Adolescent Brain Cognitive Development

Teen Brains. Today's Science. Brighter Future.

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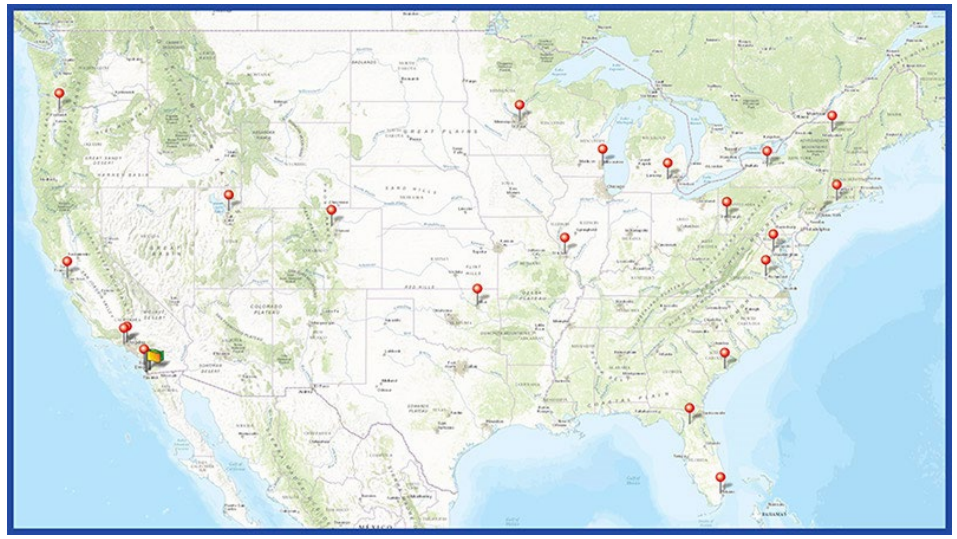
ABCD at UC San Diego

What is the ABCD study?

www.ABCDstudy.org

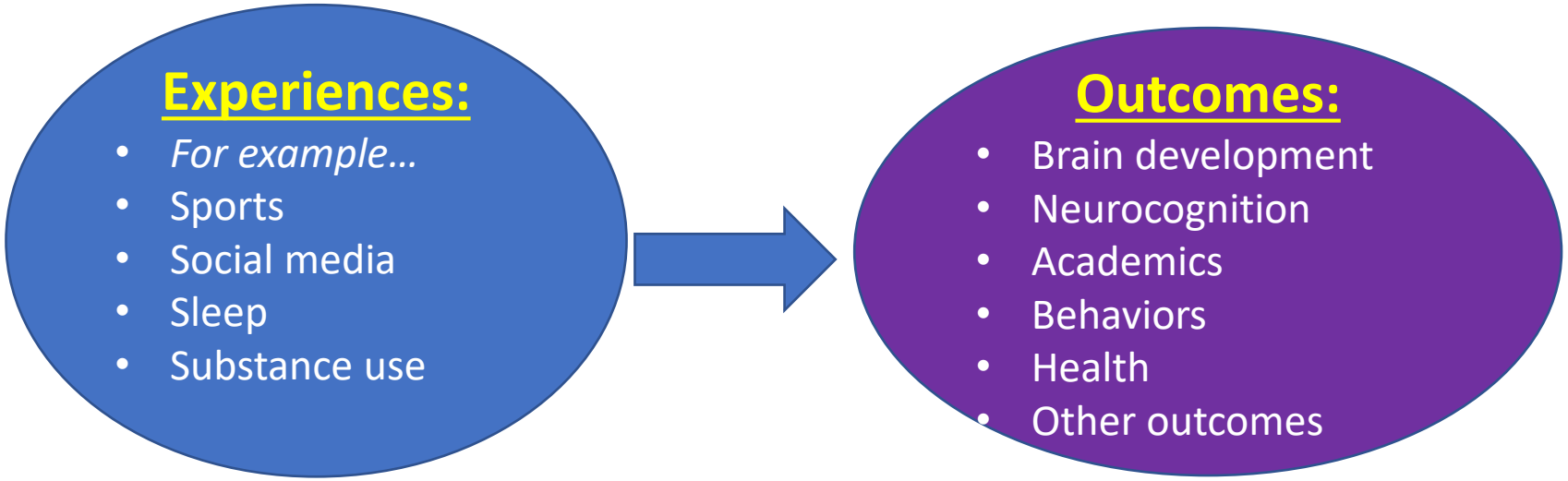


- **11,878 children (including 2,100 twins and 30 triplets) aged 9-10.**
  - **700+ in San Diego County!**
- **Annual assessments (biennial MRI) for ten years.**
- **Extensive neuroimaging, genotyping, psychometrics, hormone analysis, geocoding …**
- **Data publicly available:**

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

ABCD Study Objectives:

- Determine how childhood experiences interact to affect outcomes.



- Results will provide families, schools, health professionals, and policymakers with practical information to promote health, well-being, and success of children.

Why so large a sample?

- Gives sufficient **statistical power** to detect small effects, the cumulative impacts of multiple influences, interactions among variables, …

- Allows for rigorous **data analysis** (e.g., complex analytics)

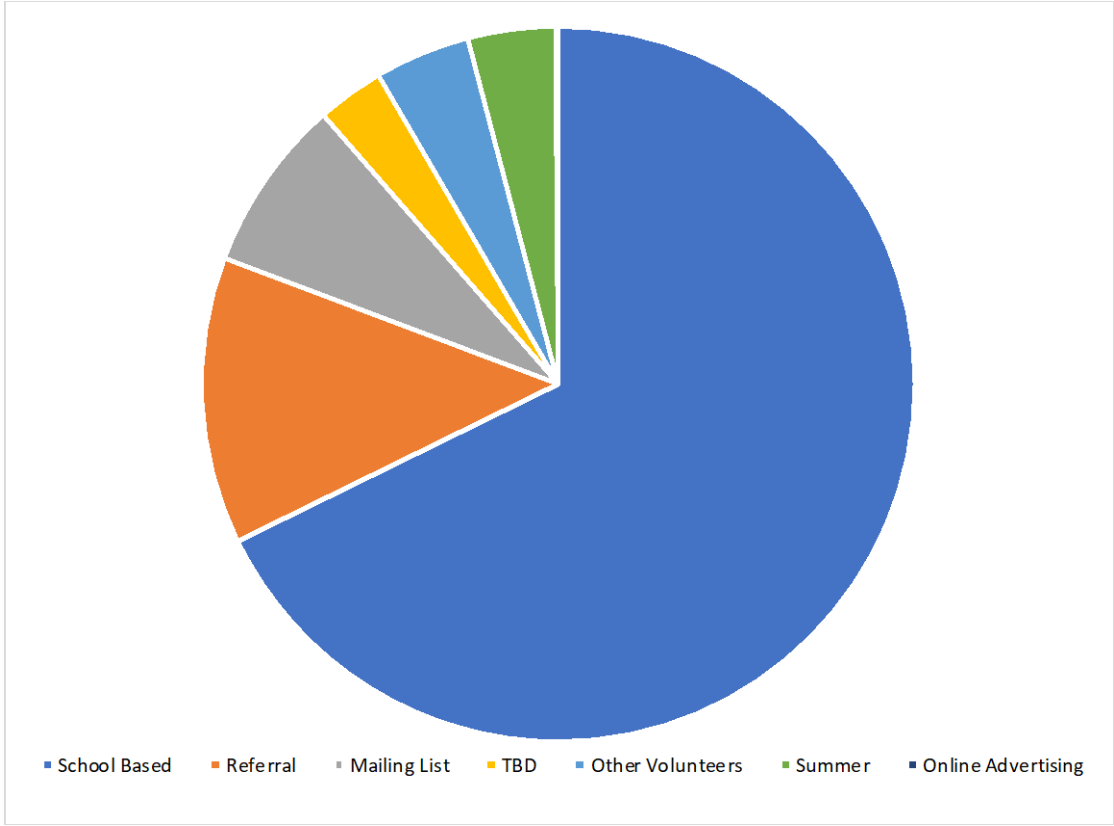
- With sufficient individual variation, we can disentangle demographics that are often confounded (e.g., urbanicity, SES).

- Can reveal if effects vary with subpopulations – for example, sex/race-specific risk factors for, and consequences of, substance use or psychopathology.

How was the sample recruited?

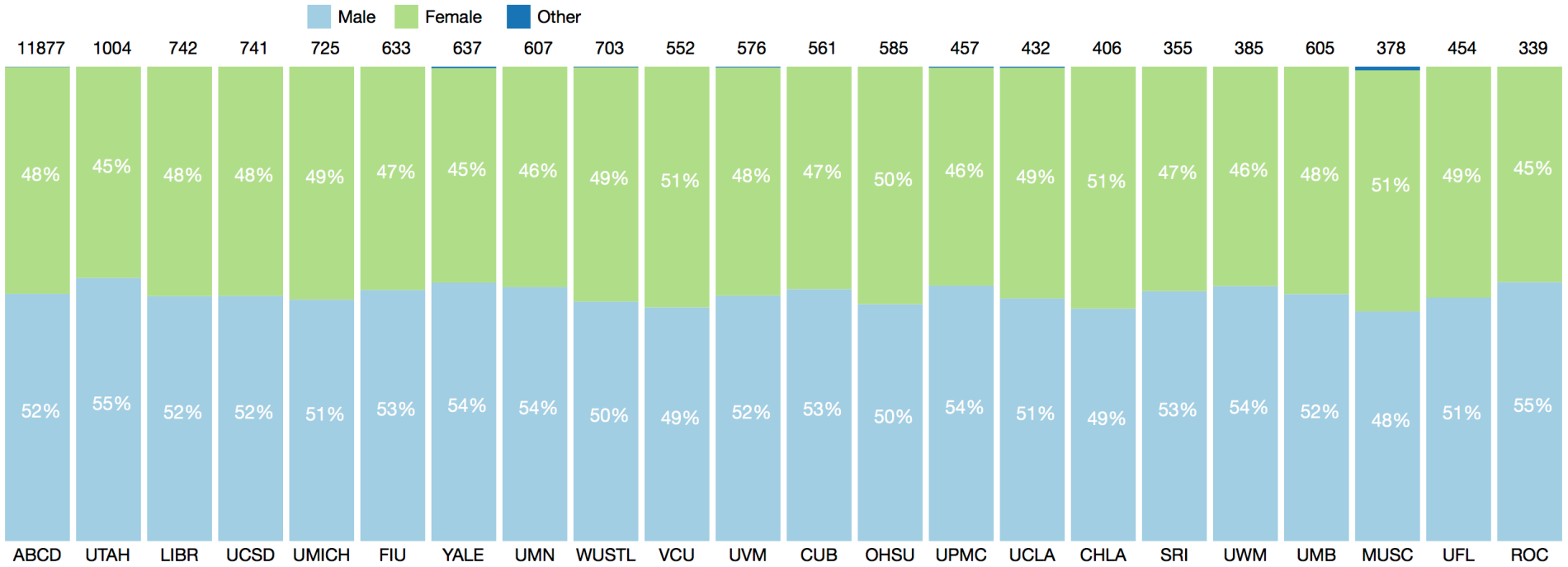
Excluding Birth Registry Twins

Recruitment Source	%
School Based	67.8
Referral	13.0
Mailing List	7.8
Other Volunteers	3.0
Summer	4.3
TBD	4.0
Online Advertising	0.1



The Sample

Female : Male



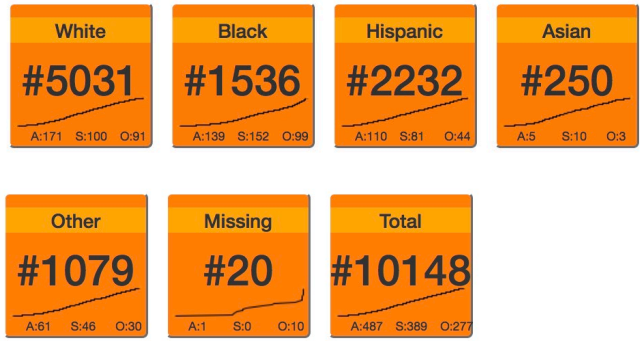
Age

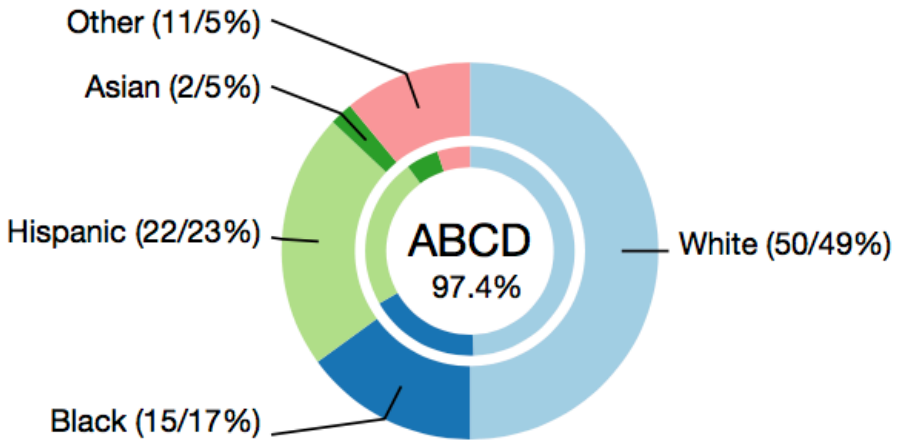
Age 9: 52%

Age 10: 48%

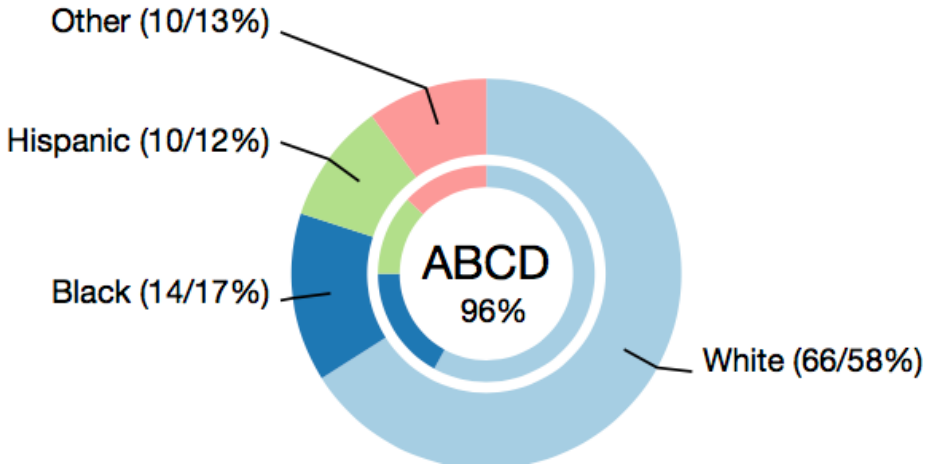
The Sample

General Population





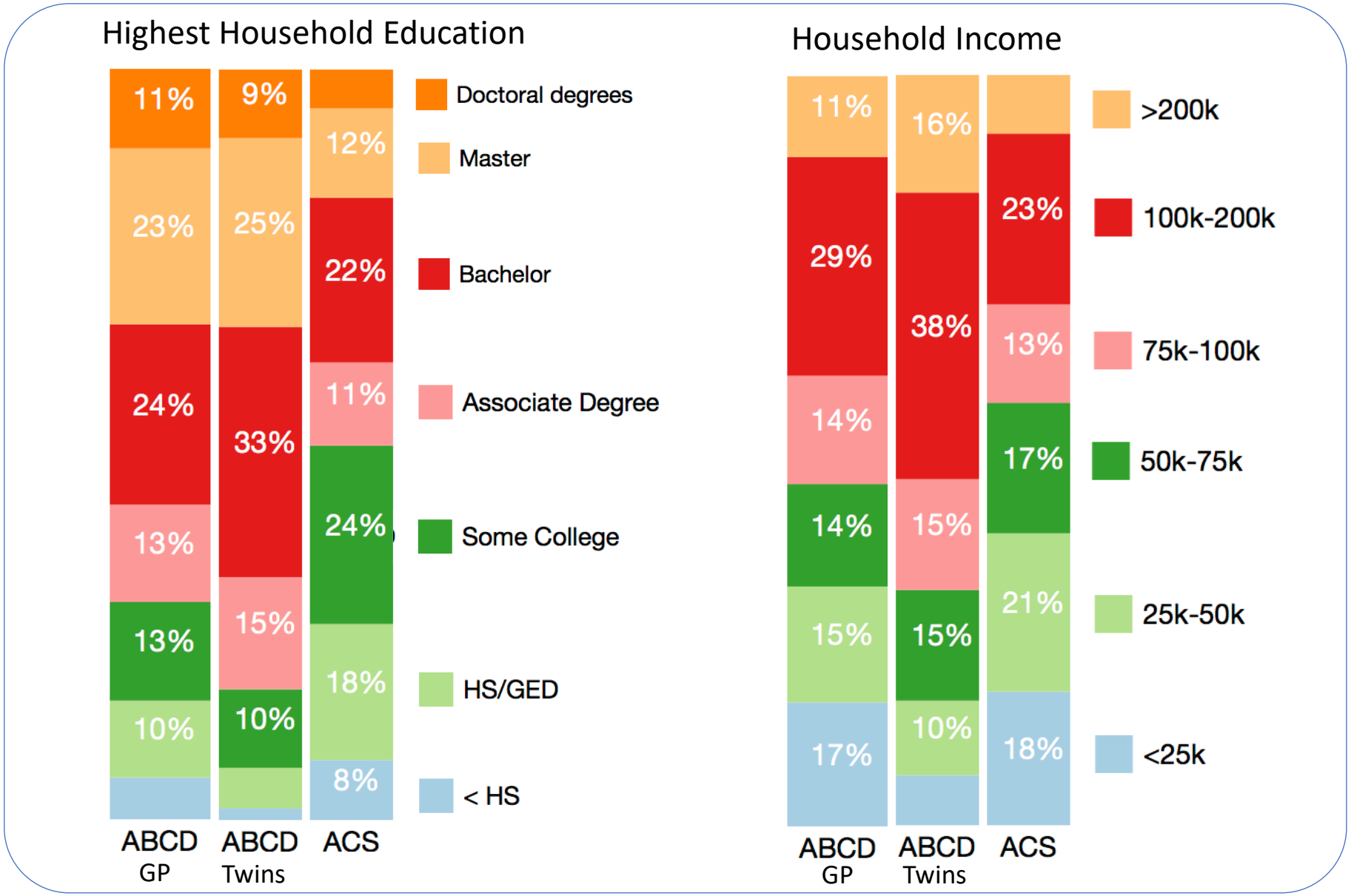
Twins Population



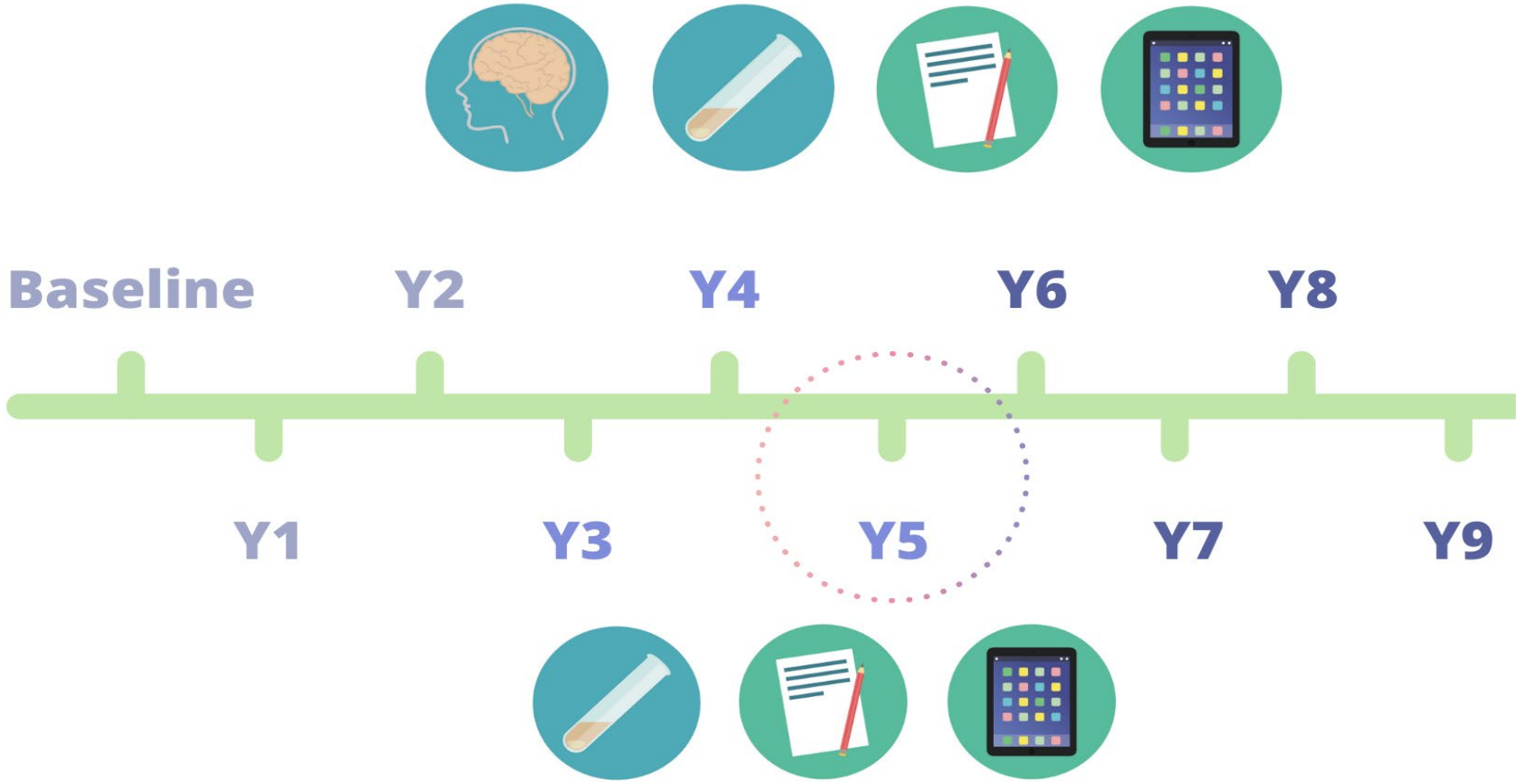
Inner ring: Targets
Outer ring: Actual

The Sample

ACS
American Community Survey is a large scale survey of approximately 3.5 million households conducted annually by the U.S. Census Bureau



Study Timeline



Assessment Protocols

Neurocognition	Attention, learning, memory, information processing, verbal IQ, motivation, impulsivity
Substance Use	Parental rules, peer influences, intention to use, use, sensitivity, consequences
Mental Health, Health, & Demography	Physical activity, mental health, puberty, sleep, TBI, screen time, family history, sports participation, food insecurity
Culture & Environment	Ethnic identity, acculturation, discrimination, religiosity, neighborhood safety, parental monitoring, school environment
Biospecimens	Breath, saliva, hair (subsample), blood (subsample), baby teeth (optional)
Mobile Tech & Passive Data	Fitbit, school records, pediatrician records, geocoding
Structural MRI	Shape, size, integrity of brain structures
rs- and task-based fMRI	Functional organization of the brain at rest or when doing a task

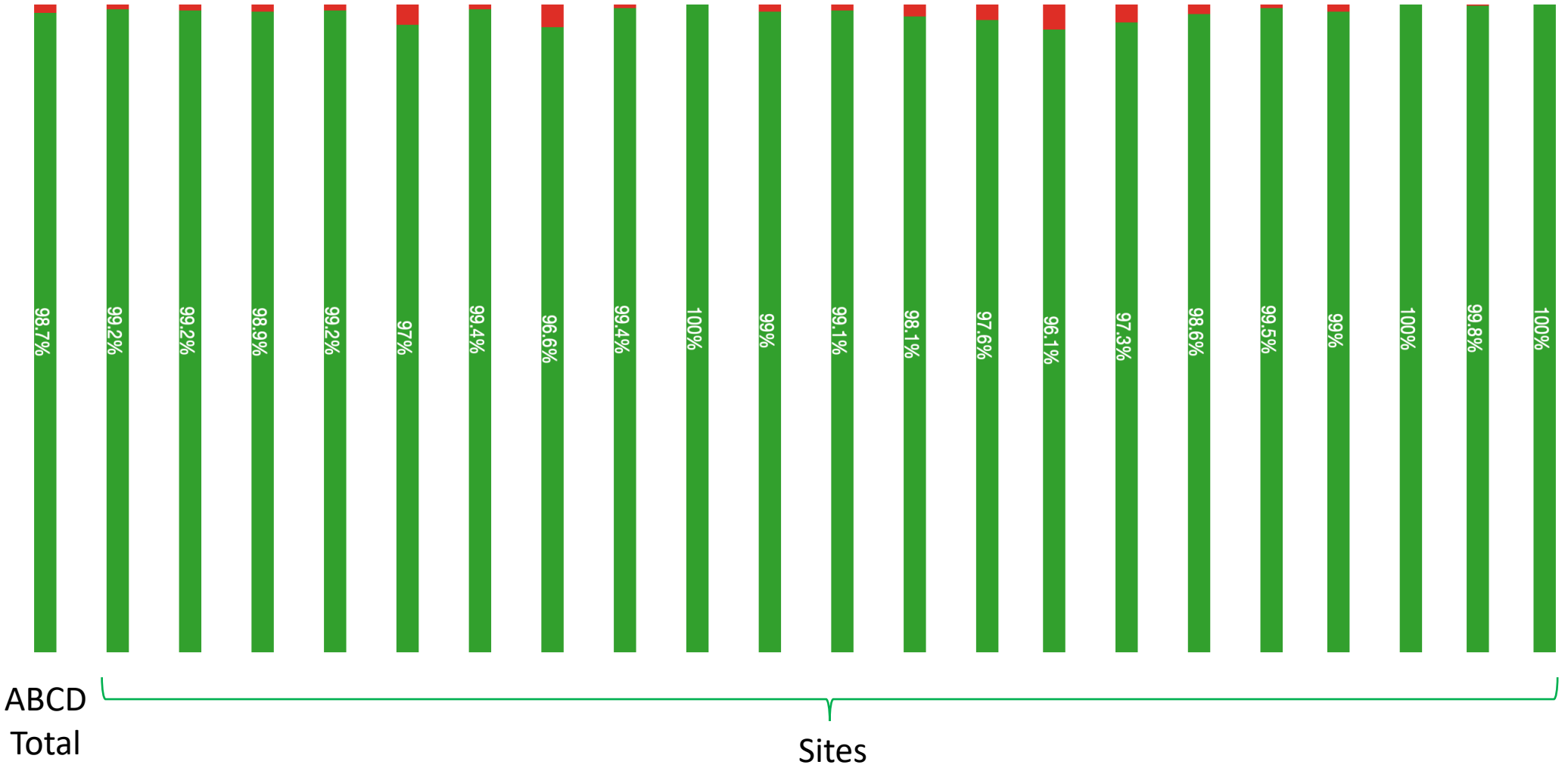
How is it going?

Now that we have baseline data the primary emphasis is on retention.

A dedicated retention working group focuses on monitoring retention, identifying trends in who is withdrawing or missing assessments, building predictive models for who withdraws, sharing best practices, working with sites, etc

How is it going?

Four years in and retention rates remain very high: 98.7%



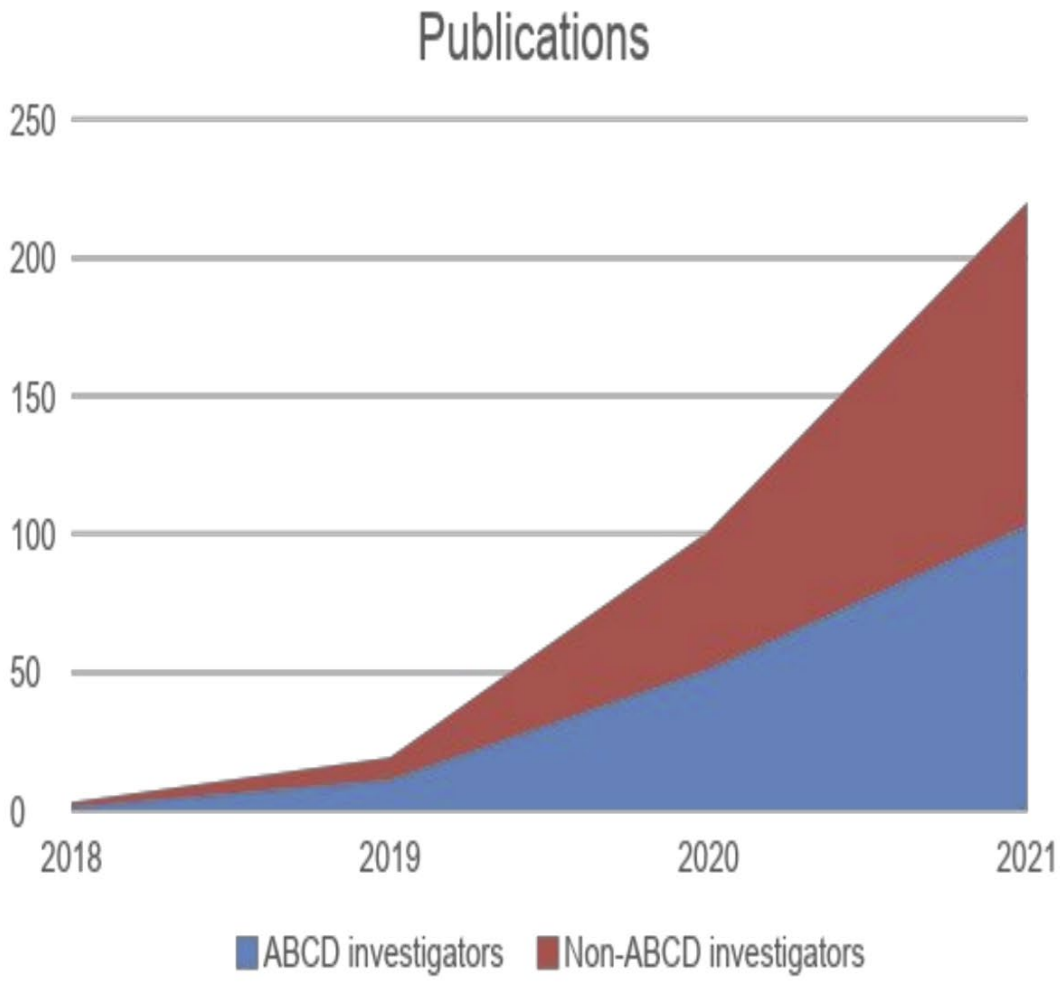
COVID Adjustments

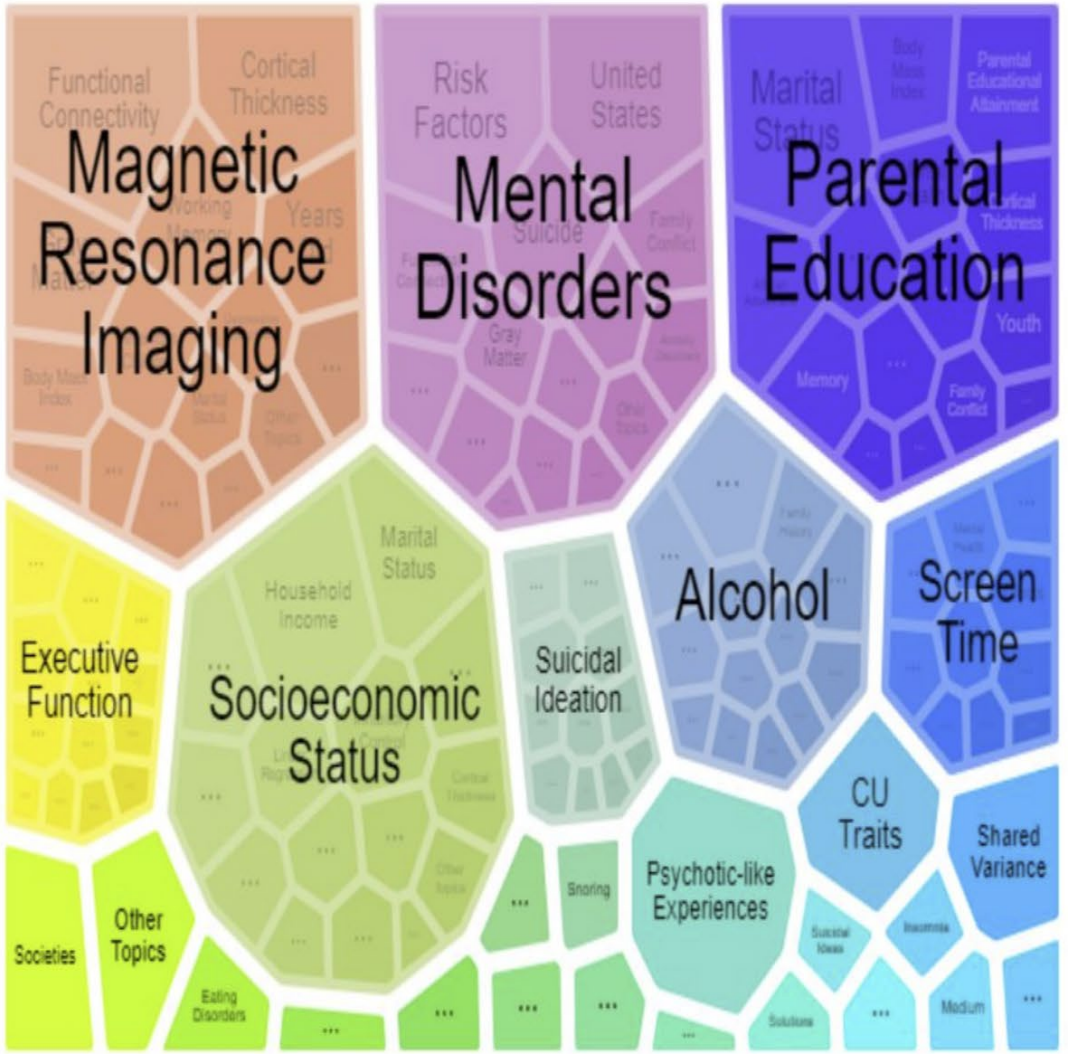
- ABCD moved quickly to virtual (on-line, at home) assessments and is now transitioning to hybrid (at-home + lab-based) and fully in-person assessments.

- Some missing data will be inevitable.

- One silver lining: Reduced sociodemographic bias in who fails to do assessments!

What are we learning?





Contents lists available at ScienceDirect

Drug and Alcohol Dependence

journal homepage: www.elsevier.com/locate/drugalcdep

Substance use patterns in 9-10 year olds: Baseline findings from the adolescent brain cognitive development (ABCD) study

Krista M. Lisdahl [a,F,*], Susan Tapert [c], Kenneth J. Sher [H], Raul Gonzalez [o], Sara Jo Nixon [n], Sarah W. Feldstein Ewing [p], Kevin P. Conway [m], Alex Wallace [a], Ryan Sullivan [a], Kelah Hatcher [a], Christine Kaiver [a], Wes Thompson [c], Chase Reuter [c], Hauke Bartsch [c], Natasha E. Wade [c],

We succeeded in recruiting a substance-naïve sample

- **22.5 % reported alcohol sipping**
- **0.2 % full alcohol drink**
- **0.7 % used nicotine**
- **<0.1 % used any other drug of abuse)**

Contents lists available at ScienceDirect

Alcohol

journal homepage: http://www.alcoholjournal.org/

Risk factors associated with curiosity about alcohol use in the ABCD cohort

Natasha E. Wade [a], Clare E. Palmer [a], Marybel R. Gonzalez [a], Alexander L. Wallace [b], M. Alejandra Infante [a], Susan F. Tapert [a], Joanna Jacobus [a], Kara S. Bagot [c, *]

Perceptions that alcohol use causes little harm and having peers with similar beliefs is related to curiosity about alcohol use among substance-naïve 10-11-year-olds.

- **Same for general mental health, parent history of AUD, and adverse life events**

Published in final edited form as:
Alcohol Clin Exp Res. 2020 June ; 44(6): 1234–1244. doi:10.1111/acer.14343.

Parental family history of alcohol use disorder and neural correlates of response inhibition in children from the Adolescent Brain Cognitive Development (ABCD) Study.

Briana Lees, BPysch (Hons)[1], **Laika Aguinaldo, PhD**[2], **Lindsay M. Squeglia, PhD**[3], **M. Alejandra Infante, PhD**[2], **Natasha E. Wade, PhD**[2], **Margie Hernandez Mejia**[4], **Joanna Jacobus, PhD**[2]

Youth with family history of alcohol use disorder show different brain activation patterns in response to cognitive inhibition tasks

Psychiatry Research 299 (2021) 113825

Contents lists available at ScienceDirect

Psychiatry Research

journal homepage: www.elsevier.com/locate/psychres

Short communication

Preliminary analysis of low-level alcohol use and suicidality with children in the adolescent brain and cognitive development (ABCD) baseline cohort

Laika D. Aguinaldo [a], Aimee Goldstone [b], Brant P. Hasler [c], David A. Brent [c], Clarisa Coronado [a], Joanna Jacobus [a,*]

[a] University of California San Diego, Department of Psychiatry, La Jolla, California, USA
[b] SRI International, Human Sleep Research Program, Menlo Park, California, USA
[c] University of Pittsburgh, Department of Psychiatry, Pittsburgh, Pennsylvania, USA

Children reporting low-level alcohol sipping at ages 9-10 have a two-fold increase in their odds of suicidality

The Lancet Child & Adolescent Health
Volume 2, Issue 11, November 2018, Pages 783-791

Articles

Associations between 24 hour movement behaviours and global cognition in US children: a cross-sectional observational study

Jeremy J Walsh PhD [a] ✉, Joel D Barnes MSc [a], Jameason D Cameron PhD [a], Gary S Goldfield PhD [a, b, c, d], Jean-Philippe Chaput PhD [a, b, c], Katie E Gunnell PhD [e], Andrée-Anne Ledoux PhD [f], Roger L Zemek MD [c, f], Prof Mark S Tremblay PhD [a, c]

- Cognition skills were best among children who got between
  - 9-11 hours sleep,
  - <2 hours recreational screen time
  - At least an hour's exercise daily.

Contents lists available at ScienceDirect

Developmental Cognitive Neuroscience

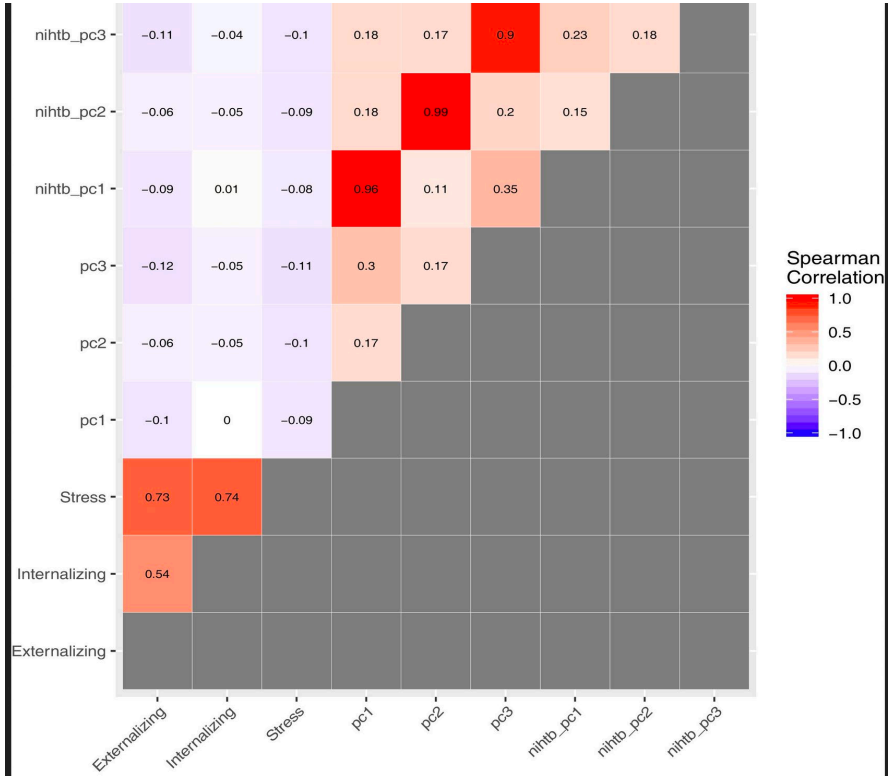
journal homepage: www.elsevier.com/locate/dcn

The structure of cognition in 9 and 10 year-old children and associations with problem behaviors: Findings from the ABCD study's baseline neurocognitive battery

Wesley K. Thompson[a], Deanna M. Barch[b], James M. Bjork[c], Raul Gonzalez[d], Bonnie J. Nagel[e], Sara Jo Nixon[f], Monica Luciana[g,*]

Better cognitive abilities associated with *less report of*

- Stress
- Externalizing symptoms
- Internalizing symptoms

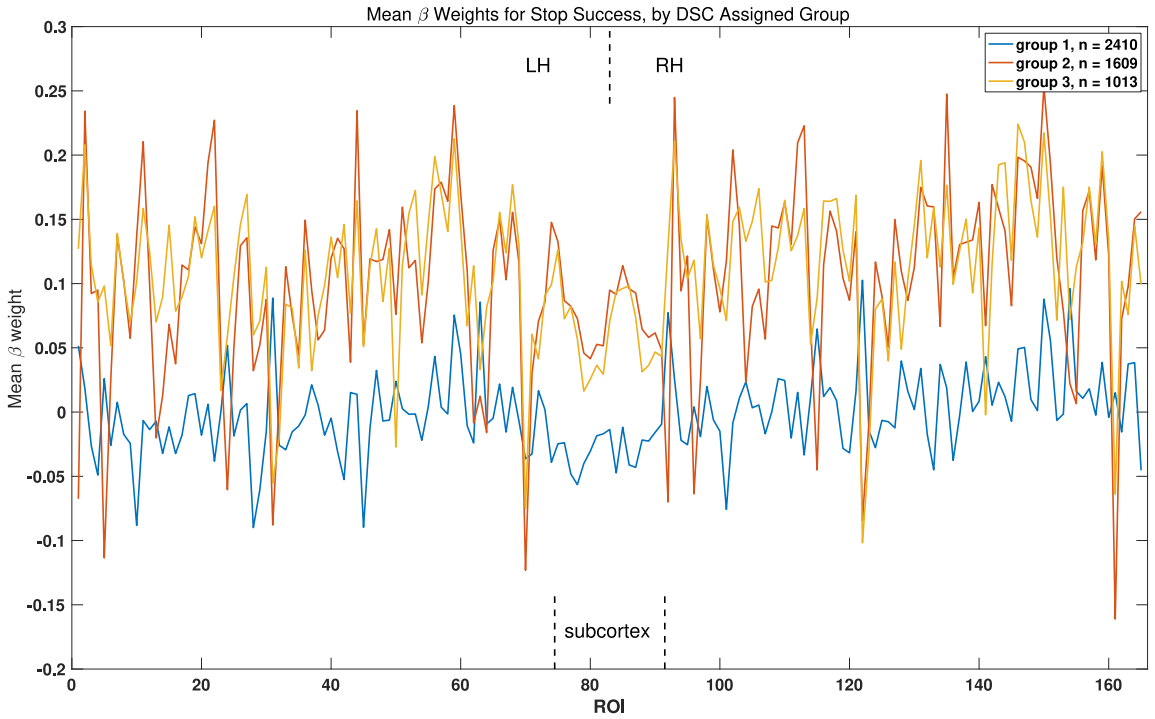


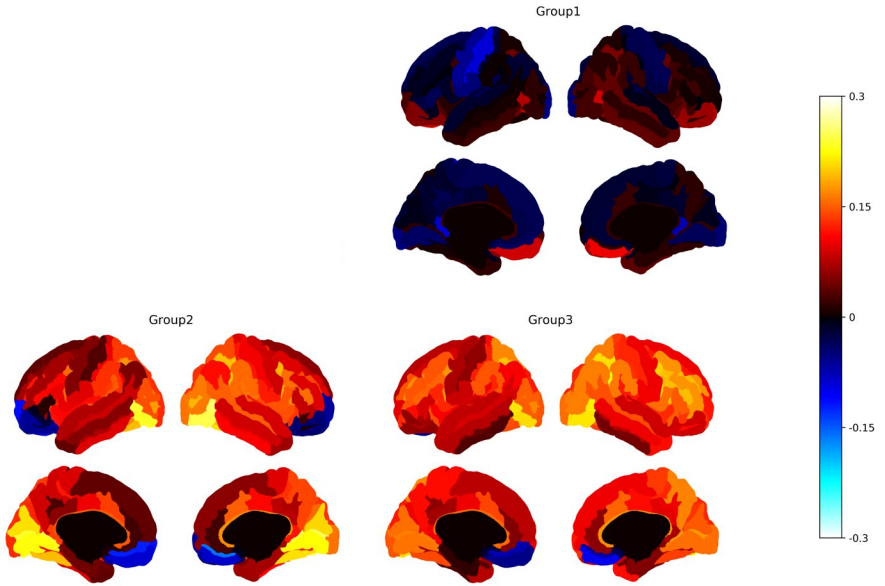
What are we learning?

Stratification

We can also empirically derive groups. For example, three groups of participants were identified from brain activation alone, during successful inhibition in the Stop Signal Task, by data spectroscopic clustering (Shi et al., 2009).

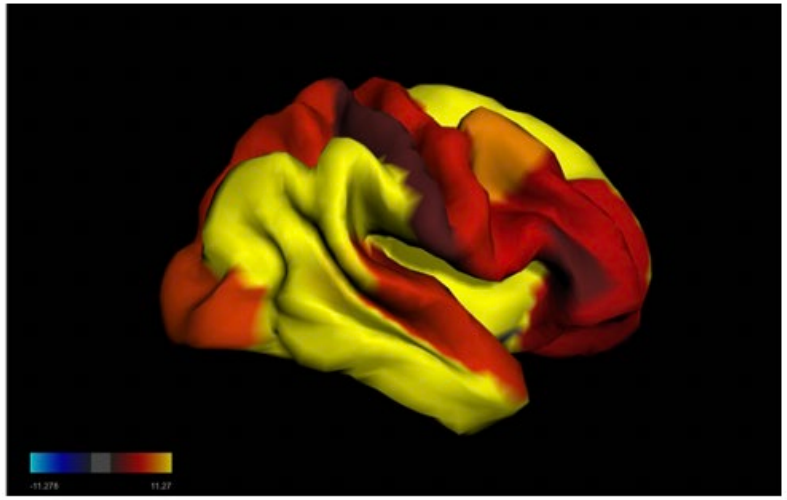
[Allgaier et al., In Prep.]

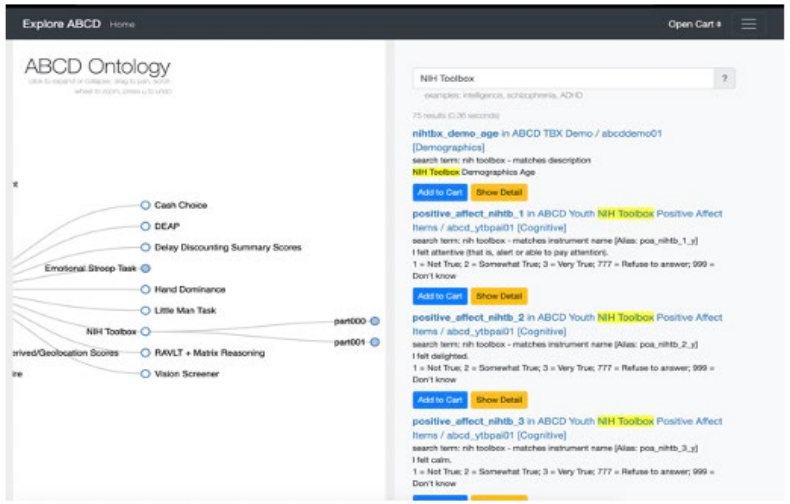




What are we learning?

Data Exploration and Analysis Portal (DEAP ABCD)



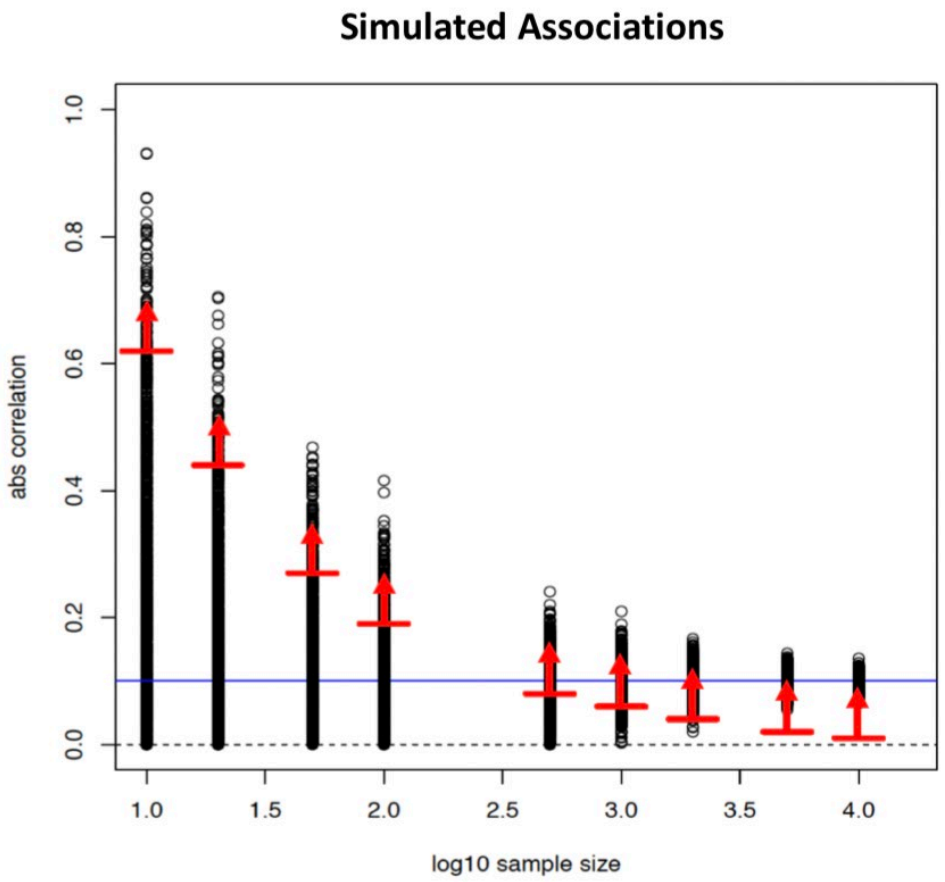


New Features:

- ROI level Image Analyses
- Interactive download of data using Explore
- Population weighting in Analyze

What are we learning?

Big Data and Small Effects



- **Small samples + Publication bias = inflated effect sizes.**
- **Analyses of the large ABCD dataset is revealing small effects (r<0.1) to be the norm.**

[Thompson et al., 2021]

Substance Use Assessment Overview

Substance Use & ABCD: Overview and Rationale

ABCD Goal: Understand the biological and environmental building blocks that best contribute to successful, resilient young adults.

Substance use

- Can be considered an “environmental” influence on youth outcomes
  - Influences on brain development
  - Influences on mental health
- As well as an outcome itself
  - Substance use problems
  - Addiction

Substance Use & ABCD: Overview and Rationale

Therefore, the data collected in the Substance Use module is critical to the goals of the ABCD Study. This includes:

1. Detailed information about substance use

1. Factors impacting risk for substance use

1. Consequences of substance use

Substance Use & ABCD: Overview and Rationale

Detailed information about substance use

- Includes low-level use questions, TLFB, hair samples
- Provides detailed information to associate with mental health, neurocognition and brain development.
  - Is co-use more harmful to the brain than the use of one substance?
  - How does early substance use impact risk for depression?
- Provides substance use outcomes:
  - What are the brain predictors of early initiation of substance use?
  - What are the environmental protective factors that keep high-risk youth from using substances?

Substance Use & ABCD: Overview and Rationale

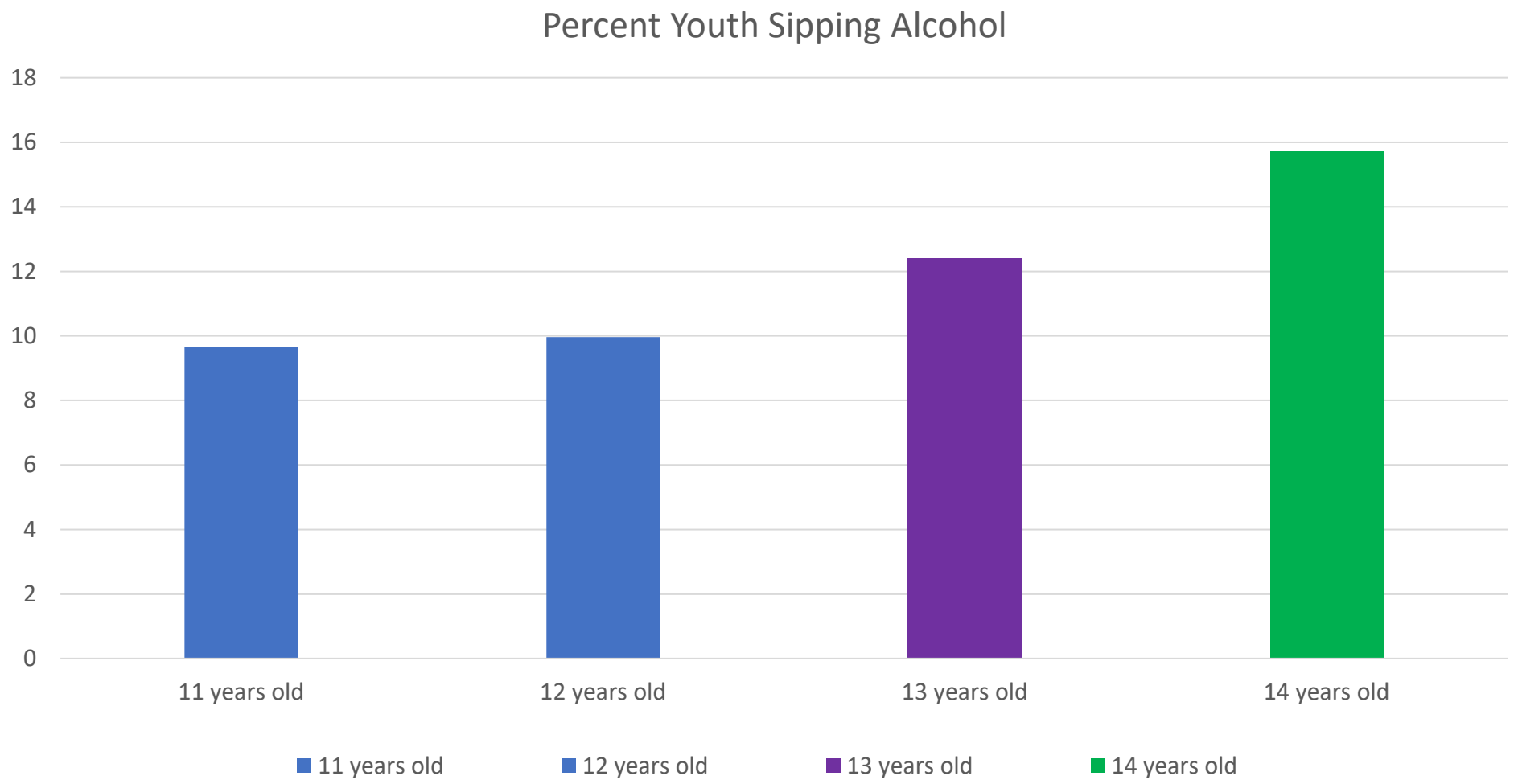
Factors impacting risk for substance use

- Includes availability of substances (in neighborhood and at home), peer use and attitudes, parent rules, youth attitudes (expectancies, intention to use)

- Provides detailed information to associate with substance use outcomes.
  - For example, if we can identify youth who have risk factors for substance use, but do not go on to have problem substance use, we can isolate **protective factors**.

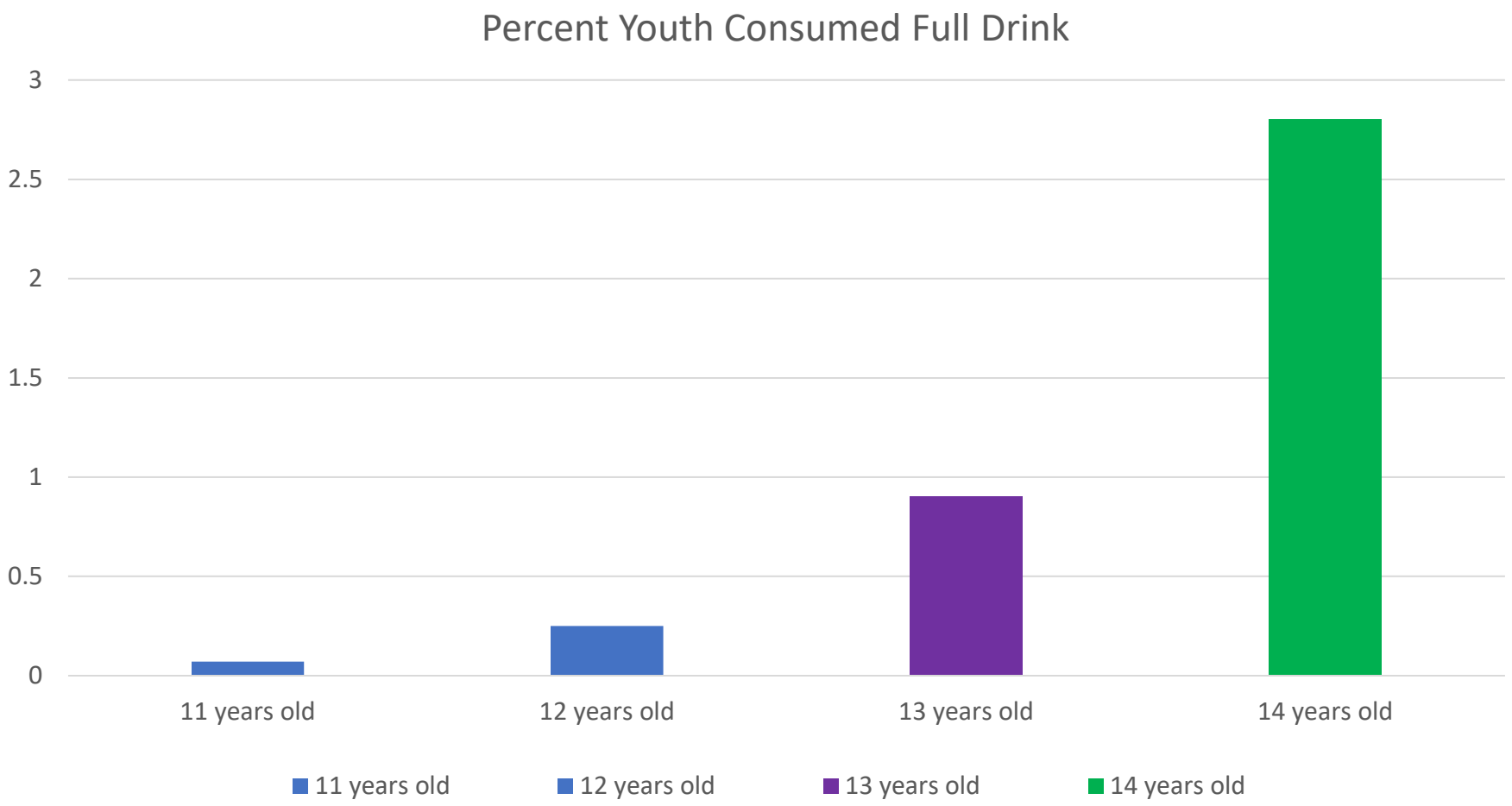
Some Data: Annual Alcohol Sipping

Increased from 9.6% in Year 1 to 15.7% in Year 4



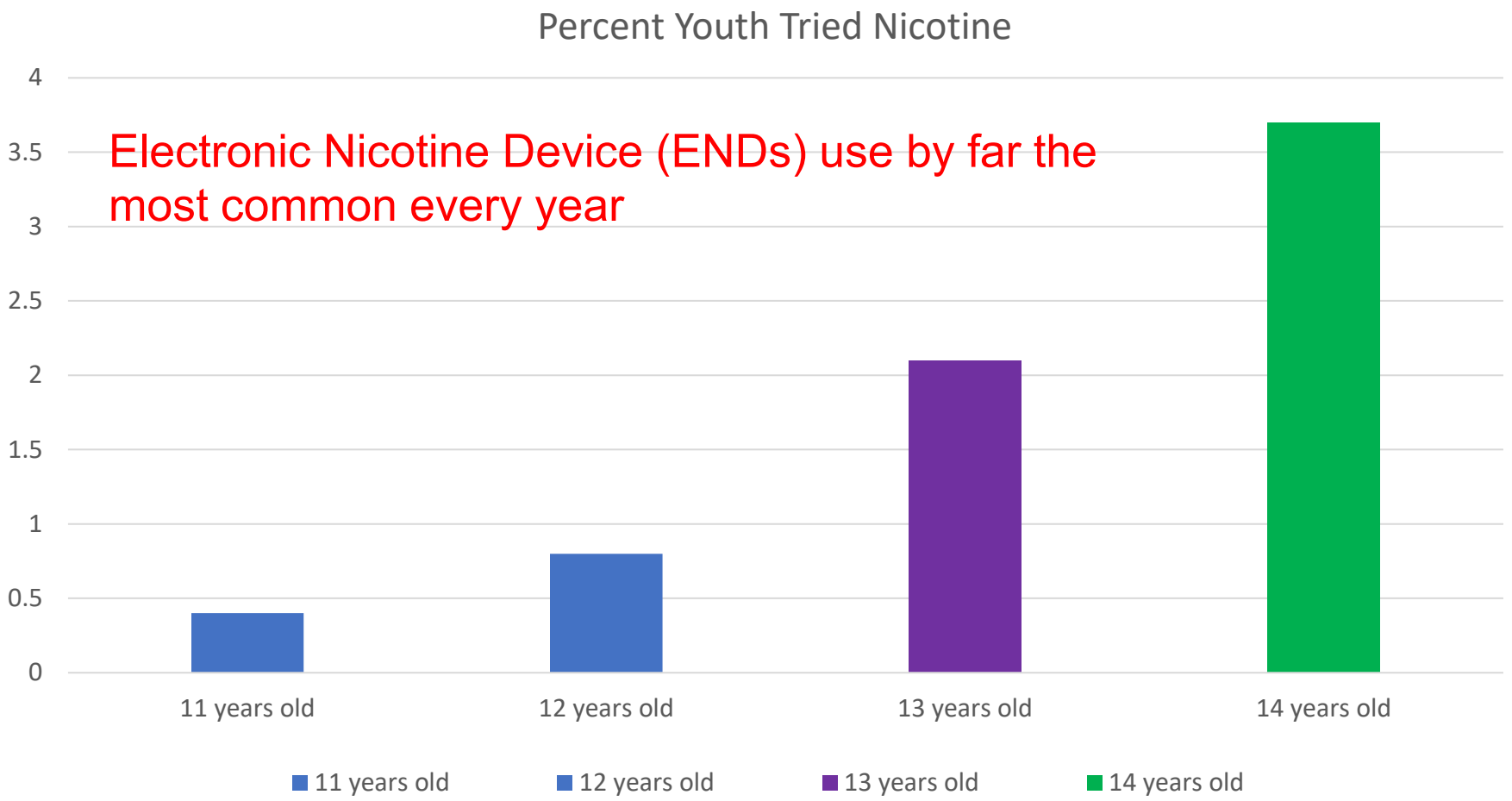
Some Data: Alcohol Full Drink

Increased from 0.07% in Year 1 to 2.8% in Year 4



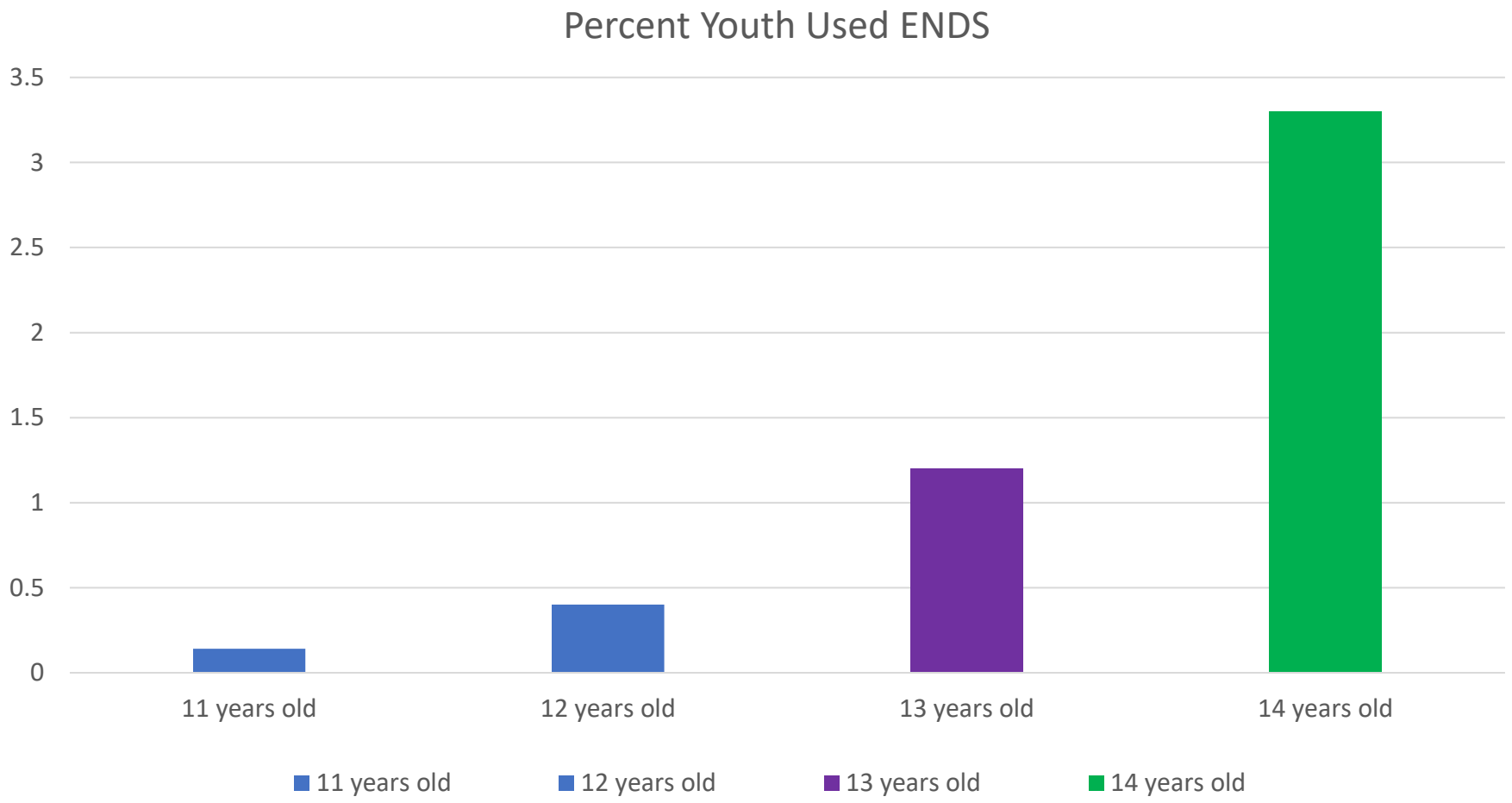
Some Data: Tried Nicotine Product

Increased from 0.4% in Year 1 to 3.4% in Year 4



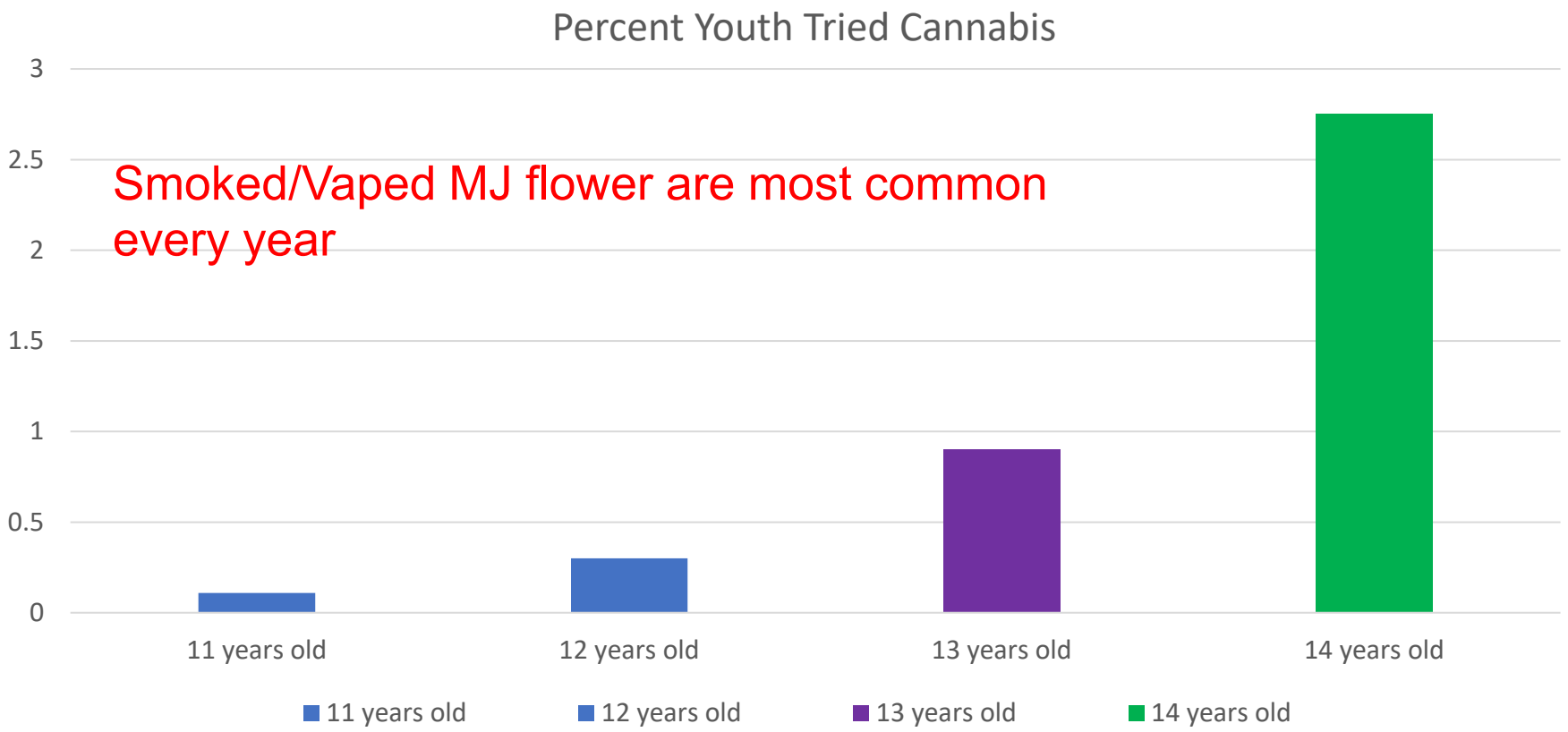
Some Data: Used ENDS

Increased from 0.14% in Year 1 to 3.3% in Year 4



Some Data: Tried Cannabis

Increased from 0.11% in Year 1 to 2.75% in Year 4



Some Data: Other Drugs

Scattered use of other drugs is also increasing, and types of drugs are shifting a bit from prescription/inhalants to stimulants/club drugs/hallucinogens.

Overall, alcohol use remains most common reported substance, followed by ENDS use.

Data Presentation: COVID-19 & Substance Use

ELSEVIER

JOURNAL OF ADOLESCENT HEALTH
www.jahonline.org

Original article

Early Adolescent Substance Use Before and During the COVID-19 Pandemic: A Longitudinal Survey in the ABCD Study Cohort

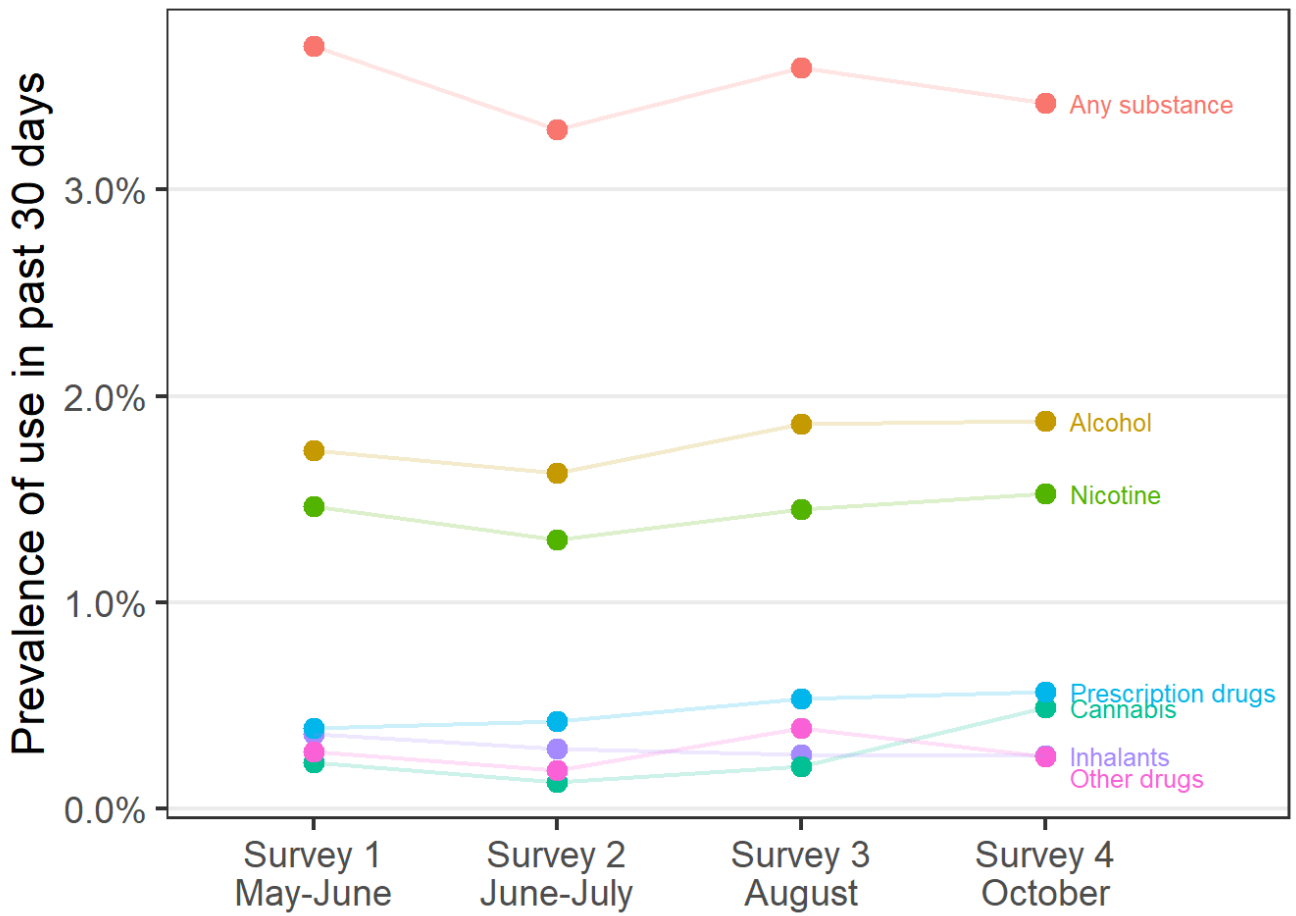
William E. Pelham III, Ph.D. [a,*], Susan F. Tapert, Ph.D. [a], Marybel Robledo Gonzalez, Ph.D. [a], Connor J. McCabe, Ph.D. [a], Krista M. Lisdahl, Ph.D. [b], Elisabet Alzueta, Ph.D. [c], Fiona C. Baker, Ph.D. [c], Florence J. Breslin, M.S. [d], Anthony Steven Dick, Ph.D. [e], Gayathri J. Dowling, Ph.D. [f], Mathieu Guillaume, Ph.D. [g], Elizabeth A. Hoffman, Ph.D. [f], Andrew T. Marshall, Ph.D. [h,i], Bruce D. McCandliss, Ph.D. [g], Chandni S. Sheth, Ph.D. [j], Elizabeth R. Sowell, Ph.D. [h,i], Wesley K. Thompson, Ph.D. [k], Amandine M. Van Rinsveld, Ph.D. [g], Natasha E. Wade, Ph.D. [a], and Sandra A. Brown, Ph.D. [a]

Youth and parent invited to complete 4 surveys during pandemic

Youth reported on substance use in the <u>past 30 days</u>:

- Alcohol
- Nicotine (cigarettes, e-cigarettes, cigar/hookah/pipe)
- Cannabis (flower, concentrate, edible)
- Inhalants
- Prescription drugs (in a way not prescribed)
- Other drugs

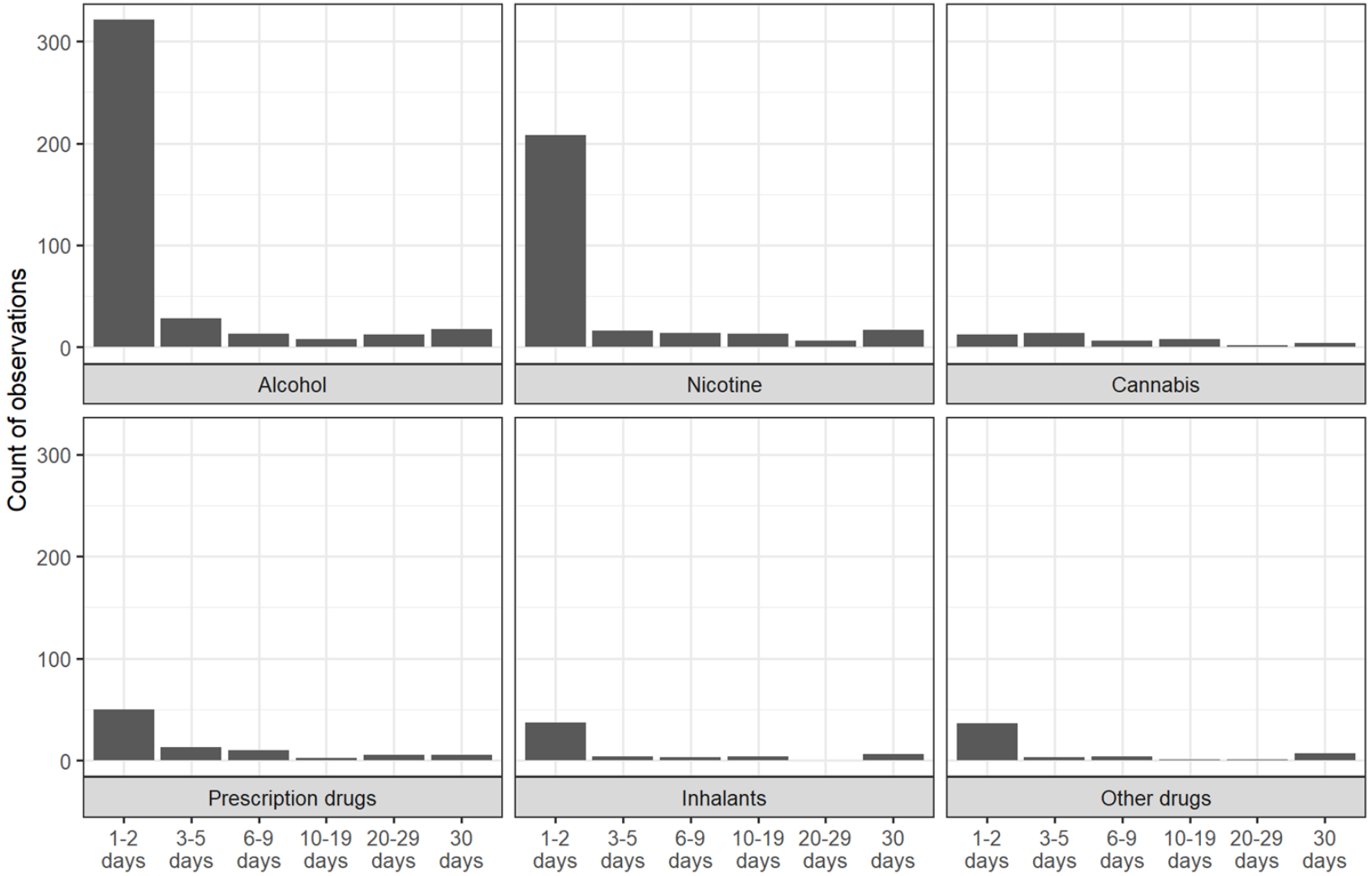
Median age = 12.4 years, IQR = [11.8, 13.1], range = [10.5, 14.6]



Rates of use were stable (*ns*) across four surveys completed during the pandemic

Among those who reported use:

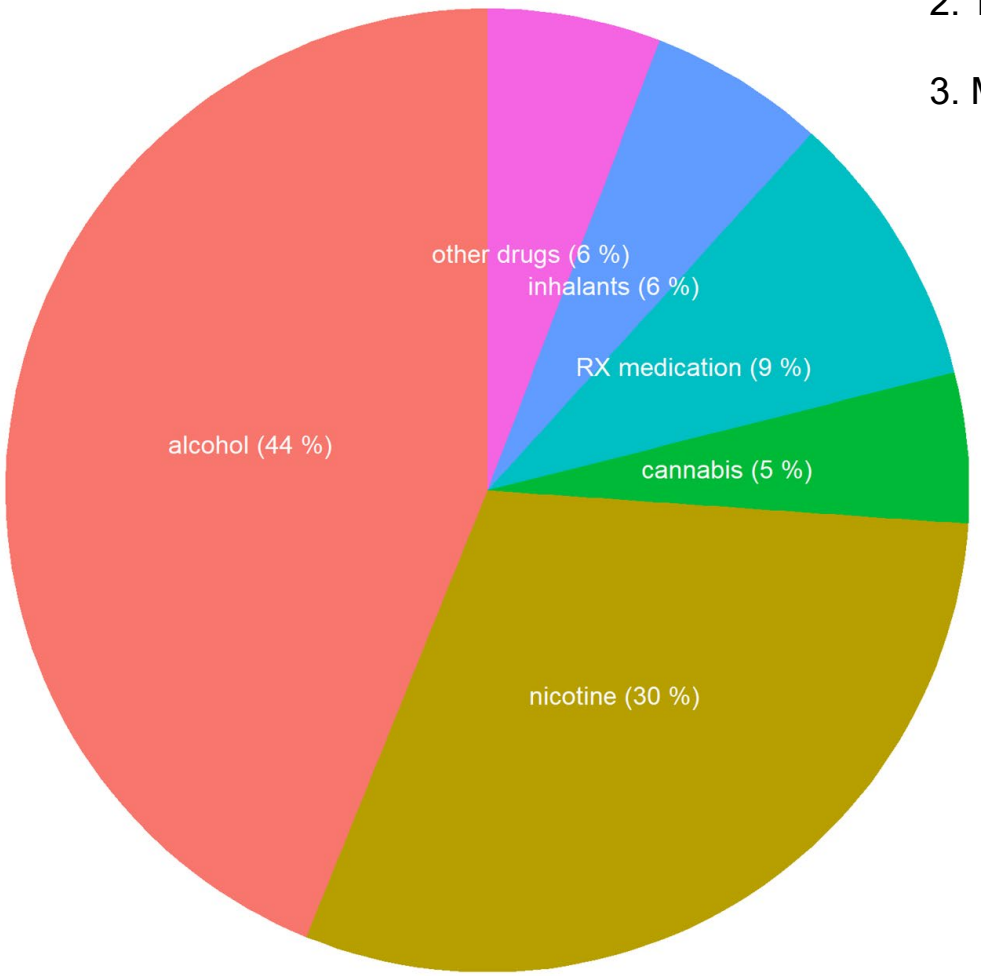
- Most (79%) used on 1-2 days in past month
- Very few youth use any substance regularly

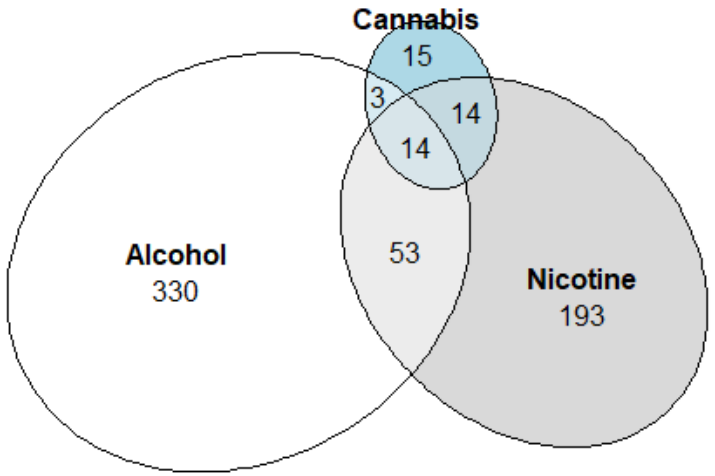


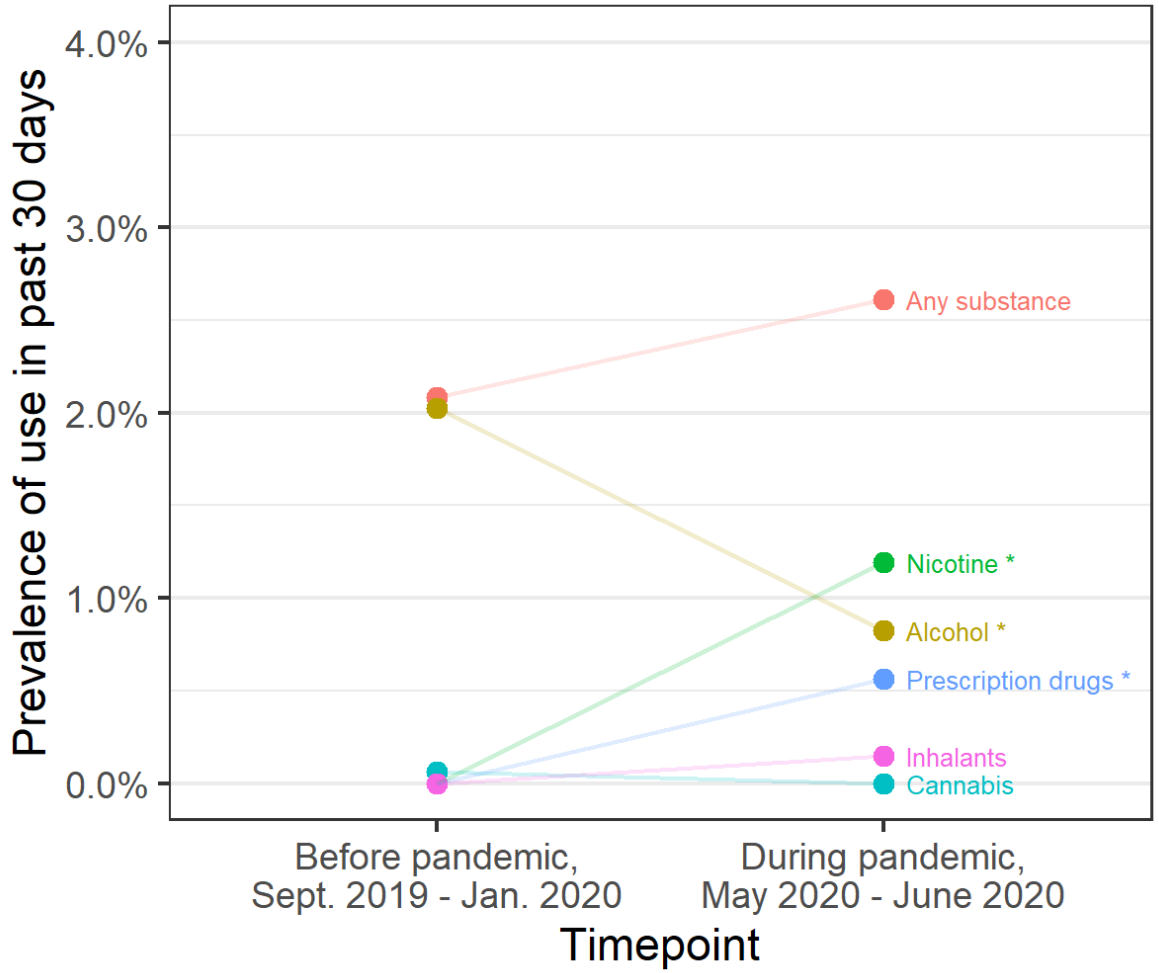
1. Most use was of **alcohol** or **nicotine**

2. Typically endorsing just **one** substance (87%)

3. Moderate overlap in users of alcohol/nicotine







Linked data from *N* = 1079 youth who completed a pre-pandemic assessment

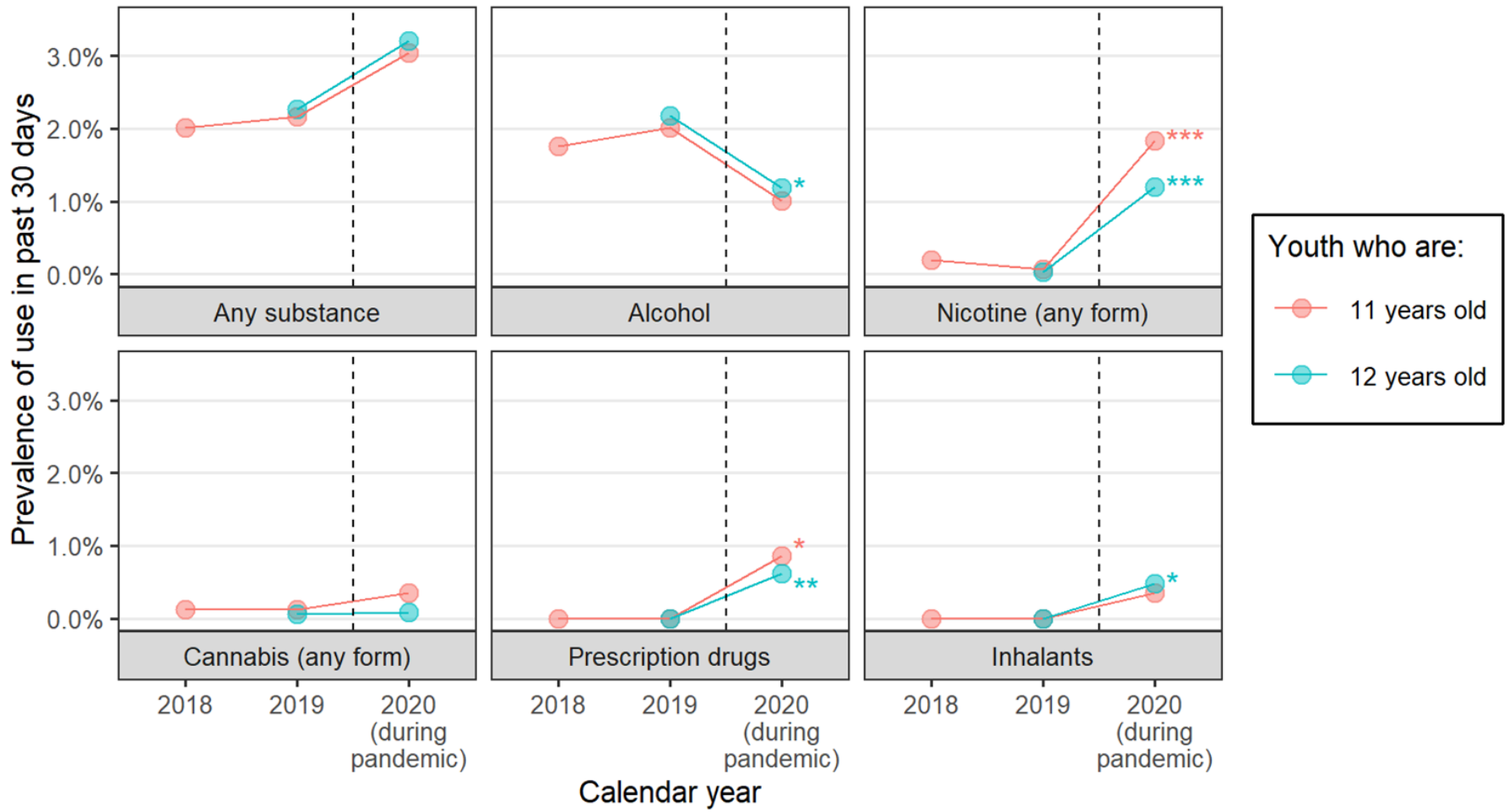
(Linked subsample skews younger)

Significant **decrease** in alcohol use ($p < .05$)

Significant **increase** in nicotine use and prescription drug misuse ($p < .05$)

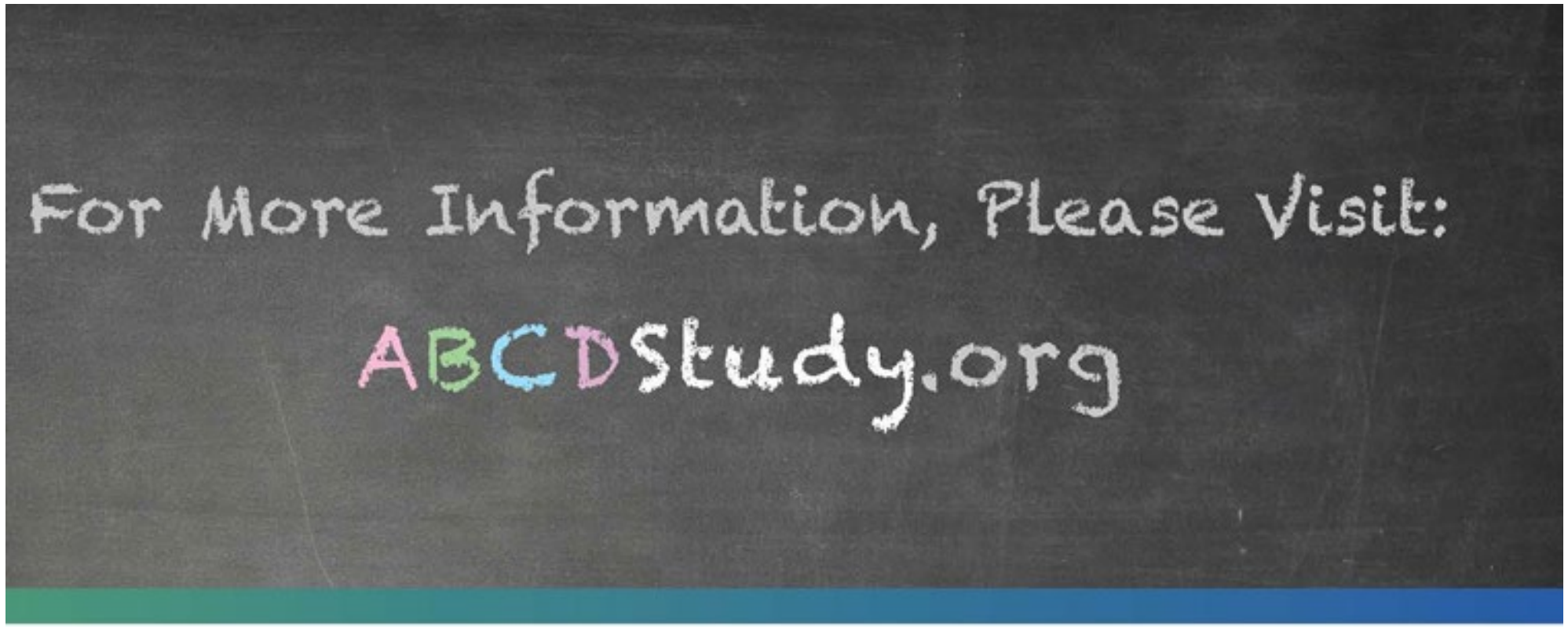
No other statistically significant changes

cf. Dumas et al. (2020) and Gaiha et al. (2020) finding reductions in nicotine use among older adolescents


Prevalence of use in past 30 days
3.0%
2.0%
1.0%
0.0%
Any substance
Alcohol
Nicotine (any form)
Cannabis (any form)
Prescription drugs
Inhalants
*
***
***
*
**
*
2018
2019
2020 (during pandemic)
Calendar year
Youth who are:
11 years old
12 years old

Thanks!

Questions?


For More Information, Please Visit:
ABCDstudy.org