Commentary

Transforming the Future of Adolescent Health: Opportunities From the Adolescent Brain Cognitive Development Study

Elizabeth A. Hoffman, Ph.D., Kimberly LeBlanc, Ph.D., Susan R. B. Weiss, Ph.D., and Gayathri J. Dowling, Ph.D.*

National Institute on Drug Abuse, Bethesda, Maryland

Adolescence is a period of dramatic expansion of the knowledge and skills critical for transitioning into adulthood. Yet, there is much to learn about how adolescent experiences affect brain, cognitive, social, and emotional development. Over the last decade, evidence has revealed associations between early life adversity (e.g., poverty) and later changes in brain structure and function [1]. More recently, research has shown that positive factors (e.g., perceived social supports, increased access to community resources) are associated with healthier development, even for children living in deep poverty, suggesting that protective factors may mitigate the possible negative influences of adverse experiences on health and development [2].

Looking into the next decade, important forces (e.g., digital media, racial inequities, climate change, long-term impacts of COVID-19) will affect adolescent health and well-being globally. Our imperative is to harness advances in science and technology to develop strategies that will enhance health and promote equity.

The Adolescent Brain Cognitive Development Study

The Adolescent Brain Cognitive Development (ABCD) study seeks to shed light on developmental trajectories by enrolling nearly 12,000 youth aged 9 and 10 years from across the United States and collecting a vast array of data repeatedly for 10 years (Table 1).

Participants were primarily recruited through a school-based strategy to mitigate selection bias and ensure diverse representation, as well as targeted recruitment from twin registries to include youth of multiple births. School selection was informed by gender, race and ethnicity, socioeconomic status, and urbanicity. Real-time monitoring allowed for corrections for deviations from recruitment targets, resulting in a baseline sample that reflects the diversity of the US population (Figure 1).

When the COVID-19 pandemic upended the world in late 2019, the ABCD study recognized its unique potential for understanding the impact of the pandemic on developmental trajectories. Questionnaires were sent repeatedly to participants between May 2020 and May 2021 to understand their experiences during the pandemic, such as family impacts (e.g., economic impact, home composition, parental support), school changes (e.g., quality, quantity, methods, supervision), changes in routine (e.g., sleep, physical activity, screen media use), as well as mental health, stress, and substance use. In addition, participants were asked about COVID-19-specific impacts such as exposure, diagnosis, attitudes and adherence to public health directives, and media/news exposure. Given the diversity of the ABCD cohort, the collection of data before, during, and after the acute pandemic will allow investigators to better understand the impact of the pandemic on adolescent development.

The ABCD Data Set—An Opportunity for the Broader Scientific Community

From its inception, a major priority of the ABCD Study has been to adopt an open science model, making deidentified data rapidly available to the scientific community via the NIMH Data Archive (NDA). This includes fast-track neuroimaging data, curated data that are released annually, supplemental COVID Rapid Response Research data, and a Data Exploration and Analysis Portal—a powerful resource for performing multilevel statistical analyses including the nested study design and its more than 100,000 shared observations (for more information, please visit the ABCD Study website https://abcdstudy.org/scientists/data-sharing/).

The ABCD Study's open science policy and frequent data releases provide opportunities to researchers around the world to leverage ABCD's complex data set to explain behavior, create predictive models, and investigate mechanistic pathways to understand health and disease in adolescents. With over 230

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* Address correspondence to: Gayathri J. Dowling, Ph.D., Division of Extramural Research, National Institute on Drug Abuse, National Institutes of Health, 3WFN Room 09D04 MSC 6021, 301 North Stonestreet Ave, Bethesda, MD 20892. E-mail address: gayathri.dowling@nih.gov (G.J. Dowling).
publications using ABCD data to date, articles have spanned a wide array of topics including psychiatric conditions (e.g., ADHD, psychotic-like experiences, suicidality) [3–5], screen time usage [6,7], neighborhood disadvantage [8,9], obesity and weight gain [10,11], polygenic risk scores for substance use disorders among substance-naïve youth [12,13], and the interactions of these factors with brain structure and function. The range and depth of ABCD Study variables allow for highly actionable analyses that can have significant policy implications, as several publications have already shown [2,14,15]. Combining ABCD Study data with other large data sets, like the UK Biobank, can provide enormous statistical power for genetic discovery [16,17], and the longitudinal design of the study will provide an unprecedented opportunity for causal inferences and scientific rigor.

### Responsible Data Use

Alongside expanding opportunities for accessing complex data sets is the responsibility for ethical data analysis and interpretation. Large, complex data sets, such as ABCD, leverage interdisciplinary expertise to understand and predict behavior, but there are important caveats to consider: a fundamental reality of population-based research is that observed associations may be statistically significant even when they explain a small proportion of the outcome variability. Such findings raise questions about how to interpret a small effect and under what conditions it may be important [18].

Researchers must also be aware of the assumptions they make when choosing variables to measure social constructs such as race, ethnicity, and socioeconomic status, among others, and should understand the limitations of their choice of measurement and address them in their articles. Social constructs are often broadly defined and should be avoided as independent variables in isolation especially in predictive models that attempt to explain variability. Research that misrepresents constructs (e.g., race as a proxy for racism), or that is not placed in context with other factors, may lead readers to draw unwarranted conclusions from observed differences that fail to consider the wider context for developmental change and environmental adaptation. Recommended practices for responsible data use include addressing factors such as study design, analytic approaches, interpretation, and communication. Above all, researchers should be mindful of the potential impact of their study on individuals, communities, and society, beyond the written article (see Simmons et al. [19] for a broad discussion of these topics).

### Conclusion

The diversity of the ABCD cohort, the breadth of data collected, and the longitudinal design of ABCD will provide opportunities for investigating the interplay of environments and experiences with long-term health outcomes. These data have the potential to facilitate the development of strategies for enhancing adolescent health and equity for generations to come.

### References


