study design and more robust controlling of potential confounders, which is the aim of the present study.

The objective of this study was to examine the prospective associations between contemporary screen time modalities and conduct disorder or oppositional defiant disorder in a population-based, demographically diverse cohort of 9-11-year-old children in the United States at 1-year follow-up. In addition to total screen time, we sought to identify specific types of screen time (television, videos, video games, texting, video chat, and social media) associated with conduct disorder and oppositional defiant disorder. We hypothesized that higher screen time would be prospectively associated with higher prevalence of conduct disorder and oppositional defiant disorder at one-year follow-up.

Methods

Study Population

We analyzed prospective data from the ABCD Study, a longitudinal study of brain development and adolescent health in 11,875 children recruited from 21 sites around the United States (U.S.). To recruit a sample representative of U.S. diversity, the ABCD study implemented epidemiologically informed strategies largely through school systems and considered sociodemographic factors (Garavan et al., 2018); additional details are described elsewhere (Barch et al., 2018). Data analyzed are from the ABCD 3.0 release for the baseline (2016–2018, 9–10-years-old) and one-year follow-up (2017–2019, 10–11-years-old) assessments. For participants with missing baseline screen time (n=63), outcome

(n=793), or covariate data (N=1,016), Gaussian normal regression imputation was used to impute missing data (Horton & Kleinman, 2012). Data used in this study were obtained from the ABCD Study (https://abcdstudy.org), held in the NIMH Data Archive (NDA).

Ethical Considerations

Centralized institutional review board (IRB) approval was obtained from the University of California, San Diego. Study sites obtained approval from their respective IRBs. Caregivers provided written informed consent and each child provided written assent.

Measures

Exposures: Screen Time

Screen time was determined based on child self-report using the ABCD Youth Screen Time Survey. Participants answered questions about typical hours per day spent on six different screen modalities (viewing/streaming TV shows or movies, watching/streaming videos [e.g. YouTube], playing videogames, texting, video chatting [e.g. Skype, Facetime], and social media [e.g. Facebook, Instagram, Twitter]) separately for weekdays and weekend days, based on a previously validated measure (Bagot et al., 2018; Gray et al., 2019; Paulus et al., 2019; Sharif et al., 2010). Similar to a previous ABCD study, we performed a weighted average calculation of the participants' typical weekday and weekend screen time consumption to obtain a typical day measure (Guerrero et al., 2019). The weighted average was calculated as:[(weekday average × 5) + (weekend average × 2)]/7 (Guerrero et al., 2019). After obtaining this screen time total for each type of media utilized by participants, we reported the weighted average as a continuous variable. We further developed thresholds of average screen time, using both a binary cutoff (>2 hours) based on prior American Academy of Pediatrics guidelines for recreational screen time (Strasburger & Hogan, 2013) and multiple categories (<2 hours, 2–4 hours, and 4 or more hours).

Outcome: Conduct Disorder and Oppositional Defiant Disorder

The ABCD Study utilized the Kiddie Schedule for Affective Disorders and Schizophrenia (KSADS-5), a computerized tool for categorizing child and adolescent mental health concerns based on the DSM-5, for the assessment of conduct and oppositional defiant disorders (American Psychiatric Association, 2013; Townsend et al., 2020). Parents/caregivers completed all the modules of the KSADS-5 on behalf of their child. Parents were asked questions about patterns, frequency and characteristics of their child's behaviors in which the basic rights of others or age-appropriate societal norms were violated (conduct disorder) or angry/irritable mood, argumentative/defiant behavior, or vindictiveness occurred (oppositional defiant disorder). Using the KSADS-5 computerized scoring system, responses to the interview questions from parents were extrapolated into their respective diagnosis from reported symptoms corresponding to the DSM-5 (American Psychiatric Association, 2013).

Confounders

Potential sociodemographic confounders for the association between screen time and behavioral disorders were selected based on previous literature and theory (Christakis

& Zimmerman, 2007; Pagani et al., 2016; Willoughby et al., 2012). Age (years), sex (female, male), race/ethnicity(White, Latino/Hispanic, Black, Asian, Native American, and other), household income (U.S. dollars, six categories: Less than $25,000, $25,000 through $49,999, $50,000 through $74,999, $75,000 through $99,999, $100,000 through $199,999, $200,000 and greater), highest parent education (high school or less vs. college or more), and parent marital status (married/partnered vs. unmarried/unpartnered) were based on parents'/caregivers' self-reports. Baseline symptoms of conduct disorder were based on the parent report of any symptoms (binary: yes, no) related to conduct disorder (e.g., lies, truancy, bullies, stealing, vandalism, and cruelty to persons) using the same questions from the KSADS-5 at 1-year follow-up. Baseline symptoms of oppositional defiant disorder were based on the parent report of any symptoms (binary: yes, no) related to oppositional defiant disorder (e.g., explosive irritability, easily annoyed, angry or resentful, and argues with adults) using the same questions from the KSADS-5 at 1-year follow-up. Baseline major depressive disorder (based on the KSADS-5 as above) and family history of psychopathology (based on a modified version of the Family History Assessment from a previously validated study) were included as confounders (Barch et al., 2018; Brown et al., 2015).

Statistical Analysis

Data analysis was performed in 2021 using Stata 15.1 (StataCorp, College Station, TX). Modified Poisson regression analyses using robust standard errors were conducted to calculate prevalence ratios estimating associations between baseline screen time (exposure variable) and conduct or oppositional defiant disorder at one-year follow-up (outcome variables), adjusting for confounders (itemized in section above) (Zou, 2004). Odds ratios from logistic regression may overestimate effect sizes if used to approximate a risk ratio (Davies et al., 1998; Tamhane et al., 2016). Therefore, we selected a modified Poisson regression approach using robust standard errors for the main analysis, which has shown to be a reliable approach to estimate relative risk (Zou, 2004). Screen time was examined as a continuous variable and as a categorical variable with previously described thresholds; statistical assumptions were checked (Table S1). We tested for effect modification of screen time by sex, given that prior studies on screen time and disruptive behavior disorders have stratified analyses by sex (Paulich et al., 2021), and one found differences in the association between screen time and conduct disorder by sex (Liu et al., 2016). Propensity weights were applied to yield representative estimates based on the American Community Survey from the US Census (Heeringa & Berglund, 2020). Logistic regression (instead of modified Poisson regression) and complete case analyses (instead of the imputation of missing data) were used in sensitivity analyses. Prior studies with low levels of missing data have found similar results between complete case analysis and imputation of missing data (Parent, 2012).

Results

The analytic sample (N=11,875) was approximately matched by sex (48.8% female) and was racially and ethnically diverse (47.8% non-White) (Table 1). At baseline, youth on average reported 4.0±3.2 hours of screen time per day, with the most time spent watching/streaming TV shows/movies (1.3±1.1 hours), playing video games (1.1±1.1 hours), and

watching/streaming videos (1.1±1.2 hours). Overall, 38.7% of participants reported four or more hours of total screen time per day. The percentage of participants who reported no screen time for each modality are shown in Table S2. At one-year follow-up, 1.9% of the sample met criteria for conduct disorder (1.1% of girls and 2.8% of boys) and 6.3% met criteria for oppositional defiant disorder (4.7% of girls and 7.9% of boys).

Table 2 shows unadjusted and adjusted regression analyses examining the prospective associations between baseline screen time and conduct disorder at one-year follow-up. After adjusting for confounders, each hour of social media (prevalence ratio [PR] 1.62, 95% CI 1.39–1.87) and total screen time (PR 1.07, 95% CI 1.03–1.11) per day at baseline was prospectively associated with higher prevalence of conduct disorder.

Table 3 shows unadjusted and adjusted regression analyses examining the prospective associations between baseline screen time and oppositional defiant disorder at one-year follow-up. After adjusting for confounders, each hour of video chat (prevalence ratio [PR] 1.21, 95% CI 1.06–1.37), texting (PR 1.19, 95% CI 1.07–1.33), television/movies (PR 1.17, 95% CI 1.10–1.25), video games (PR 1.14, 95% CI 1.07–1.21), and total screen time (PR 1.05, 95% CI 1.03–1.08) was prospectively associated with higher prevalence of oppositional defiant disorder.

The prevalence ratios for confounders are shown in Table S3. Baseline symptoms of conduct or oppositional defiant disorder, family history of psychopathology, and male sex were associated with conduct and oppositional defiant disorder at follow-up. Latino ethnicity and Asian race were associated with a lower prevalence of conduct disorder compared to White race, while Black and Asian races were associated with a lower prevalence of oppositional defiant disorder compared to White race. Lower household income was associated with lower prevalence of conduct disorder compared to higher household income. Baseline depression and higher parent education were associated with higher prevalence of oppositional defiant disorder. Sex did not modify the association between screen time and oppositional defiant disorder or conduct disorder (all $p>0.05$).

When examining thresholds of total screen time (Table 4), exposure to >2 hours compared with ≤ 2 hours of daily screen time was associated with oppositional defiant disorder but not conduct disorder; however more refined resolution of categories showed that exposure to >4 hours per day was associated with a 69% higher prevalence of conduct disorder and a 46% higher prevalence of oppositional defiant disorder. Sensitivity analyses with logistic regression and with complete case analysis yielded similar findings, with slightly stronger effect sizes with logistic regression (data not shown).

Discussion

In a population-based, demographically diverse cohort study of 9–11-year-old children in the U.S., we found that more screen time across several modalities was prospectively associated with higher prevalence of new-onset disruptive behavior disorders one year later, even after adjusting for confounders. Each additional hour spent on social media was associated with a 62% higher prevalence of conduct disorder and more time spent

video chatting (21% higher prevalence), texting (19% prevalence), watching television (17% higher prevalence), and playing video games (14% higher prevalence) were associated with oppositional defiant disorder.

The effect sizes for total screen time were relatively small as each additional hour of total screen time was associated with a 7% higher prevalence of conduct disorder and a 5% higher prevalence of conduct disorder. This is consistent with previous literature finding weak but statistically significant associations between screen time and children's behavior problems (Eirich et al., 2022; Przybylski et al., 2020b). Effect sizes are reported for each hour of screen exposure per day; therefore, total effects are greater with more hours per day of screen exposure. In addition, cumulative exposure to screen time over several years may yield stronger associations. Four or more hours of total screen time per day were associated with a 69% higher prevalence of conduct disorder and a 46% higher prevalence of oppositional defiant disorder. Although the effect sizes for screen time were small relative to other factors, such as baseline symptoms of conduct or oppositional defiant disorder or family history (i.e., genetic risk), many of these risks may cluster together and screen use likely co-occurs with these other variables, which may entrench symptoms across development. For instance, children with a family risk of psychopathology may live in a context where screen time is more common, contributing to behaviors (e.g., less sleep) or interactions (e.g., less social interaction) which may lead to symptoms of which they are predisposed to. Despite smaller effect sizes, screen use is an important exposure because it can be modifiable through intervention, whereas the ability to intervene on genetics and baseline symptoms may be more limited.

The estimates of daily screen time during discretionary periods (four hours per day, on average) and conduct and oppositional defiant disorder in the ABCD Study were consistent with those from other epidemiologic studies with overlapping age ranges (Fiechtner et al., 2018; Maughan et al., 2004; Olds et al., 2006). However, with the onset of the COVID-19 pandemic, adolescents from the ABCD Study reported an average of 8 hours of recreational screen time per day, so screen exposure for many adolescents has substantially increased (Nagata et al., 2022). Middle childhood, heralding the onset of puberty and further social and cognitive development, may be an important window for the onset of adolescent behavioral disorders (Dorn et al., 2019; Goddings et al., 2019; Mendle et al., 2020; Ullsperger & Nikolas, 2017). Middle childhood is often characterized by increasing peer pressures, lack of impulse control, need for immediate gratification, and testing authority, all of which are factors that may be associated with screen time and social media (Dorn et al., 2019; Goddings et al., 2019; Mendle et al., 2020; Ullsperger & Nikolas, 2017).

Our findings comport with those of previous studies examining these relationships in children. While prior studies have demonstrated associations with higher screen time and symptoms of externalizing disorders such as rule-breaking and aggressive behaviors (Christakis & Zimmerman, 2007; Pagani et al., 2016; Willoughby et al., 2012), the present study adds to the literature by assessing DSM-5 conduct disorder and oppositional defiant disorder diagnoses as primary outcomes in a large, national prospective cohort (Guerrero et al., 2019). Further, given the evolution of media platforms beyond television viewing and

video games, which have been the main foci of prior studies, the inclusion of contemporary screen time modalities more closely captures media usage trends in modern day youth.

Notably, the pattern of associations with specific screen time modalities differed between conduct disorder and oppositional defiant disorder. Previous studies have described overlap between the risk factors for conduct disorder and oppositional defiant disorder, although some evidence suggests that each disorder has its own risk profile (Boden et al., 2010; Murray & Farrington, 2010; Petty et al., 2009). Social media was prospectively associated with a higher prevalence of conduct disorder but not oppositional defiant disorder. It is possible that conduct disorder as a diagnostic category may involve more bullying-like behavior which may be enacted or encouraged on social media. Social media may also enable involvement with other antisocial peers, which could be more common in those with conduct disorder (Moor & Anderson, 2019). Finally, social media addiction or self-control failure, the tendency of an individual to use social media even when it coincides with other important goals, can lead to antisocial aggressive behavior (Hameed & Irfan, 2021). Watching television/movies, watching/streaming videos, playing video games, and texting were prospectively associated with oppositional defiant disorder. Although screen time is associated with moderate risk, it is modifiable and thus a potential point for intervention. However, to consider screen time reduction as a preventive intervention for disruptive behavior disorders would require a randomized controlled trial, similar to prior screen-related intervention studies (Christakis et al., 2013; Salmon, 2010).

The American Academy of Pediatrics previously recommended limiting recreational screen time to ≤2 hours per day (Strasburger & Hogan, 2013), and has since removed this specific guidance in 2016 (Hill et al., 2016b). Using a binary cutoff, there was an association between >2 vs ≤2 hours per day for prevalence of conduct disorder but not oppositional defiant disorder. When examining a higher screen time threshold, >4 hours of screen time per day was associated with both conduct and oppositional defiant disorder. Although higher than previous guideline levels, we note that this threshold is specifically for associations with disruptive behavior disorders, whereas guidelines must consider many other factors.

Among the various screen modalities, the strongest association found was between social media and conduct disorder. Several putative mechanisms may explain the association between social media use and conduct disorder. Social learning theory suggests that children adopt observed behaviors (Chavis, 2011). Thus, exposure to harmful behaviors including violence, stealing, and destruction of property on social media platforms may normalize them for youth to mimic (David, 2015). Consistent with this theory, time spent on social media has been found to have modest associations with conduct problems in an older group of adolescents (Brunborg & Burdzovic Andreas, 2019). Of note, social media use has been shown to increase with older age during adolescence (Rideout & Robb, 2019). For example, one nationally representative study of adolescents ages 13–15 revealed that one third of participants reported social media use greater than 3 hours per day (Scott, Biello, & Woods, 2019). The associations between social media use and conduct disorder in middle childhood underscores the importance of early interventions to prevent excessive social media use. Social media algorithms that prioritize attractive and revenue-generating content over viewer safety may further contribute to exposure to harmful behaviors, as children and parents

have less control over the content they engage in (Radesky et al., 2020). For instance, one study found that videos appropriate for children 1–5 years old lead to an inappropriate video recommendation 3.5% of the time within 10 recommendations (Papadamou et al., 2020). Social media platforms allow for anonymized interactions with fewer boundaries and regulations (Lowry et al., 2016) and have demonstrated the more propagation of hateful posts as compared to non-hateful ones (Mathew et al., 2019). These patterns may contribute to the positive relationship between higher social media, screen time, and conduct disorder underpinned by social learning theory tenets. Finally, in the U.S., the age of permissible use for most popular social media platforms is 13 years; thus, study participants (9–10 years old at baseline) were likely breaking this rule by being on social media. Parents who permit children to misrepresent their age to be on social media may have fewer rules around screen time, which could drive risk for both social media and conduct problems. Therefore, parental monitoring and rules could be a potential confounder; in one study, 40% of middle schoolers reported that their parents did not monitor their social media use (Martin, Wang, Petty, Wang, & Wilkins, 2018). We found that 80% of the sample reported zero social media use at baseline, consistent with one study of middle schoolers finding that 17% started using social media at age nine or younger (Martin et al., 2018). The association between social media and conduct disorder may be driven by the users and the large group of non-users. Future research could investigate how parent knowledge and enforcement of age restrictions, parental rules, and monitoring related to social media, may affect adolescent social media use and conduct problems.

As opposed to social media, watching television/movies, watching/streaming videos, playing video games, and texting were prospectively associated with higher prevalence of oppositional defiant disorder. Multiple factors could contribute to this association, including screen time displacing sleep or physical activity, and negatively affecting social support from family and peers (Sadeh, 2007). Screen time may lead to less sleep or delayed onset of sleep (Hale & Guan, 2015), which in turn could exacerbate disruptive behaviors (Aronen et al., 2014). Additionally, television viewing and video game playing is associated with attention problems (Gentile et al., 2012; Swing et al., 2010), and attention-deficit/hyperactivity disorder (ADHD) has been shown to be related with later argumentative/defiant symptoms (Harvey et al., 2016). Future research could examine sleep and ADHD as potential mediators between screen use and disruptive behavior disorders. While these same mechanisms may contribute to conduct disorder, it is notable that social media was the only screen time modality prospectively associated with conduct disorder at one-year-follow-up. Although this discrepancy may be explained by the nature of social media compared to other screen modalities, additional research is needed to better understand the differences. In particular, examining the content of media viewed, which could further identify the types of media that should be limited, and the context (i.e., viewing alone or with others) could also strengthen or weaken associations.

Although prior research has stratified analyses by sex (Liu et al., 2016; Paulich et al., 2021), we found that sex did not modify the association between screen time and oppositional defiant disorder or conduct disorder. There may be similarities in the associations between screen time and disruptive behavior disorders for boys and girls in our diverse, national sample, though this should be replicated in future studies. Although we found that higher

income was associated with a lower prevalence of conduct disorder as expected, higher parental education was associated with a higher prevalence of oppositional defiant disorder, contrary to previous literature (Granero et al., 2015; Loeber et al., 1995). The current sample may have more educated parents than prior studies given that nearly 80% of participants had a parent with at least a college education.

Several study limitations should be noted. While the prospective study design improves on prior cross-sectional evidence, causal associations cannot be inferred. Although we adjusted for several potential confounders, including baseline levels of conduct disorder and oppositional defiant disorder, there is the possibility of residual confounding (e.g., cultural differences between households, parenting, and resilience-promoting activities). The screen time measures were self-reported, which could be subject to recall and social desirability (prevarication) bias. Self-report may underestimate actual screen time; thus, the magnitude of these associations may be stronger than reported. Although the screen measures did not explicitly specify recreational (i.e., not school/work related) screen time, the majority of the screen time types and durations reported are likely to be recreational (e.g., television, videos, video games, social media). It is important to note that some of the effect sizes of the prospective associations between total screen time and each disorder, respectively, were small and their clinical implications unclear. Future research could examine the role of cyberbullying in the relationship between social media and conduct disorder. Screen time use and incidence of behaviors disorders may rise after ages 9–11 (Dorn et al., 2019; Goddings et al., 2019; Mendle et al., 2020; Ullsperger & Nikolas, 2017); thus, studies following the ABCD cohort into later adolescence will be an important area of future research. The questions related to conduct and oppositional defiant disorder relied on parent/caregiver reports on their child's behaviors and mental health, which may be discrepant from child reports (De Reyes & Kazdin, 2005). However, they came from a validated tool (KSADS-5) that was based on DSM-5 diagnostic criteria. Strengths of the study include the large, population-based, diverse sample, a focus on middle childhood, and the prospective study design.

These findings have several clinical and public health implications. Given the rapid rise in screen time usage in today's youth, and more acutely, the increase in child and adolescent screen time during the COVID-19 pandemic (with the ABCD cohort reporting a mean of eight hours of recreational screen time per day) (Nagata et al., 2022), further guidance for children and parents regarding screen time usage is needed (Nagata et al., 2020). Parents should develop family media use plans and implement parental controls, as appropriate (Hill et al., 2016a). Health care providers should consider assessing for behavioral problems among children with high screen use and advise about potential risks associated with excessive screen time. Digital media industries could develop further protections, such as more robust age verification, algorithms prioritizing developmentally appropriate content, and systems to help parents monitor and limit excess screen time. Interventions to support children's mental health and develop more effective coping strategies to address biopsychosocial stressors may also benefit. The strongest association was between social media and conduct disorder, indicating that social media may be an important platform to focus future research and interventions to prevent conduct disorder.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Abbreviations:

DSM-5	Diagnostic and Statistical Manual, 5th Edition
ABCD Study	Adolescent Brain Cognitive Development Study
NDA	NIMH Data Archive
KSADS-5	Kiddie Schedule for Affective Disorders and Schizophrenia

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Key points

Cross-sectional studies have demonstrated associations between screen time and disruptive behavior disorders (conduct disorder and oppositional defiant disorder); however, prospective associations remain unknown.

In a population-based, demographically diverse cohort study of 9–10-year-old children in the U.S., we found that greater screen time was prospectively associated with a higher odds of conduct disorder and oppositional defiant disorder one year later, even after adjusting for covariates.

Clinicians should assess screen time and behavior disorders in children and advise parents about potential risks associated with excessive screen time.

Table 1.

Sociodemographic, screen time, and behavioral characteristics of 11,875 Adolescent Brain Cognitive Development (ABCD) Study participants

Sociodemographic characteristics (baseline)	**Mean (SD) / %**
Age (years), mean (SD)	9.9 (0.6)
Sex (%)	
Female	48.8%
Male	51.2%
Race/ethnicity (%)	
White	52.2%
Latino / Hispanic	20.0%
Black	17.3%
Asian	5.5%
Native American	3.2%
Other	1.9%
Household income (%)	
Less than $25,000	18.1%
$25,000 through $49,999	20.7%
$50,000 through $74,999	18.0%
$75,000 through $99,999	15.7%
$100,000 through $199,999	20.9%
$200,000 and greater	6.7%
Parent with college education or more (%)	79.7%
Parent marital status (%)	
Married/partnered	66.7%
Unmarried/unpartnered	33.3%
Recreational screen time variables (baseline)	
Total screen time, hours per day, mean (SD)	4.0 (3.2)
Less than 2 hours (%)	30.1%
Between 2 and 4 hours (%)	31.2%
4 or more hours (%)	38.7%
Television shows/movies, hours per day, mean (SD)	1.3 (1.1)
Videos (e.g. YouTube), hours per day, mean (SD)	1.1 (1.2)
Video games, hours per day, mean (SD)	1.1 (1.1)
Texting, hours per day, mean (SD)	0.2 (0.6)
Video chat, hours per day, mean (SD)	0.2 (0.5)
Social media, hours per day, mean (SD)	0.1 (0.4)
Mental health	
Any conduct symptoms, baseline (%)	20.6%
Any oppositional defiant symptoms, baseline (%)	34.7%
Major depressive disorder, baseline (%)	0.3%
Any family history of psychopathology (%)	59.7%

Sociodemographic characteristics (baseline)	Mean (SD) / %
Conduct disorder, one-year follow-up (%)	1.9%
Oppositional defiant disorder, one-year follow-up (%)	6.3%

Propensity weights were applied to yield nationally representative estimates based on the American Community Survey from the US Census. SD = standard deviation

Table 2.

Unadjusted and adjusted associations between baseline screen time and conduct disorder at one-year follow-up in the Adolescent Brain Cognitive Development Study

Screen time	Conduct disorder, unadjusted		Conduct disorder, adjusted[a]	
	Prevalence Ratio (95% CI)	p	Prevalence Ratio (95% CI)	p
Total screen time	**1.13 (1.10–1.16)**	**<0.001**	**1.07 (1.03–1.11)**	**<0.001**
Television shows/movies	**1.29 (1.12–1.47)**	**<0.001**	1.07 (0.94–1.23)	0.296
Videos (YouTube)	**1.24 (1.11–1.39)**	**<0.001**	1.08 (0.96–1.21)	0.198
Video games	**1.38 (1.24–1.54)**	**<0.001**	1.11 (0.99–1.25)	0.072
Texting	**1.28 (1.07–1.52)**	**0.006**	1.18 (0.99–1.42)	0.064
Video chat	**1.22 (1.03–1.44)**	**0.021**	1.15 (0.96–1.38)	0.119
Social networking	**1.93 (1.72–2.16)**	**<0.001**	**1.62 (1.39–1.87)**	**<0.001**

The prevalence ratios in the cells represents abbreviated outputs from a series of modified Poisson regression models with conduct disorder as the dependent variable and screen time as the independent variable. Thus, the table represents the outputs from fourteen modified Poisson regression models in total. Estimates for the confounders are shown in the Supporting Information. The prevalence ratio is reported for each hour per day of screen time. Bold indicates p<0.05

[a]Confounders: race/ethnicity, sex, household income, parent education, parent marital status, site, baseline conduct disorder symptoms, baseline major depressive disorder, and family history of psychopathology.

Table 3.

Unadjusted and adjusted associations between baseline screen time and oppositional defiant disorder at one-year follow-up in the Adolescent Brain Cognitive Development Study

	Oppositional defiant disorder, unadjusted		Oppositional defiant disorder, adjusted[a]	
	Prevalence Ratio (95% CI)	**p**	**Prevalence Ratio (95% CI)**	**p**
Total screen time	**1.08 (1.06–1.10)**	**≤0.001**	**1.05 (1.03–1.08)**	**<0.001**
Television shows/movies	**1.23 (1.15–1.31)**	**<0.001**	**1.17 (1.10–1.25)**	**<0.001**
Videos (YouTube)	**1.13 (1.06–1.21)**	**<0.001**	1.05 (0.98–1.11)	0.163
Video games	**1.25 (1.18–1.33)**	**<0.001**	**1.14 (1.07–1.21)**	**<0.001**
Texting	**1.19 (1.05–1.33)**	**0.005**	**1.19 (1.07–1.33)**	**0.002**
Video chat	**1.22 (1.08–1.39)**	**0.002**	**1.21 (1.06–1.37)**	**0.003**
Social networking	1.04 (0.87–1.24)	0.662	0.99 (0.83–1.19)	0.938

The prevalence ratios in the cells represents abbreviated outputs from a series of modified Poisson regression models with oppositional defiant disorder as the dependent variable and screen time as the independent variable. Thus, the table represents the outputs from fourteen modified Poisson regression models in total. Estimates for the confounders are shown in the Supporting Information. The prevalence ratio is reported for each hour per day of screen time. Bold indicates p<0.05

[a]Confounders: race/ethnicity, sex, household income, parent education, parent marital status, site, baseline oppositional defiant disorder symptoms, baseline major depressive disorder, and family history of psychopathology.

Table 4.

Associations between total screen time based on thresholds, conduct disorder, and oppositional defiant disorder at one-year follow-up in the Adolescent Brain Cognitive Development Study

	Conduct disorder[a]			Oppositional defiant disorder[a]		
	Prevalence[b]	Prevalence Ratio (95% CI)	p	Prevalence[b]	Prevalence Ratio (95% CI)	p
≤ 2 hours per day	0.97%	REF	-	4.75%	REF	-
> 2 hours per day	2.35%	1.52 (1.00–2.31)	0.052	6.99%	**1.29 (1.07–1.55)**	**0.007**
≤ 2 hours per day	0.97%	REF	-	4.75%	REF	-
>2 and ≤ 4 hours per day	1.56%	1.26 (0.79–2.00)	0.331	5.45%	1.09 (0.88–1.35)	0.432
> 4 hours per day	2.95%	**1.69 (1.08–2.65)**	**0.022**	8.26%	**1.46 (1.20–1.79)**	**<0.001**

Bold indicates p<0.05

[a]Confounders: race/ethnicity, sex, household income, parent education, parent marital status, site, baseline conduct or oppositional defiant symptoms, baseline major depressive disorder, and family history of psychopathology.

[b]Prevalence of conduct disorder or oppositional defiant disorder among participants reporting the respective screen time threshold at baseline. For instance, the prevalence of conduct disorder was 0.97% among participants reporting ≤ 2 hours of screen time per day