Albatros Conférence –
ABCD & Évolution des addictions

Nora D. Volkow M.D.

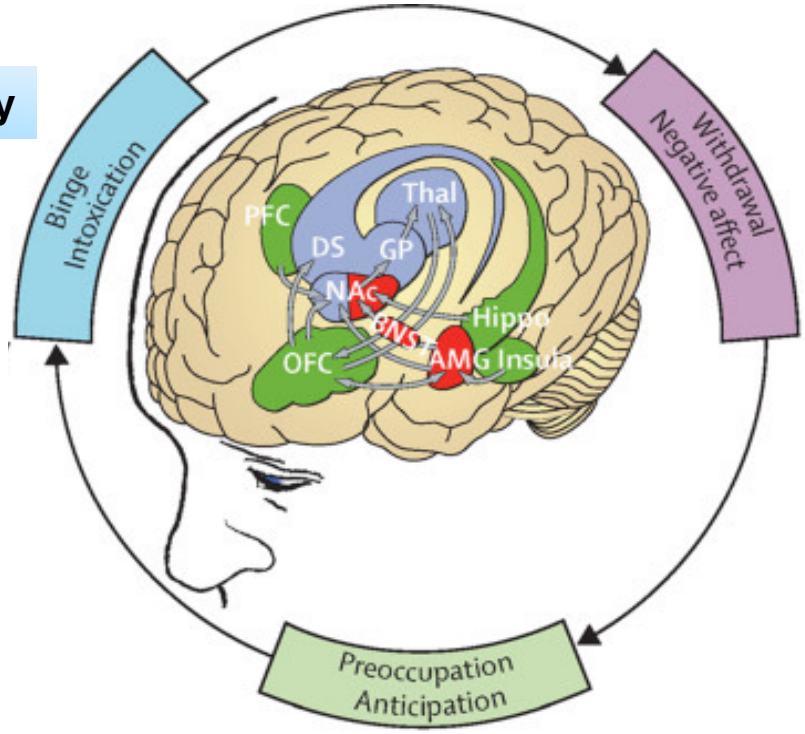
Director

National Institute on Drug Abuse

Neurocircuitry of the Addiction Cycle

Reward Motivation Circuitry

Emotion and Fear Circuitry

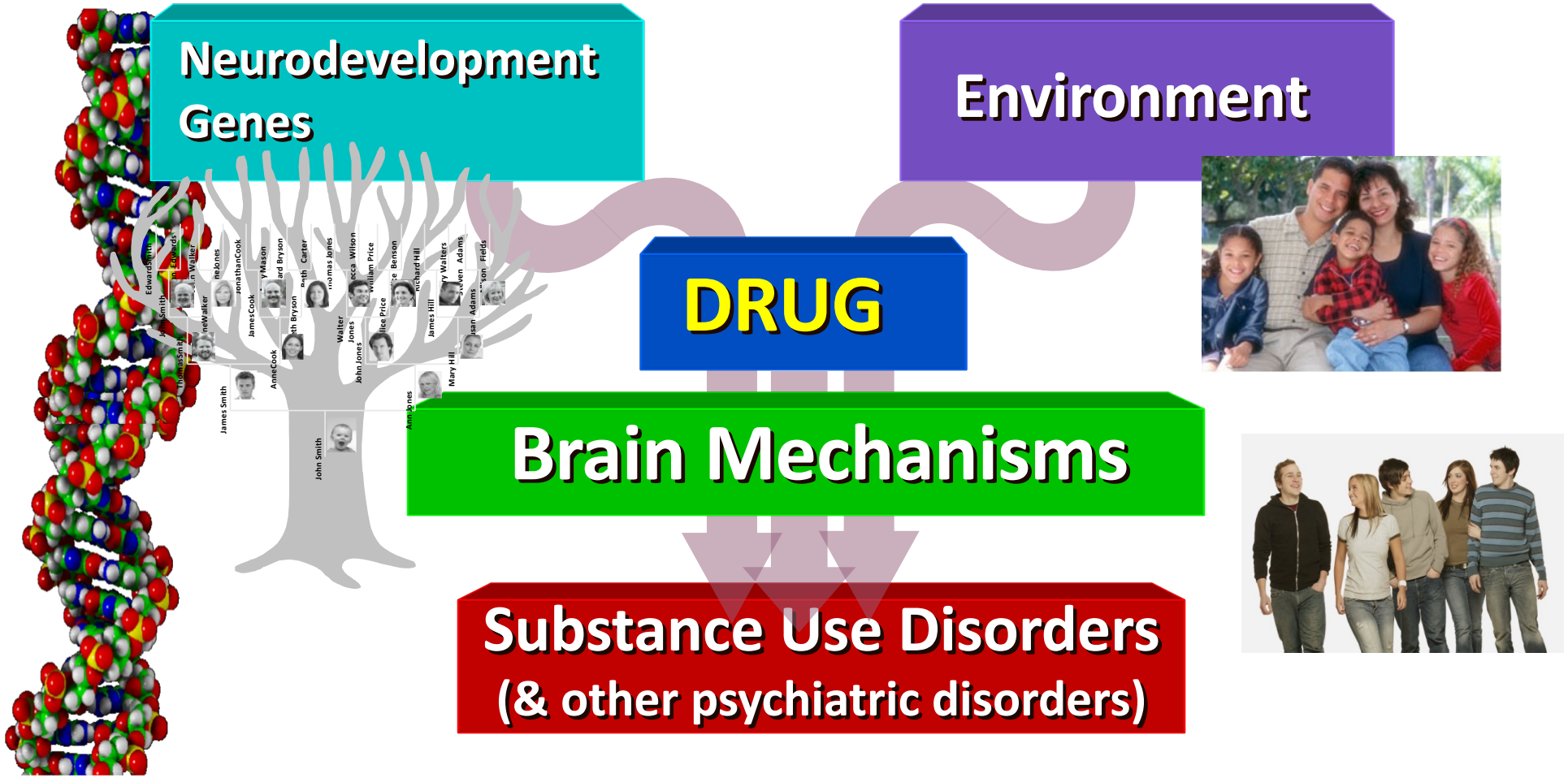


Executive Neurocircuitry

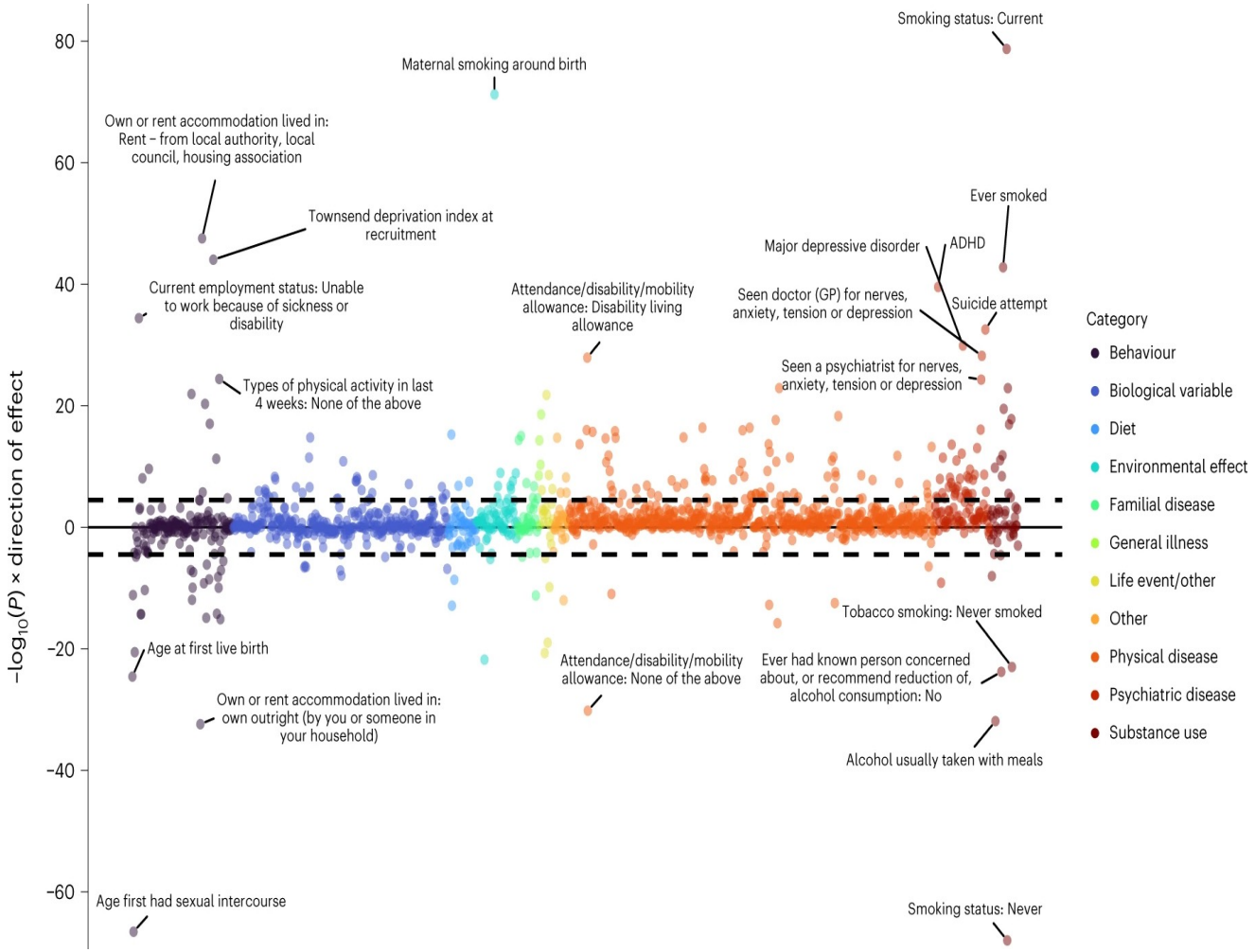
Saliency and Interoceptive Circuitry

Koob and Volkow, Lancet Psychiatry (2016).

Multiple Shared Factors Influence Substance use Disorders



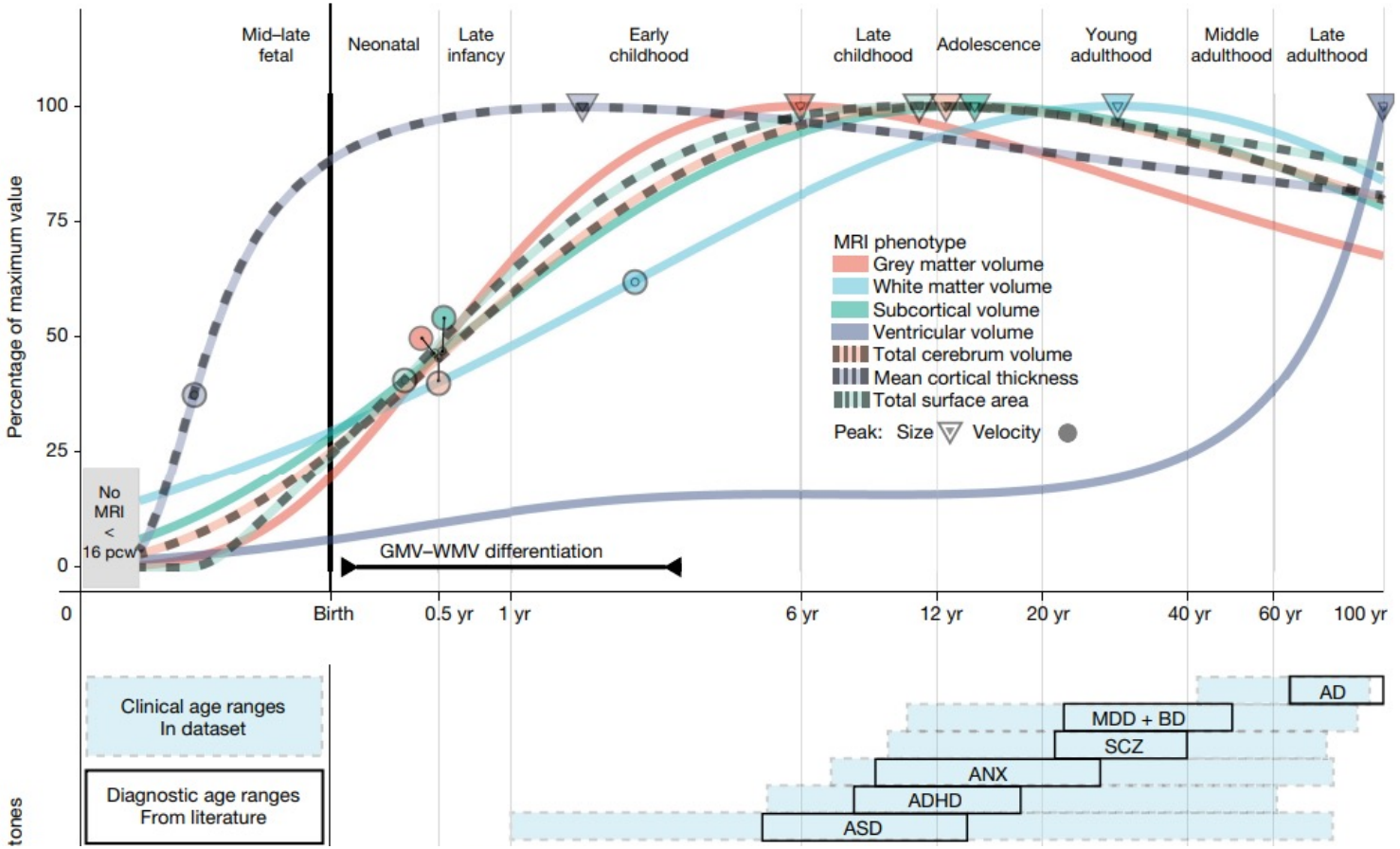
GENETICS: GWAs >1 Million Subjects Identifies Loci Underlying Multiple SUD and other Psychiatric Phenotypes



A general addiction risk factor identified 42 genes that included **FTO, DRD2 and PDE4B** and that also correlated with several psychiatric associated traits including suicidal behavior, anxiety, depression and externalizing behaviors.

Hatoum et al., Nature MH (2023)

Neurodevelopmental Milestones

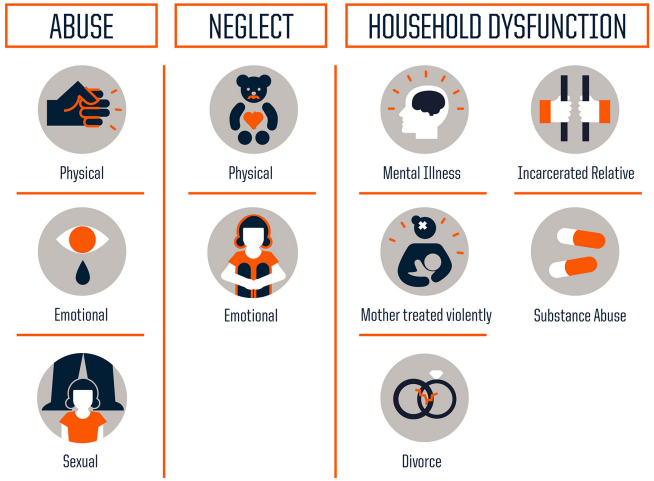


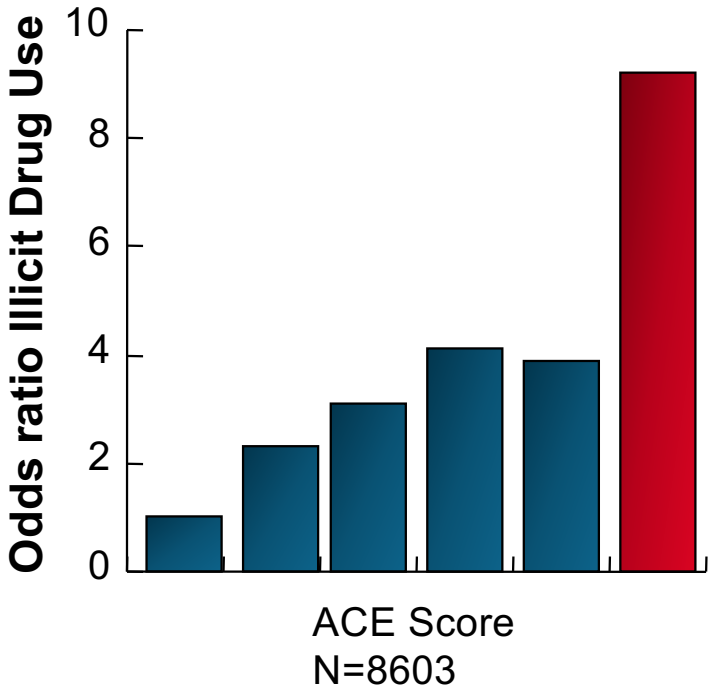
Bethlehem R et al., Nature (2022)

What Drives Vulnerability for Drug Use?

Social Determinants of Health

Adverse Childhood Experiences (ACE)





ACE account for one half to two third of serious problems with drug use

PEDIATRICS 111: 564-572, 2003

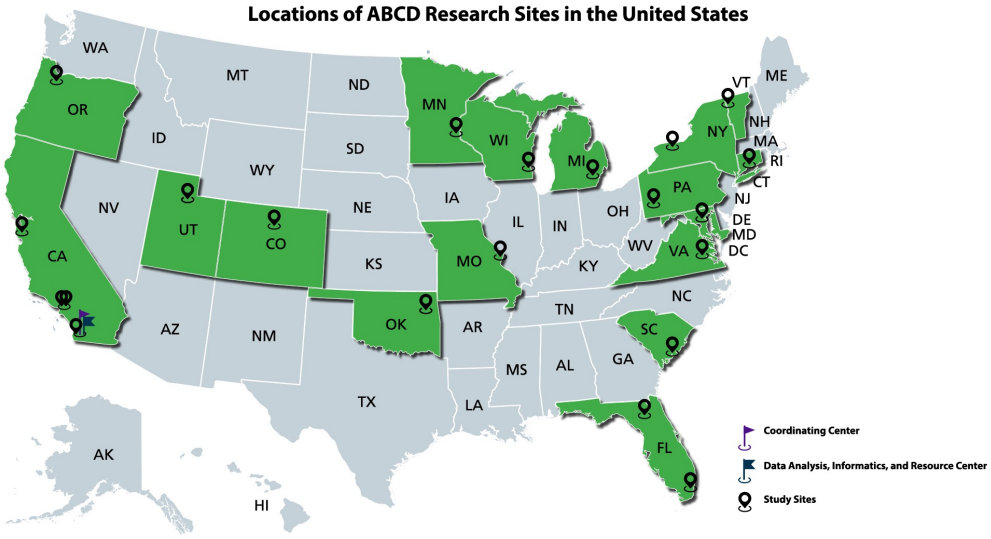
Adolescent Brain Cognitive Development®

Teen Brains. Today's Science. Brighter Future.

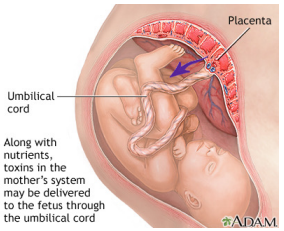
ABCD Study Design

Longitudinal study ~12,000 children, including ~2,000 youth of multiple births, from ages 9-10 into early adulthood to assess factors that influence individual brain development trajectories and functional outcomes.

Approximately 95% of participants retained 8 years into the study



Prenatal Drug Exposures: Effects on Brain Development



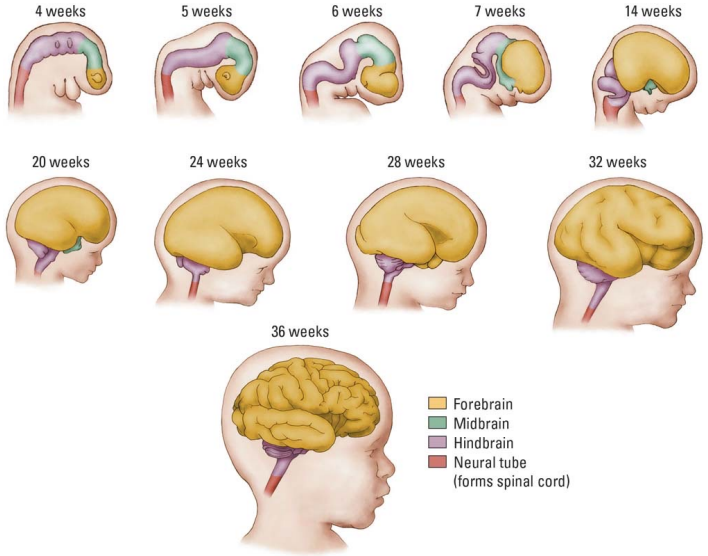
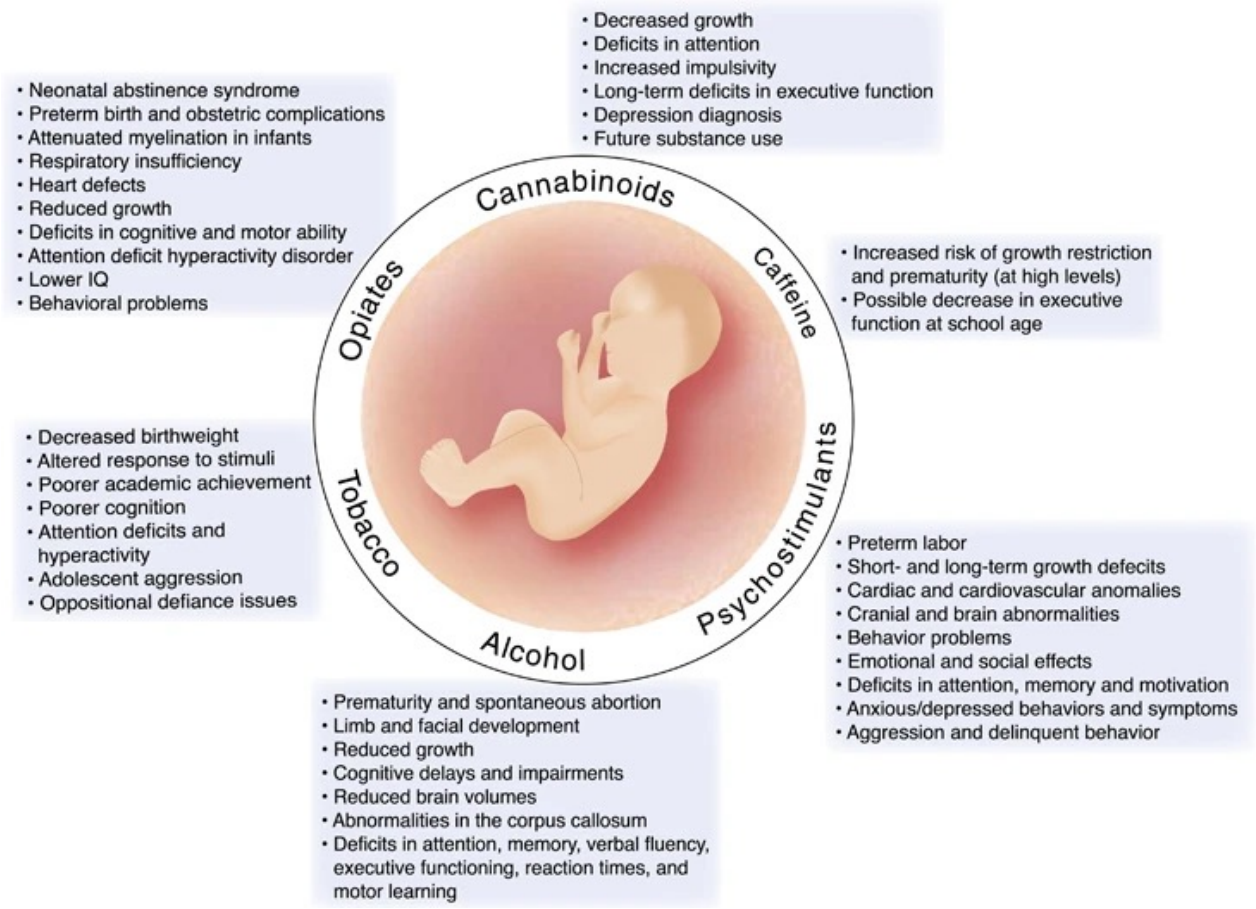


Figure 8.7
Kolb/Whishaw/Teskey, *Intro to Brain & Behavior,* 5e, © 2016 Worth Publishers
Research from Cowan, W. M. (1979). The development of the brain. *Scientific American,* 241(3), p. 116.



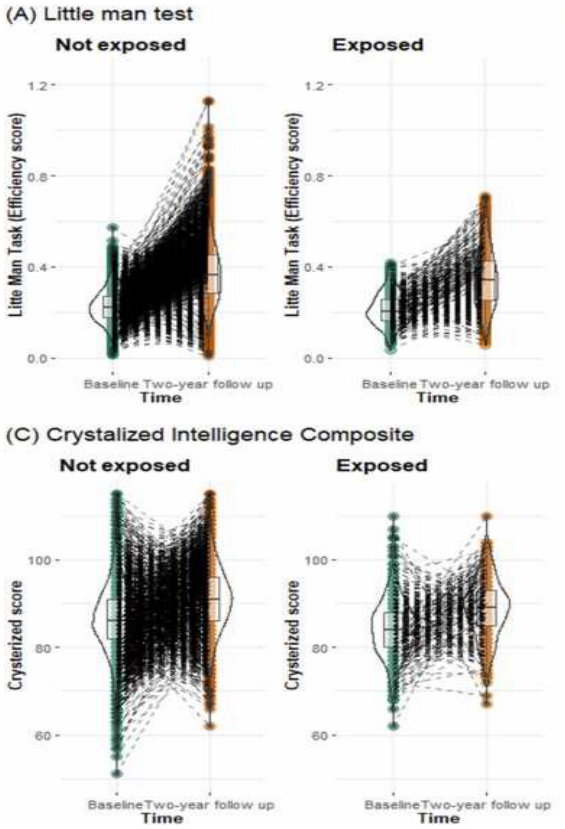
Prenatal Cannabis Effects on Developmental Trajectories Cognition and Brain Volumes

2002-2016

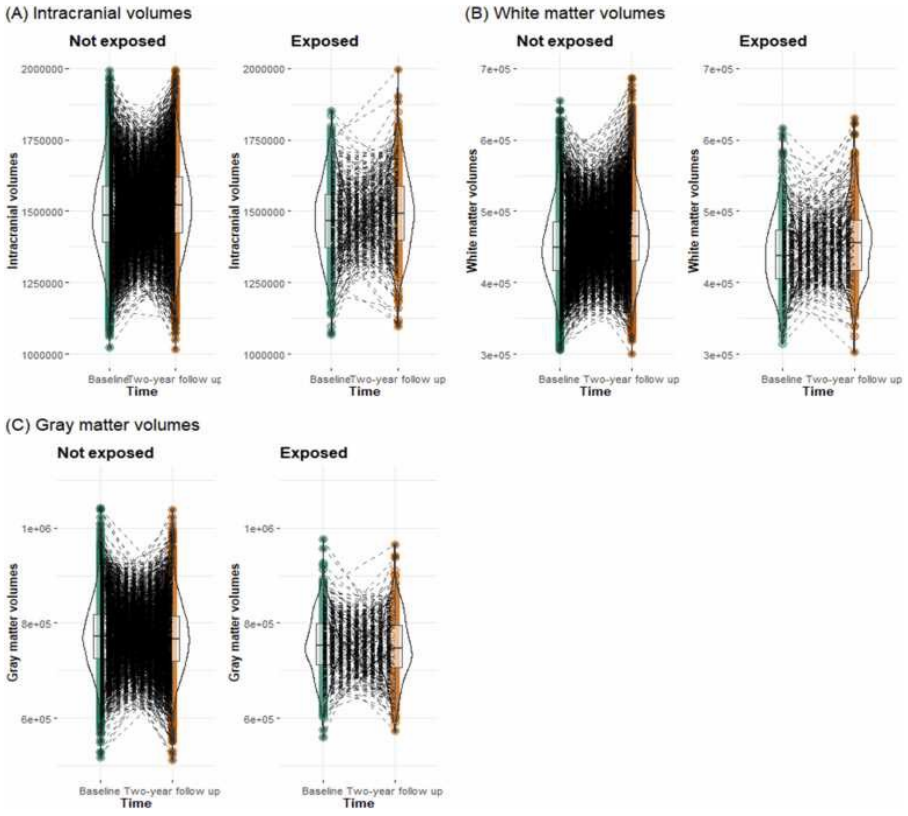
Increase in past-month Cannabis use in pregnant mothers in US

Agrawal et al., 2018

Cognitive Abilities



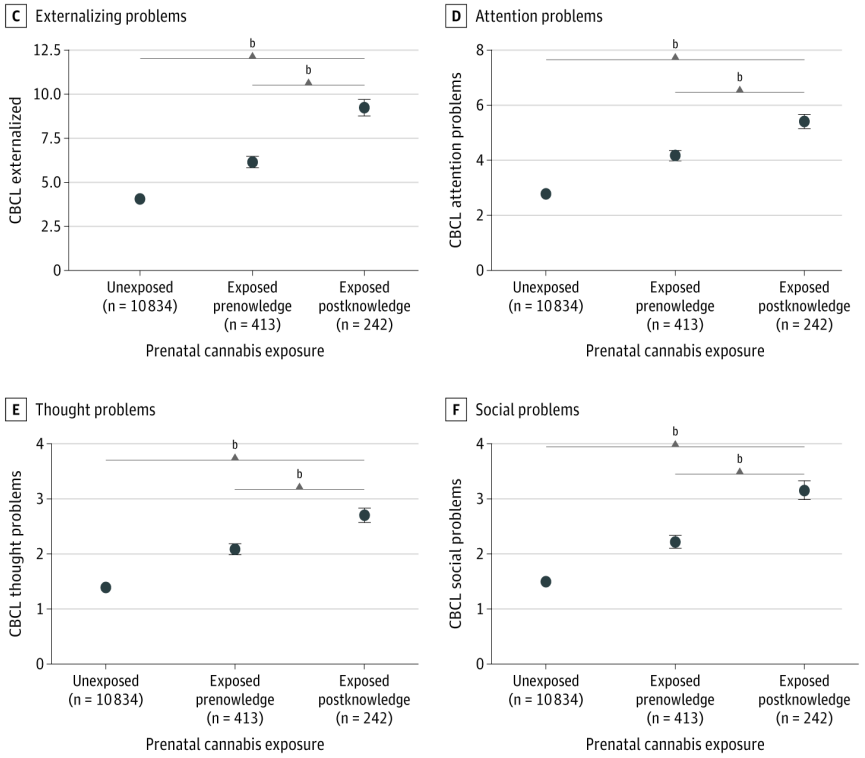
Brain Volumes



Hiraoka et al., Dev Cogn Neurosci. 2023

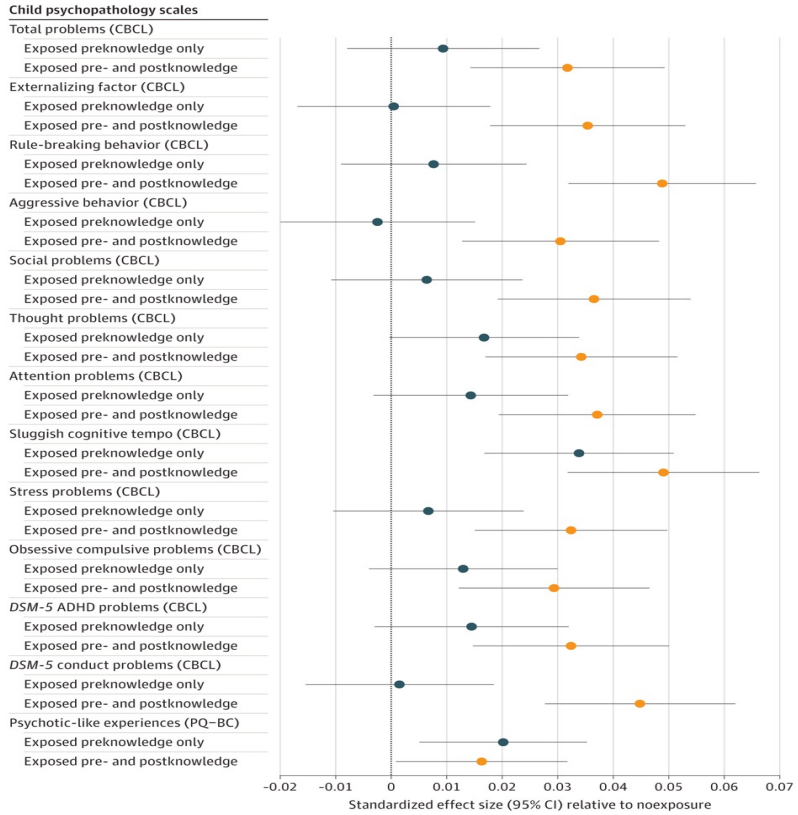
CANNABIS Prenatal exposure after maternal knowledge and mental health problems

Baseline (9-10 years old)



Paul et al. JAMA Psychiatry 2021

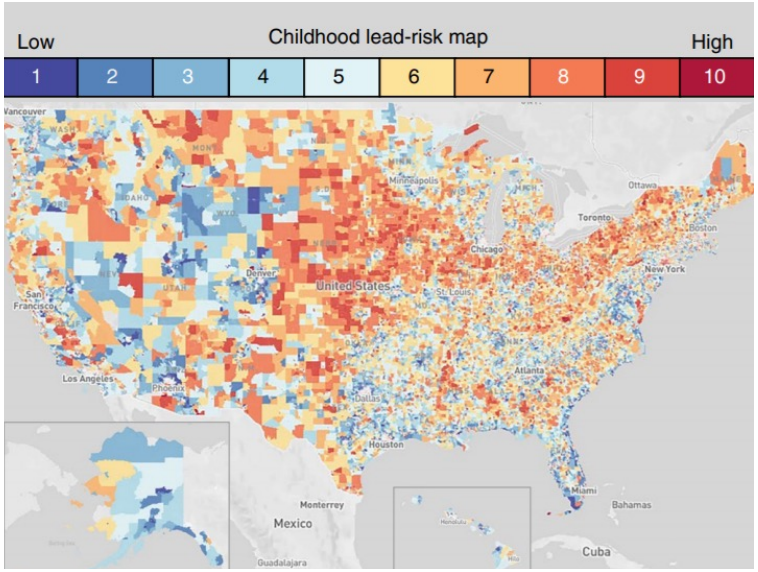
Two years follow up (11-12)

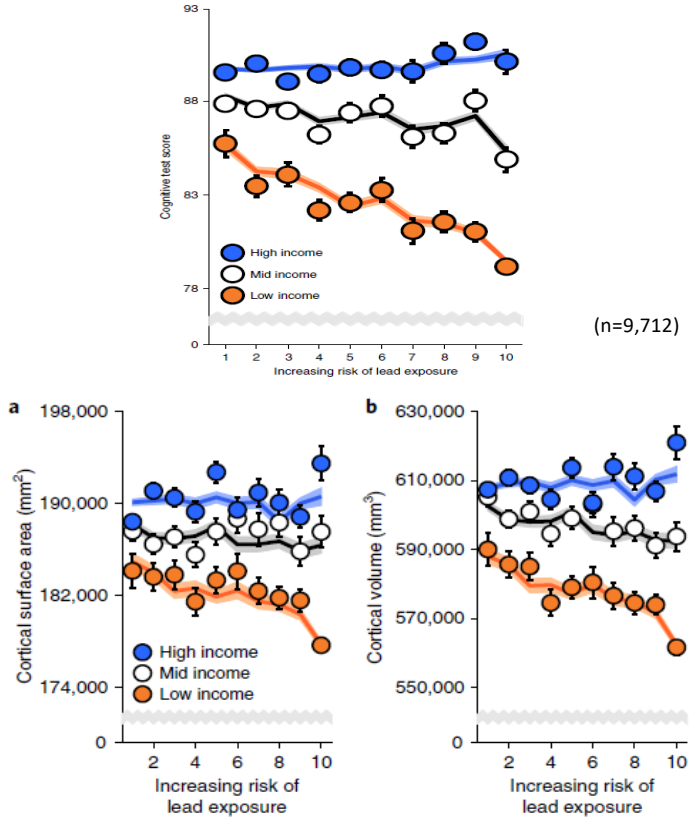


Baranger et al., JAMA Pediatr 2022

Social Determinants of Health: Effects on Brain Development

Lead Risk, SES, Cognition, and Brain

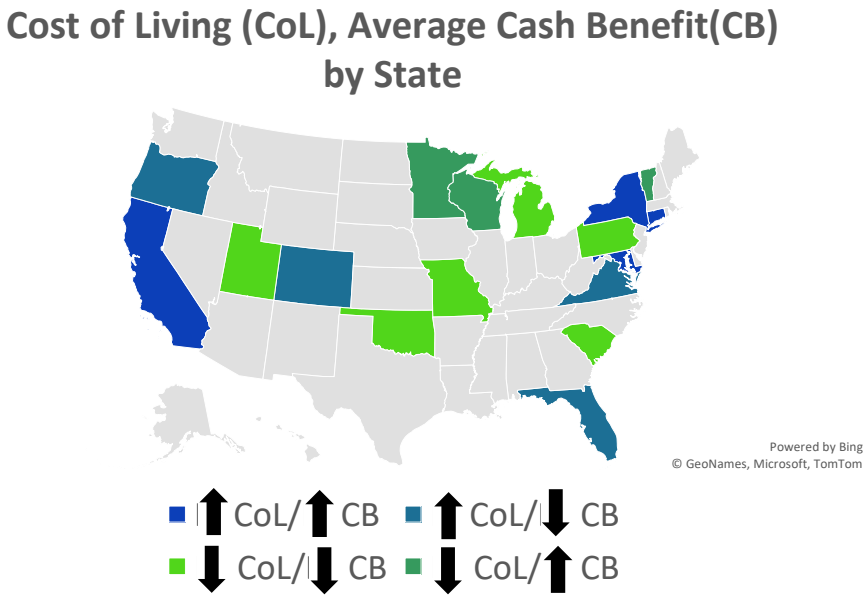


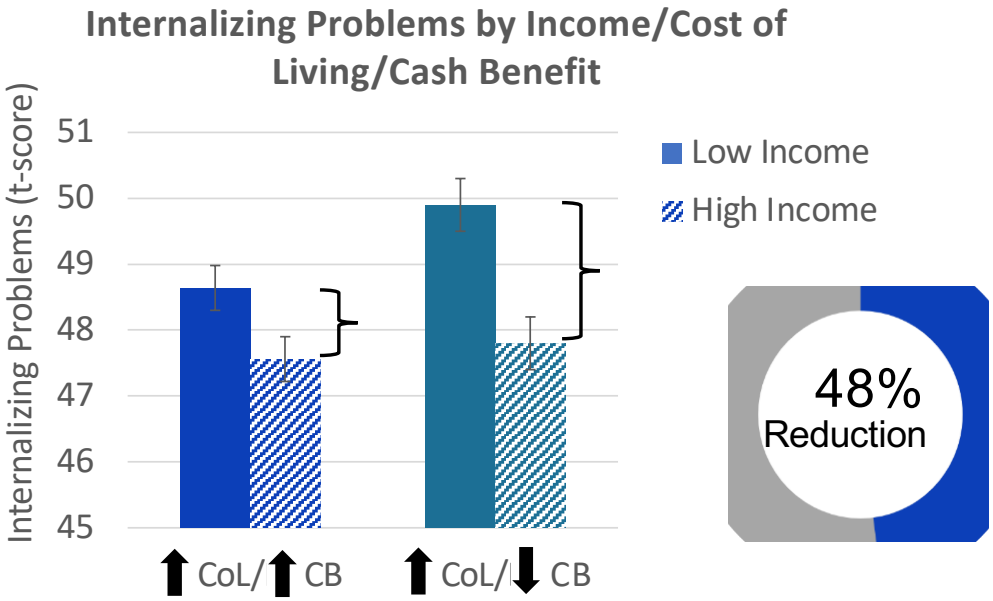


(n=9,712)

Marshall AT et al. (2020) Nature Medicine 26: 91–97. https://www.nature.com/articles/s41591-019-0713-y

Antipoverty Programs Associated with Reduced Disparities in Brain Development and Mental Health





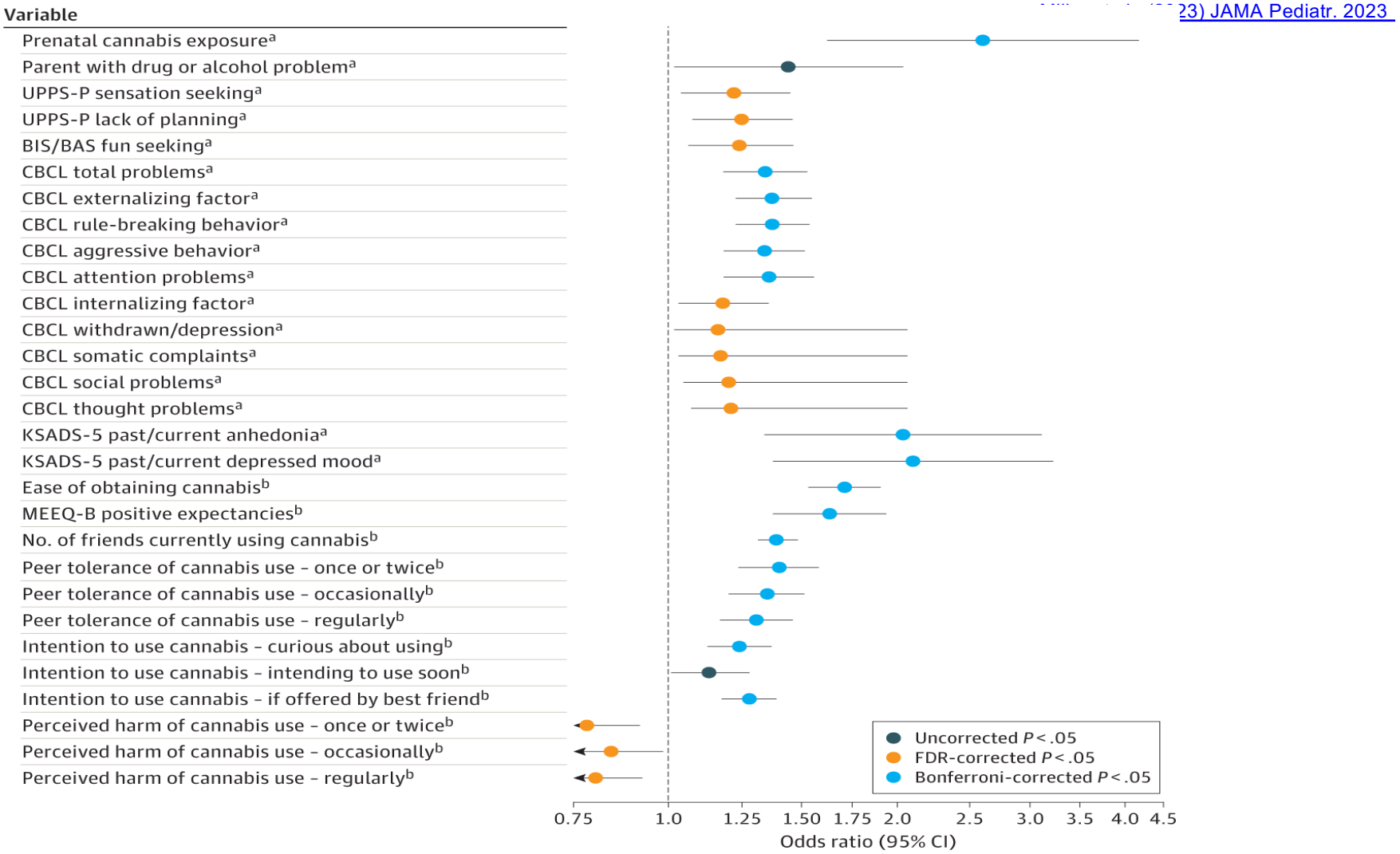
Controlled for:

- Population density
- State economic conditions (economic inequality, unemployment rate),
- Non-economic characteristics social and political factors (political preferences, women's political participation, reproductive rights, incarceration rate, tightness/looseness—i.e., cultural differences around rule and norm adherence),
- Education system equity (state-funded preschool enrollment, reading proficiency among students from low-income backgrounds).

Weissman, et al. Nature Communications. (2023).

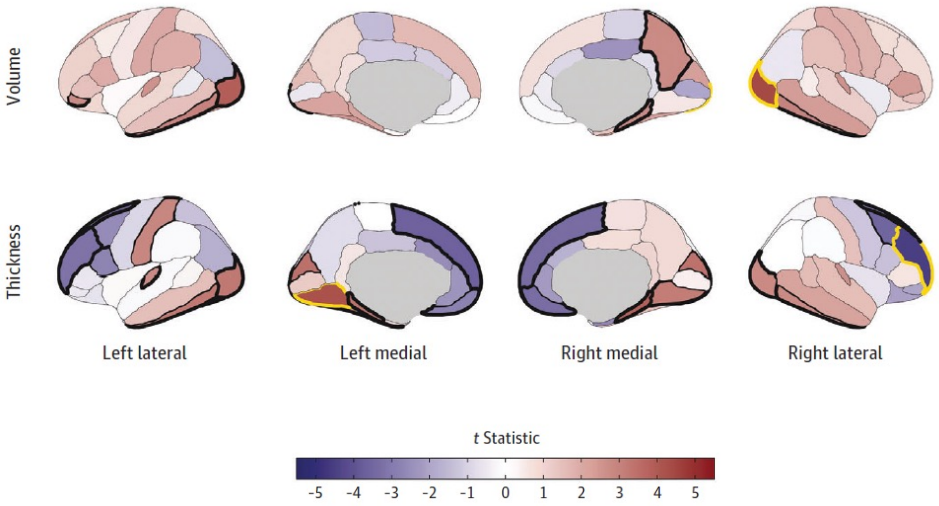
Variables associated with cannabis use in early adolescence

23) JAMA Pediatr. 2023

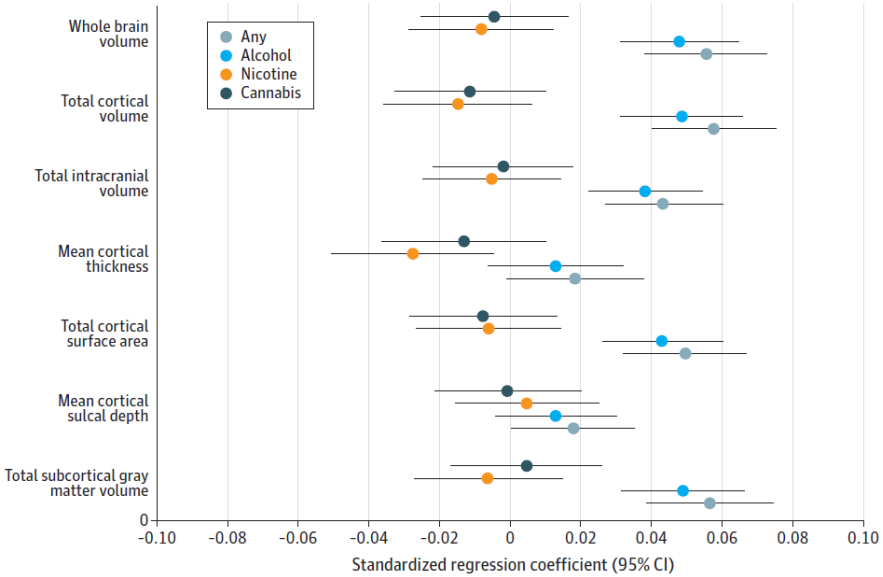


Neuroanatomical Variability and Substance Use Initiation in Late Childhood and Early Adolescence

Regional Cortical Volume and Thickness Associations With Early Substance Use

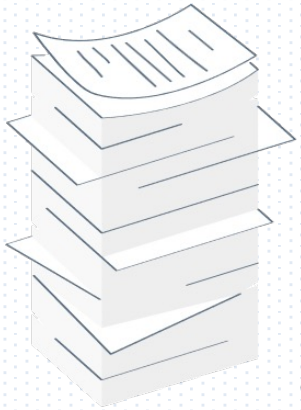


Standardized regression coefficients for associations between global metrics and substance use initiation.



Preexisting neuroanatomical variability was associated with substance use initiation and may reflect a predispositional risk for initiating substance use earlier in life with potential cascading implications for development of later problems

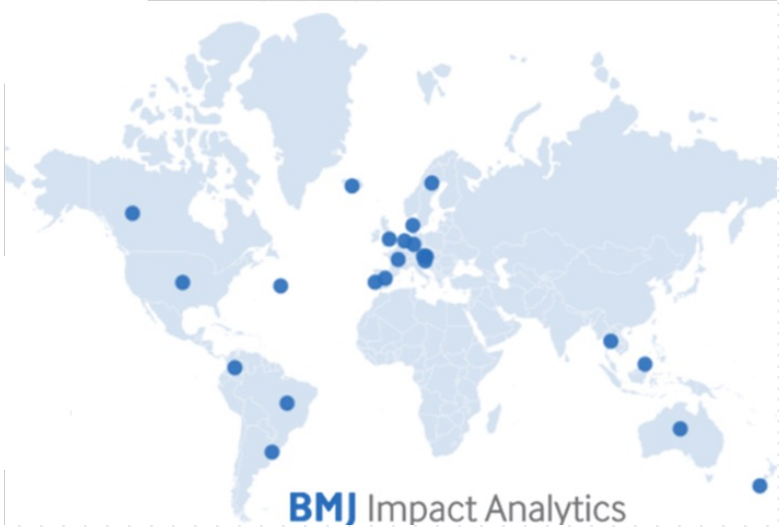
Miller et al. JAMA Network Open. 2024;7(12):e2452027

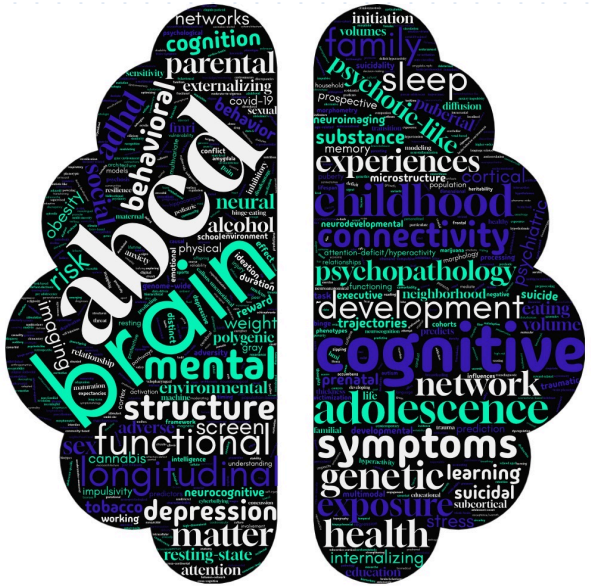


1300+ scientific publications

Cited in **83** clinical or other guidelines

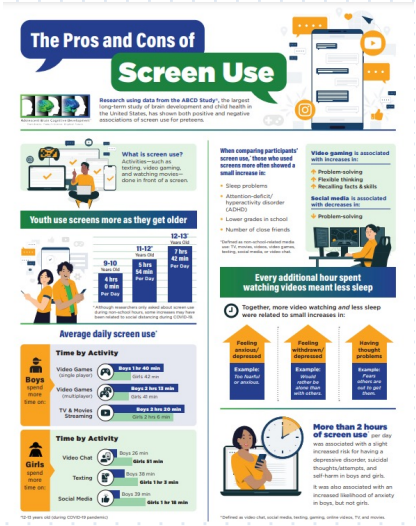
ABCD Impact

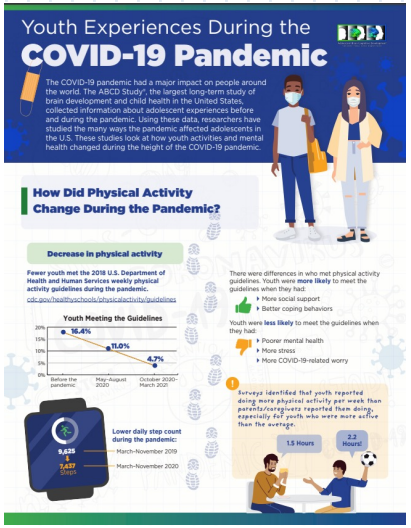




ABCD publications available at:

Infographics and webinar recordings available at:

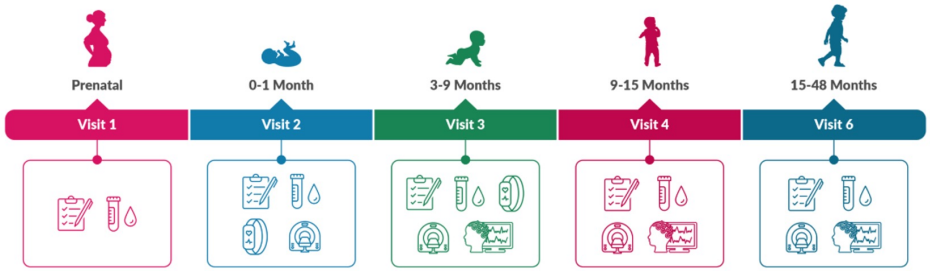




HEALthy Brain and Child Development Study (HBCD)

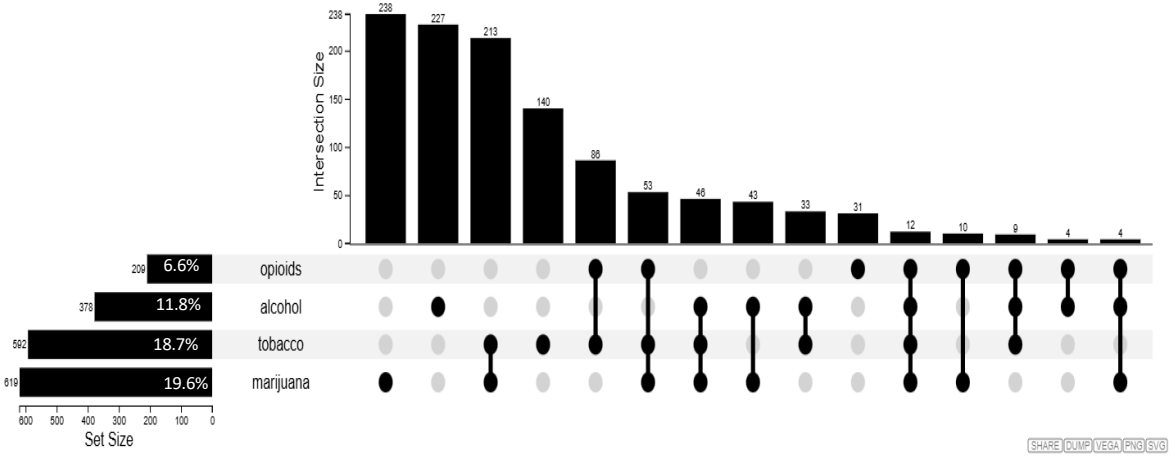
Longitudinal study of >7000 children, tracking brain and behavioral development from **prenatal stages through 9-10 years of age**. It aims to understand how biological, environmental, and social factors—including substance exposure—impact child development.

Enrollment began July 2023
3282 participants enrolled (104% of target)
36.3% reported prenatal substance use
1st data release Spring 2025 via NBDC platform
Full sample enrolled by 2027



N=3181 N=1967 N=952 N=377 Coming soon!

Prenatal Substance Use: 36.3% (N=1149/3163)

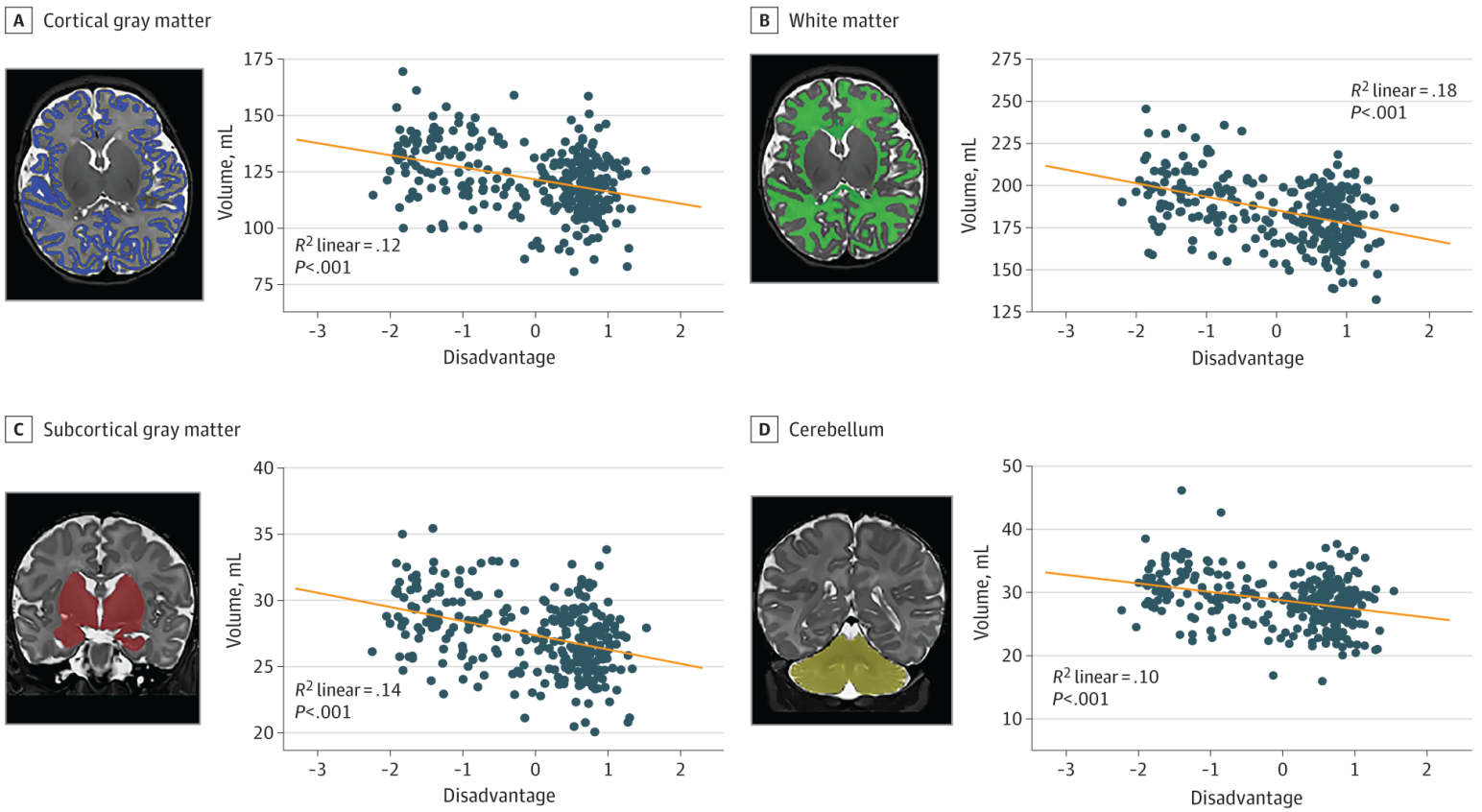


Prenatal Substance Use Criteria

Opioids: ≥Weekly for ≥2 weeks
Tobacco/Nicotine: ≥Weekly for ≥4 weeks
Marijuana/Cannabis: ≥Weekly for ≥4 weeks
Alcohol: ≥7 standard drinks/week for ≥2 weeks; or ≥3 standard drinks/ occasion on ≥2 occasions

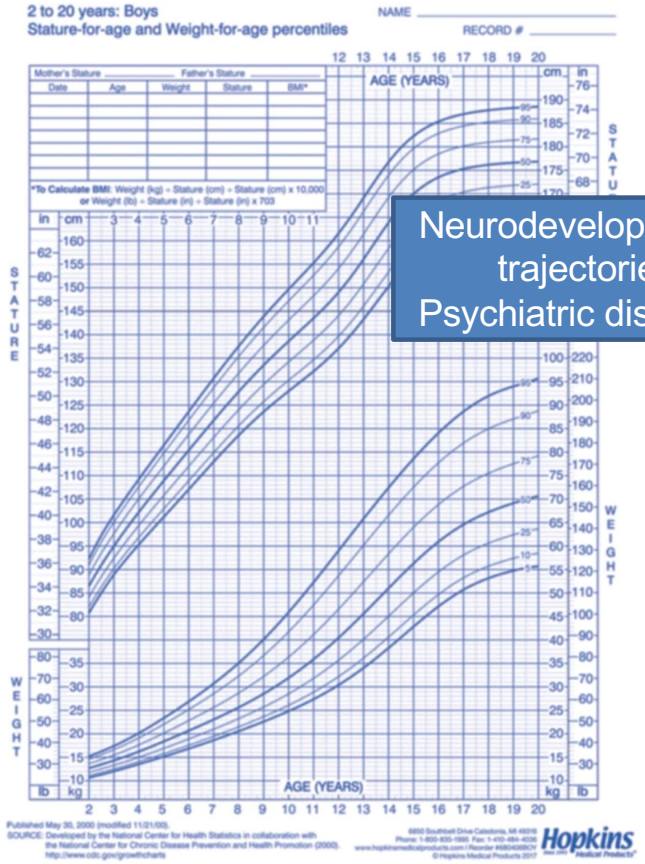
Association of Prenatal Exposure to Early-Life Adversity With Neonatal Brain Volumes at One Year of Age

Correlation Between Total Brain Volume and Maternal Social Disadvantage Factor



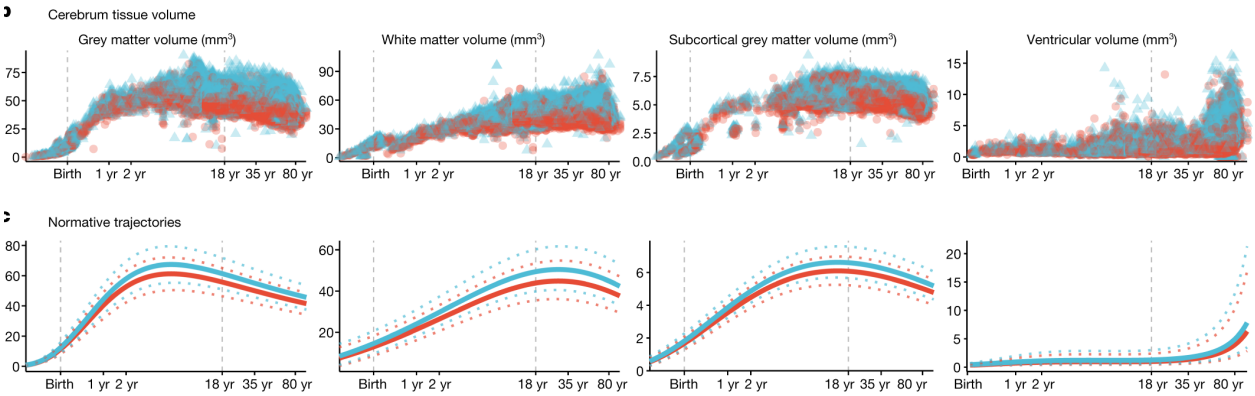
Miller et al. JAMA Netw Open. 177(8):861-863 (2022)

No standards currently exist for brain development



Neurodevelopmental trajectories
Psychiatric disorders

Neurodegenerative disorders

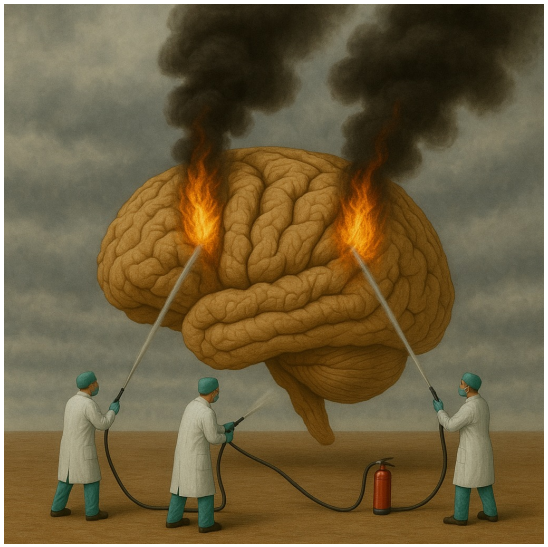


Bethlehem et al. (2022) *Nature*

Prevention is the Most Effective Strategy to

1. Address/alleviate the negative impact of drugs and SUD
2. promote healthy brain development
3. nip the vicious cycle of dual disorders in the bud

Prevention



Treatment

Recovery

THANK YOU!