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# Screen Media Activity in Youth: Observations from the Adolescent Brain Cognitive Development (ABCD) Study

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## Adolescent Brain Cognitive Development<sup>®</sup>

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- *The Adolescent Brain Cognitive Development (ABCD) Study<sup>®</sup> is the largest long-term study of brain development and child health in the United States. The ABCD Research Consortium consists of a Coordinating Center, a Data Analysis, Informatics & Resource Center, and 21 research sites across the country. 11,880 children ages 9-10 joined the study. Researchers will track their biological and behavioral development through adolescence into young adulthood.*

**Federal Partners: *Teen Brains. Today's Science. Brighter Future.***

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The ABCD Study® was initiated by the Collaborative Research on Addiction at NIH (CRAN): NIDA, NIAAA, NCI

Today 10 NIH ICs are involved in the study as well as 4 additional federal partners



# Visit Schedule



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- Comprehensive assessments at baseline and biennial follow up visits (including multimodal imaging)
- Briefer assessments at face-to-face interim year visits
- More frequent phone/web assessments

# ABCD Youth Protocol Summary: Baseline

## Physical Health

PhenX Anthropometrics (height/weight/waist measurements)  
Snellen Vision Screener  
Edinburgh Handedness Inventory  
Youth Risk Behavior Survey: Exercise  
Pubertal Development Scale  
Menstrual Cycle Survey (pubescent girls)  
Screen Time Survey

## Brain Imaging

### Structural MRI

- 3D T1 - Weighted
- 3D T2 - Weighted
- Diffusion Tensor Imaging

### Functional MRI (fMRI)

- Resting State
- Monetary Incentive Delay Task
- Stop Signal Task
- Emotional N-Back Task

## Biospecimens

Breathalyzer and Oral Fluids (subset)  
Saliva Samples for DNA, Puberty  
Blood Samples (subset)  
Hair Sample  
Baby Teeth

## Mental Health

### Kiddie Schedule for Affective Disorders and Schizophrenia

- Background Items Survey
- Diagnostic Interview for DSM-5 (5 modules)

PhenX UPPS-P for Children Survey

PhenX Behavioral Inhibition/Behavioral Approach System (BIS/BAS) Scales

Prodromal Psychosis Scale

Youth Resilience Scale

## Neurocognition

### NIH Toolbox tasks:

- Picture Vocabulary
- Flanker Inhibitory Control & Attention
- List Sorting Working Memory
- Dimensional Change Card Sort
- Pattern Comparison Processing Speed
- Picture Sequence Memory
- Oral Reading Recognition

Rey Auditory Verbal Learning Task

Cash Choice Task

Little Man Task

Matrix Reasoning Task

RAVLT Delayed Recall

## Culture & Environment

Prosocial Tendencies Survey

PhenX Acculturation Survey

Parental Monitoring Survey

Acceptance Subscale from Children's Report of Parental Behavior Inventory (CRPBI) - Short

PhenX Family Environment Scale - Family Conflict

PhenX Neighborhood Safety/Crime Survey

PhenX School Risk & Protective Factors Survey

## Substance Use

### For most participants\*:

Timeline Follow-Back Survey

PhenX Peer Group Deviance Survey

PATH Intention to Use Tobacco Survey

Caffeine Intake Survey

Participant Last Use Survey (PLUS) for substance use within the last 24 hrs

## Other Data Sources

Geocoding from Residential History

School Records

FitBit® (subset)

Brief Problem Monitor - Teacher Form



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\*For participants with differing levels of substance use (low, moderate, heavy), follow-up items include: iSay II Q2 Sipping items; Tobacco Low-Level Use Measure; MJ Low-Level Use Measure; PhenX Acute Subjective Response to Alcohol, Tobacco, or MJ; Hangover Symptom Scale; Rutgers Alcohol Problem Index (RAPI); Nicotine Dependence (PATH); Drug Problem Index (MAPI); MJ Problem Index (MAPI)

# ABCD Parent Protocol Summary: Baseline

## Physical Health

PhenX Demographics Survey  
Medical History Questionnaire  
Developmental History Questionnaire  
PhenX Medications Survey  
Menstrual Cycle Survey  
**Sleep Disturbances Scale for Children**  
Sports and Activities Involvement Questionnaire  
Screen Time Survey  
Ohio State TBI Screen - Short

## Mental Health

### Kiddie Schedule for Affective Disorders and Schizophrenia

- Background Items Survey
- Diagnostic Interview for DSM-5

### Child Behavior Checklist

General Behavior Inventory - Mania  
Adult Self Report Survey  
Family History Assessment Survey

## Substance Use

Parent Rules Survey  
PhenX Community Risk and Protective Factors  
Participant Last Use Survey (PLUS) for substance use within the last 24 hrs.

## Culture & Environment

Vancouver Index of Acculturation - Short Survey  
Multi-Group Ethnic Identity Measure-R Survey  
Prosocial Tendencies Survey  
Mexican American Cultural Values Scale  
PhenX Acculturation Survey  
PhenX Family Environment Scale - Family Conflict  
PhenX Neighborhood Safety/ Crime Survey  
Native American Acculturation Scale



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ABCDStudy.org

\*For participants with differing levels of substance use (low, moderate, heavy), follow-up items include: iSay II Q2 Sipping Items; Tobacco Low-Level Use Measure; MJ Low-Level Use Measure; PhenX Acute Subjective Response to Alcohol, Tobacco, or MJ; Hangover Symptom Scale; Rutgers Alcohol Problem Index (RAPI); Nicotine Dependence (PATH); Drug Problem Index (MPI); MJ Problem Index (MAPI)

<https://abcdstudy.org/scientists/protocols/>

# ABCD Open Science Model

A Unique Resource for the Entire Scientific Community

<https://data-archive.nimh.nih.gov/abcd>

## ABCD Study Fast Track Data

Unprocessed neuroimaging data & basic participant demographics (age, sex)

- Currently available

## Annual Curated Data Release

Annual release of curated data, including all assessment domains and many computational analysis pipelines.

- 1.0 Released in **2018** with the first 4500+ participants
- 2.0 Released in **2019** with 11,800+ participants
- 3.0 Released in **2020** with several thousand 2 year FU visits
- 4.0 Released in **2021** with interim follow-up data

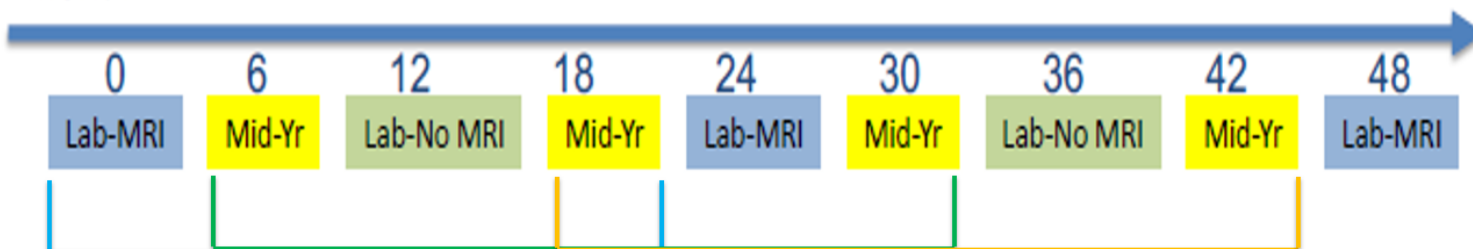
For more information on ABCD data sharing:

<https://abcdstudy.org/scientists.html>



# Versioned Data Releases

Month



## 2019 Data Release 2.0

- Full cohort baseline (with imaging)
- Hurricane Irma substudy
- Fitbit data
- Interim:
  - 6-month
  - 18-month
  - 1-year

## 2020 Data Release 3.0

- Full cohort 1-year follow-up
- Full cohort 6-month follow-up
- Interim:
  - 18-month
  - 30-month
  - 2-year (imaging)

## 2021 Data Release 4.0

- Full cohort 2-year follow-up (with imaging)
- Full cohort 18-month follow-up
- Interim:
  - 30-month
  - 42-month
  - 3-year



ABCD COVID-19  
Supplemental Data  
Release is now available

This release consists of survey responses from ABCD families about the impact of the pandemic on their lives. Visit the NIMH Data Archive for more information.



Welcome to the NIMH Data Archive

<https://nda.nih.gov/abcd>

**RFA-DA-22-037** – Accelerating the Pace of Drug Abuse Research Using Existing Data (R01 Clinical Trial Optional)

**RFA-DA-22-038** – Accelerating the Pace of Drug Abuse Research Using Existing Data (R21 Clinical Trial Optional)

**PAR-22-137** – Accelerating the Pace of Child Health Research Using Existing Data from the Adolescent Brain Cognitive Development (ABCD) Study (R01 Clinical Trial Not Allowed)

**PAR-22-138** – Accelerating the Pace of Child Health Research Using Existing Data from the Adolescent Brain Cognitive Development (ABCD) Study (R21-Clinical Trial Not Allowed)

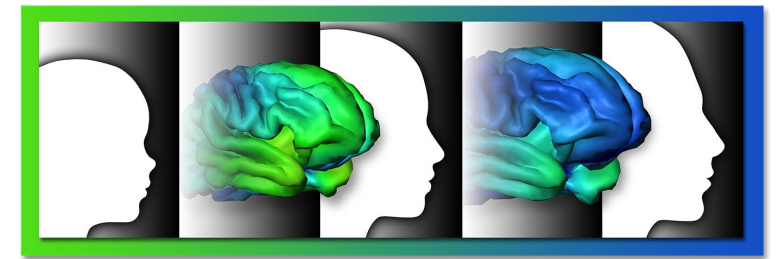
# ABCD Open Science Model

## Community Response

- The NIMH Data Archive reports that at the end of 2021:
  - Over 3700 unique users were authorized users of ABCD Data.
  - 32 countries are home to user institutions
  - Users download an average of 115 terabytes of data per month.
- Over 500 publications (listed on the website) have reported observations from ABCD data, more than half from outside investigators.
- Over 150 grants proposing to use ABCD data have been funded.

# ABCD Screen Time Questionnaire

## A measure of screen media activity (SMA)



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*A 14-question Screen Time Questionnaire (STQ) is completed annually in ABCD by youth, providing self-report measures of screen time use, divided by weekdays and weekends.*

*Participants are asked how many hours per use “on a typical weekday” or “on a typical weekend” they use screens for different types of media. Response choices range from none coded 0 to 4+ hours coded 4.*

*12 questions ask about six different forms of recreational (not for schoolwork) media use, e.g., How many hours...do you:*

- “watch TV shows or movies”*
- “watch videos (such as YouTube)?”*
- “Play video games on a computer, console, phone, or other device (Xbox, Play Station, iPad)?”*
- “Text on a cell phone, tablet, or computer (e.g., GChat, WhatsApp, etc.)?”*
- “visit social networking sites like Facebook, Twitter, Instagram, etc.?”*
- “video chat (Skype, Facetime, etc.)?”*

*The total amount of time spent on screens on an individual weekday or weekend day is a composite across all six forms of media types.*

*The questionnaire also asks children to report the frequency with which they engage in mature video gaming and R-rated movie viewing (0 = never, 3 = all the time).*

# Youth use screens more as they get older



\*Although researchers only asked about screen use during non-school hours, some increases may have been related to social distancing during COVID-19.

## Average daily screen use\*



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- Data from 4.0 Release
- SMA is higher in boys
- Youth were 12-13 during pandemic
- Results of published studies have mostly focused on baseline data so far (9 and 10 year olds)

**Boys** spend more time on:

- Video Games
- TV & Movies Streaming

### Time by Activity



**Girls** spend more time on:

- Video Chat
- Texting
- Social Media

### Time by Activity



# Screen Media Activity and Brain Structure in Youth: Evidence for Diverse Structural Correlation Networks from the ABCD Study

Paulus MP, Squeglia LM, Bagot K, Jacobus J, Kuplicki R, Breslin FJ, Bodurka J, Sheffield Morris A, Thompson WK, Bartsch H, Tapert SF (Neuroimage, 2019)

- An exploratory ‘group factor analysis’ revealed different patterns of association between SMA variables and brain morphometry.
  - Factors with generally high SMA or with specifically high ‘social media use’ loadings were associated with externalizing, but not internalizing, behaviors on the CBCL and lower cognitive test scores, after covariate adjustment
  - However, a factor with specifically high gaming loadings was associated with higher cognitive performances.
- 1.0 Data Release
  - Partial Baseline:
    - N=4277
  - Methods:
    - Group Factor Analysis
      - Screen time
      - Brain morphology
    - Focus on associations with
      - Child mental health scales (parent report)
      - Cognitive Function
    - Adjusted for:
      - Sex, BMI, ethnicity/ancestry, parental education, household income.



# Screen time and early adolescent mental health, academic, and social outcomes in 9- and 10- year old children:

## Utilizing the Adolescent Brain Cognitive Development (ABCD) Study

Paulich KN, Ross JM, Lessem JM, Hewitt JK (PLOS ONE, 2021)

- Higher total SMA was moderately associated with more mental health and behavioral problems (externalizing), and poorer academic performance and sleep measures (parent report).
  - However, higher SMA was also moderately associated with better peer relationships, and ‘internalizing’ mental health problems were not associated with SMA.
  - Authors emphasized the small effect sizes for SMA in this young cohort (accounting for less than 2% of the variance in the outcome measures) and the considerably larger SES (income) effects.
  - They concluded that SMA was *unlikely* to be substantially increasing health and mental health problems in 9 and 10 year olds.
- 2.0 Data Release
  - Full Baseline:
    - N=11,727 Age: 9 and 10 years
  - Methods
    - Linear Regressions estimated effects on:
      - Mental health and behavior problems (CBCL)
      - Academic performance
      - Sleep quantity/quality
      - Peer relationships
    - Separately for weekday and weekend
    - Adjusting for sex, income and ethnicity/ancestry



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# Associations between screen time and internalizing disorder diagnoses among 9- to 10-year-olds

Roberston L, Twenge JM, Joiner TE, Cummins K (J Affect Dis, 2022)

- Depression and self-harm were diagnosed in 5-7% and anxiety disorders in <2% of youth at baseline.
- Youth reporting more SMA were modestly more likely to be diagnosed with depression and self-harm. Weak evidence for an association of digital media use with anxiety diagnosis was observed.
- Authors caution against inferring causality but the analyses suggest modest associations between some symptom profiles and higher SMA at 9 and 10 years of age.

- 2.0 Data Release
- Full Baseline:
  - N = 11,780
- Methods:
  - Compared groups with below and above 2 hrs p/day of reported use, and then examined exposure-response curves to compute relative risk.
  - Focus was on diagnoses from abbreviated KSADS administered at baseline to youth.
  - Adjusted for sex, income, parental education, caregiver employment, and ethnicity/ancestry



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# Screen time and problem behaviors in children: exploring the mediating role of sleep duration

Michelle D. Guerrero, Joel D. Barnes, Jean-Philippe Chaput, Mark S. Tremblay (Int J Behav Nutr Phys Act, 2019)

- Modest associations of SMA variables with increased rule breaking, social problems, aggressive behavior, and thought problems, as well as reduced sleep duration were described.
- The strongest effects reported were between reduced sleep duration and increases in these (and other) problem behaviors reported by parents.
- In statistical mediation models there was some evidence for partial mediation of SMA-problem behavior associations by sleep duration.

- 2.0 Data Release
- Full Baseline:
  - N=11,875
- Methods:
  - Focus on problem behavior scales from CBCL and sleep measures
  - Estimated mediation of effects of SMA on behavioral measures by sleep duration.
  - Adjusted for sex, income, parental education, caregiver employment, and ethnicity/ancestry, BMI, and physical activity



# Contemporary screen time modalities and disruptive behavior disorders in children: a prospective cohort study

Jason M Nagata, Jonathan Chu, Kyle T Ganson, Stuart B Murray, Puja Iyer, Kelley Pettee Gabriel, Andrea K Garber, Kirsten Bibbins-Domingo, Fiona C Baker (J Child Psychol Psychiatry, 2023)

- At the 1 yr follow up visit, parent-report KSADS assessments yielded 'conduct disorder' diagnoses in 1.9% of the ABCD cohort, and 'oppositional defiant disorder' diagnosis in 6.3%.
- Analyses based on 2 thresholded groups (i.e., reporting < or > 4 hrs p/day of SMA at BL) yielded a 69% higher rate of CD in the higher SMA group, and a 46% higher rate of ODD, adjusting for covariates.
- Each additional hour of SMA was associated with 7% increase in CD risk and 5% increase in ODD risk.
- For CD diagnoses, only social media use showed a significant association.

- 3.0 Data Release
- Full BL and 1Yr FU :
  - N=11,875
- Methods:
  - Poisson regression analyses estimated associations of BL (9-10 yo) youth-reported SMA with 1Yr (10-11 yo) parent-report KSADS diagnoses of conduct or oppositional defiant disorder.
  - Adjusted for sex, income, parental education, caregiver employment, and ethnicity/ancestry, BL symptoms of CD or ODD, depression diagnosis, or family history of psychopathology



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# Screen Time Use Among US Adolescents During the COVID-19 Pandemic

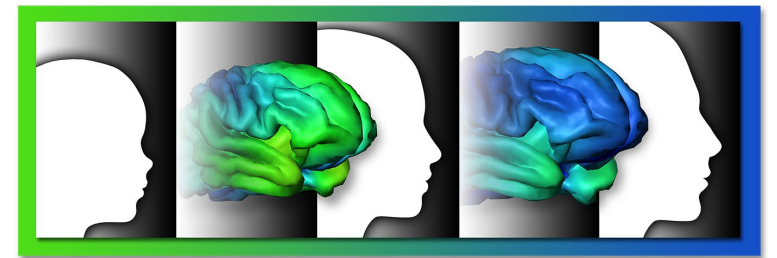
Jason M. Nagata, MD, MSc, Catherine A. Cortez, BS, Chloe J. Cattle, BS, Kyle T. Ganson, PhD, MSW, Puja Iyer, BA, Kirsten Bibbins-Domingo, PhD, MD, MAS, and Fiona C. Baker, PhD (JAMA, 2022)

- At this assessment, early in the pandemic in May 2020, this subgroup of the ABCD cohort reported total SMA for 7.7 hours p/day (up from 3.8 hours p/day at BL). This may relate to differences in the survey items and/or the age of the youth.
  - COVID-related worry and stress were associated with more SMA.
  - More social support and coping behaviors were associated with less SMA.
- Special Release of COVID Survey Data
  - Responses were voluntary
    - 5,412 responded
  - Methods:
  - Remotely administered survey assessed COVID related changes in mental health, schooling, coping behaviors, social support, and a COVID-adapted survey of screen media activity.
  - Regressions estimated associations of SMA with MH factors.
  - Adjusted for sex, ethnicity/ancestry, household income, parental education.



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# ABCD Cyberbullying Questionnaire



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**Cyberbullying victimization** was assessed with the question:

"Have you ever been cyberbullied, where someone was trying on purpose to harm you or be mean to you online, in texts, or group texts, or on social media (like Instagram or Snapchat)?"

**Cyberbullying perpetration** was assessed with the question,

"Have you ever cyberbullied someone, where you purposefully tried to harm another person or be mean to them online, in texts, or group texts, or on social media (like Instagram on Snapchat)?"

For both cyberbullying victimization and perpetration, participants were also asked if this occurred in their lifetime as well as in the past 12 months.

# Social Epidemiology of Early Adolescent Cyberbullying in the United States

Jason M Nagata, Nora Trompeter, Gurbinder Singh, Kyle T Ganson, Alexander Testa, Dylan B Jackson, Shervin Assari, Stuart B Murray, Kirsten Bibbins-Domingo, Fiona C Baker (Acad Pediatr., 2022)

- Lifetime cyberbullying victimization was reported in 9.6% of the cohort, and perpetration in 1.1%
  - Girls reported higher rates of victimization and boys reported higher rates of perpetration.
  - While there was no evidence for ethnicity/ancestry differences in victimization, **sexual minorities reported 2.83 higher odds of victimization.**
  - Lower household income was associated with 1.64 higher odds of victimization.
- 4.0 Data Release
  - Cross-sectional analyses of 2Yr follow-up data:
    - N=9,429
  - Methods:
    - Logistic regressions to estimate associations between sociodemographic factors and cyberbullying victimization and perpetration



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# Association of Video Gaming With Cognitive Performance Among Children

Bader Charani, PhD; Joseph Ortigara, MS; DeKang Yuan, MS; Hannah Loso, PhD; Alexandra Potter, PhD; Hugh P. Garavan, PhD (JAMA Network, 2022)

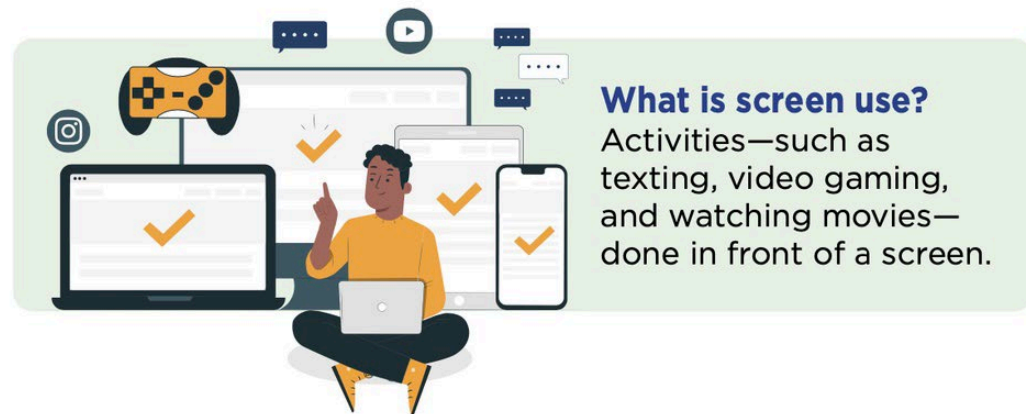
- Based on the ABCD youth STQ administered at baseline, subgroups of participants reporting over 21 hours p/week of video gaming (VGs) were compared to nongamers (NVGs) on task performance and brain activation from 2 task fMRI paradigms: one while performing a motor response inhibition task, and the other while performing a working memory task.
  - Although scores on mental health problems from the CBCL were consistently slightly elevated in the VGs, these were not significant differences nor were the scores in the clinical range.
  - Task performance on the in-scanner inhibitory and working memory measures were both significantly higher in the VGs, not confounded by sex.
  - Focal changes of brain activation in regions known to contribute to performance on the tasks were also enhanced in the VGs during task performance.
- 2.0.1 Data Release
  - Case Control Sampling:
    - N=2217
  - Methods:
    - Performance on behavioral tasks administered during fMRI paradigms and brain activation were compared in groups of heavy gamers and nongamers.
  - Adjusting for sex, scanner, estimates of IQ, pubertal staging, and household income.



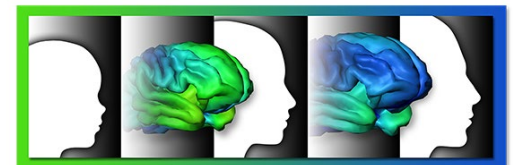
# Public Facing Summary (Infographic) for Distribution to ABCD Cohort, Consortium, Collaborators, and Community Followers (courtesy of our NIH Collaborators)



Research using data from the ABCD Study<sup>®</sup>, the largest long-term study of brain development and child health in the United States, has shown both positive and negative associations of screen use for preteens.



- ABCD assesses screen media activity on an annual basis.
- Questions are asked about TV, streaming videos, gaming, internet browsing, social networking sites and apps, etc.
- Weekday and weekend use and mature content are also queried.



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# Youth use screens more as they get older



\*Although researchers only asked about screen use during non-school hours, some increases may have been related to social distancing during COVID-19.



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- SMA is increasing with age and is higher in boys
- Youth were 12-13 during pandemic
- Boys and girls use different types of digital media.

## Average daily screen use\*

**Boys** spend more time on:

- Video Games
- TV & Movies Streaming

### Time by Activity



**Girls** spend more time on:

- Video Chat
- Texting
- Social Media

### Time by Activity





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## When comparing participants' screen use, those who used screens more often showed a small increase in:

- Sleep problems
- Attention-deficit/hyperactivity disorder (ADHD)
- Lower grades in school
- Number of close friends

\*Defined as non-school-related media use: TV, movies, videos, video games, texting, social media, or video chat.

### Video gaming is associated with increases in:

- ↑ Problem-solving
- ↑ Flexible thinking
- ↑ Recalling facts & skills

### Social media is associated with decreases in:

- ↓ Problem-solving



- Several studies have shown that there are modest SMA associations with behavioral problems and academic achievement, but also with higher social functioning.
- Video gaming exhibits associations with stronger cognitive skills, including inhibitory functions and working memory.
- High levels of social media may also be associated with anxiety, and conduct disorder in boys.

## Every additional hour spent watching videos meant less sleep



Together, more video watching *and* less sleep were related to small increases in:

Feeling anxious/  
depressed

Example:  
*Too fearful or anxious.*

Feeling withdrawn/  
depressed

Example:  
*Would rather be alone than with others.*

Having thought problems

Example:  
*Fears others are out to get them.*



### More than 2 hours of screen use\* per day

was associated with a slight increased risk for having a depressive disorder, suicidal thoughts/attempts, and self-harm in boys and girls.

It was also associated with an increased likelihood of anxiety in boys, but not girls.

\* Defined as video chat, social media, texting, gaming, online videos, TV, and movies.



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- Sleep problems are also associated with high SMA and may mediate some component of the associations with mental health symptoms and other outcomes.
- In ABCD data, associations of poor health and mental health with sleep are stronger than those with SMA.





These studies showed that time spent on screens was associated with a lot of things, good and bad, at the time data were collected. They didn't show that one thing caused the other. Many things could have affected these findings, which may also change over time. Researchers continue to explore these questions.

### Recommendations for Caregivers

- Consider limiting screen time to 2-3 hours per day.
- If your child spends time on social media, have regular conversations with them about cyberbullying.
- Consider limiting your child's use of smartphones and other devices at bedtime to help ensure they get enough sleep.



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- Causal links are hard to make with this early view from an observational study.
- Effects of sleep quality and household income were often considerably larger than those of SMA in the same models
- Upcoming releases should clarify whether the weak SMA associations with poorer outcomes in mental health, academic achievement, and problematic behavior persist and strengthen.



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## This information is made possible by the Adolescent Brain Cognitive Development Study

Thank you to ABCD families for giving so much of their time to make this study possible. Youth participating in this research help scientists answer important questions that improve their understanding about screen use in adolescence and beyond. These and other ABCD-supported studies help us learn more about how the brain develops, improving the health and well-being of youth now and in future generations.

**Learn more: <https://abcdstudy.org/families>**

# Thanks!

