Adolescent Cannabis Use

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NIH National Institute on Drug Abuse

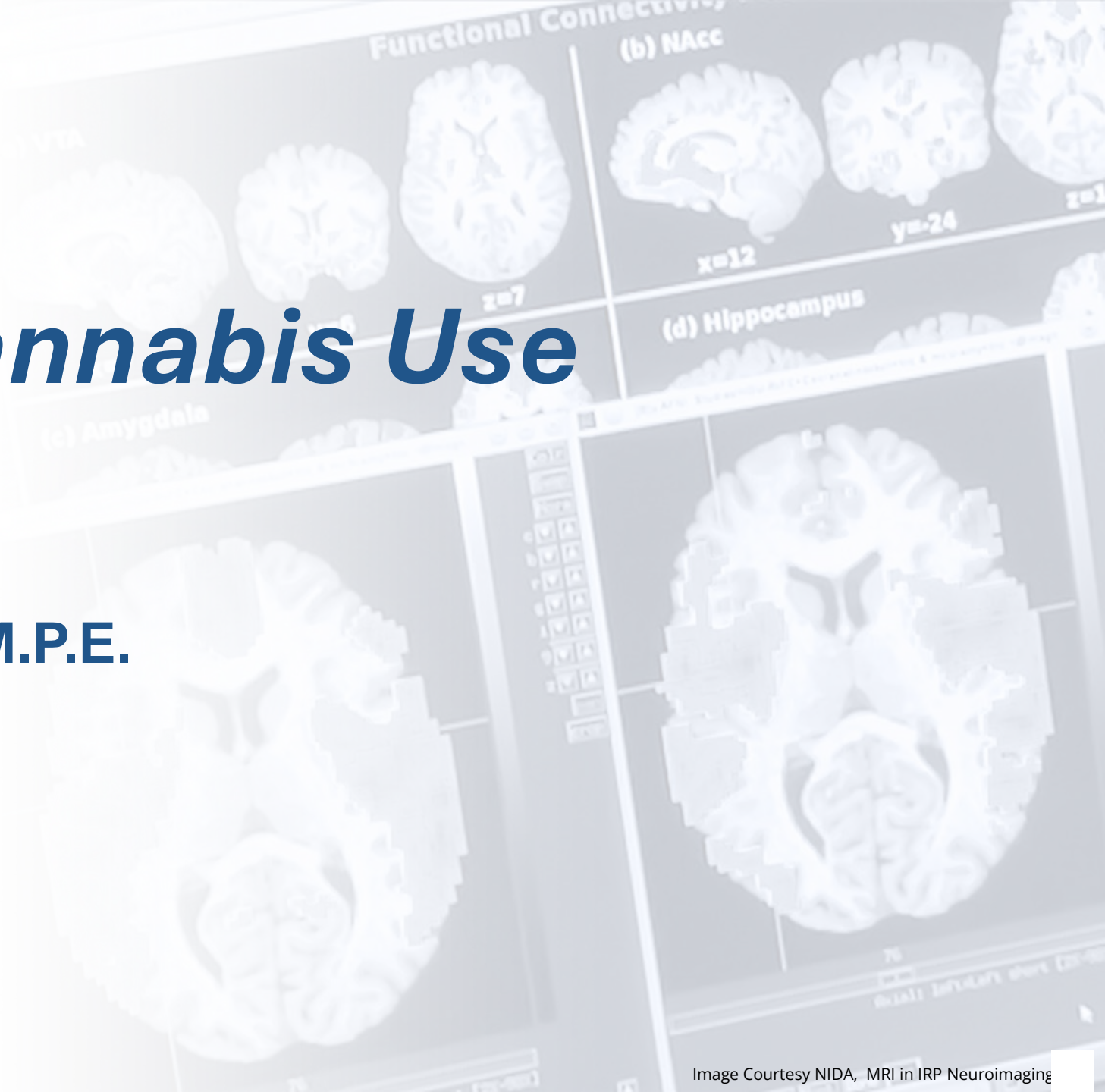

Image Courtesy NIDA, MRI in IRP Neuroimaging

Disclosures of Interests: Wilson M. Compton, MD, MPE

- **Stock Equity**:
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  - Pfizer, Inc. (under $5,000)
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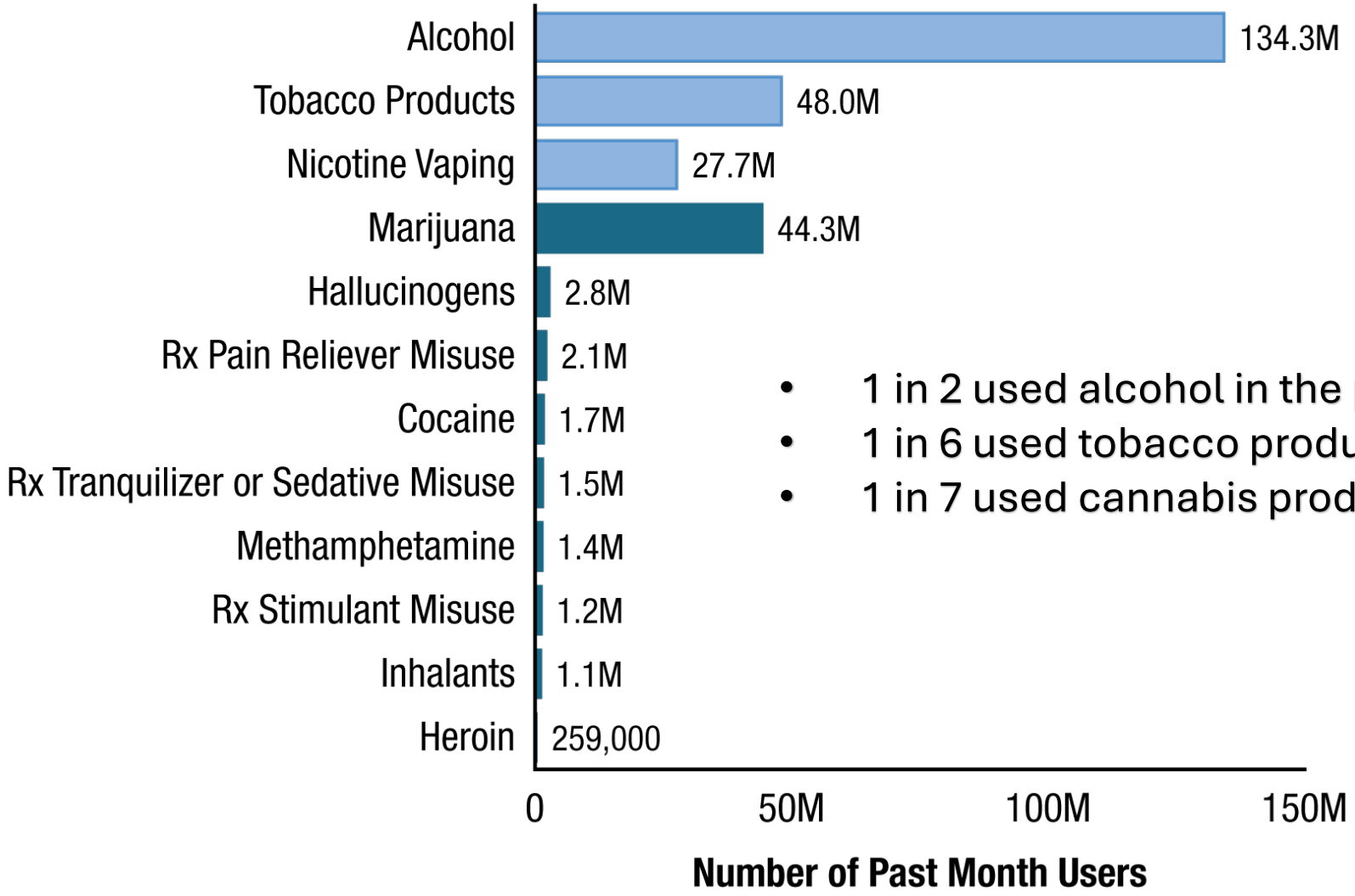
- **Sources of Research Support**: National Institutes of Health
- **Consulting Relationships**: None
- **Current Positions**:
  - Deputy Director, National Institute on Drug Abuse, NIH
  - Professor (adjunct), Georgetown University

Alcohol, Nicotine, and Cannabis are the Most Commonly Used Substances in the U.S.

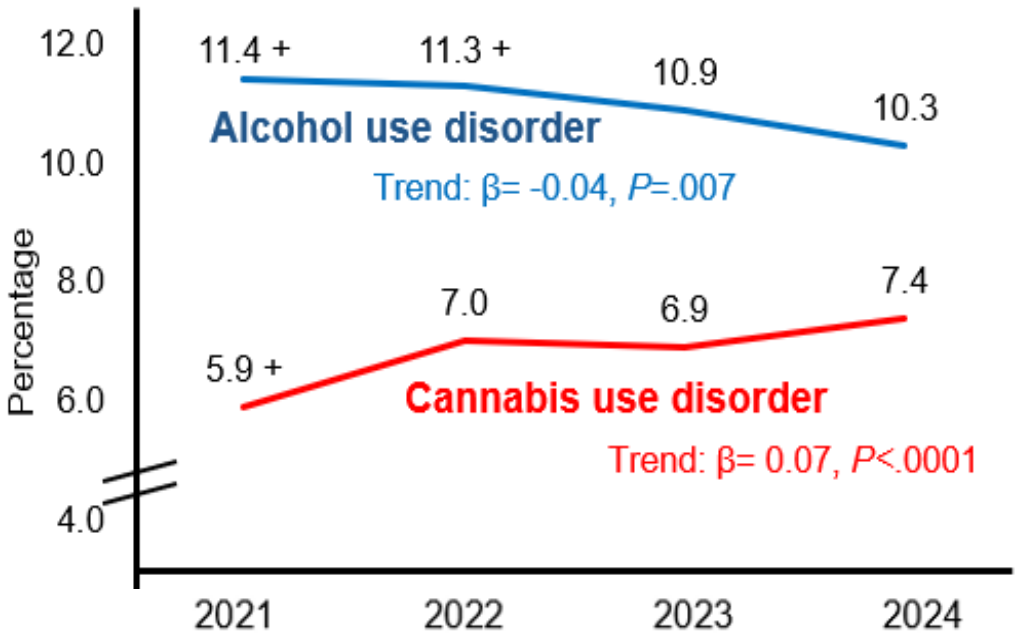


- 1 in 2 used alcohol in the past month
- 1 in 6 used tobacco products in the past month
- 1 in 7 used cannabis products in the past month

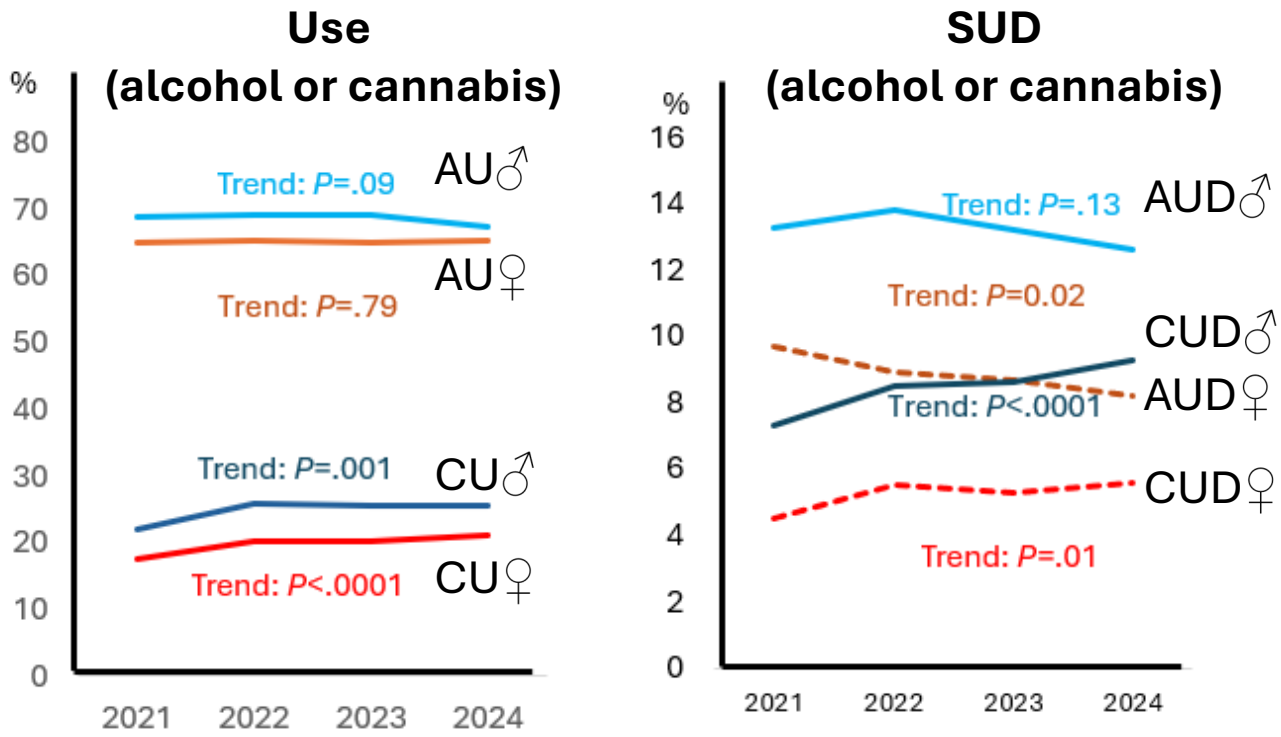
Source: SAMHSA NSDUH, 2024

Trends in Past-Year Cannabis and Alcohol Use and Substance Use Disorders Among Adults

Past-Year Cannabis and Alcohol Use Disorders Among Adults



Past-Year Cannabis and Alcohol Use and Use Disorders Among Male and Female Adults

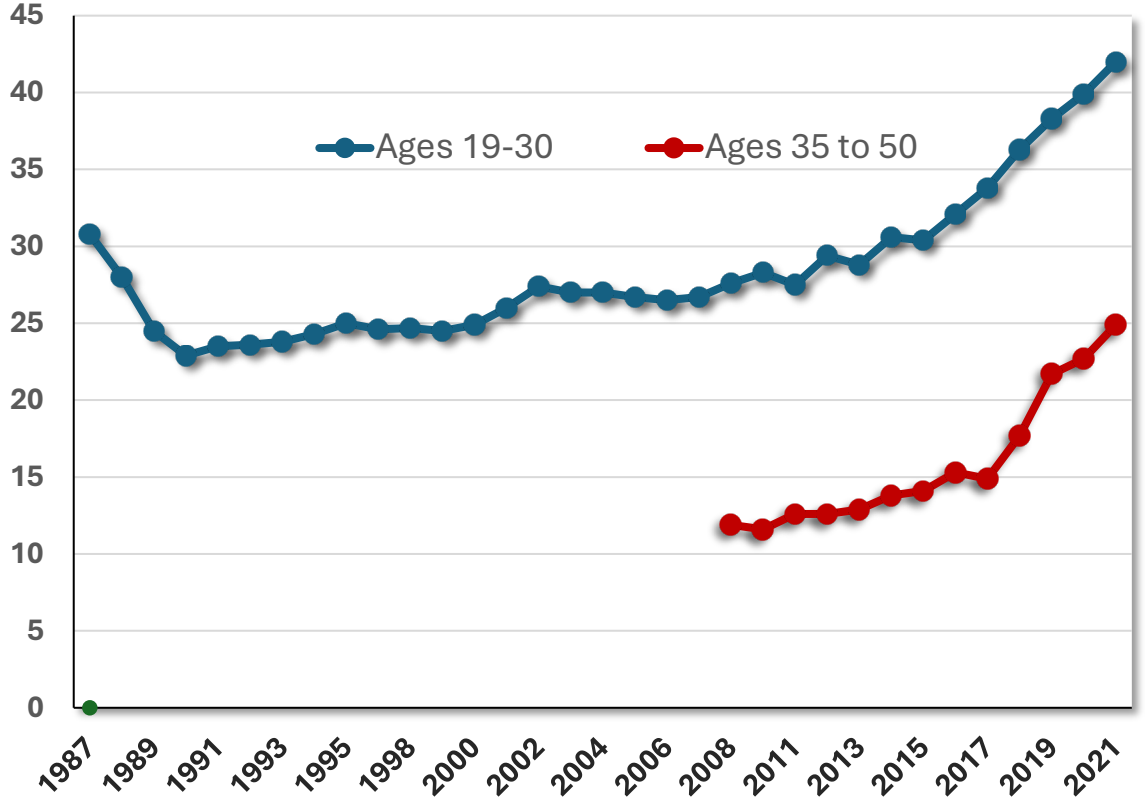


Source: SAMHSA, NSDUH 2024

Cannabis Use Increasing Among Adults Age 19-59: MTF Survey

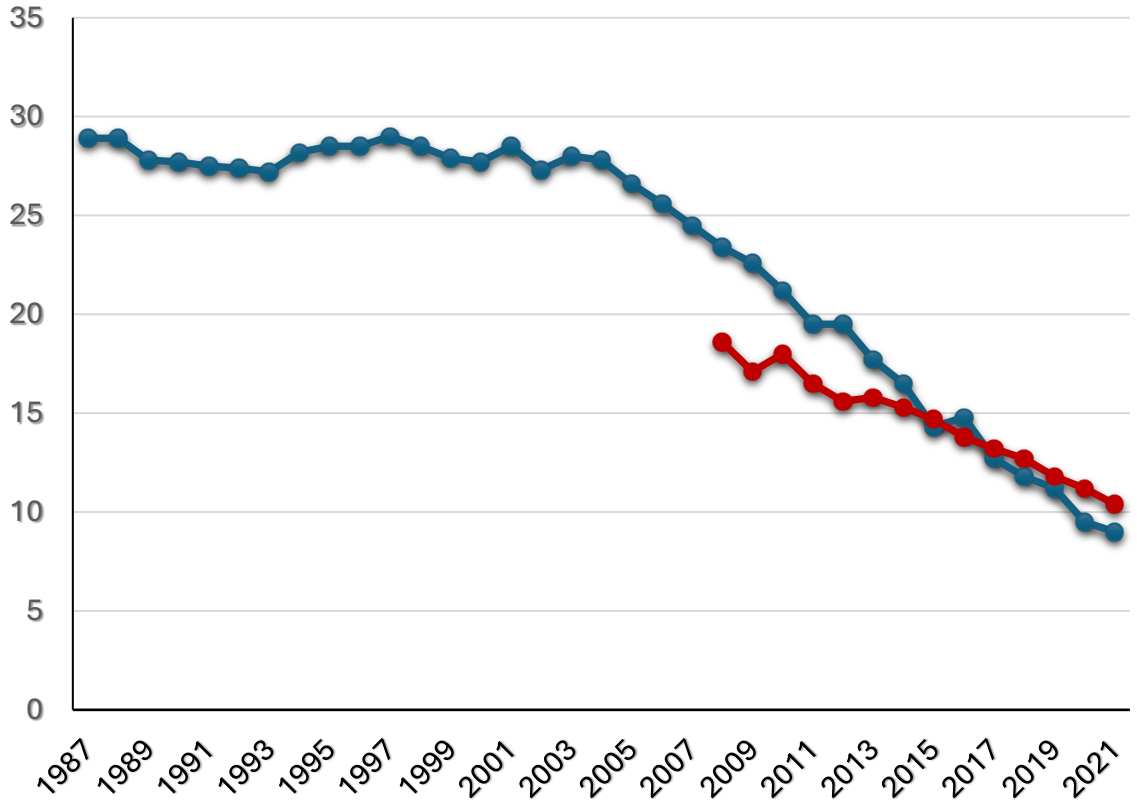
MARIJUANA

Trends in 12 Month Prevalence
Among Respondents of Modal Ages 19 through 59



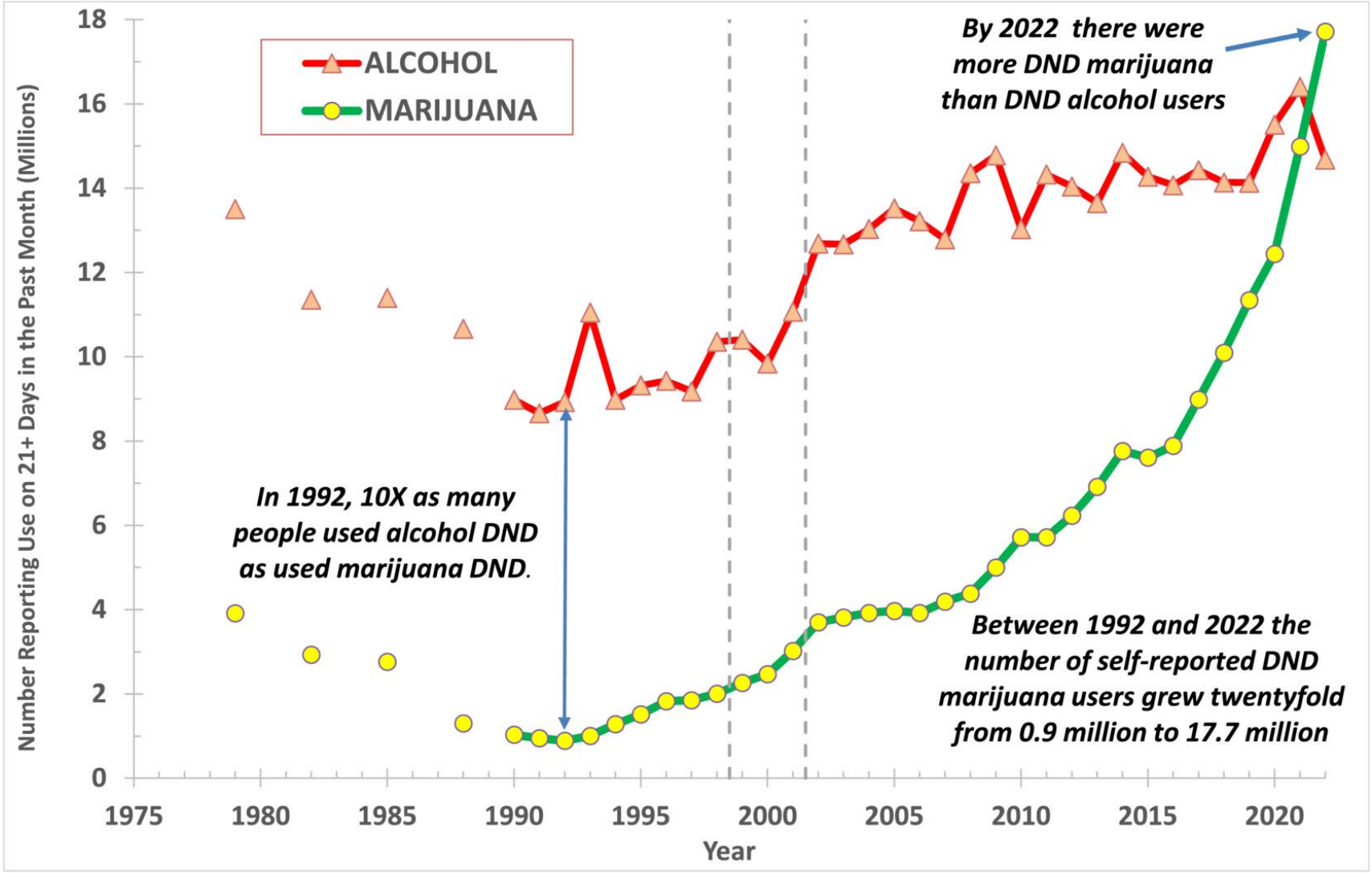
CIGARETTES

Trends in 12 Month Prevalence
Among Respondents of Modal Ages 19 through 59



Source: Patrick ME et al (2022). Monitoring the Future Monograph Series. : doi:10.7826/ISR-UM.06.585140.002.07.0001.2022

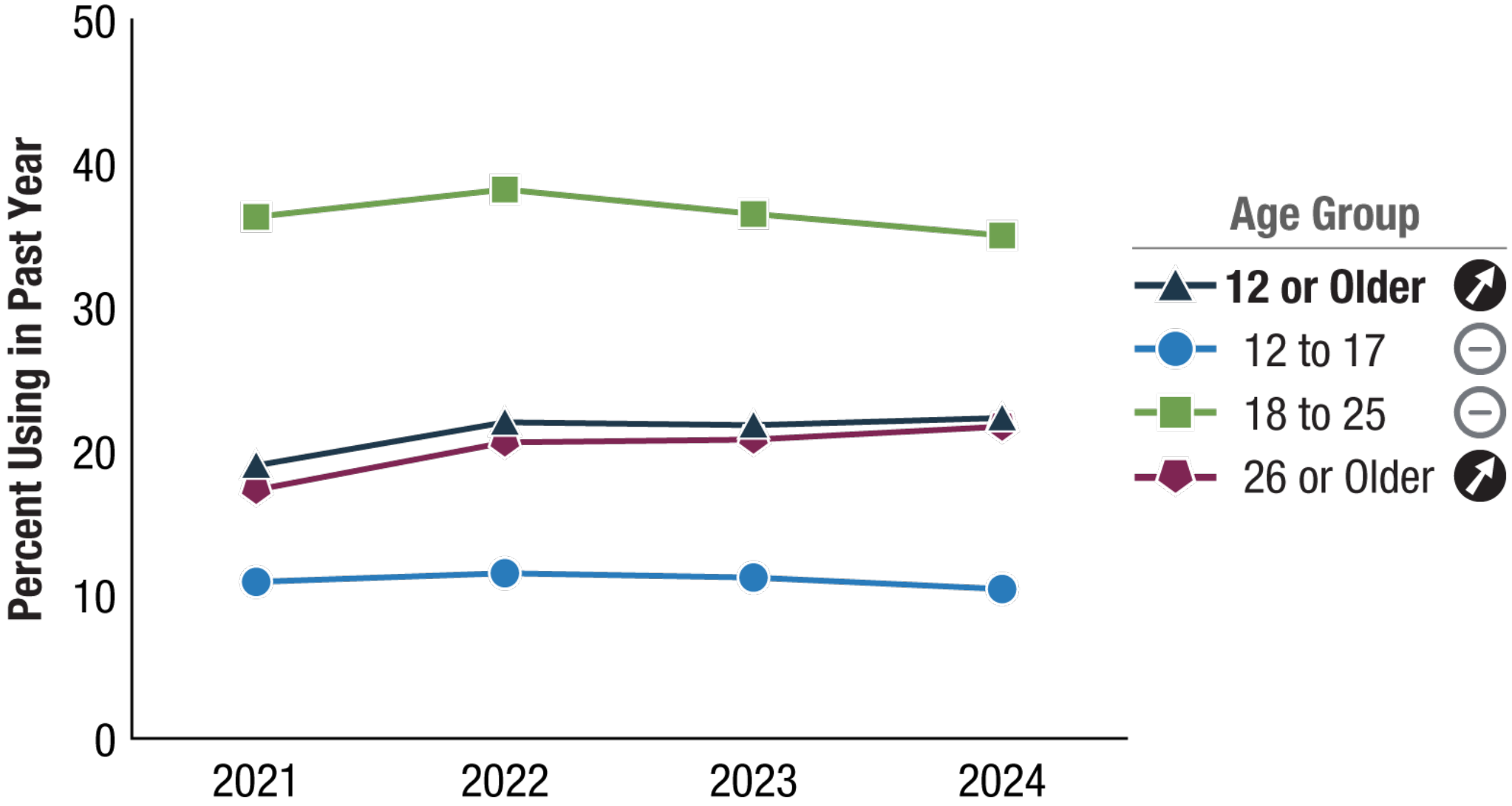
Changes in Self-Reported Daily or Near-Daily Cannabis Use Among U.S. Adults from 1979-2022



Source: Caulkins, *Addiction* (2024;)

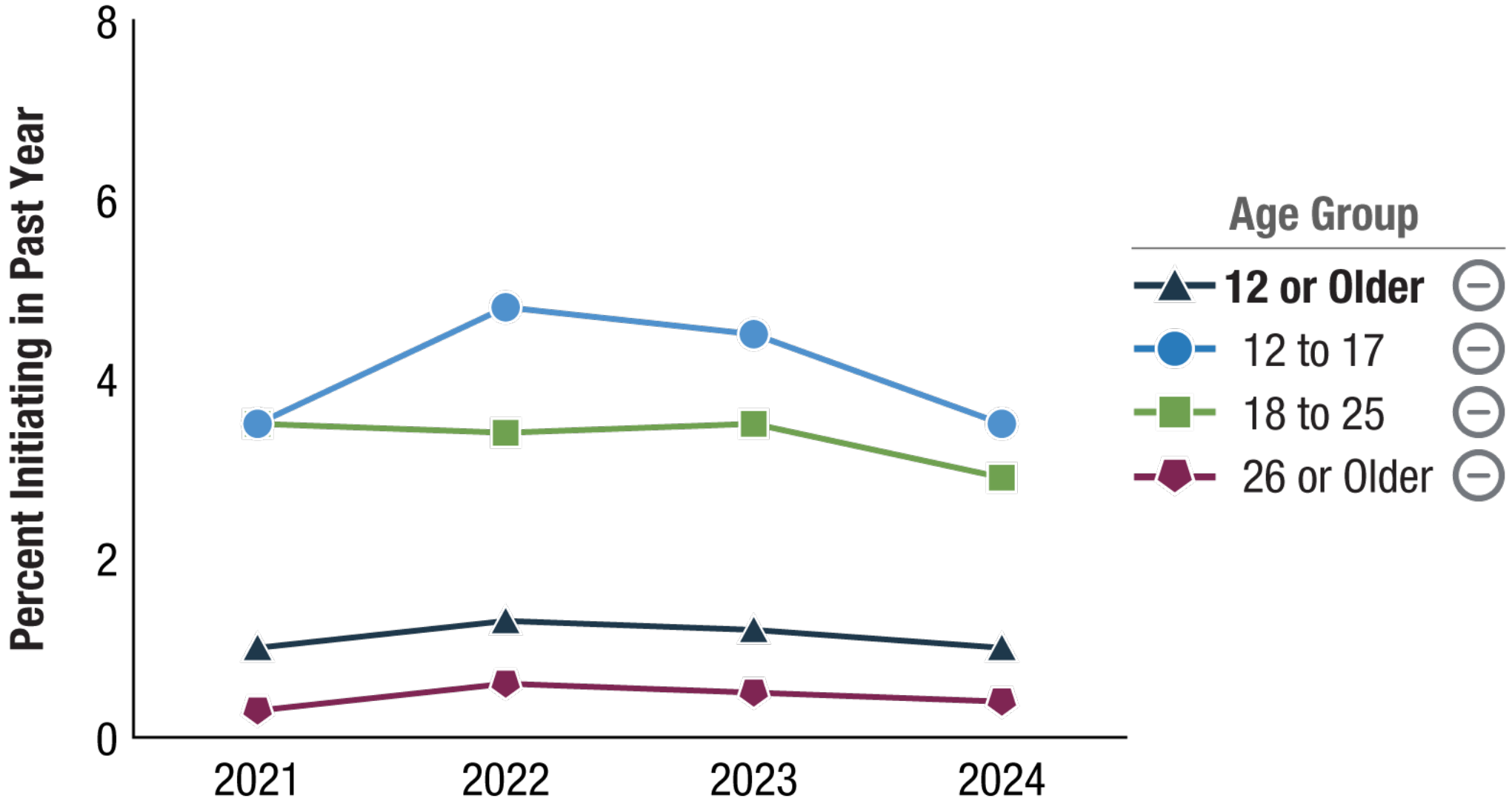
Epidemiology of Adolescent Substance Use

Young Adults have the Highest Rates of Past-Year Cannabis Use



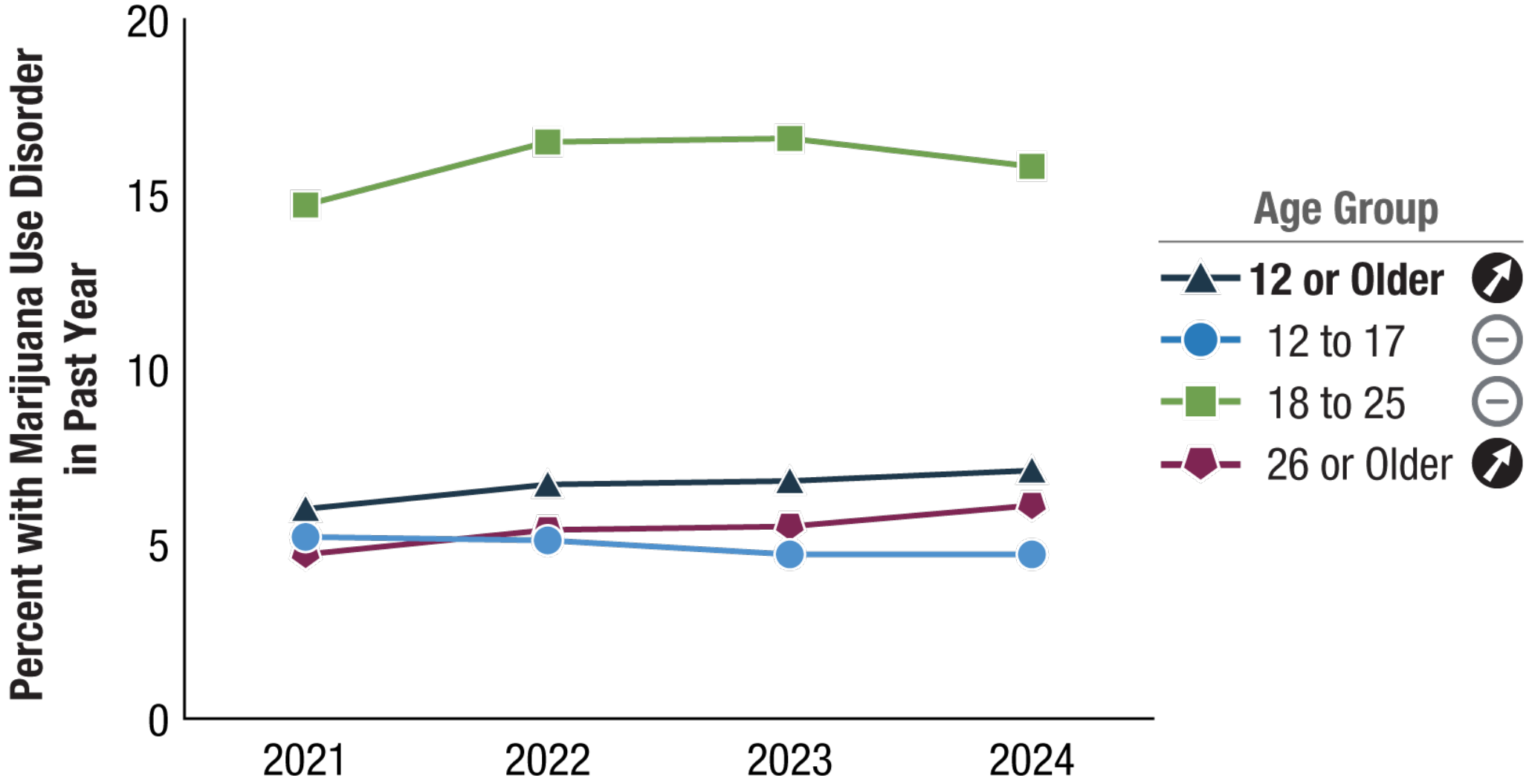
Source: SAMHSA NSDUH, 2024

Youth and Young Adults Have the Highest Rates of Cannabis Use Initiation



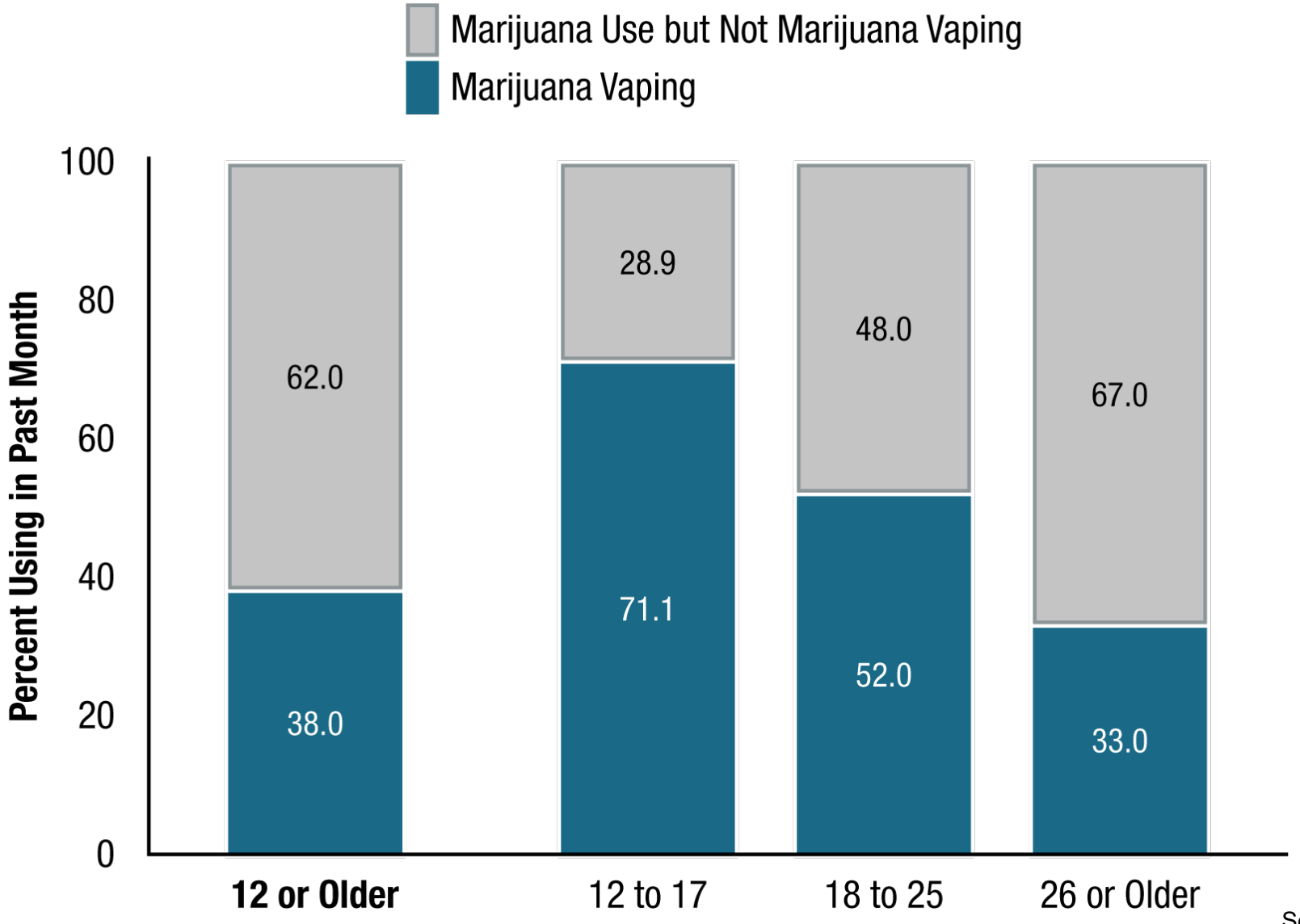
Source: SAMHSA NSDUH, 2024

Young Adults have the Highest Rates of Cannabis Use disorder



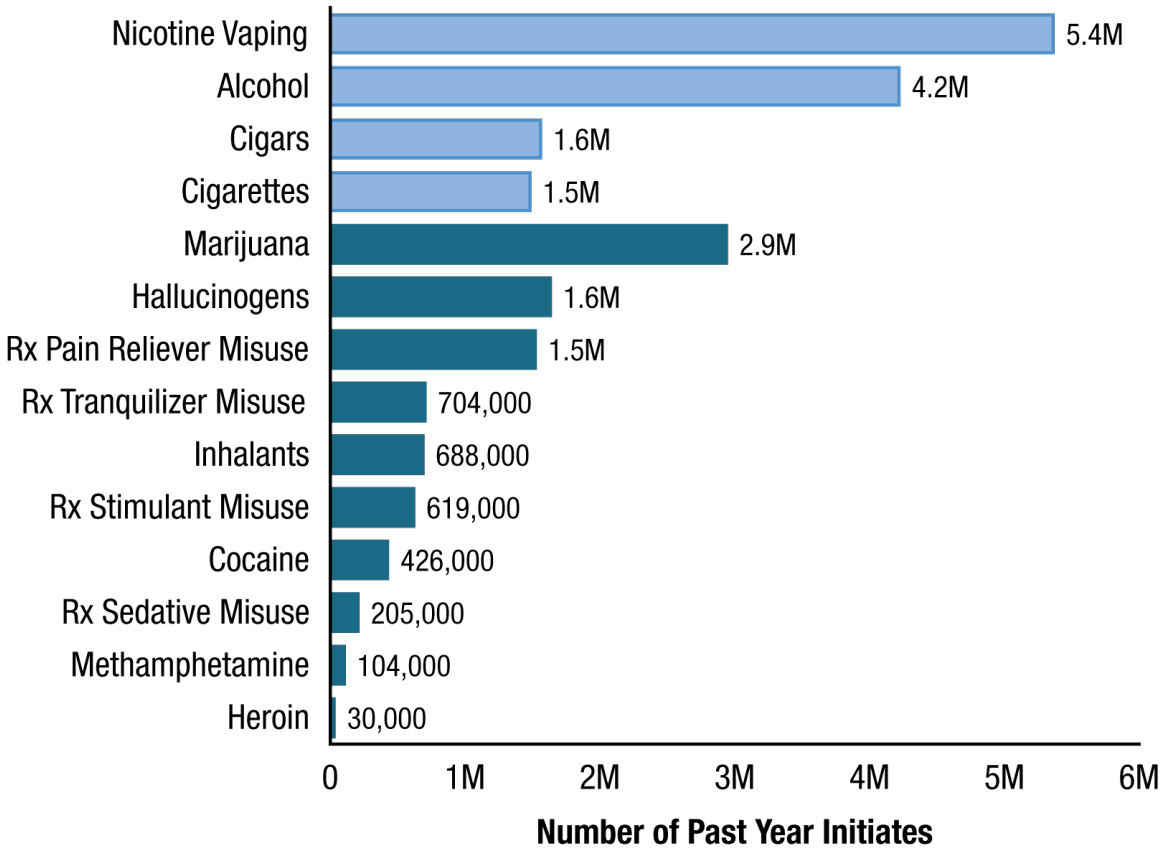
Source: SAMHSA NSDUH, 2024

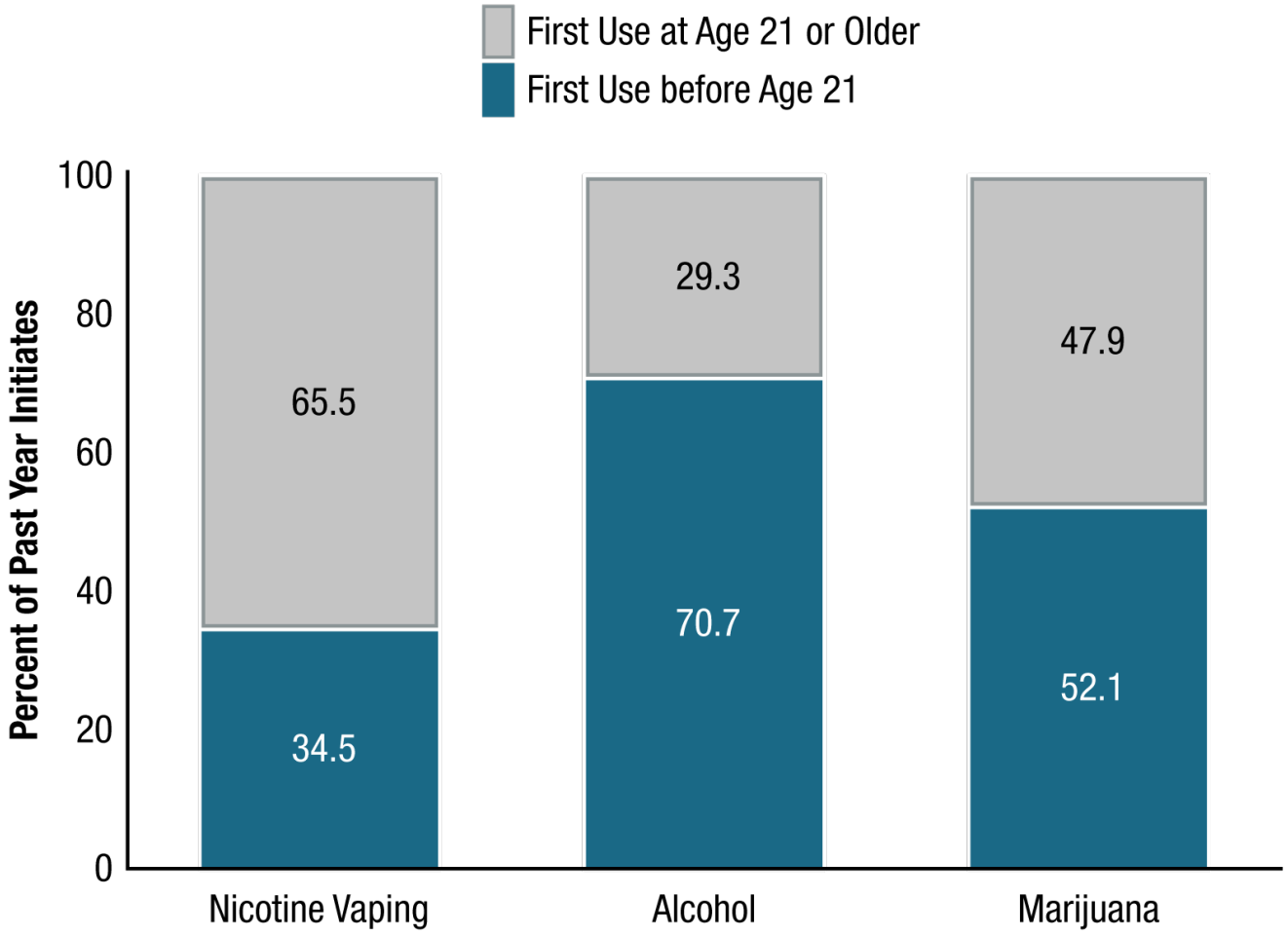
Cannabis Vaping is More Common Among Youth and Young Adults



Source: SAMHSA NSDUH, 2024

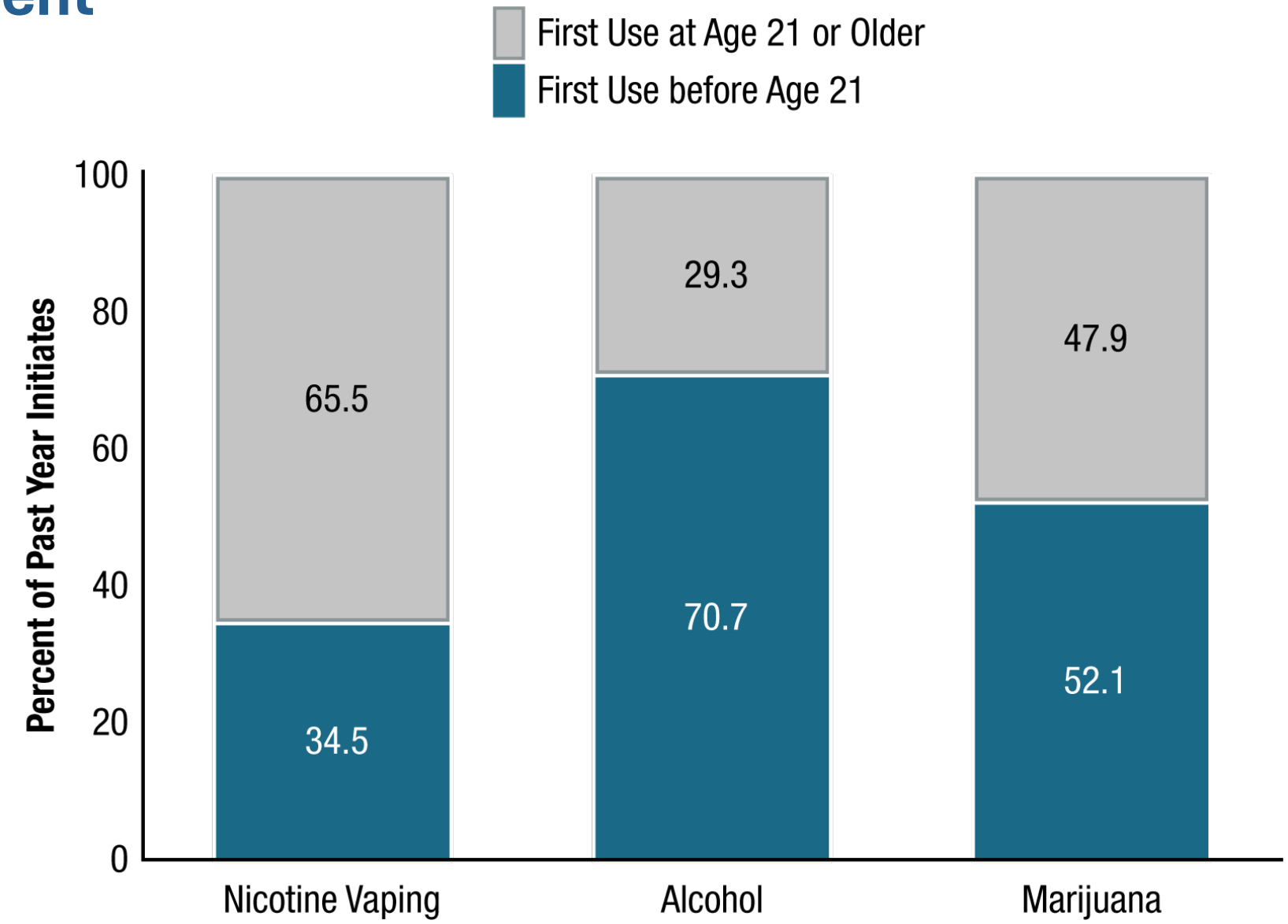
Substance Use Initiation Prior to Age 21





Source: SAMHSA NSDUH, 2024

Substance Use Initiation Varies by Age, with Early Initiation Prominent



Source: SAMHSA NSDUH, 2024

Cannabis Use Among Youth Aged 12-17 is Associated with Broader Substance Use Risk

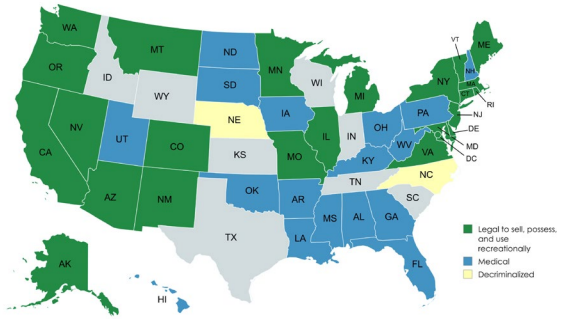
Among those reporting cannabis use in the past year,

- **12.5%** reported daily or near daily cannabis use
- Many reported other past-year substance use
  - **69.5%** reported past-year alcohol use
  - **69.1%** reported past-year nicotine use
  - **22.9%** reported past-year other Illicit drug use
- **2.0M** had a substance use disorder
  - **1.2M** had cannabis use disorder
  - **775K** had alcohol use disorder
  - **267K** had opioid use disorder

Source: SAMHSA NSDUH, 2024

Changing Landscape of Cannabis Products in the U.S.

Federal and State Policies Differ Dramatically



Federal Policies

Controlled Substances Act

- Cannabis (>0.3% delta-9 THC dry weight) is controlled under Schedule I; high abuse potential; no currently accepted medical use
  - *Per a 2025 Executive Order, cannabis may be moved to Schedule III to facilitate research*

Agriculture Improvement Act of 2018 ("Farm Bill")

- Hemp (≤0.3% delta-9 THC dry weight) is not controlled
  - Intoxicating hemp-derived cannabinoid products (e.g., delta-8 THC) emerged and are widely available
  - *The FY26 Agriculture Appropriations Act places these products in Schedule I by November 2026; Industrial hemp and CBD set to remain uncontrolled*

State Policies

40 States & DC with Medicinal Cannabis Laws

Laws vary on:

- Allowable conditions and routes of administration
- Dispensaries/home growth and registries
- Testing, regulatory requirements

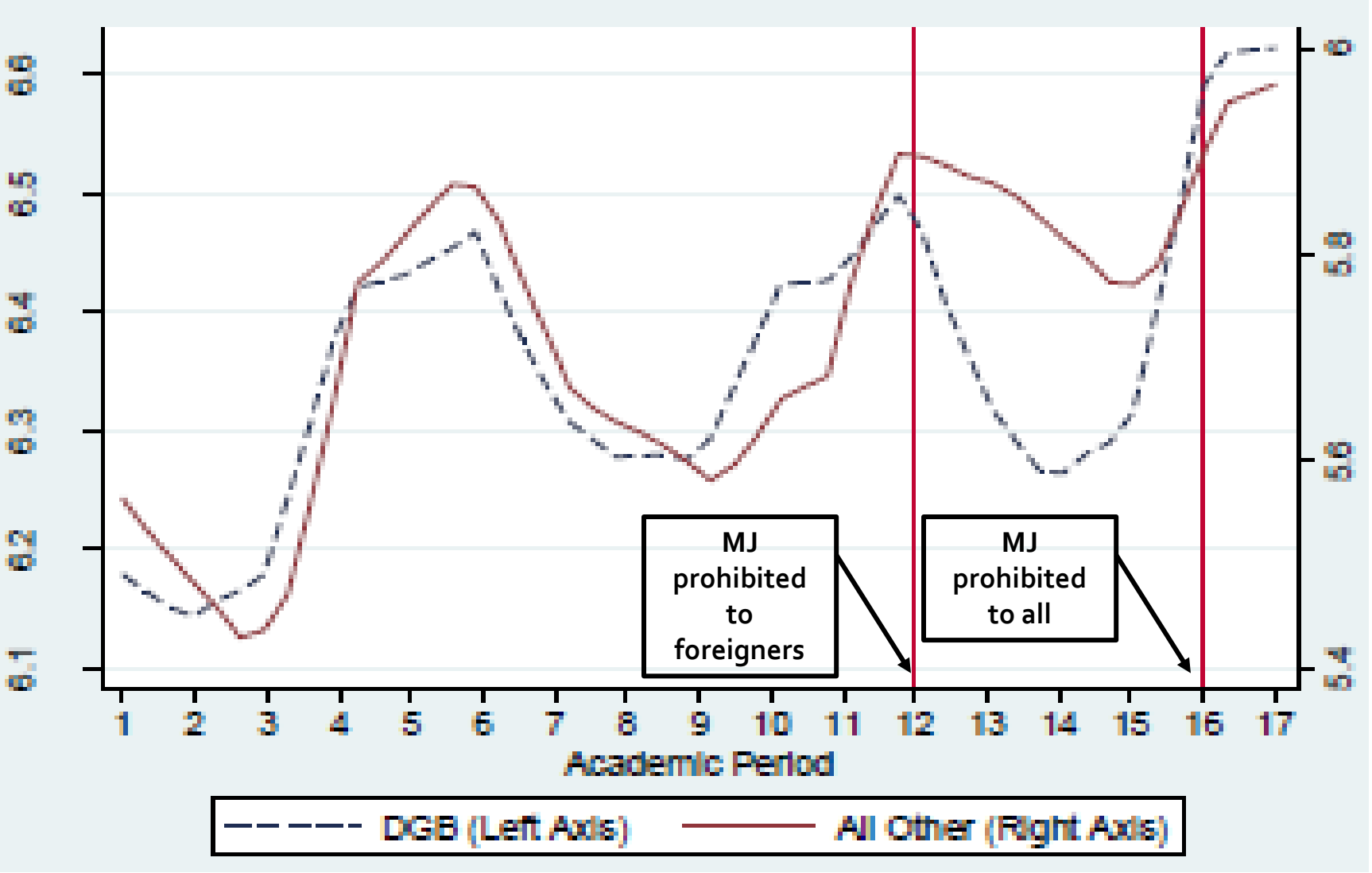
24 States & DC with Non-Medicinal Use Laws

Laws vary on:

- Marketing, product labeling, distribution (home growth, delivery), public consumption, taxation, licensing, expungement and equity

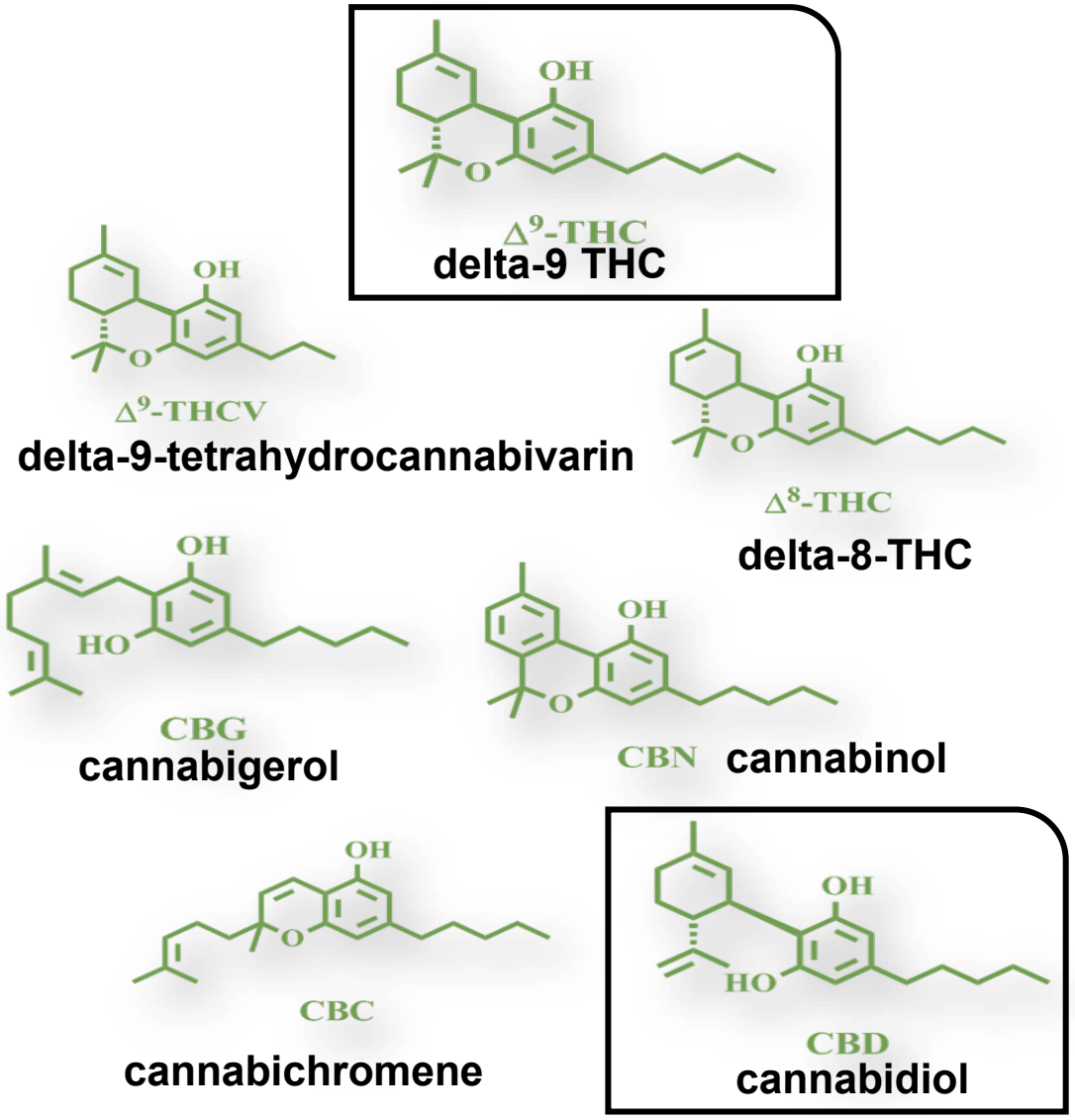
Most cannabis in the U.S. comes from black and gray markets

Policy Impacts: When Cannabis Sales were Restricted in the Netherlands, University Grades Improved



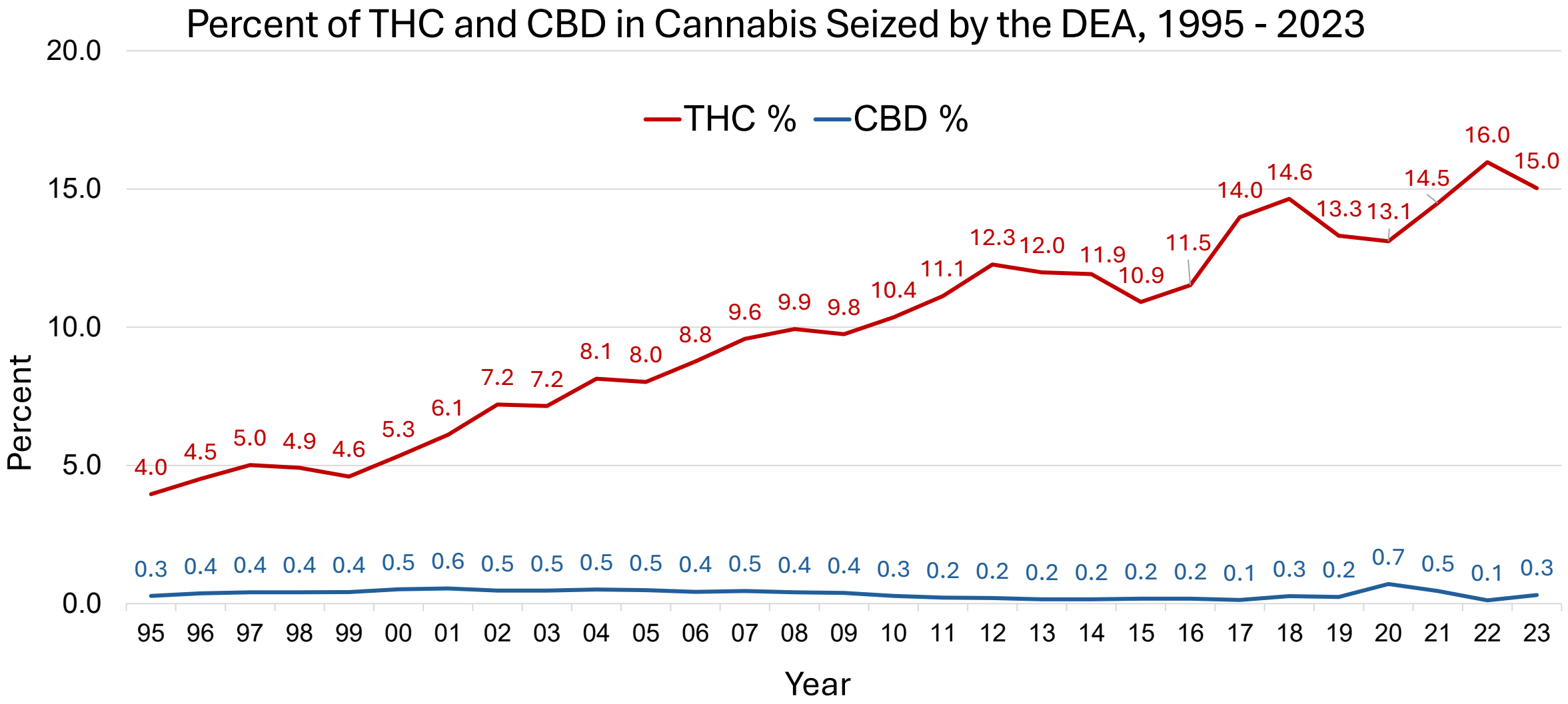
Marie O, Zollitz U. Review of Economic Studies 2017;84:1210-123

Cannabis is a Highly Complex Plant



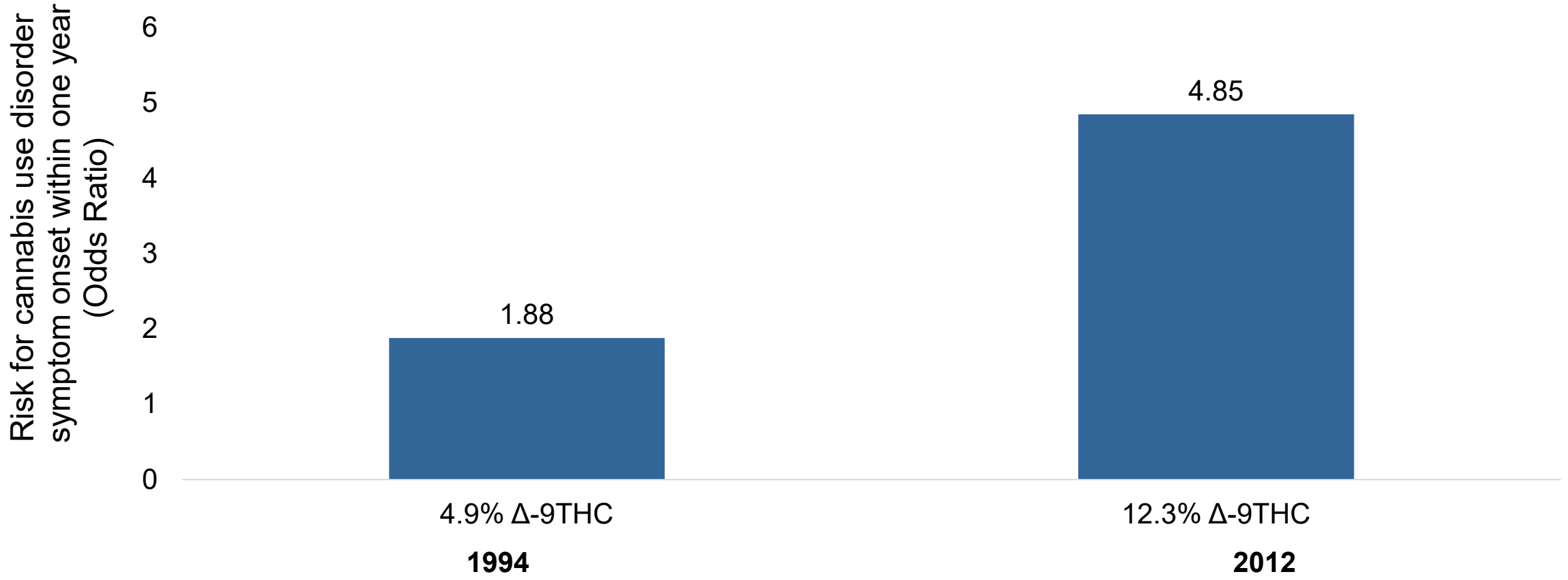
- The *Cannabis sativa* L plant contains >500 chemicals, including >120 cannabinoids
- Primary cannabinoids are delta-9 tetrahydrocannabinol (THC) and cannabidiol (CBD).
- THC is intoxicating; CBD is not.
- Different routes of administration have various onset times, duration, and effects.

The Potency (THC Concentration) of Cannabis has Drastically Increased



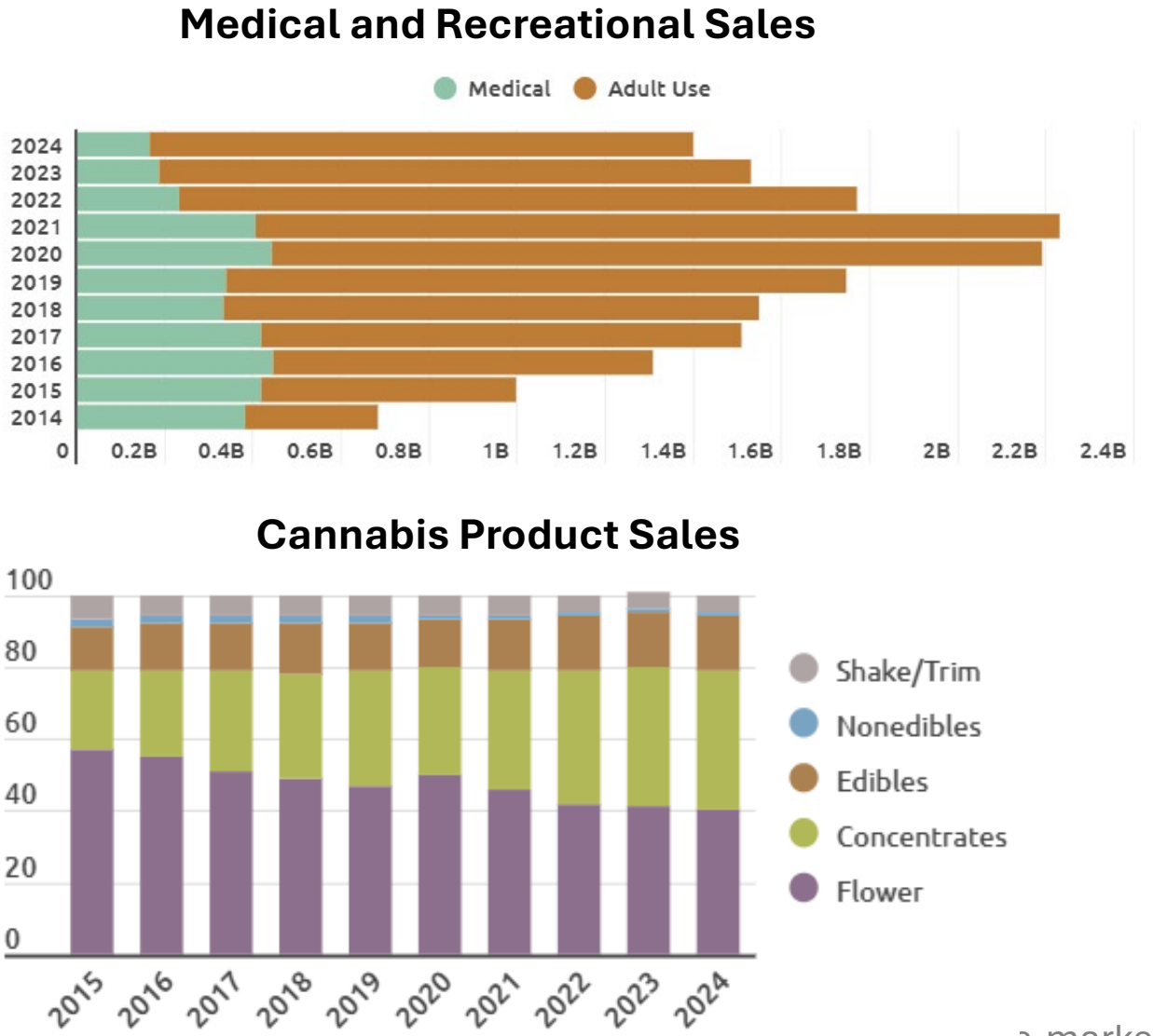
Source: U Miss, Potency Monitoring Program

Higher Potency Cannabis, on Average, Increases Risk for Cannabis Use Disorder Onset Within 1 Year



Source: Arterberry, BJ et al., Drug and Alcohol Dependence (2019)

Colorado Market is Shifting Away From Flower Toward Concentrates

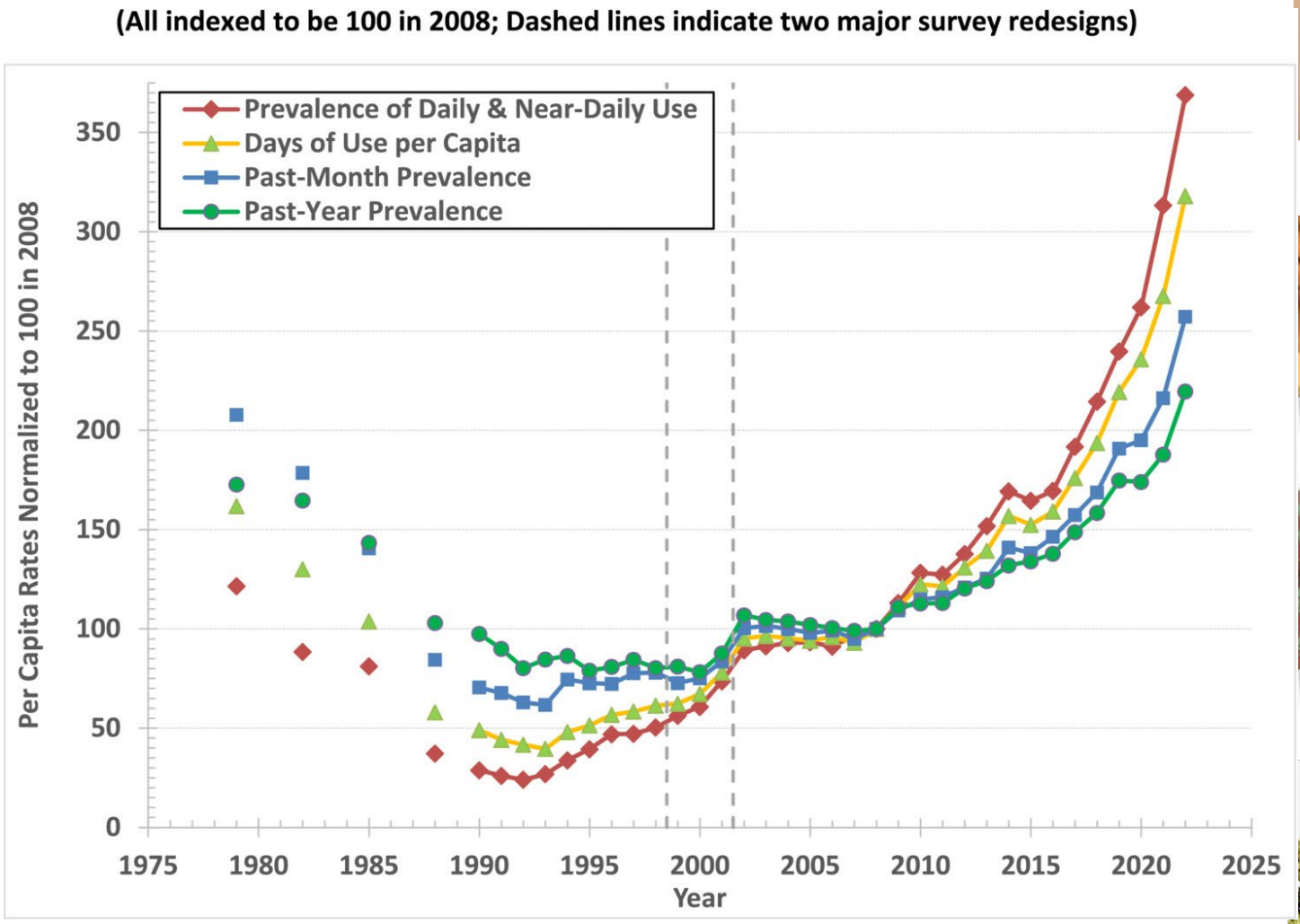


- Colorado's retail sales in adult-use and medical dispensaries combined grew from $675 million in 2014 to about $1.77 billion in 2022, including $231 million medical and $1,538 million recreational cannabis sales.
- In 2023, cannabis consumers spent $1,529 million, including $185 million medical and $1,344 million recreational cannabis sales.
- In 2024, cannabis sales averaged $1.87 million per retail location in Colorado's adult-use market and $0.53 million per location in the medical channel.

s-market/

As Cannabis Products have Diversified, Use has Increased

- The diversity of products has expanded dramatically; new routes of administration (edibles, concentrates, vapes, tinctures…)
- Patterns of use have changed, including far more daily/near daily use
- Measurement of exposure is difficult: Products are not labeled consistently or in ways that consumers understand; population studies do not provide sufficient granularity



Source: Caulkins, *Addiction* (2024; updated)

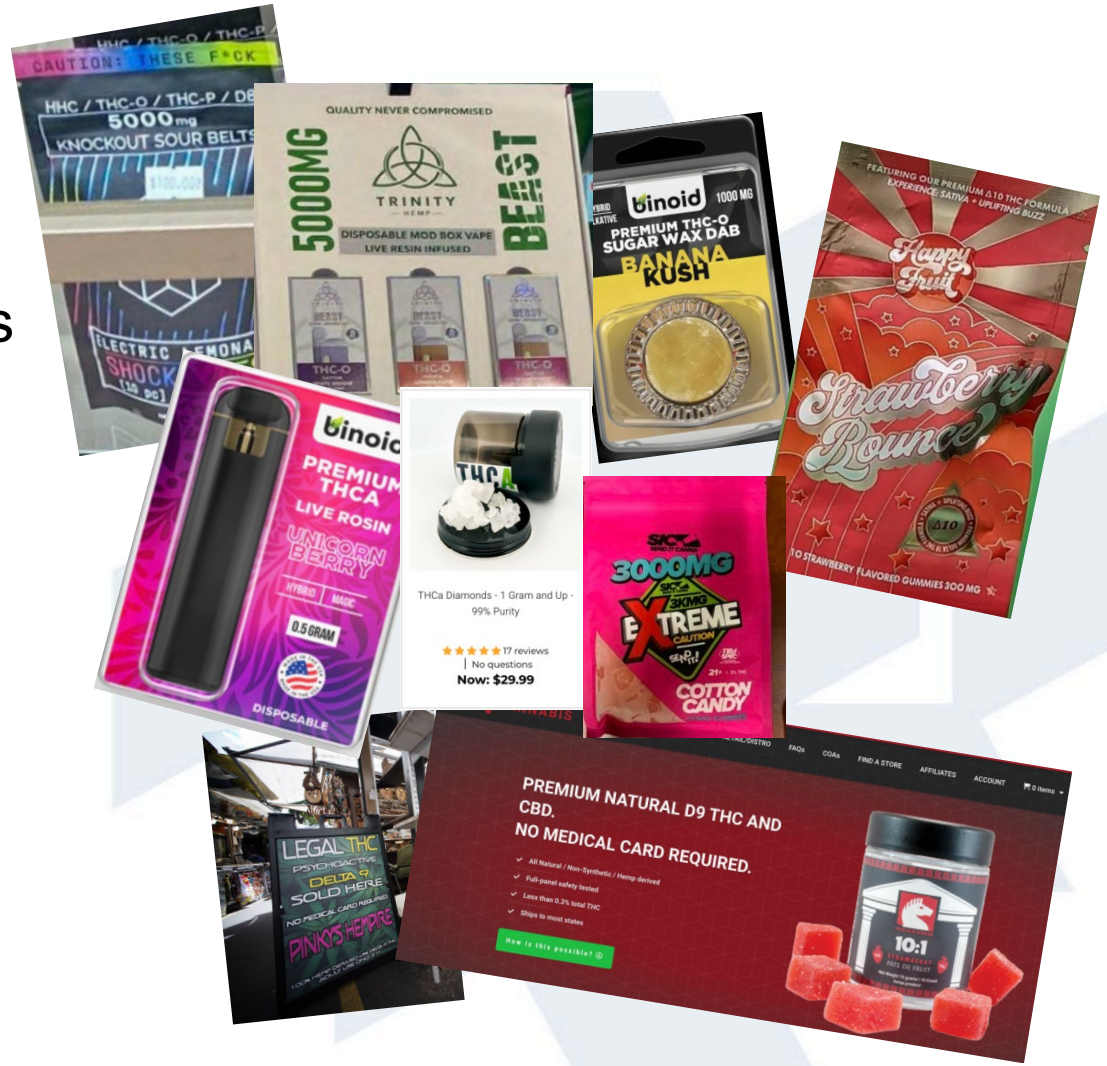
Intoxicating Hemp Products have Emerged from Loopholes in the Agriculture Improvement Act of 2018 (Farm Bill)

Derivatives - Chemically derived impairing cannabinoids (Delta-8, Delta-10, HHC, THCO, etc.)

THCA – Products being marketed with high levels of THCA that are indistinguishable from cannabis products.

0.3% loophole - Impairing amounts of Delta-9 THC in products that meet the legal definition of “hemp” per the 2018 farm bill.

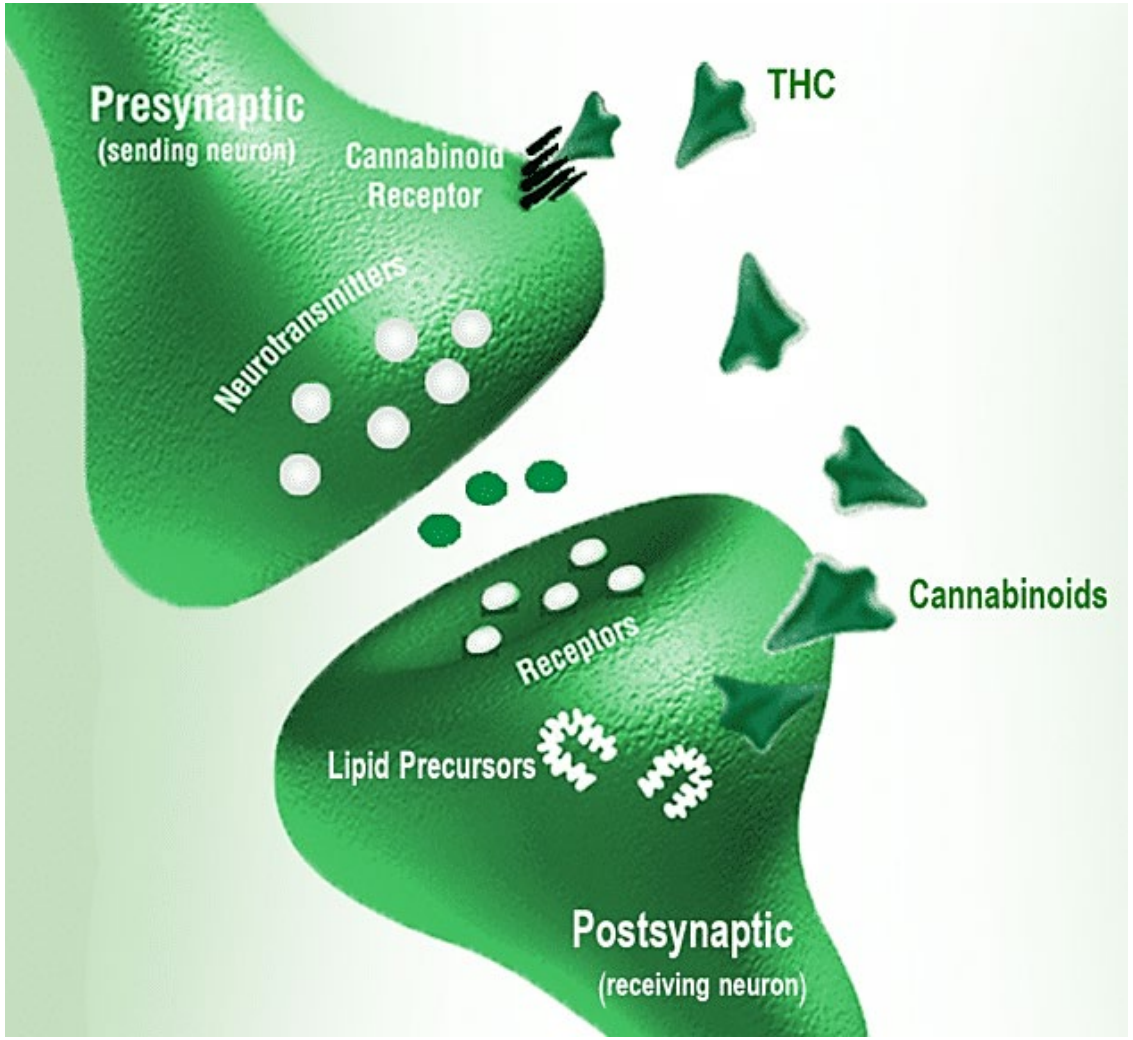
These products are widely available in gas stations, convenience stores, dispensaries, and online



Slide courtesy of Gillian Schauer, CANNRA, 2023

Endocannabinoid System

Endocannabinoid System Plays Key Role in Regulating Homeostasis



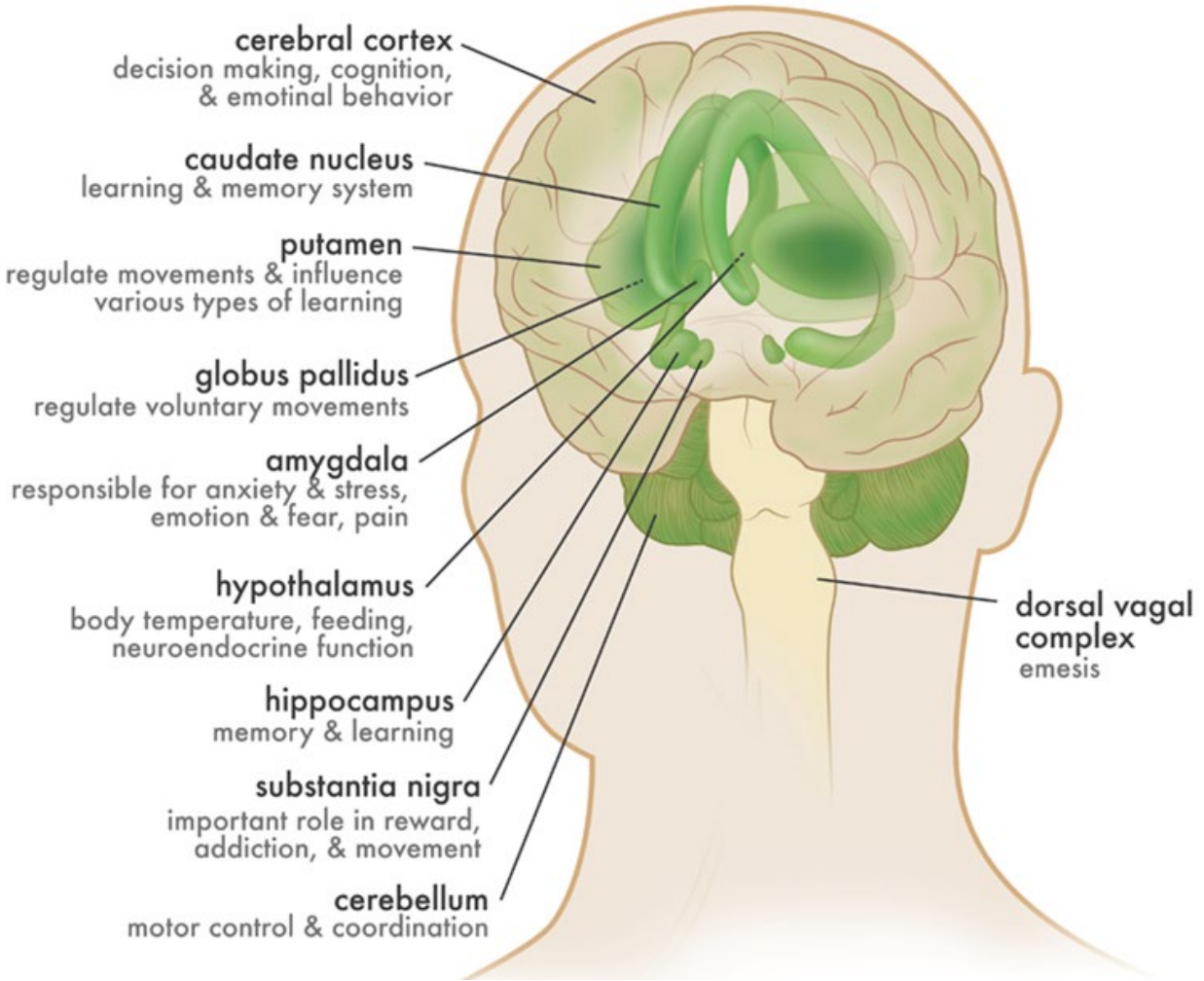
Endogenous cannabinoids play a central role in regulating physiological processes to maintain homeostasis.

Endocannabinoids are produced *on demand*. They travel back to the transmitting neuron to dampen further activity.

Two cannabinoid receptors:
Cannabinoid Receptor 1 (CB1)
Cannabinoid Receptor 2 (CB2)

Cannabinoid Receptors are Located Throughout the Brain

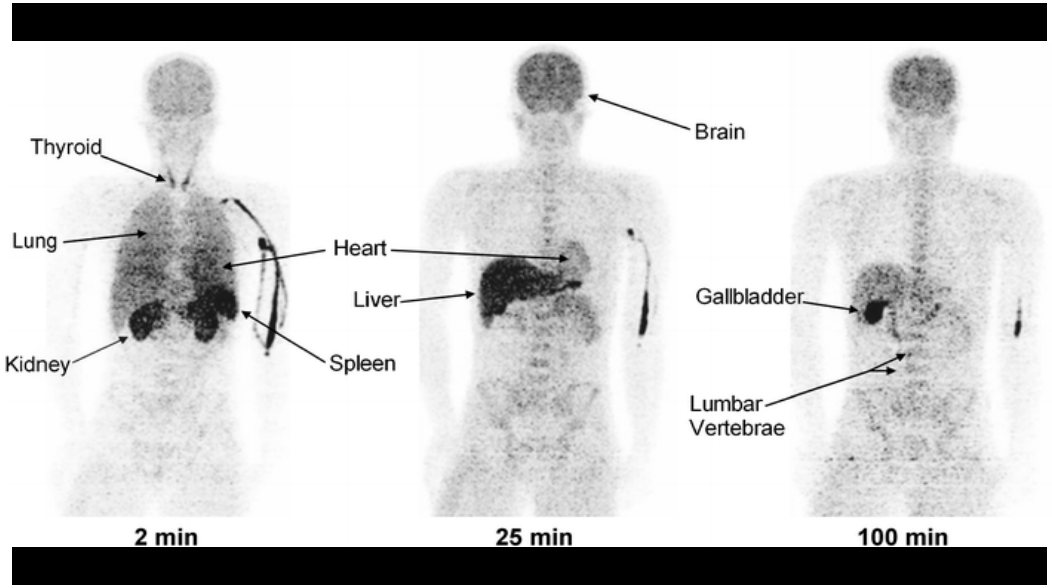
- Brain Development
- Memory & Cognition
- Coordination & Balance
- Pain Regulation & Analgesia
- Immune Function
- Appetite
- Motivational Systems & Reward



Source: Canadian Consortium for the Investigation of Cannabinoids, http://www.ccic.net/

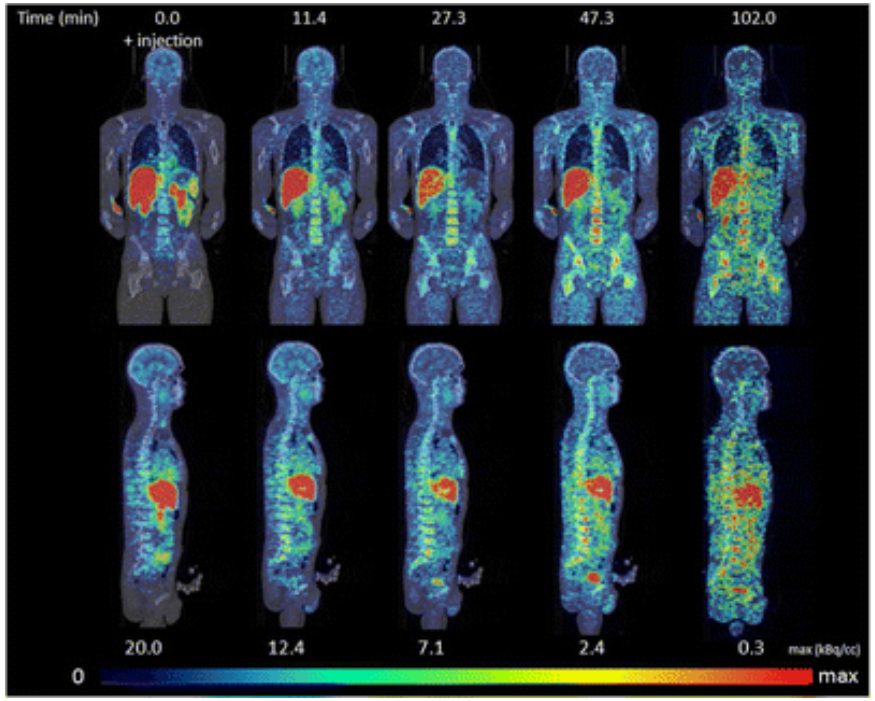
Cannabinoid Receptors are Distributed Throughout the Body

Whole Body Distribution of CB1 Receptors



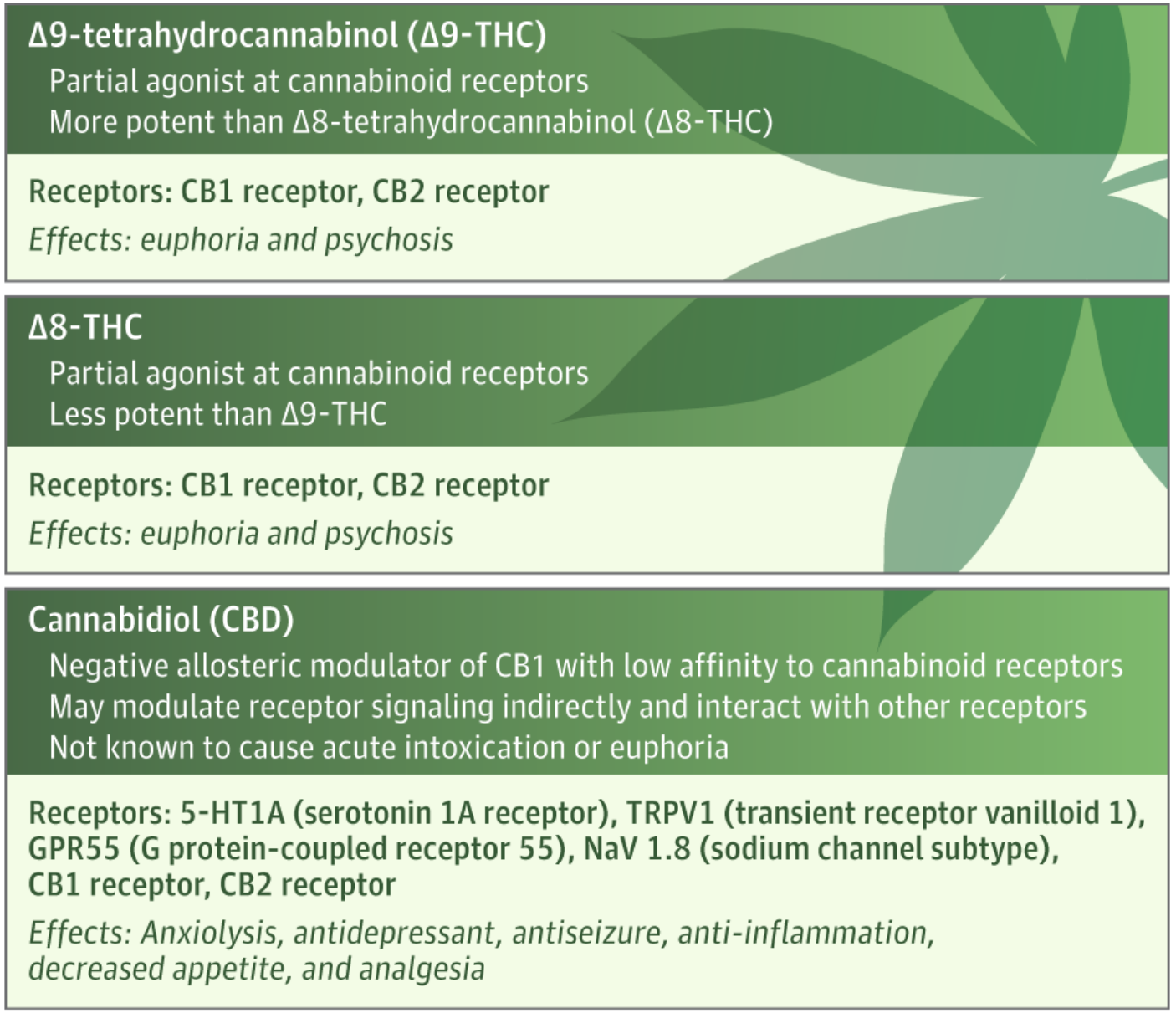
Source: Terry et al., Eur J Nucl Med Mol Imaging. 2010

PET Images



Source: Ahmad et al., Mol Imaging Biol. 2013

Exogenous Cannabinoids Modulate the Endocannabinoid System



Source: Hsu et al., JAMA (2025)

Acute Cannabis Use Impairs Cognition, Memory, Mood, and Psychomotor skills

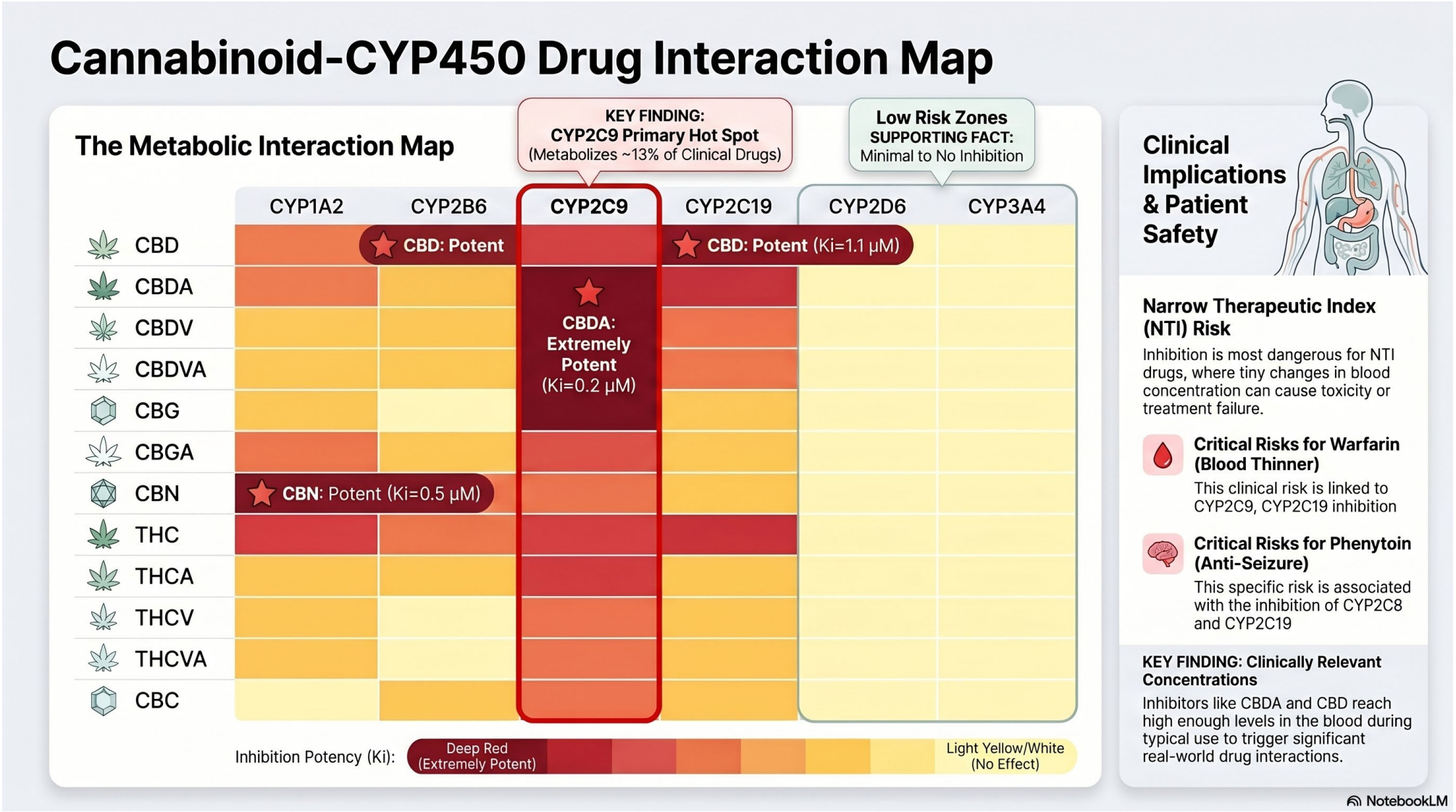
- Euphoria
- Appetite Stimulation
- Heightened Sensation
- Increased Heartrate
- Altered Perception of Time
- Anxiety/Panic
- Impaired Cognition/Memory
- Impaired Decision-Making
- Psychomotor Impairment
- Increased Risk-Taking
- Reduced Inhibition
- Increased Risk of Accidents

Chronic Cannabis Use and Substance Co-Use Raise Risks of Health Harms

- Cannabis Use Disorder
- Poorer School/Career Outcomes
- Mental Illnesses
- Cannabis hyperemesis
- Heart and lung problems
- Head and neck cancers

- Co-Use of Other Substances
  - Enhances reinforcing effects, increasing addiction risk
  - Elevates risk for mental illnesses
- Tobacco Co-Use
  - Heightens respiratory and cardiovascular risks
  - Increases exposure to toxins and carcinogens
- Alcohol Co-Use
  - Amplifies intoxication and impairment
  - Exacerbates risk taking

Cannabinoids Can Alter the Metabolism, Levels, and Effects of Co-Administered Medications



Source: Doohan et al. AAPS J. (2021)

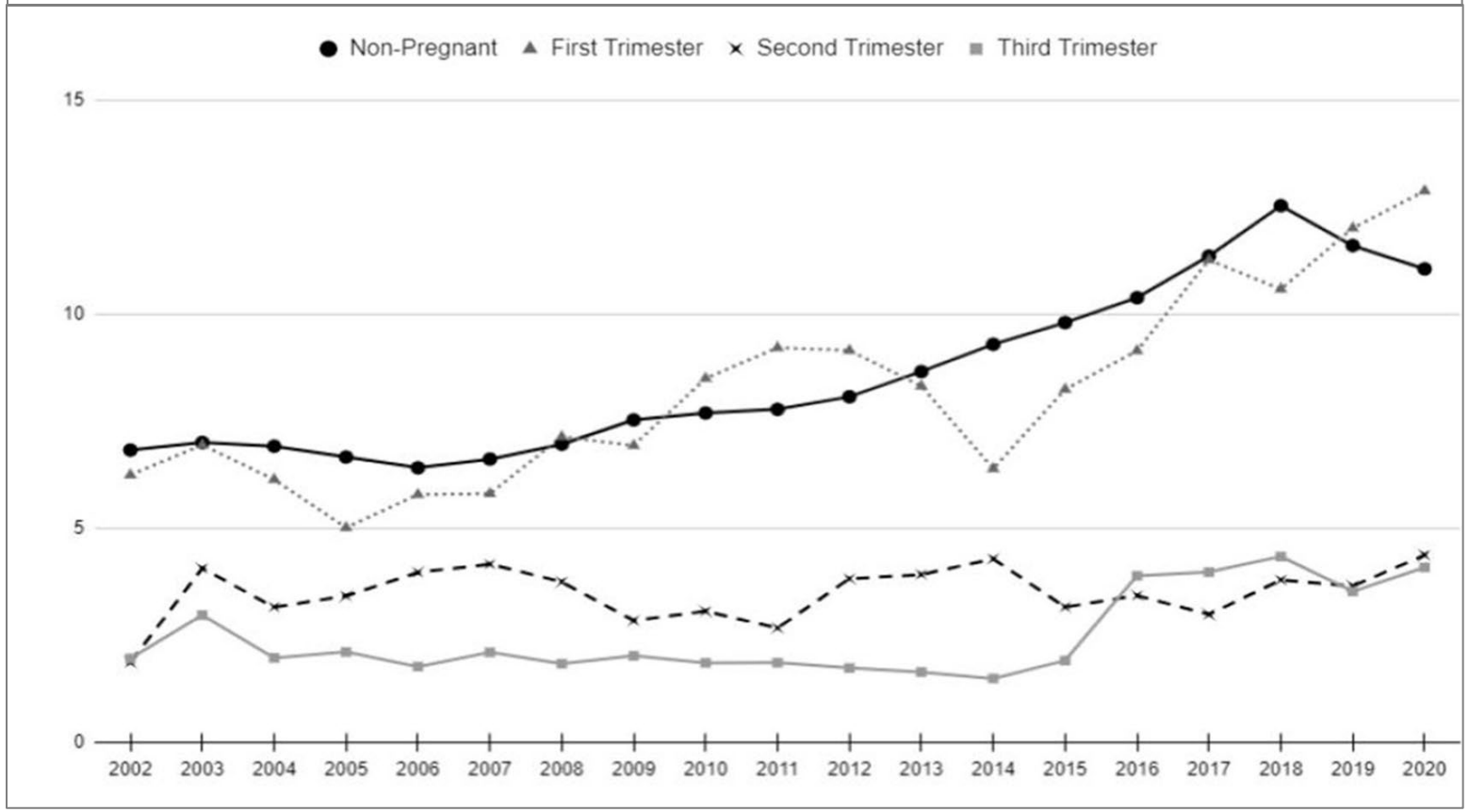
Cannabinoid Exposure and the Developing Brain

Cannabinoids and Fetal Development: ECS Function and Exposure Risks

- Endocannabinoid system (ECS) is involved in implantation; placentation; fetal organ development; and neural development
- Exogenous cannabinoids cross the placenta and accumulate in fetal tissues, especially brain.
- Human fetal imaging studies find changes in dopamine D2 receptors; may be sex-dependent.
- Prenatal exposure is linked to fetal growth restriction and low birth weight.
- Longitudinal human studies report subtle to modest impact on later cognition and neuropsychiatric outcomes (with multiple caveats).
- Preclinical studies show changes in synapse formation and function; and lasting effects of THC exposure on adult drug seeking, stress responses, and brain reward systems.

Cannabis Use is Increasing Among Pregnant Women

Percentage of Women Reporting Past-Month Cannabis use
By Pregnancy Status (NSDUH, 2002-2020)



- Past-month use in the first trimester increased more than 2.5-fold, from 6.3% to 16%, with the largest increase occurring in first month.
- Past-month use in the second trimester increased about 2.2-fold, from 1.9% to 4.2%
- Past-month use in the third trimester increased 2.3-fold, from 2% to 4.6%

Source: Grigsby et al., J Prev Med. (2025)

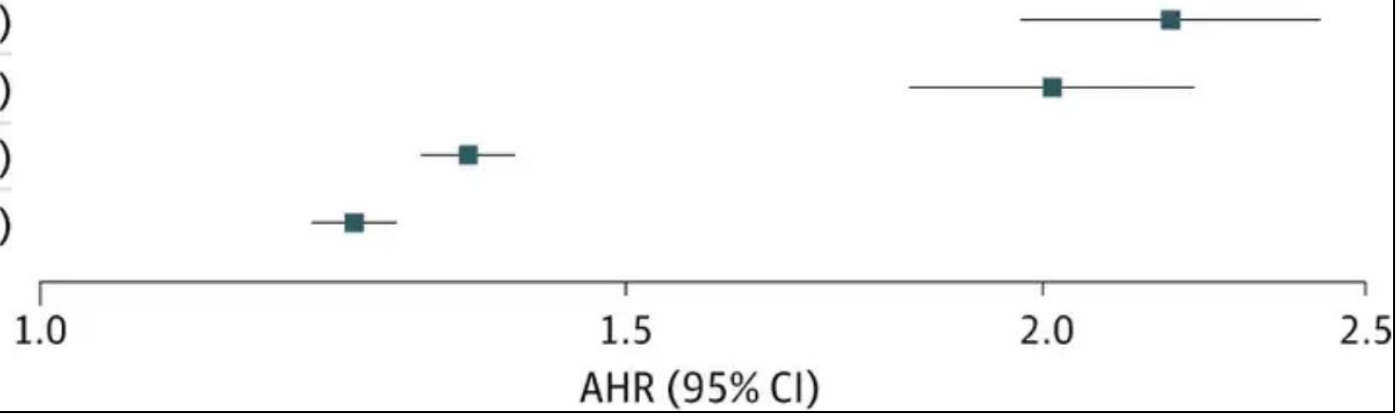
Adolescent Cannabis Use is Associated with Serious Risks

- Impaired learning and measures of IQ
- Lower motivation
- Worse long term academic and career outcomes
- Greater risk for cannabis use disorder and other SUDs
- Higher risk of mental disorders

Adolescent Cannabis Use is Linked with Increased Incidence of Mental Disorders

- Late adolescence and young adulthood is the most vulnerable window for the onset of mental illness.
- A retrospective analysis of a longitudinal cohort study found that past-year cannabis use at ages 13-17 was linked with an increase in new cases of mental disorders by age 26.

Outcome	Diagnoses, No.	AHR (95% CI)
Psychotic disorder	4105	2.19 (1.97-2.42)
Bipolar disorder	4061	2.01 (1.82-2.22)
Depressive disorder	62 137	1.34 (1.30-1.39)
Anxiety disorder	73 096	1.24 (1.21-1.28)

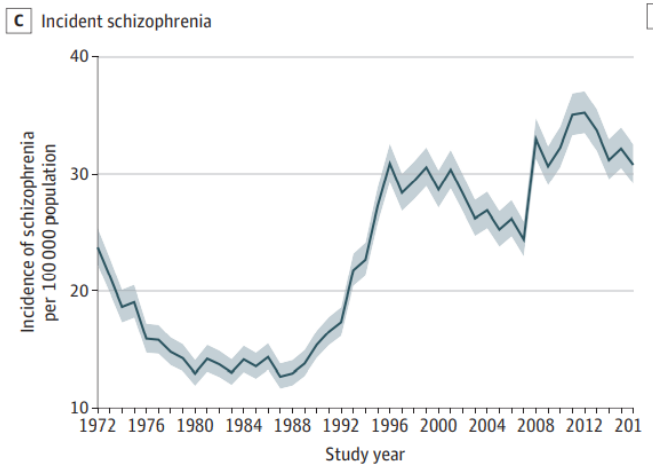


Source: Young-Wolff et al., JAMA Health Forum (2026)

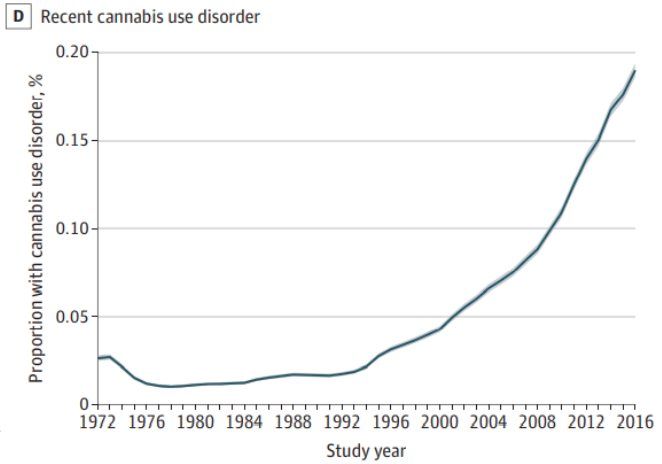
Population-attributable risk fraction (PARF) for schizophrenia increased during the last 20 years.

Danish nationwide prospective cohort study of all people aged 16-49 at some point during 1972-2021.

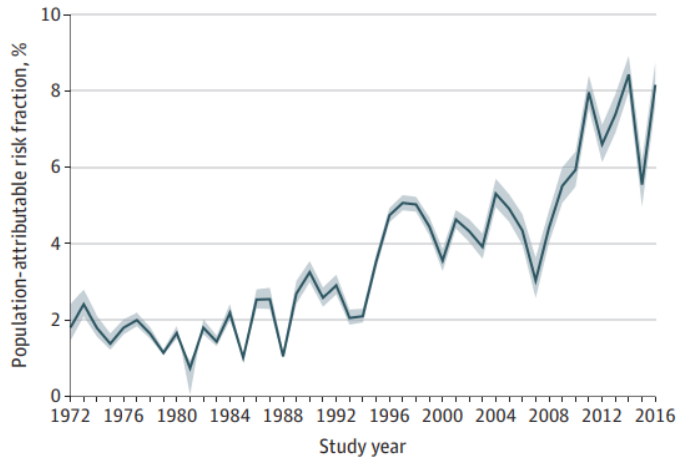
Incidence of Schizophrenia



Recent Cannabis Use Disorder

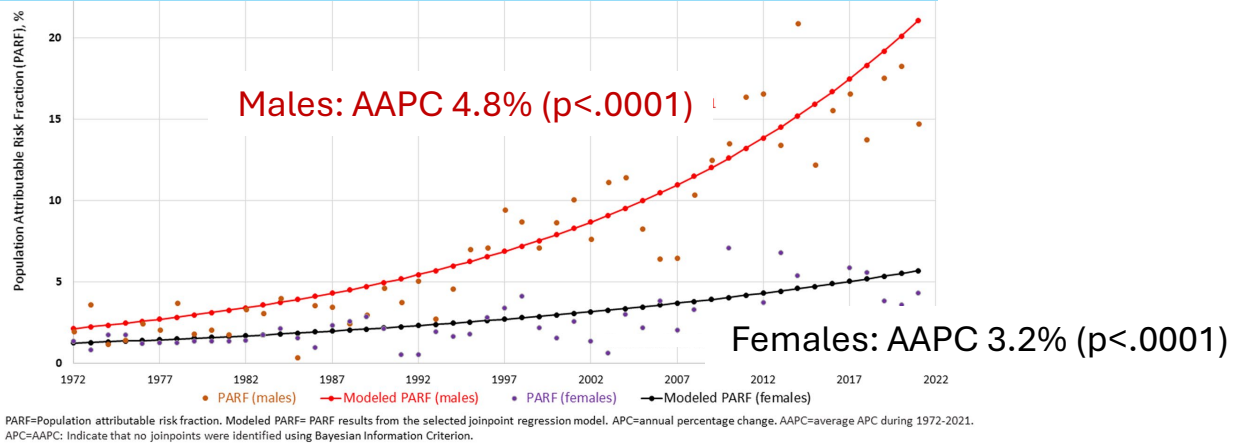


(PARF) of CUA in Schizophrenia



- Schizophrenia associated with CUD increased 3- to 4-fold during the past 2 decades *(alongside increases in cannabis use and potency)*
- Supports hypothesis that cannabis may be involved in the etiology of a growing number of schizophrenia cases, especially for males.
- What are the mechanisms?

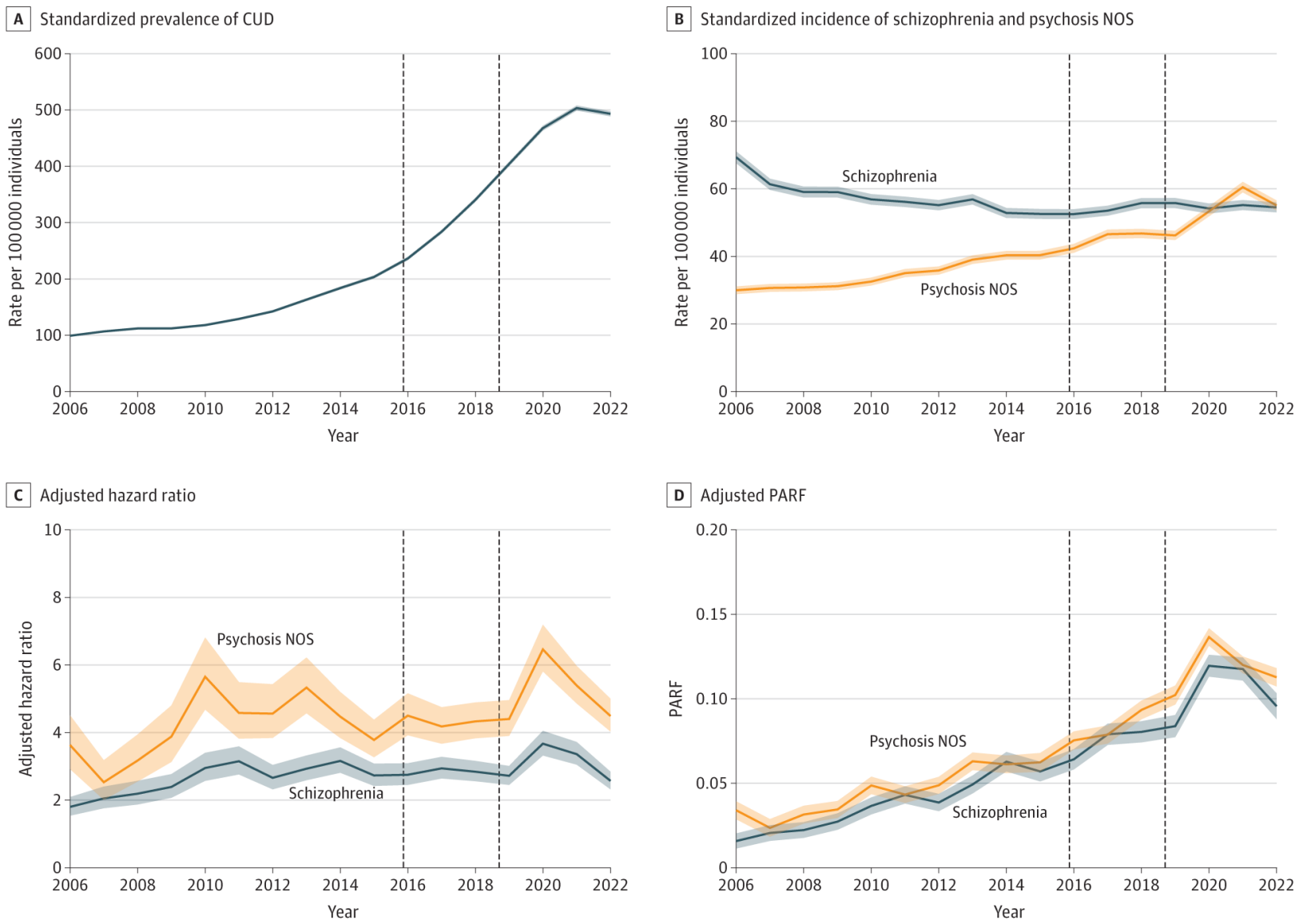
(PARF) of CUA in Schizophrenia for Males and Females



Source: Hjorthøj, et al. *JAMA Psychiatry* 2021;78(9):1013-1019 (2021) and *Psychological Medicine* 2023;53(15):7322-8.

Incident Schizophrenia Diagnoses Associated with Cannabis Use Disorder after Cannabis Legalization in Ontario (Canada)

Myran et al. *JAMA Network Open*. 2025 Feb 4;8(2):e2457868.



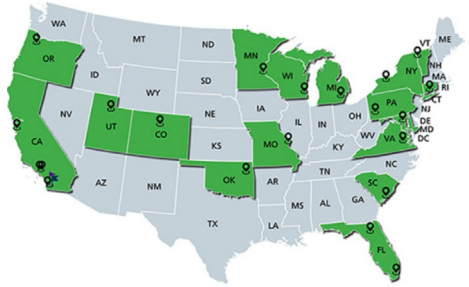
Changes in the Past 3-Year Prevalence of Cannabis Use Disorder (CUD), Incidence of Schizophrenia and Psychosis NOS, and the Population-Attributable Risk Fraction (PARF) Over Time. Rates standardized for age and sex using the 2022 population. Shaded regions indicate 95% CIs. The dashed vertical lines indicate, from left to right, the liberalization of medical and nonmedical cannabis and the legalization of nonmedical cannabis, respectively.

Preventing Substance Use and Substance Use Disorders Among Adolescents

Trans-NIH Funded Longitudinal Studies of Child and Adolescent Development

Adolescent Brain Cognitive Development®

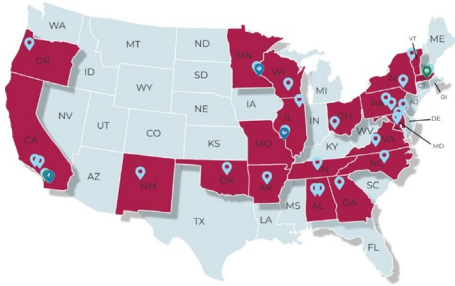
Teen Brains. Today's Science. Brighter Future.



- **Largest long-term study of brain development and child and adolescent health**
- Longitudinal study of **~12,000** children
- Ages 9-10 through early adulthood
- Launched in 2015, now supported by NIDA, 9 other NIH ICOs, and the Centers for Disease Control and Prevention (CDC)

HEALthy Brain and Child Development

Babies · Brains · Bright Futures

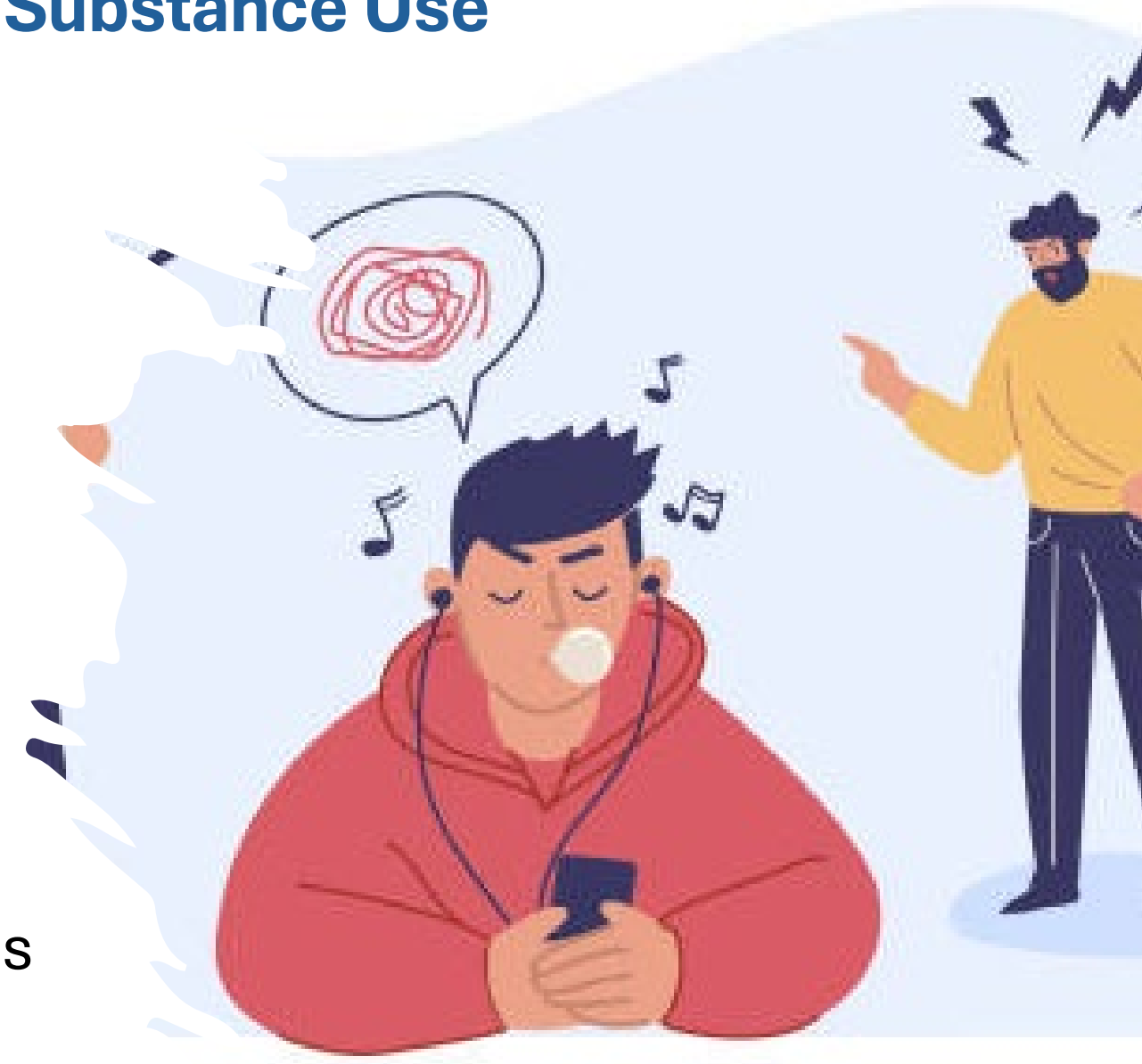


- **Largest single study of infant MRI and EEG data in the world**
- Longitudinal study of **~5,000** mother/child dyads
- Prenatal/birth through 9-10 years of age
- Launched in 2023, supported by NIDA, 11 other NIH ICOs, and the Helping to End Addiction Long-Term Initiative® (HEAL)

Together, ABCD + HBCD provide an unprecedented set of publicly available data for investigators to examine factors shaping child health and development from birth through adulthood

Predictive Factors for Adolescent Substance Use

- Adverse childhood experiences
- Family and environmental stress
- Peer use, approval, bullying
- Positive expectations about the effects of substances
- Neurocognitive factors, impulsivity, externalizing problems



Evolution of Substance Use Prevention: Adding Strategies, Targets, and Levels of Impact

Information Dissemination (1960s-1980s)

Focused on population/community-level awareness

Information as a deterrent

E.g., Early media campaigns, “Just Say No”

Skills-based prevention (1980s -1990s)

Emphasized personal competencies

Self-management, decision-making, social and communication skills

E.g., LifeSkills Training

Risk and protective factor models (1990s -2000s)

Targeted underlying influences

Individual, peer, family, social, and community domains

E.g., Communities that Care

Community-based systems (2000s-2010s)

Shifted toward coordinated, cross-sector delivery

Local partnerships; implementation quality and sustainability

E.g., PROSPER

Source: U.S. Surgeon General Report on Alcohol, Drugs, and health, 2016

Modern Prevention: Integrating Decades of Evidence

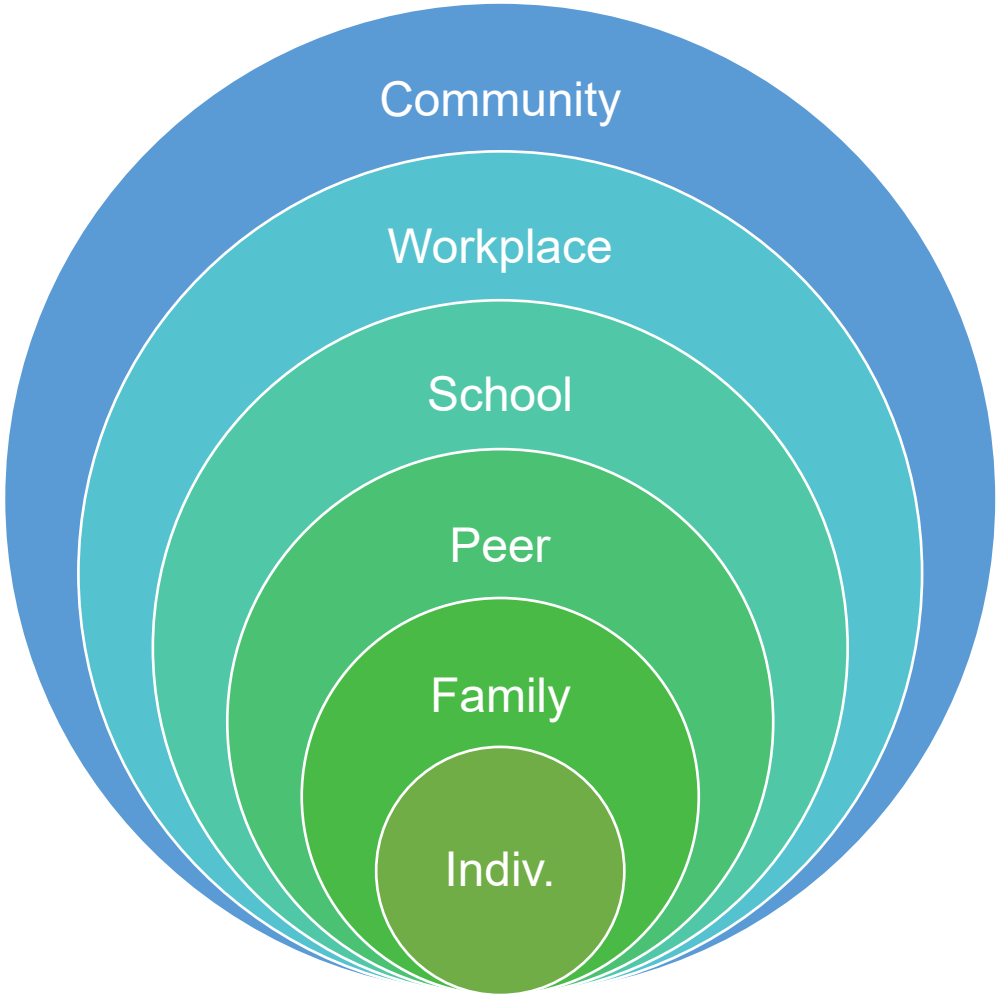
RISK FACTORS

- Adverse childhood experiences
- Poor social skills
- Lack of access to early childhood education
- Family instability
- Poverty

PROTECTIVE FACTORS

- Self control
- Positive relationships
- Academic competence
- Strong neighborhood
- Physical health

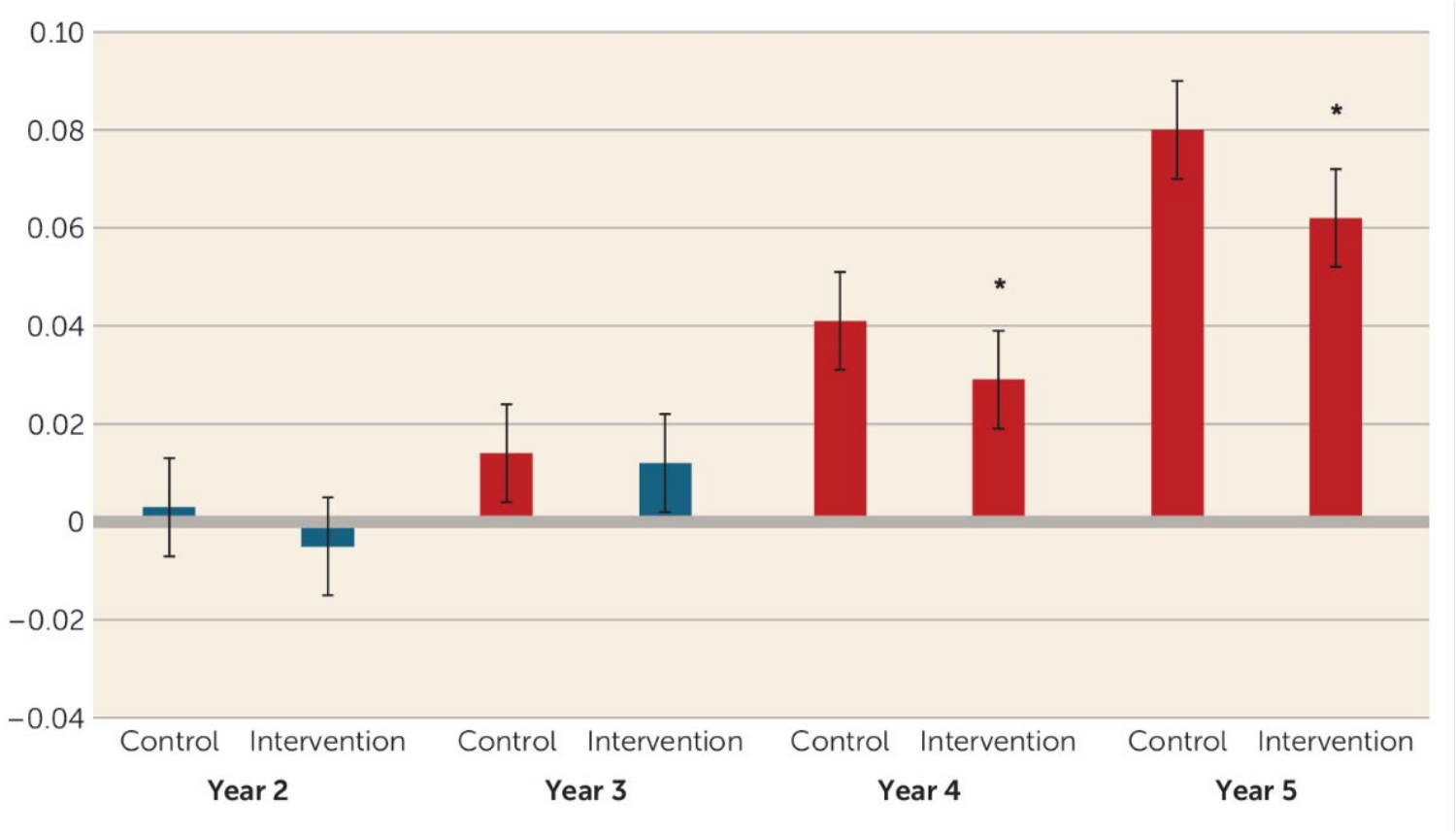
Sphere of Influence



Adapted from slide courtesy of Amy Goldstein, NIDA

Personality-Focused Intervention Decreased Odds of Substance Use Disorders Among Adolescents

Simple Contrast Estimates Comparing Probability of SUD at Each Year Relative to Baseline



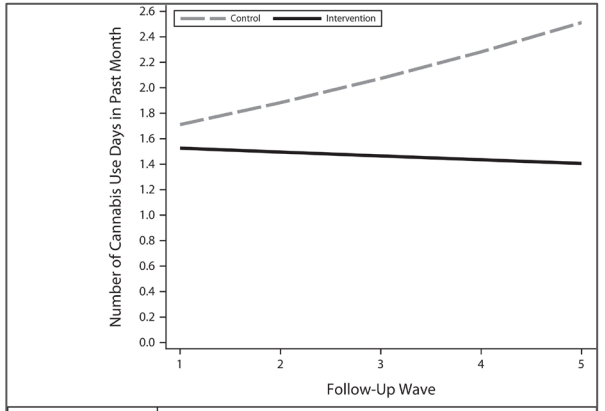
- 7th grade students participated in two 90-min small-group CBT sessions led by a school counselor.
- Focused on personality-specific skills and self-efficacy to strengthen coping strategies.
- Intervention group showed significantly lower increases in odds of SUD vs. control.

Source: Conrod et al., Am. J. Psych.(2025)

Combined School and Family Intervention Lowered Expected Increases in Adolescent Substance Use

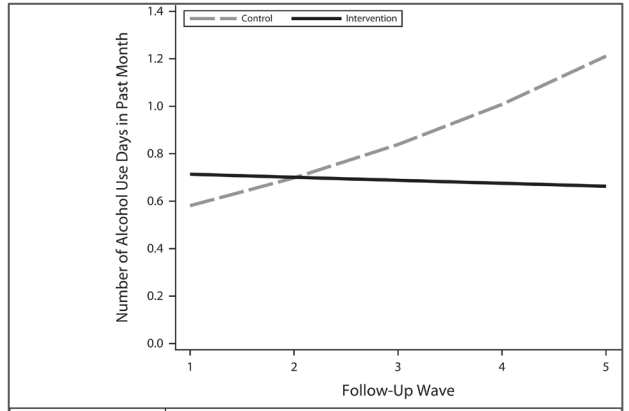
- Rural/tribal students received 15-minute computerized motivational interviewing (MI) + family intervention to strengthen relationships, health, and wellbeing.
- Delivered up to 4 times over 2 years via an animated narrator assessing risk, providing info, and initiating MI; higher-risk students got coach follow-up.
- Family component promoted time together, guidance on substance use and mental health, and media literacy and advocacy skills.
- The combined intervention significantly reduced typical substance use escalation at ages 16-18.

Cannabis



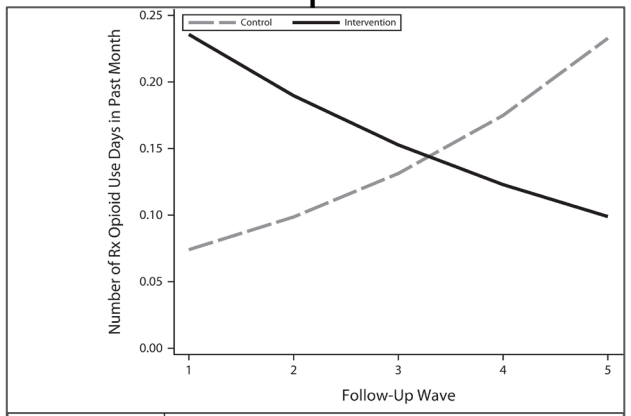
No. of Days, Control	1.71	1.88	2.07	2.28	2.51
No. of Days, Intervention	1.53	1.50	1.46	1.44	1.41

Alcohol



No. of Days, Control	0.58	0.70	0.84	1.01	1.21
No. of Days, Intervention	0.71	0.70	0.69	0.68	0.66

Rx Opioids



No. of Days, Control	0.07	0.10	0.13	0.17	0.23
No. of Days, Intervention	0.24	0.19	0.15	0.12	0.10

Source: Komro et al., AJPH (2025)

Key Takeaways

- The cannabis product landscape is rapidly evolving with higher THC potency, hemp-derived cannabinoids, and diverse routes of administration.
- Early initiation is associated with increased risk of addiction and mental disorders, including lasting psychosis.
- Cannabis use during adolescence is linked to other adverse outcomes like impaired cognition, lower motivation, and school/work problems.
- Prevention works: Targeted school- and family-based interventions can reduce adolescent substance use and SUD.