

ABCD-ReproNim: An ABCD Course on Reproducible Data Analyses

ABCD: Sampling, Recruitment, and Retention

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ABCD-ReproNim

Learning Objectives of this Lecture



- Convey how the ABCD Study® sample was recruited.
- Describe the diversity of the sample.
- Appreciate why we shy away from calling it representative.
- Understand our ongoing retention practices.

Why so large a sample? (Why care about recruitment?)



- Provides a comprehensive survey of neurodevelopment.
- Allows us to study specific groups of interest.
 - And matched controls.
- Gives sufficient statistical power to detect small effects.
- Allows for rigorous data analysis (e.g., built-in replication; appropriate nested variances; appropriate covariates).
- With sufficient individual variation, we can disentangle demographics that are often confounded (e.g., race, urbanicity, SES).
- Can reveal if effects vary with subpopulations – for example, sex/race-specific risk factors for, and consequences of, substance use or psychopathology.



- Population neuroscience refers to the application of epidemiological practices such as purposeful sampling to neuroscience research which, heretofore, has typically studied relatively small and homogenous convenience samples.
- In contrast, a population neuroscience approach embraces the variation that exists across members of the population and strives to identify the broad range of biological, social and environmental influences on neurobiological function and development.
- Such an approach may reveal a much more complex tapestry of etiological mechanisms than are typically derived from averaging over a relatively homogenous sample.

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What is a representative brain? Neuroscience meets population science

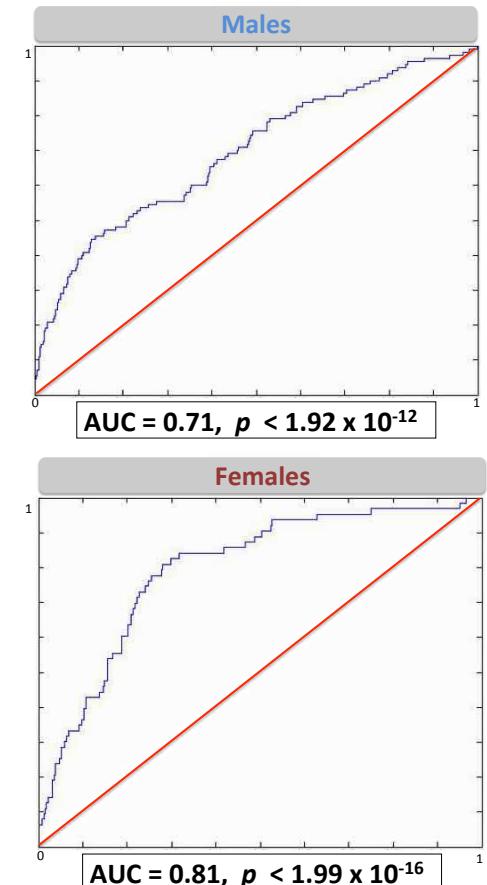
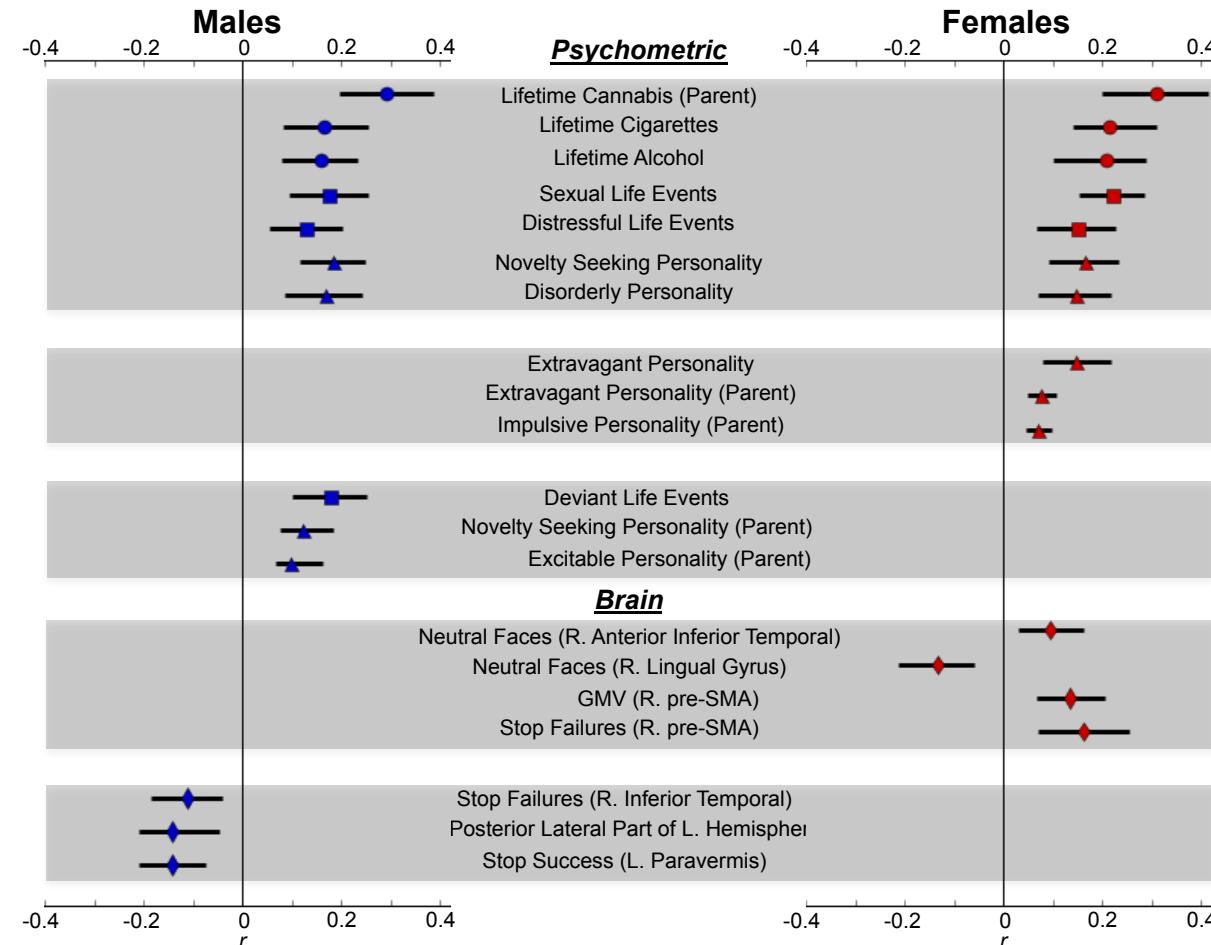
Emily B. Falk^{a,b,c,1}, Luke W. Hyde^{d,e,f,1}, Colter Mitchell^{e,g,1,2}, Jessica Faul^{e,3}, Richard Gonzalez^{b,d,h,3}, Mary M. Heitzeg^{i,3}, Daniel P. Keating^{d,e,i,j,3}, Kenneth M. Langa^{e,k,l,3}, Meghan E. Martz^{d,3}, Julie Maslowsky^{m,3}, Frederick J. Morrison^{d,3}, Douglas C. Noll^{n,3}, Megan E. Patrick^{e,3}, Fabian T. Pfeffer^{e,g,3}, Patricia A. Reuter-Lorenz^{d,e,o,3}, Moriah E. Thomason^{p,q,r,3}, Pamela Davis-Kean^{b,d,e,f,4}, Christopher S. Monk^{d,e,f,i,o,4}, and John Schulenberg^{d,e,f,4}

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Will demographic differences matter?



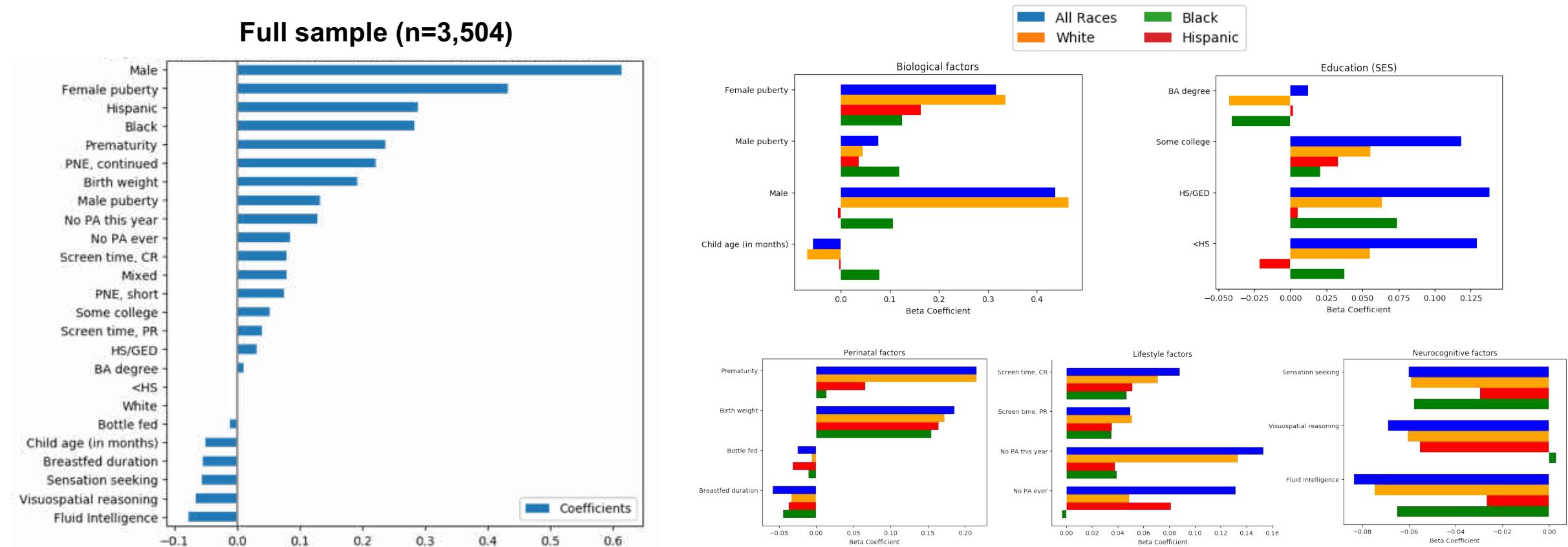
- Similarities and differences between boys and girls in the predictors of adolescent cannabis use. (Data from the IMAGEN study: <https://imagen-europe.com>)



Will demographic differences matter?



- ABCD: Correlates of BMI for different races and ethnicities



ABCD: Who did we want to recruit?

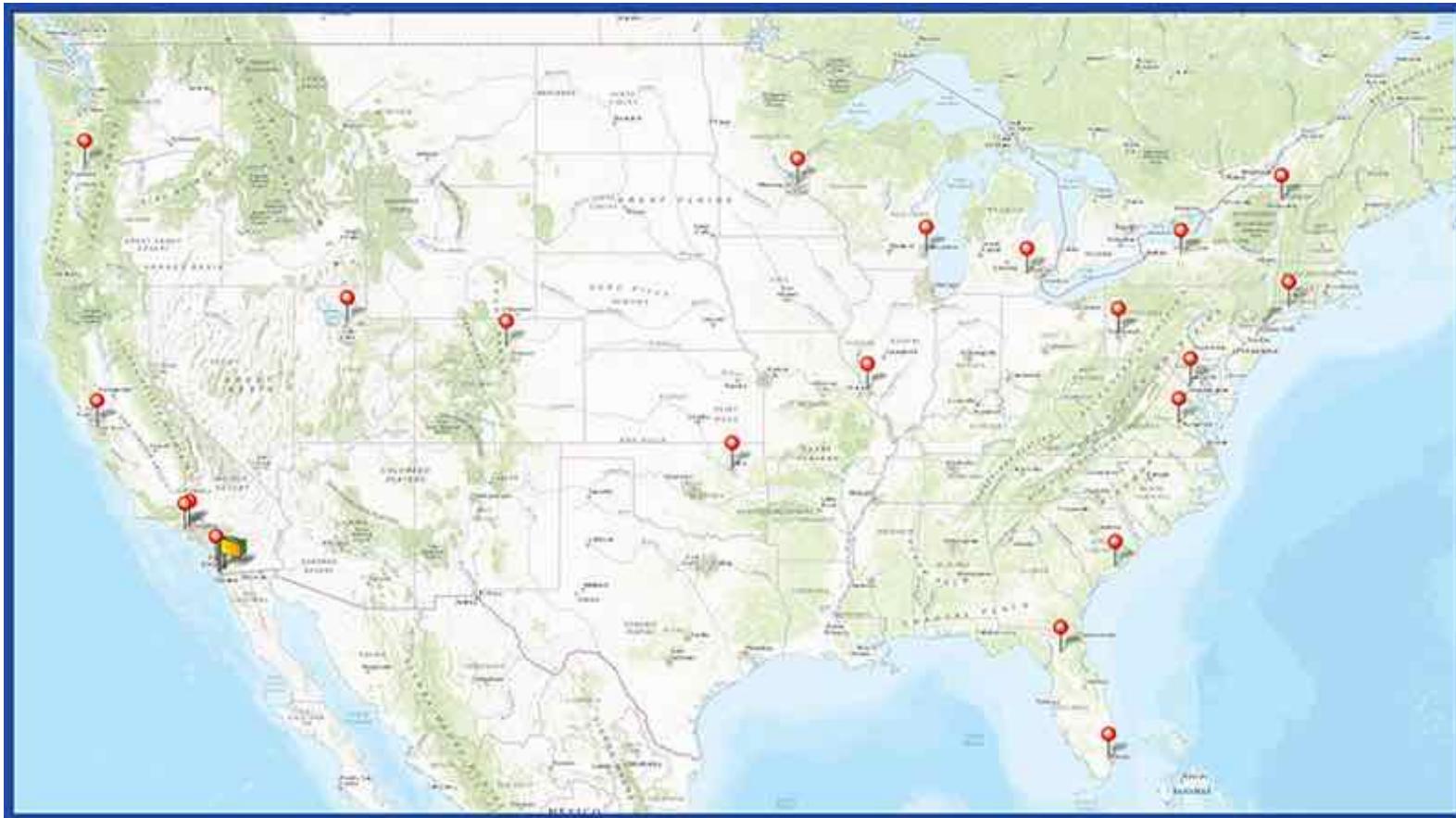


- A sample that broadly reflects the US population of 9-10 year olds on sex, race/ethnicity, SES and urbanicity.
 - (But we knew that urbanicity would likely not be possible.)
 - Demographic targets were based on the American Community Survey (ACS), a survey of approximately 3.5 million households conducted annually by the U.S. Census Bureau.
- ~11,000 participants, including 1,600 twins (800 twin pairs) to arrive at a final sample of 10,000 (~10% attrition).
 - The target numbers increased as we realized that we were reaching our targets.
 - We also wanted to ensure good representation of lower income families.

ABCD: Who did we want to recruit?

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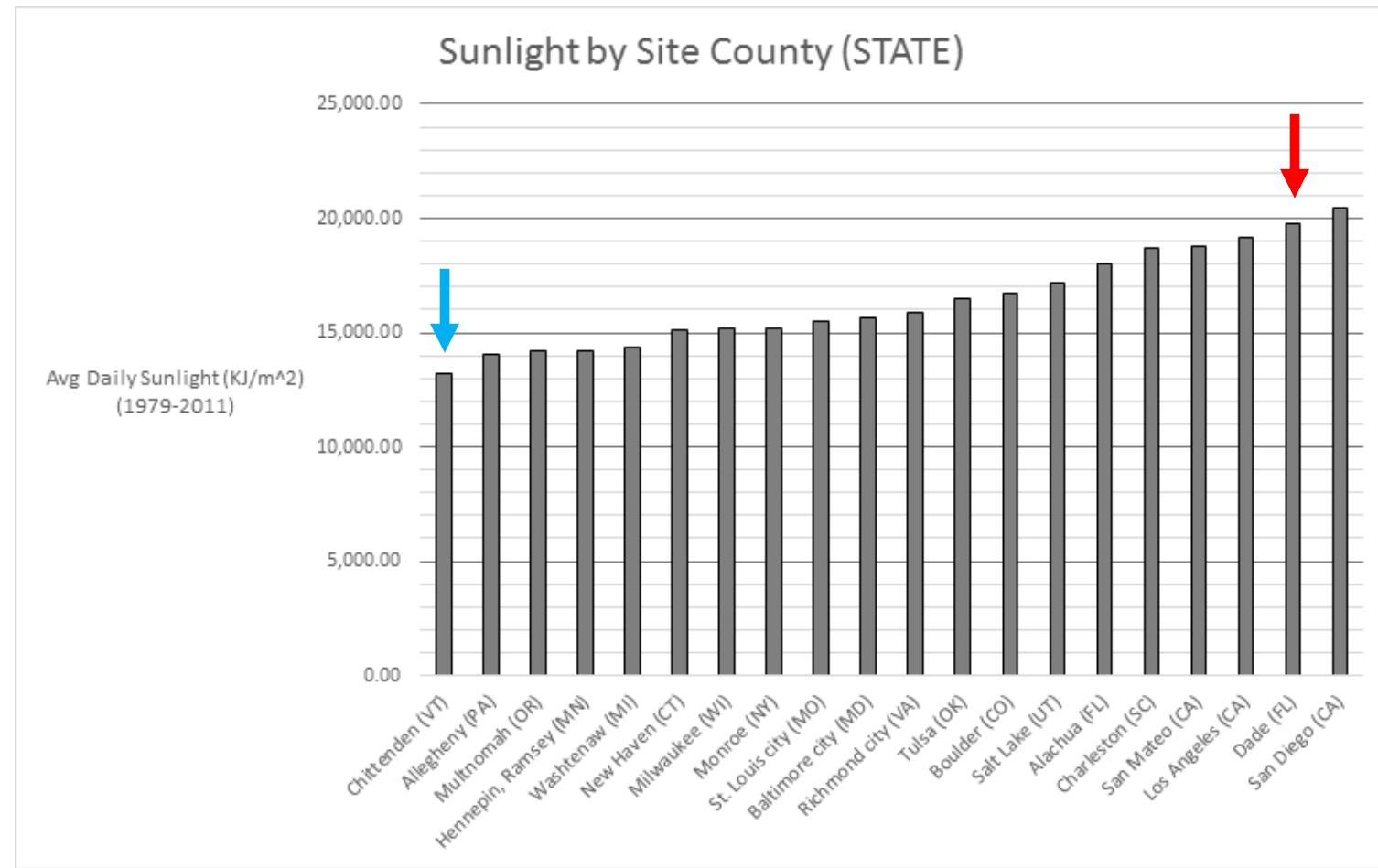
- By necessity, this would have to be a multi-site study



ABCD: Who did we want to recruit?



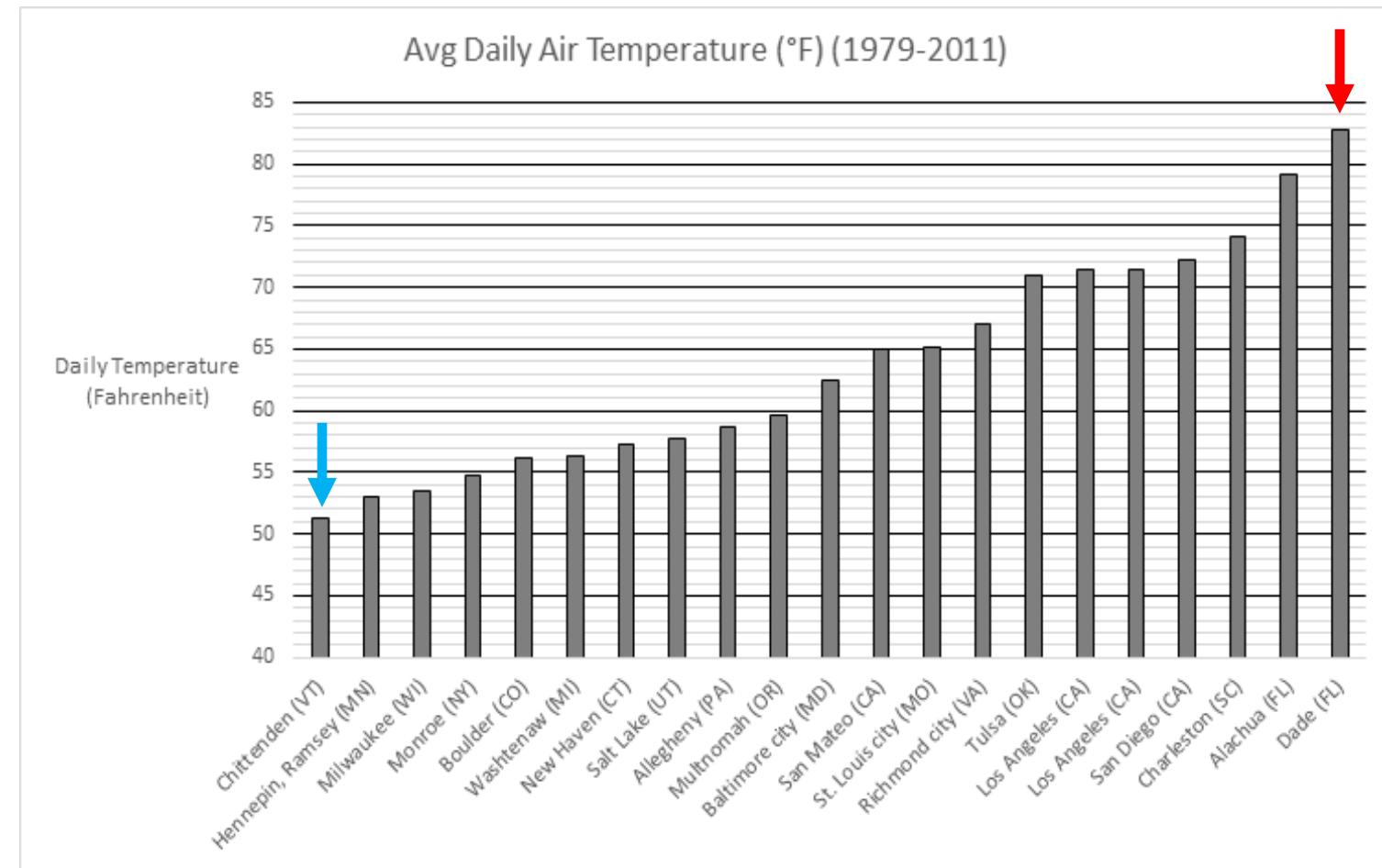
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ABCD: Who did we want to recruit?



- By necessity, this would have to be a multi-site study



ABCD: Who did we want to recruit?



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- The challenge involved setting viable targets for sites – compromising between our national targets and the available demographics at each site.



ABCD: How did we recruit?



- Recruitment was largely through public, private and charter schools.
 - Enabled a standardized recruitment across all sites.
 - Sociodemographic stats are available on school composition enabling us to target our recruitment.
- A demographic analysis (race/ethnicity; SES; urbanicity) of all schools within a site's recruitment area was conducted. Lists of schools were created to match that site's demographic targets and released in a staggered manner to sites.
- Demographics of the accumulating sample were carefully monitored allowing a deviation from recruitment targets to be adjusted within and between sites by altering the selection of schools in subsequent releases.
 - This means we did not need to ask about race or SES at screening and did not have to exclude any willing participants.
- Because of their relative scarcity, twins at the four main twins sites were recruited through birth registries.

ABCD: How did we recruit?



- Schools-based recruitment required significant time commitments:
 - Outreach to state education departments;
 - Outreach to school superintendents;
 - Outreach to school principals;
 - Outreach to teachers and students (including in-class presentations);
 - Outreach to parents.
- Recruitment materials were standardized with "branding" support from the NIH.



A Study on Brain Development

A photograph of a person's hand holding a chalk-drawn anatomical illustration of a human brain. The brain is shown in a lateral view, with arrows above it labeled 'A' pointing to the left, 'B' pointing to the right, and 'C' pointing downwards. The background is a dark chalkboard.

JOIN US!

The Adolescent Brain Cognitive Development Study (ABCD)

A photograph of a diverse group of teenagers of various ethnicities and ages, all smiling and posing closely together for a group portrait.

is the largest of its kind to date,
enrolling 10,000+ healthy children
and following them from
age 9-10 into early adulthood.

Three stylized profile illustrations of human brains, each with a different color scheme: white, green, and blue.

Adolescent Brain Cognitive Development
Teen Brains. Today's Science. Brighter Future.

ABCD: How did we recruit?



In addition:

- During the ramp-up period (establishing links with schools) some sites used mailing lists.
- To enable recruitment to continue over summer vacations, sites recruited from summer camps, YMCAs etc.
- We allowed referrals from enrolled families – we hoped this would help retention.
- In very limited numbers we allowed *ad hoc* volunteers (e.g., so as to enroll home-schooled children).

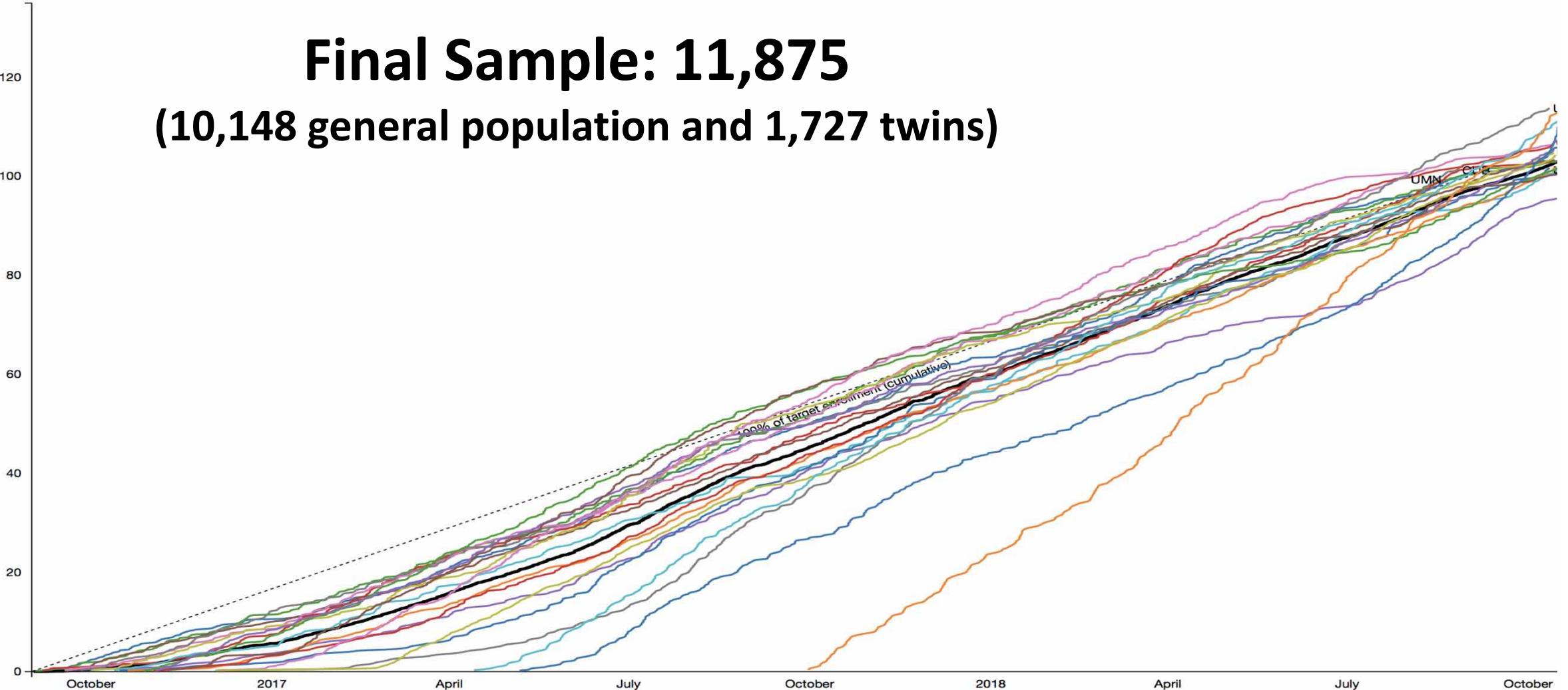
All of this was overseen by Steven G. Heeringa (Institute for Social Research, University of Michigan)

And just how much fun was recruitment?



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Final Sample: 11,875
(10,148 general population and 1,727 twins)

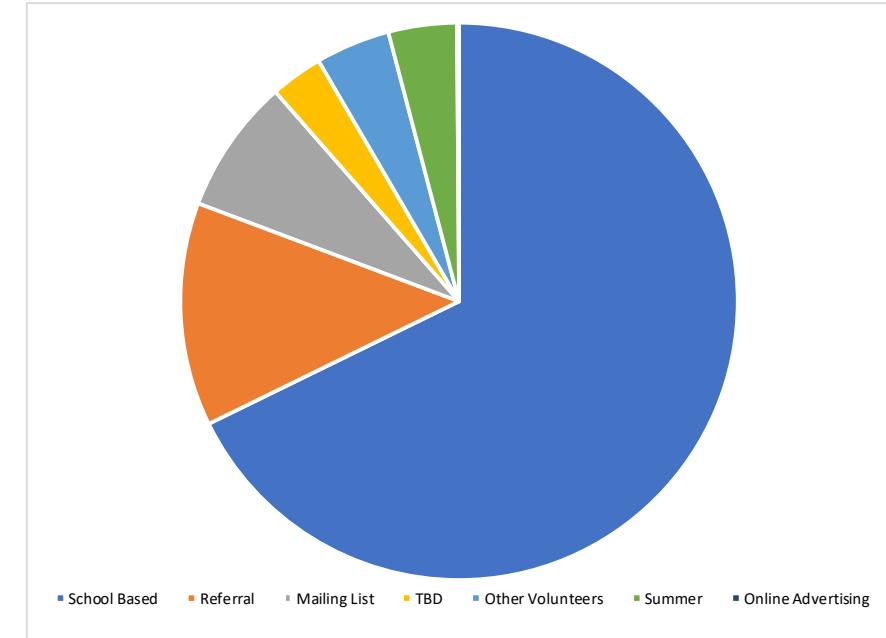


Recruitment Sources



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 |

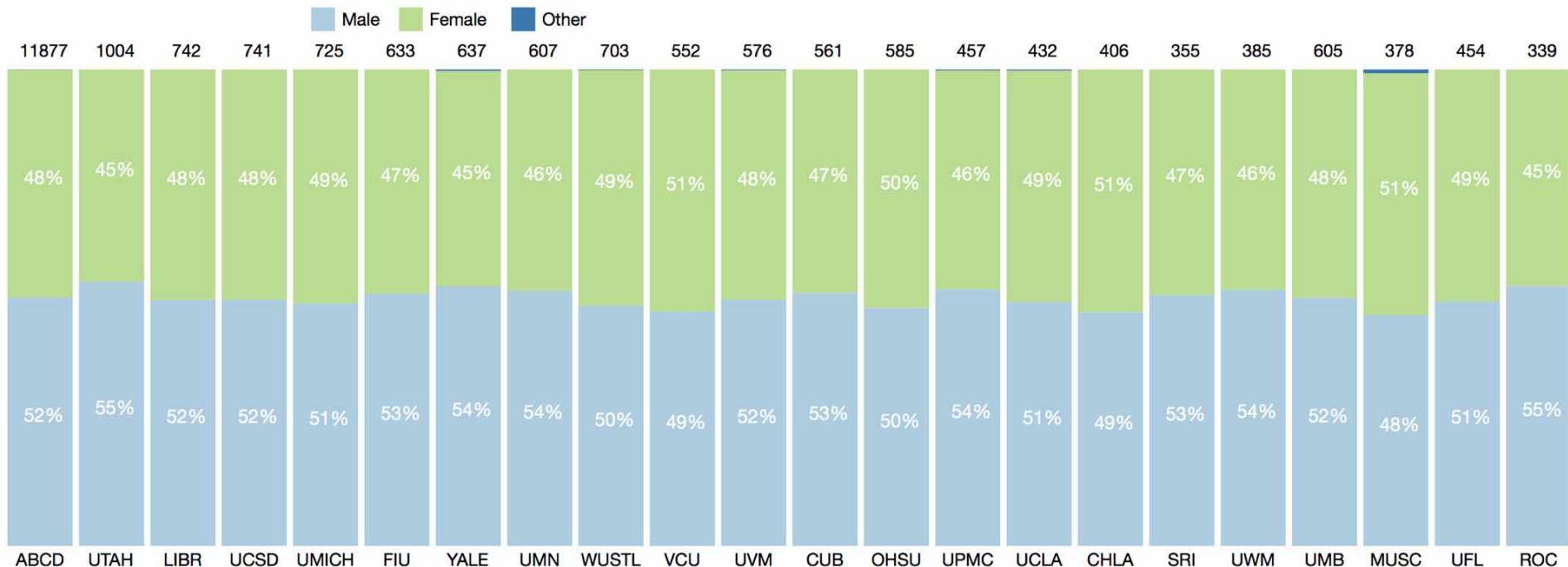


ABCD: Final Sample Demographics



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Female : Male



Age

Age 9: 52%

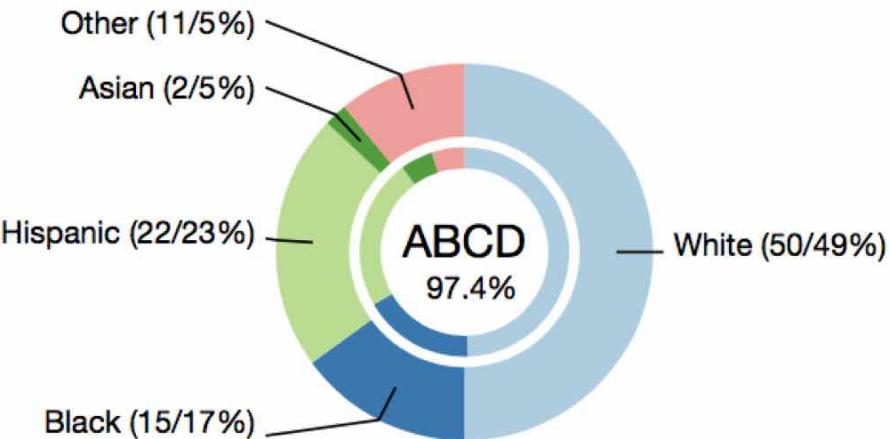
Age 10: 48%

ABCD: Race and Ethnicity



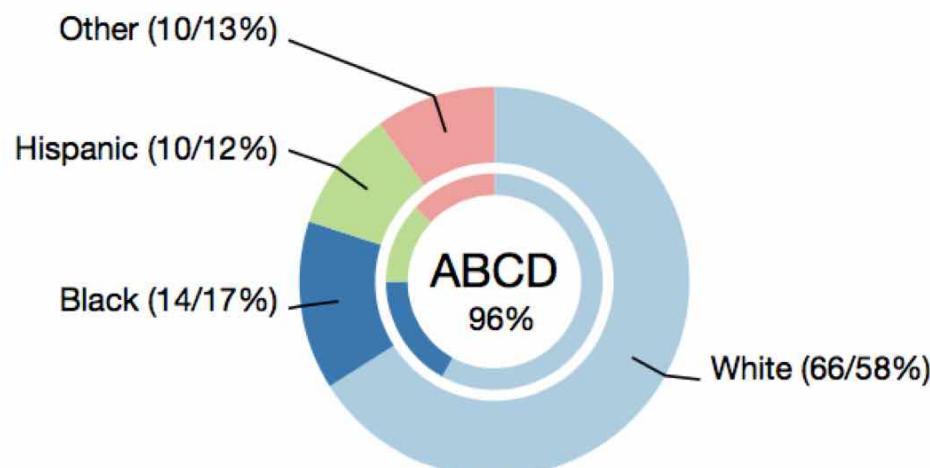
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General Population

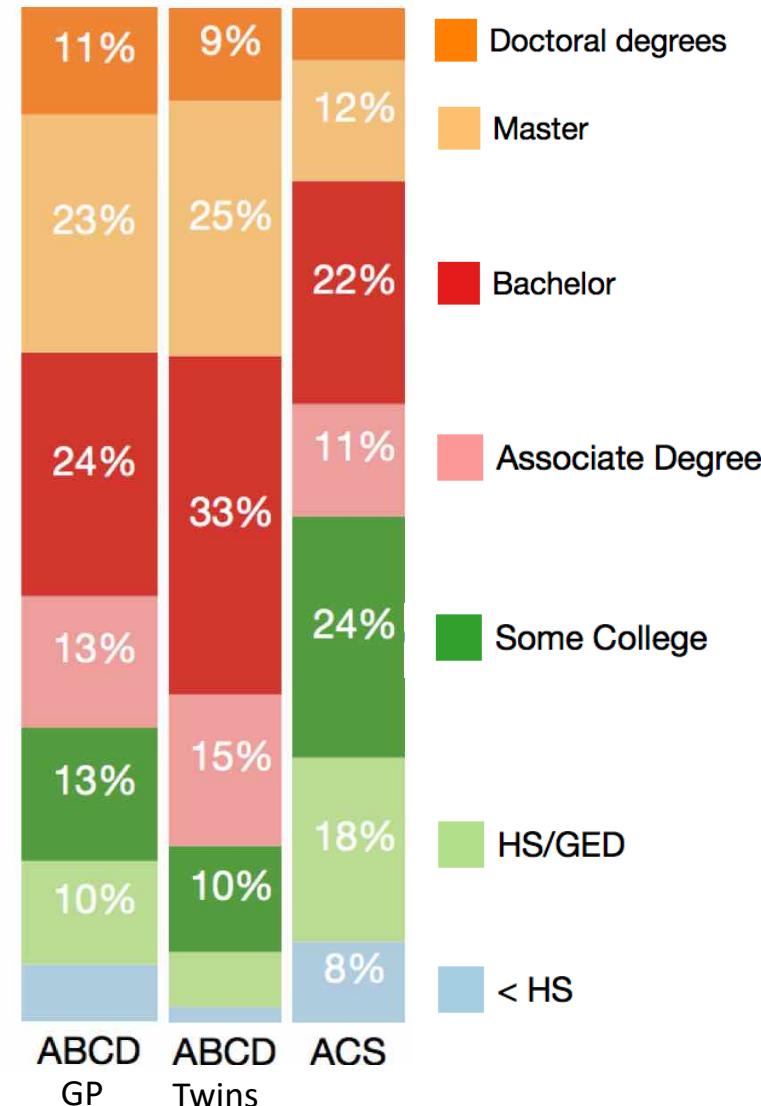


Inner ring: Targets
Outer ring: Actual

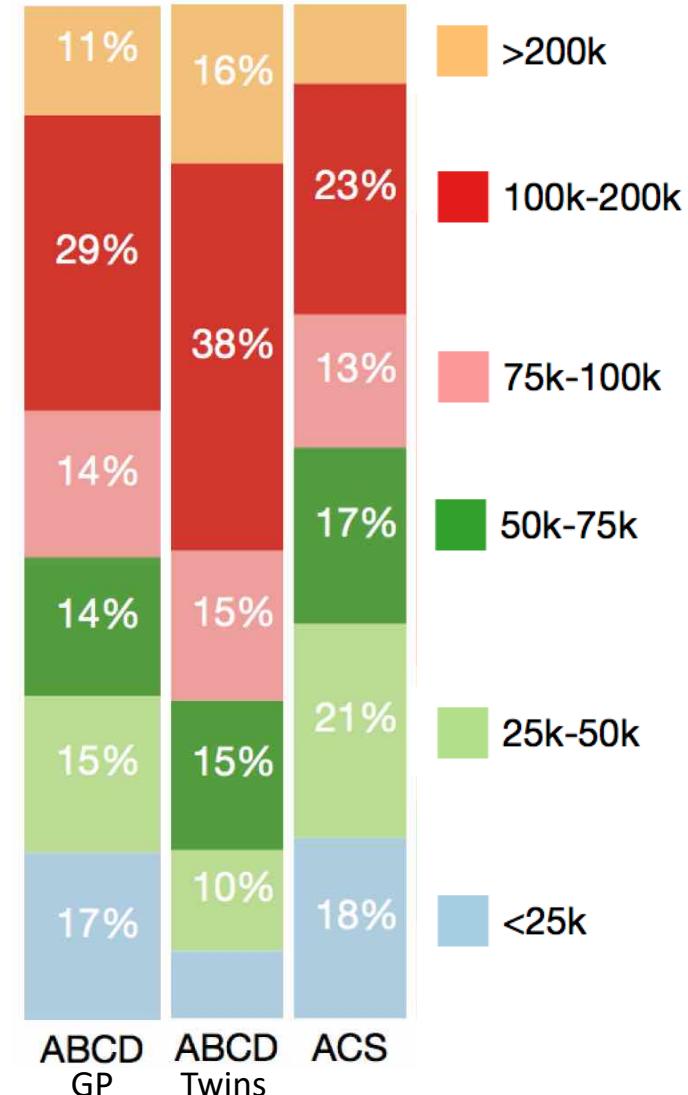
Twins Population



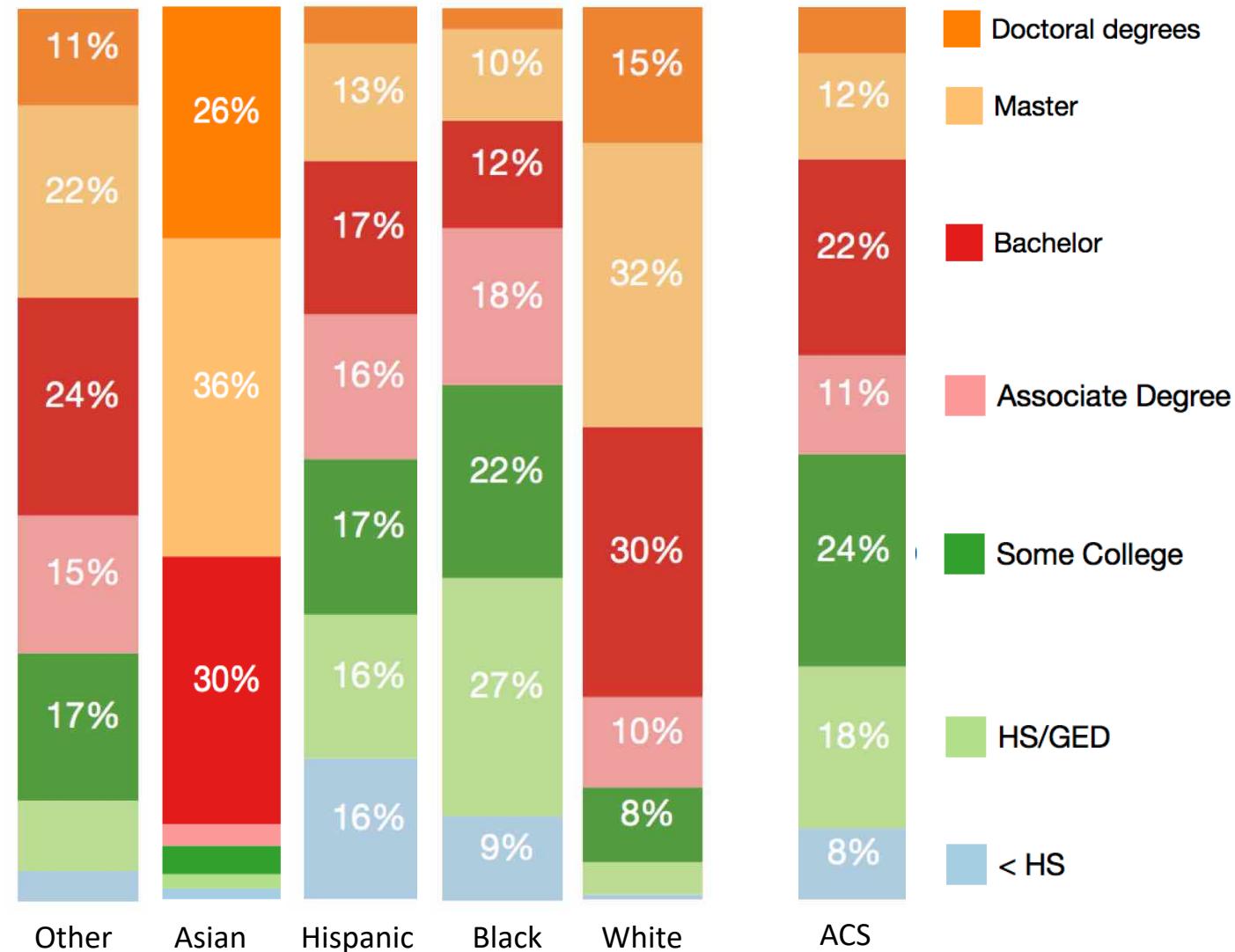
Highest Household Education



Household Income



Highest Household Education





| Family Type x Employment | ABCD | ACS |
|---------------------------------|-------------|------------|
| Married, 2 in Labor Force | 50.6% | 40.8% |
| Married, 1 in Labor Force | 22.0% | 23.7% |
| Married, 0 in Labor Force | 1.3% | 1.9% |
| Single Head in Labor Force | 20.8% | 26.5% |
| Single Head not in Labor Force | 5.3% | 7.0% |

| Household Size | ABCD | ACS |
|-----------------------|-------------|------------|
| 2-3 Persons | 17.2% | 18.5% |
| 4 Persons | 33.5% | 33.5% |
| 5 Persons | 25.2% | 25.3% |
| 6 Persons | 14.0% | 12.5% |
| 7 or More Persons | 10.2% | 10.1% |



Short answer is no.

- Not all US kids had an equal chance of participation.
- Is this consequential?

JAMA Pediatrics January 2019 Volume 173, Number 1

Prevalence of Eating Disorders Among US Children Aged 9 to 10 Years: Data From the Adolescent Brain Cognitive Development (ABCD) Study

Methods | The present study used baseline data collected in 2016 and 2017 from the Adolescent Brain Cognitive Development (ABCD) study.³ Participants were a US representative sample of 4524 children aged 9 to 10 years and 1 of their caregivers. Partici-

ABCD: So is this a representative sample?



Short answer is no.

- Not all US kids had an equal chance of participation.
- Is this consequential?

Mind you, defining “representative” is hard.

- There are likely numerous sources of bias in the creation of the sample, the largest of which is likely the unavoidable self-selection of families into the study.
- Users of the ABCD should be aware of the recruitment methods and sample characteristics so they can determine if these particulars are consequential for how they conduct or interpret their analyses.
- Note that propensity weighting for the sample is available.

We tend to describe the sample as “demographically diverse” or “population-based.”

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

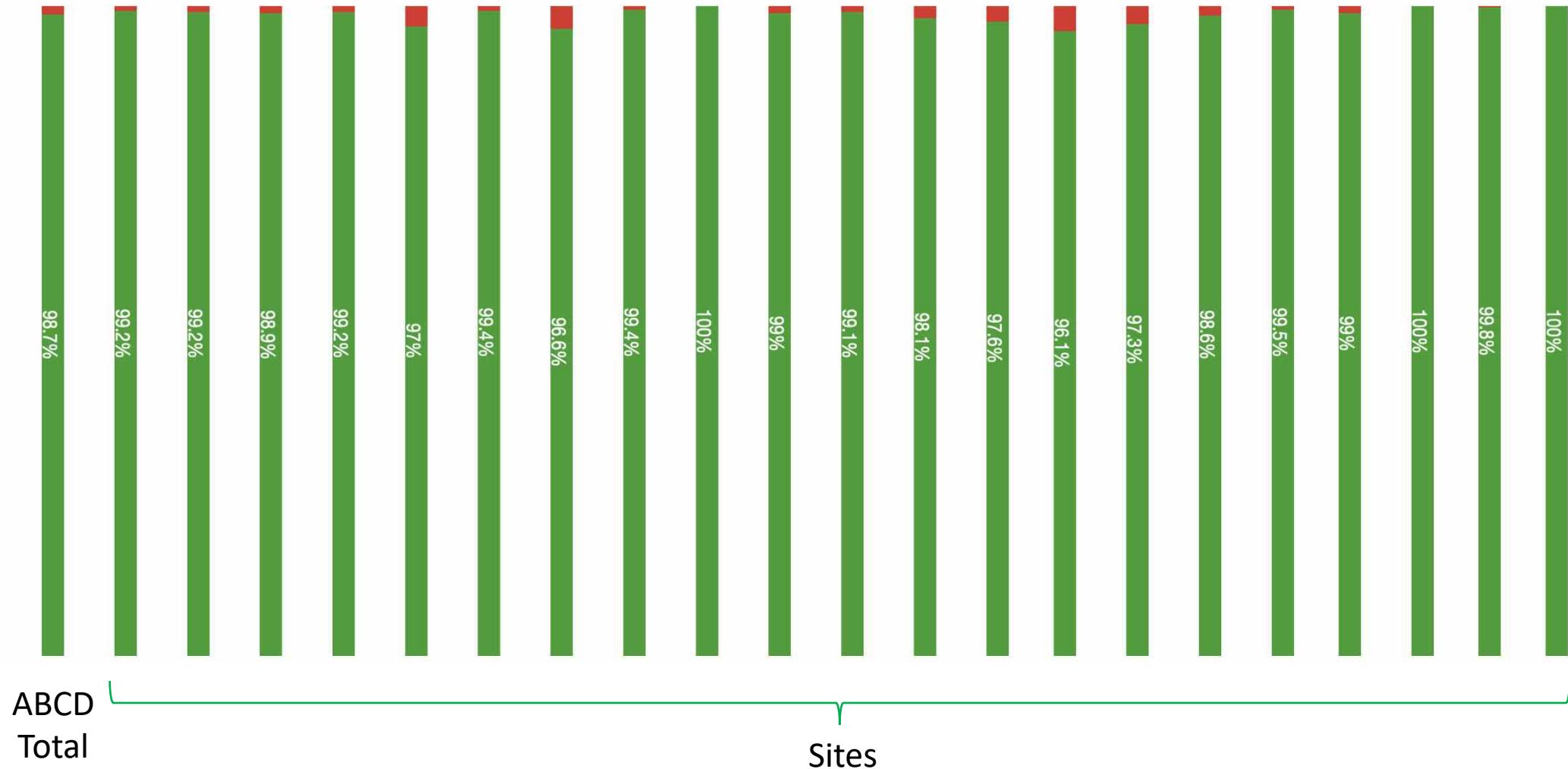
- 1. Hispanic/Latino** and many are Spanish-speaking families: demographics of our staff is similar to our cohort and Spanish/English bilingual.
- 2. “Clinical practice model”**: Schedule next visit at end of visit + send reminders.
- 3. In home reminders**: "fridge magnets" with next appointment.
- 4. Site Escalation Protocol**: After multiple failures to reach/confirm, escalate to calls from coordinator, then PI --- always address issues or concerns that may be moving someone to withdraw (passively).
- 5. Public information sources**: Lexis Nexus, Facebook, and visit their home to reconnect (inform via mail or phone messages ahead of time).
- 6. Diversity of effort**: time of calls, texting, and emailing families with reminders and confirmations.
- 7. Flexibility/accommodation**: weekend or weekday visits, single or 2 day sessions.
- 8. Provide transportation** vouchers for those and/or arrange taxi service.
- 9. Family appreciation events** (serve the most interested families).
- 10. Setting accommodations**: food, rooms that can accommodate other children in the household, etc.

Retention: Percentage withdrawals



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Retention rates remain very high: 98.7%

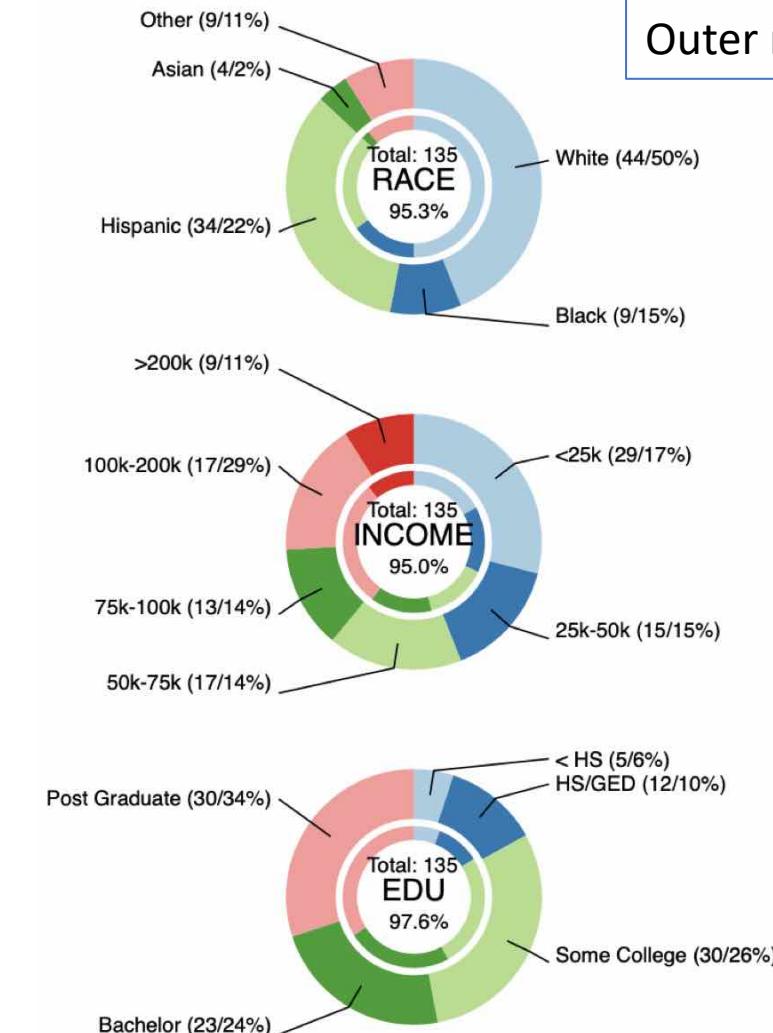
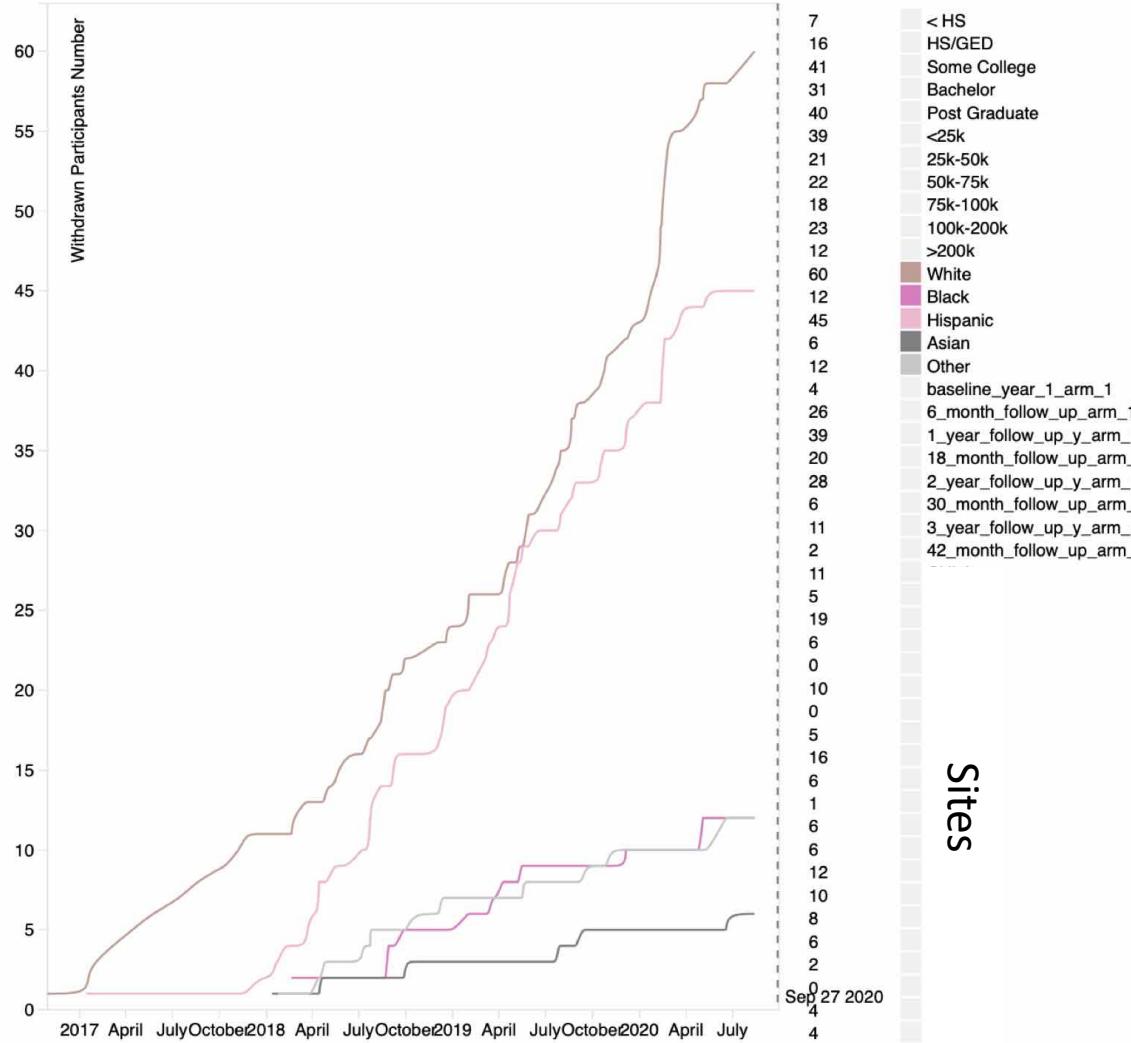


Retention: Trends in who withdraws?



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Retention rates remain very high: 98.7%

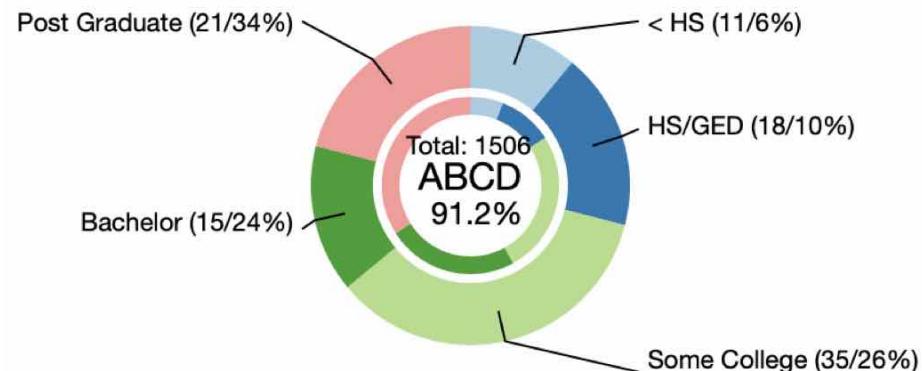
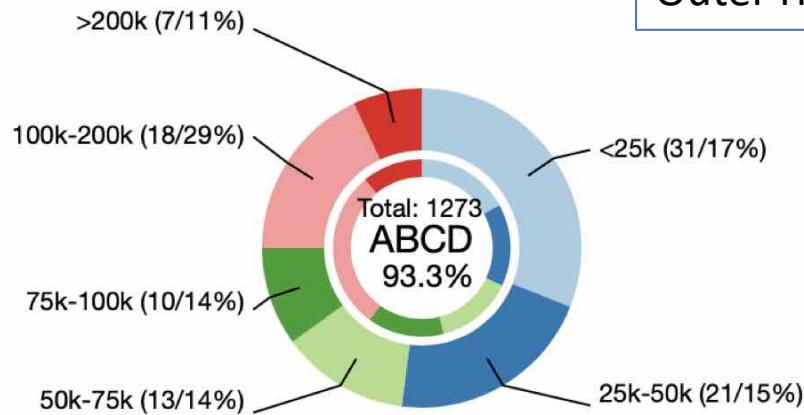
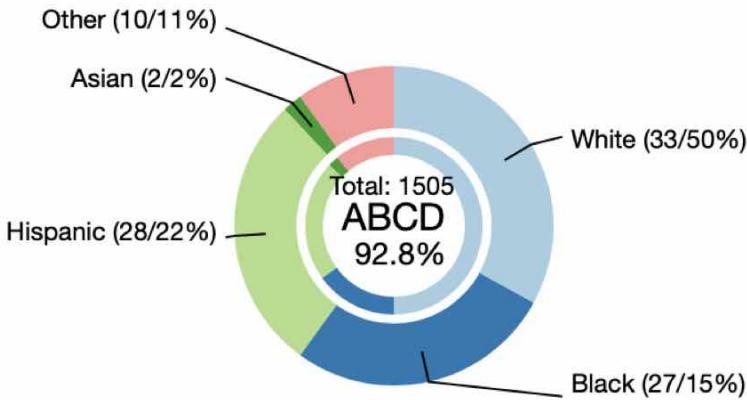


Retention: Monitoring who misses assessments



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General Population



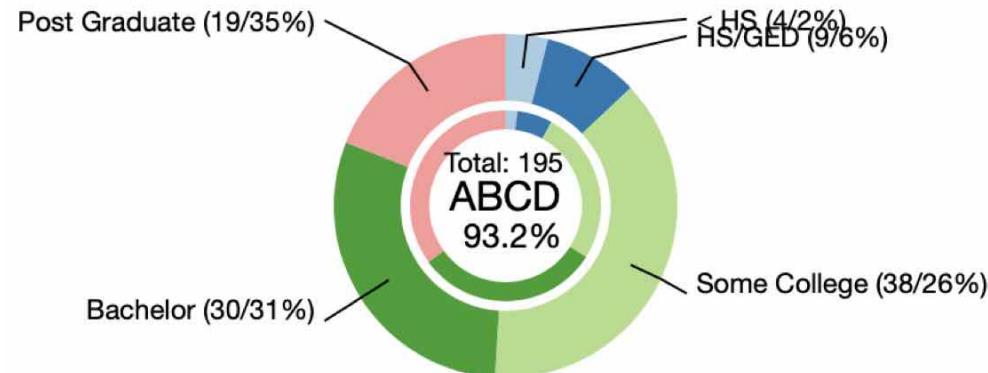
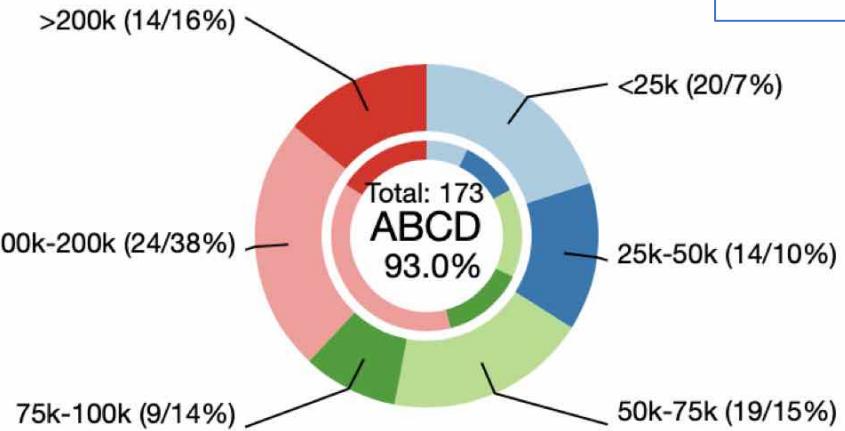
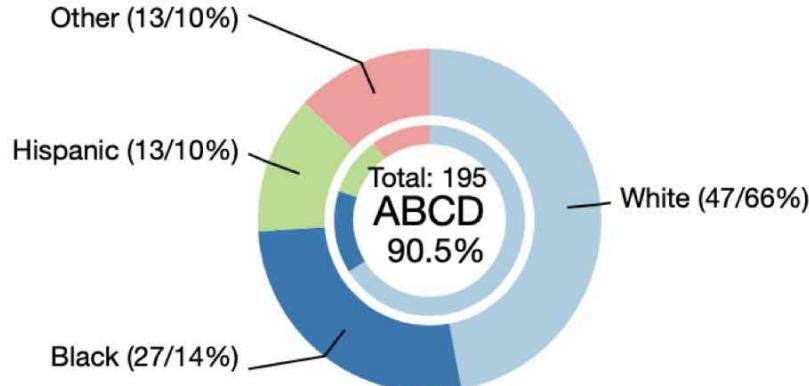
Inner ring: Full Sample
Outer ring: Actual

Retention: Monitoring who misses assessments



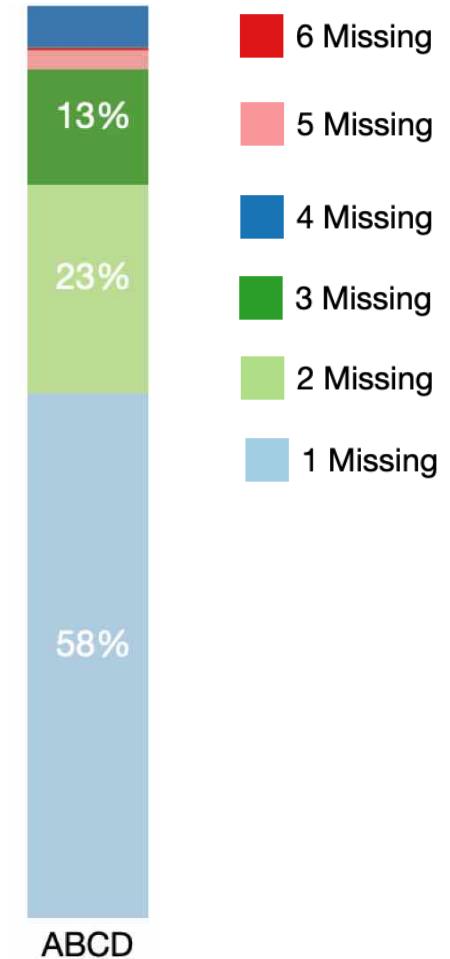
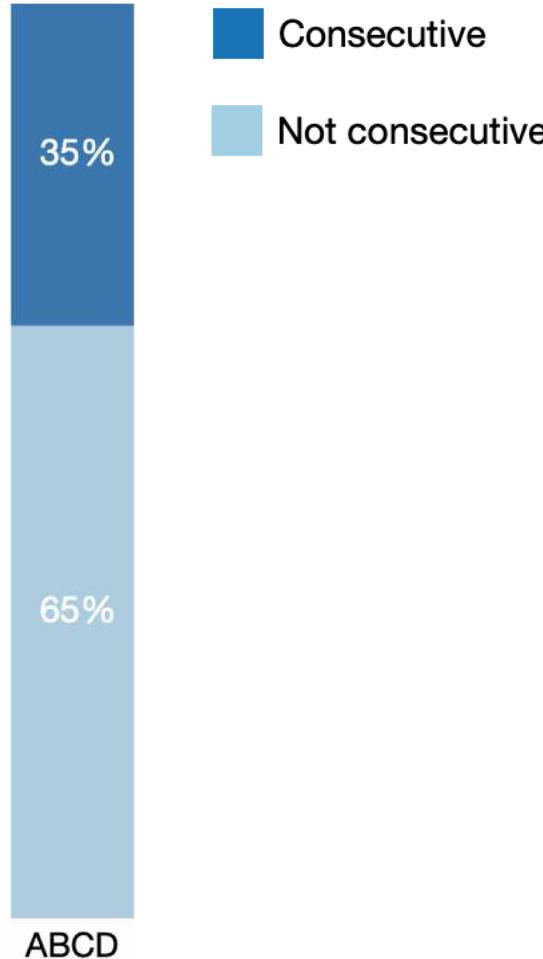
ABCD-ReproNim

Twins

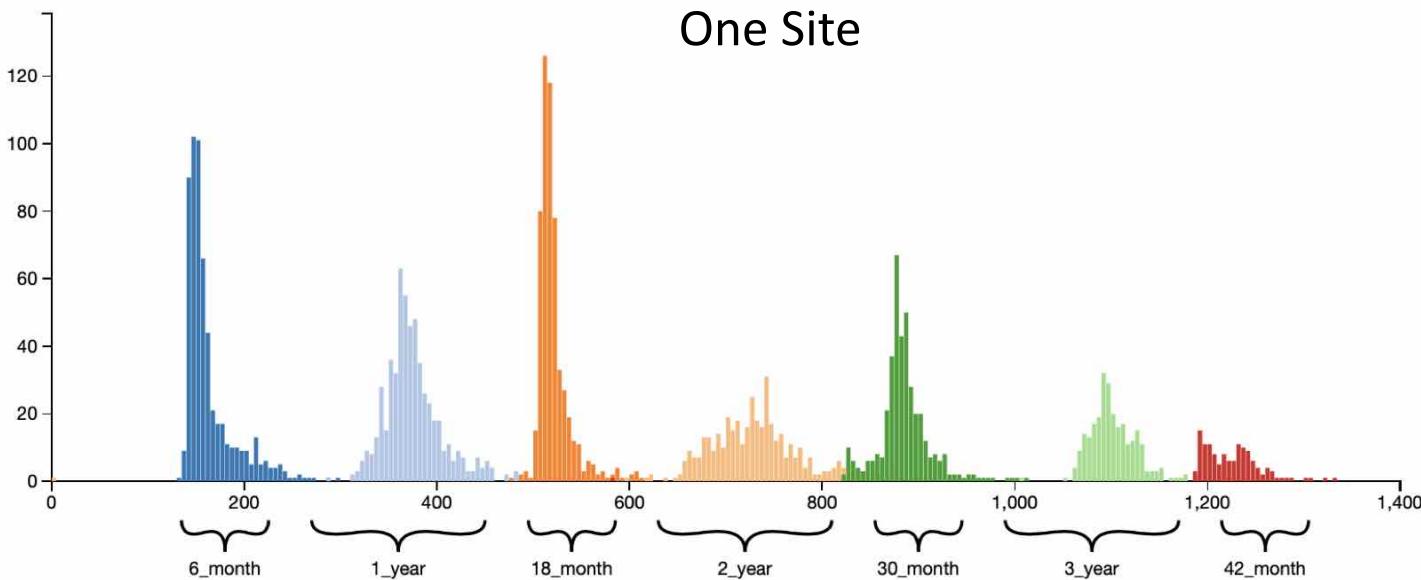
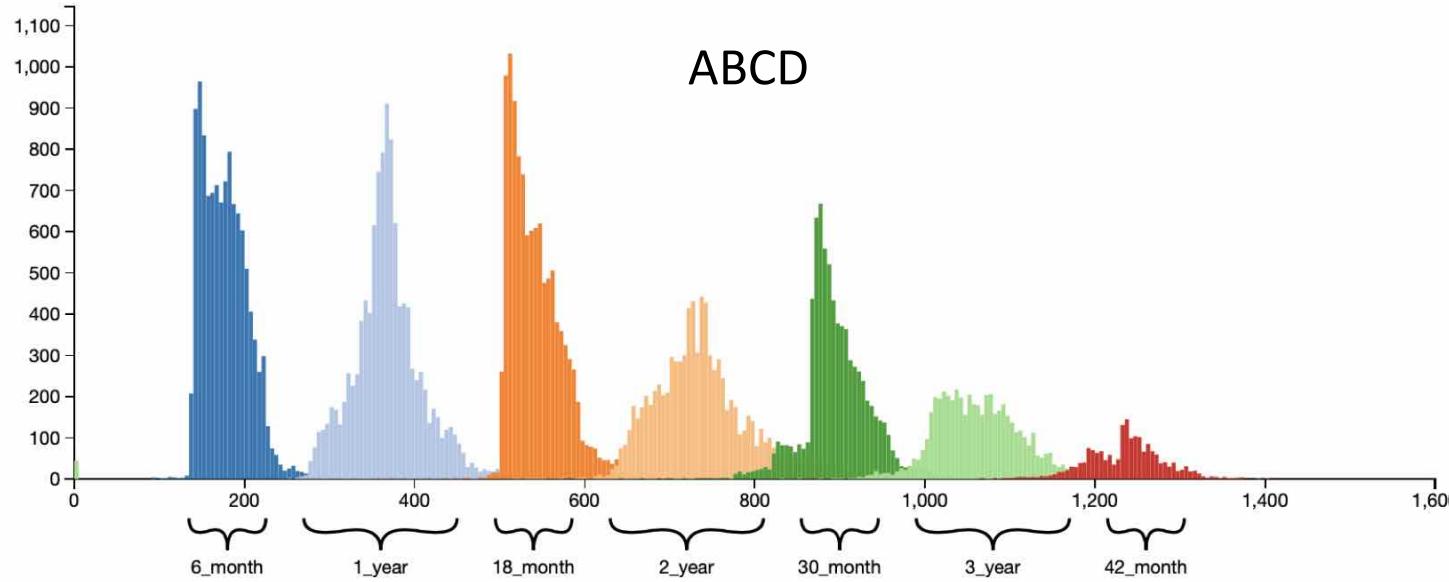


Inner ring: Full Sample
Outer ring: Actual

Retention: Monitoring who misses assessments



Retention: And lots of other metrics ... timeliness of assessments



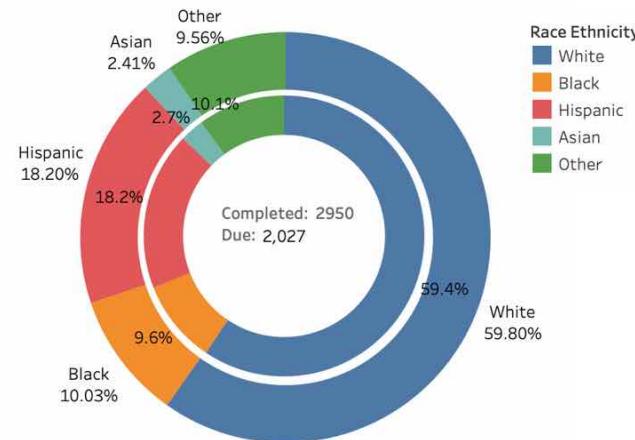


- ABCD moved quickly to virtual (on-line, at home) assessments and is now transitioning to hybrid (at-home + lab-based) assessments.
- Some missing data will be inevitable.
- One silver lining: Reduced sociodemographic bias in who fails to do assessments!

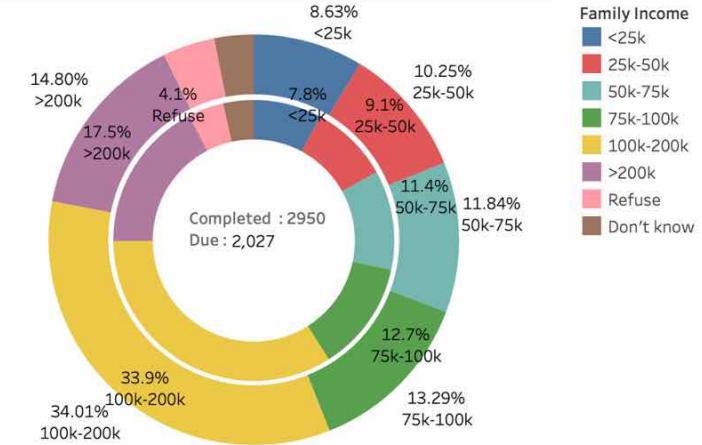
COVID adjustments



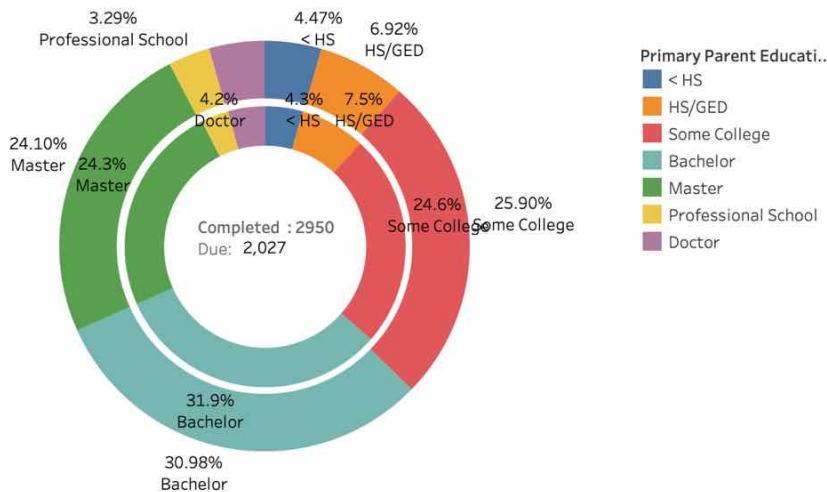
Year 3 Race Ethnicity Analysis



Year 3 Income Analysis



Primary Parent Education



Outer Rings: Actual completions
Inner Rings: Due Assessments

- Garavan, H, H Bartsch, K Conway, A Decastro, RZ Goldstein, S Heeringa, T Jernigan, A Potter, W Thompson, & D Zahs. (2018). Recruiting the ABCD Sample: Design Considerations and Procedures. [Developmental Cognitive Neuroscience](#). 32:16-22.
- Compton WM, Dowling G, & Garavan H. (2019). Ensuring the Best Use of Data in Scientific Inquiry: The Adolescent Brain Cognitive Development Study. [JAMA Pediatrics](#). doi: 10.1001/jamapediatrics.2019.2081

Thank You



Thank you for your attention.

Please contact me if you have any questions: hgaravan@uvm.edu