

EVIDENCE-BASED RESOURCE GUIDE SERIES

Preventing Marijuana Use Among Youth



SAMHSA
Substance Abuse and Mental Health
Services Administration



Issue Brief

Addressing marijuana use among youth is a major public health concern. Some studies suggest early use can cause disruptions to adolescent brain development that may result in negative consequences, such as cognitive impairment and delayed maturation of the brain areas responsible for decision-making.²

Research on long-lasting effects has produced mixed results. However, there is increasing evidence that heavy and/or regular (e.g., daily or near daily) marijuana use among young people may be associated with cognitive deficits, such as impaired learning.² Other concerning risks include physical changes in the brain areas responsible for attention and memory, and increased risk for and early onset of psychiatric conditions and SUDs, such as schizophrenia and marijuana use disorder.⁹

Youth marijuana use is also correlated with suicidal ideation and behavior,¹⁰ poor school performance, increased high school dropout rates,¹² and negative effects on male fertility.¹⁴⁻¹⁵

Terminology

The terms "marijuana" and "cannabis" are often used interchangeably, although there are historical and scientific distinctions.⁴⁻⁵ This document primarily uses the term "marijuana," including when speaking about use disorders.

The full scope of long-term health and social effects of youth marijuana use is still unknown, particularly among those who may be using marijuana regularly or daily.¹²

The high prevalence of youth marijuana use is concerning, with rates of daily use among 8th and 10th graders increasing between 2018 and 2019 (although rates of daily use remained relatively constant between 2010 and 2020).^{7, 16} Daily use rates rise rapidly by the ages of 18 to 22, and marijuana use among this age group is currently at a 35-year high.¹⁷

National estimates indicate more than 3 million youth aged 12 to 17 used marijuana in the past year and 1.9 million in the past month; more youth reported using marijuana than any other illicit drug.⁶⁻⁷

Several factors impact the growing use of marijuana. For example:

- Widespread availability of marijuana via illegal market sources and state-regulated retail sales
- Increasing legalization of medical and non-medical adult use of marijuana across the country, despite remaining illegal at the federal level

- Mass commercialization of higher potency marijuana, and the availability of an array of consumer-friendly products that often appeal to youth (e.g., candy and baked goods infused with marijuana)
- High and frequent rates of youth use, with increases in the number of people initiating marijuana use each year

These factors, combined with marijuana’s clear evidence of harm, makes preventing initiation of its use among youth a public health priority.

The purpose of this Evidence-Based Resource Guide is to provide states, communities, the prevention workforce, and other stakeholders with strategies for preventing youth marijuana use. The population of focus is youth aged 12 to 17, as significant evidence suggests initiation of marijuana use at a young age is associated with some of the most serious harms.¹⁸⁻¹⁹

The guide reflects regulatory structures that currently exist in the country, including states where non-medical (i.e., recreational) or medical use of marijuana is considered legal. It is important to note that no state has legalized non-medical marijuana use for people under the age of 21.

To fully recognize the nature and consequences of youth marijuana use, it is important to first understand the different types of marijuana, its potency (THC content), and how methods of use have evolved in the 21st century.

What Is Marijuana?

Under the Controlled Substances Act (CSA), cannabis (family Cannabaceae) falls into two categories—marijuana and hemp—but, in fact, both come from the same group of plants. Marijuana refers to the cannabis plant, or derivative products that contain more than 0.3 percent of the chemical compound delta-9-tetrahydrocannabinol (THC), the main psychoactive component responsible for the plant’s intoxicating effects. The term “hemp” denotes a cannabis plant that contains THC levels no more than 0.3 percent or less.

Composition and characteristics vary across marijuana plants and products. Marijuana plants contain more than 100 cannabinoids (chemical substances unique to the cannabis plant), in addition to many other chemicals (e.g., terpenes and flavonoids) found in other plant species. THC is the principal psychoactive constituent

of marijuana, producing psychotropic or mind-altering effects, with high misuse potential.¹ The other chemical constituents present in marijuana have minor effects relative to THC, and, therefore, the potency of marijuana is related to its THC content. Cannabidiol¹ (CBD), the second most common ingredient in marijuana, does not produce a high.

Marijuana Types¹

Plant form or “flower”: The most known form of marijuana; the dried flowers of the cannabis plant.

Sinsemilla: Seedless flowers from unfertilized female plants; contain more THC than other marijuana plant parts or fertilized flowers.

Hashish: Historically produced by a manual process of compressing dried cannabis flowers through screens to amass trichomes—the part with the most THC—resulting in a dried resin-type substance more potent than dried flowers.

Concentrates/Extracts: The modern process of extracting cannabinoids, especially THC, from the entire marijuana/cannabis plant with solvents or carbon dioxide extraction processes. The plant body is mostly discarded, leaving a more potent product (akin to grain alcohol). Concentrates may not smell like marijuana, depending on how refined the extraction is. Commonly used terms for concentrates include dabs, budder/badder, wax, shatter, crystalline, distillate, crumble, and sift.

Learn more about the different types of marijuana [here](#) and [here](#).

Specific pharmaceutical CBD and THC formulations have approval from the U.S. Food and Drug Administration (FDA) for the treatment of defined health conditions. For example, these include seizures, nausea from cancer treatments, and acquired immunodeficiency syndrome (AIDS) wasting syndrome.

The following FDA-approved medications are available through a pharmacy via prescription written by a licensed healthcare provider:

- Epidiolex[®] contains cannabis-derived CBD and is approved for the treatment of seizures associated with Lennox-Gastaut syndrome, Dravet syndrome, or tuberous sclerosis complex in patients one year of age and older.

- Marinol® and Syndros® (dronabinol) are synthetic THC and are indicated for treating anorexia associated with weight loss in patients with AIDS and for nausea and vomiting associated with cancer chemotherapy.
- Cesamet® (nabilone) is a synthetic THC analogue approved for nausea and vomiting associated with cancer chemotherapy.²⁰

These FDA-approved products are distinct from non-FDA-approved medical marijuana products, which consumers acquire from a state-run marijuana dispensary rather than a pharmacy.

Medical marijuana is the use of the whole, unprocessed marijuana plant or its basic extracts to treat symptoms of illness as recommended by an authorized practitioner in a state with a medical marijuana law. The FDA does not recognize or approve the marijuana plant as medicine; only the two synthetic and one derivative product described above are approved for medical use.

Sold under a variety of names, such as Spice and K-2, other synthetic cannabinoids are also available on illicit commercial markets. These products activate the same cannabinoid receptors in the human brain as THC.²¹ However, they are 10 to 200 times more potent than THC, and, therefore, have the potential to cause serious adverse events, including psychosis and fatal overdose.²²

Evolution of the Marijuana Market: Increasing Potency and Product Diversification

Variation in the content of THC and CBD, as well as how it is consumed (e.g., inhaled, orally ingested, or topically applied) heavily influences its effects. In recent decades, the marijuana products in both state-run legal markets and illicit marijuana markets have been increasingly diverse with respect to route of administration, formulation, and dose. Marijuana from both markets is increasingly available, has higher THC content, has flavors and flavor-sounding names, and greater marketing and promotion. All of these factors may have significant impact on youth initiation and use.¹³

Slang terms for marijuana include ganja, pot, weed, boom, bud, gangster, grass, green, hash, herb, kush, loud, reefer, skunk, dope, Mary Jane, hooch, brew, and greens.

Furthermore, the emergence of the legal marijuana industry has led to a wide range of new products, many composed of extracts or concentrates, including vaping products, other oils and resins, edibles, and topical products.

The amount of THC in marijuana flowers has increased from an average of 3 to 4 percent in the early 1990s to 14 percent currently,²³⁻²⁵ though some marijuana flowers can have THC concentrations of up to about 30 percent.^{23, 26} Marijuana concentrates typically have THC concentrations of 40 to 90 percent or greater.²⁴ Overall, the market has been rapidly shifting to products with increased THC concentrations and higher THC:CBD ratios, with no pre-market evaluation of safety.^{25, 27}

Four primary concerns regarding increased THC concentration are:

1. It is difficult to know how much THC is inhaled or otherwise being ingested.
2. Use of marijuana products with higher THC concentrations is associated with greater risk of marijuana use disorder.²⁸
3. Use of high potency products is associated with greater risk of psychosis.²⁹
4. State adult-use laws limiting sales of these products generally use weight-based measures rather than potency-based measures (the amount of money spent per milligram of THC is lower for concentrates). This allows people to purchase a small amount of high potency products, with potentially high levels of intoxicating effects. The National Institutes of Health (NIH) currently has an initiative working to establish a standard unit for THC, currently asking researchers to use 5 milligrams as the standard unit for consistency.³⁰

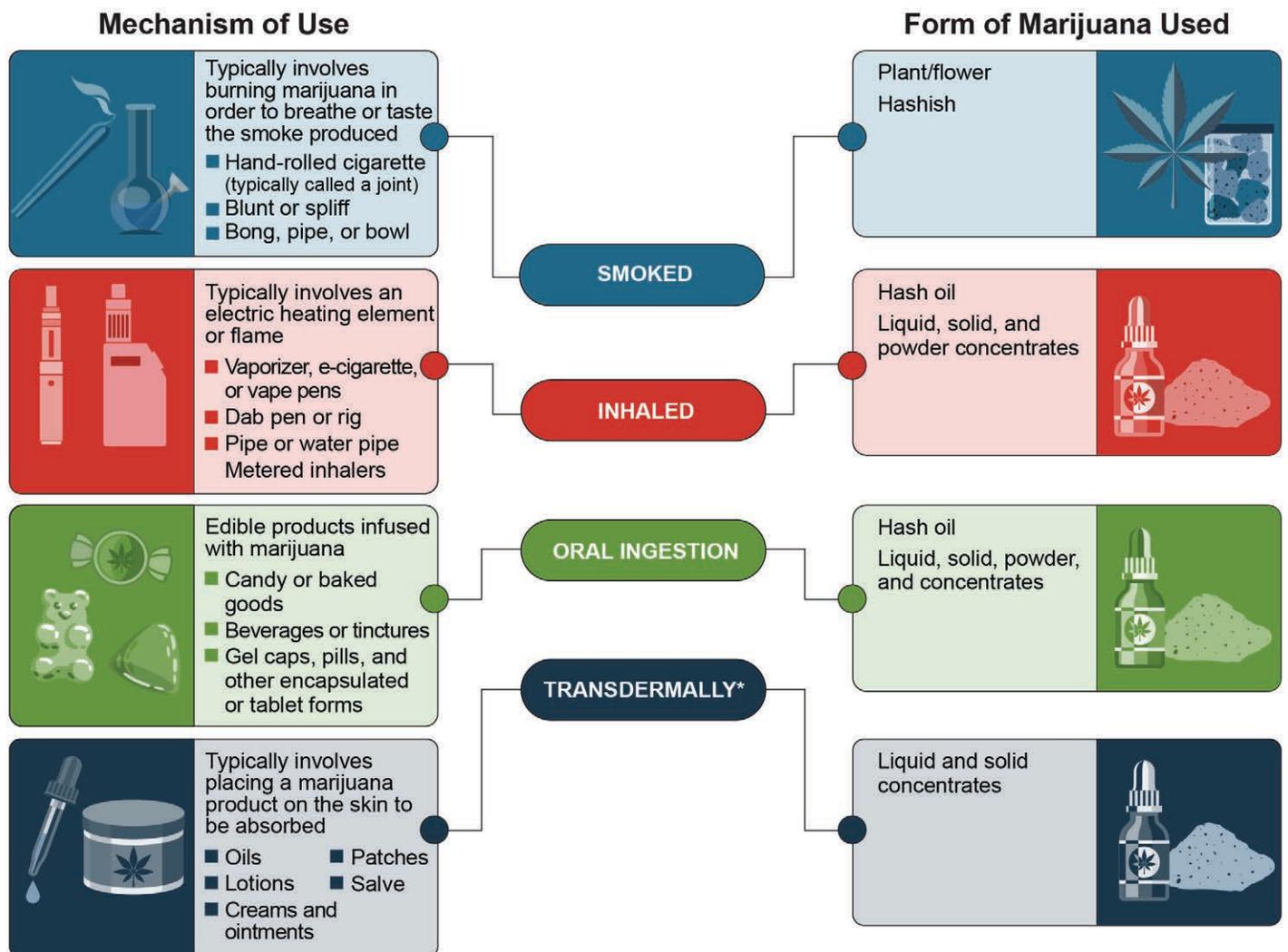
How Is Marijuana Used?

How people use marijuana has changed substantially over the years. In addition to smoking traditional marijuana cigarettes, a vast array and combinations of manufactured products have evolved. These include edibles, marijuana-infused beverages, topical applications, and various devices for inhalation. There has also been an increase in people using products originally designed for nicotine/tobacco for marijuana, such as blunts, vaporizing devices, and e-cigarettes.³¹ Youth are using marijuana via all of these routes, especially edibles and concentrates.³²

The graphic below shows the variety of ways people can consume marijuana.

In 2018, among U.S. 12th grade students who used marijuana in the past year, 89 percent reported smoking it, 34 percent reported vaping it, and 40 percent ingested it in food.¹⁶ Youth who ingest edibles are at increased risk of adverse events in part because the THC concentration can vary across products and batches of a single product. Consumption also has a delayed rate of absorption compared to other routes of administration.¹⁶ As a result, youth may not know how the amount of THC will affect the body. This is relevant because of the variability in how much and how quickly THC is absorbed in the body.

Foods and beverages can be infused with THC, including products such as brownies and cookies, candies such as gummies and lollipops, sodas, and alcoholic beverages

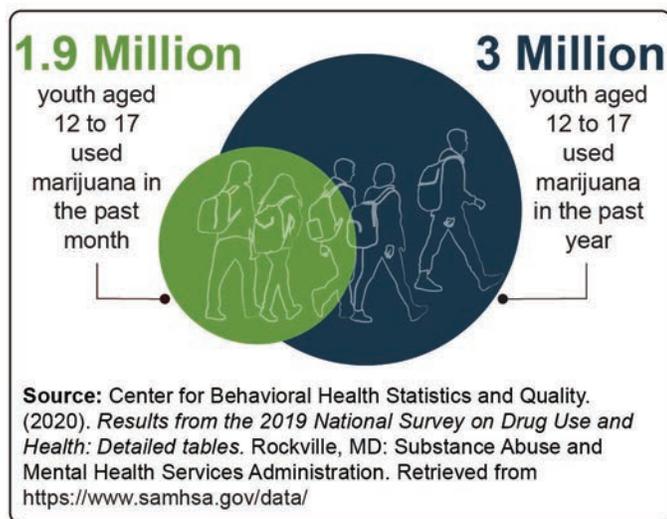
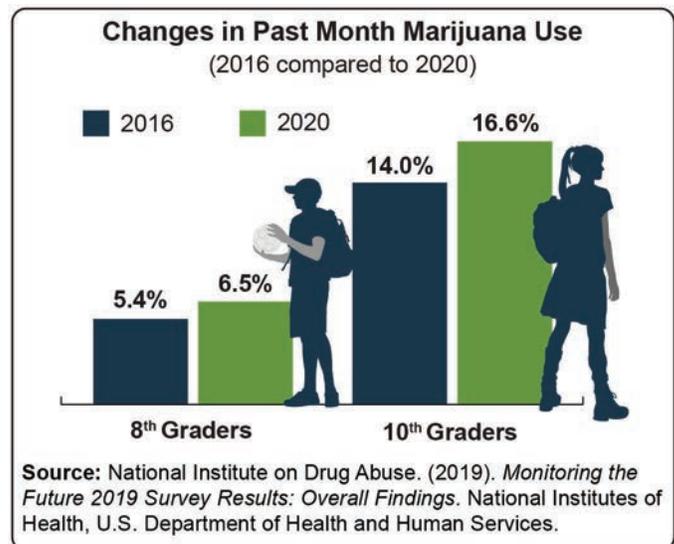
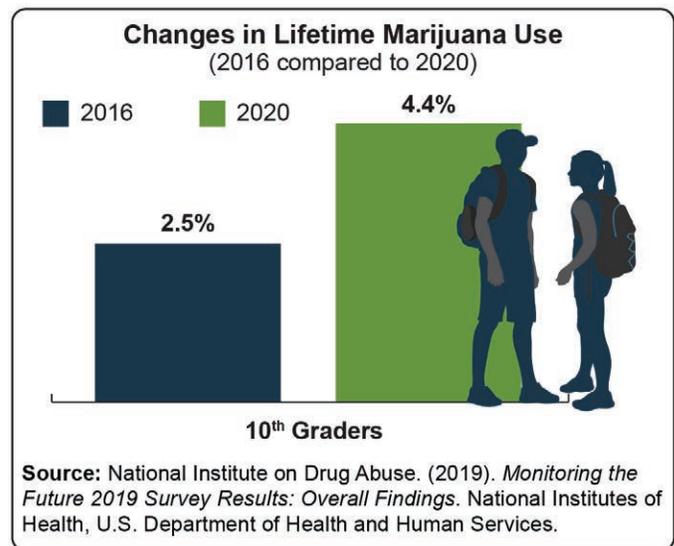


*Transdermal use of marijuana has low misuse potential and has not been shown to cause acute intoxication or impairment.

such as wine and beer. Edible marijuana products are especially attractive to youth, as their packaging often look very similar to that of non-marijuana products. Although some states prohibit such packaging, there is little evidence of enforcement.³³ Marijuana-infused beverages, often with sweet flavors such as orange soda, are similar to alcopops that are often marketed in the form of juices, sodas, lemonade, and iced tea, which are known to attract teens, especially girls.³⁴

Of note, the timing of a THC high from edibles is different from that of inhaled/smoked sources; it can take 1 to 2 hours to feel an effect from edibles, and peak effects occur later and may last for several hours. When the high is felt and how long it lasts depends on a user’s metabolism, the product formulation, what the person ate, and the dose consumed. Overconsumption can lead to severe intoxication and overdose.³⁵

Vaping liquid marijuana products can lack the characteristic smell of marijuana, making detection of use difficult. Vaping devices are also packaged in ways that resemble memory sticks or other non-drug paraphernalia devices.³⁶⁻³⁷ Detection-free use may be one reason why vaping marijuana has become increasingly popular among youth.³⁸



Marijuana products, such as vaping concentrates or hemp wrappers used for blunts, may be flavored. This is a strategy well documented to attract youth to tobacco products and is associated with over 80 percent of youth tobacco initiation.³⁹⁻⁴¹ Marijuana products also frequently use names implying fruit or other flavors (e.g., grape, peanut butter cup, or pineapple haze), even if that fruit/ flavor is not present.

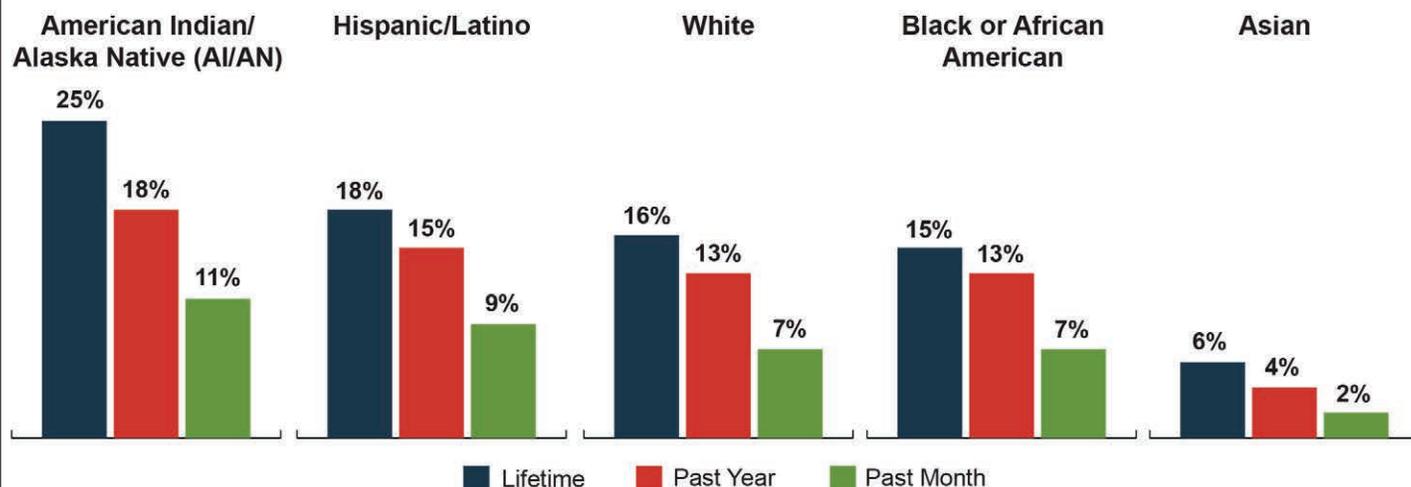
Prevalence of Marijuana Use Among Youth

Overall Prevalence

According to the 2019 National Survey on Drug Use and Health (NSDUH), marijuana was the most commonly used substance after alcohol among 12- to 17-year-olds.⁷ Among the youth surveyed, 16, 13, and 7 percent, respectively, reported having used marijuana within their lifetime, within the past year, and within the past month.⁷ In this age group, 16- to 17-year-olds had the highest rates of marijuana use; 31 percent reported using marijuana in their lifetime, 25 percent reported using marijuana in the past year, and 14 percent reported using marijuana in the past month. Those aged 12 to 13 reported the lowest rates of marijuana use.^{7,17}

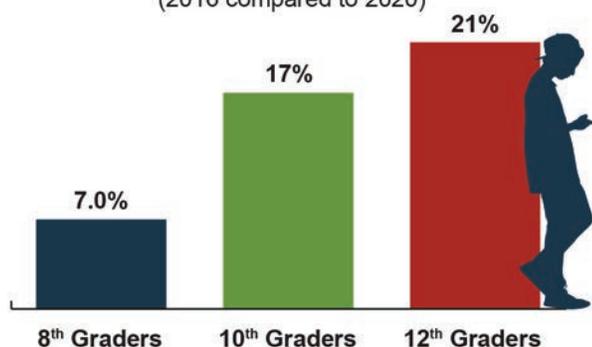
Data from the 2019 Monitoring the Future Survey further highlight concerns about youth marijuana use as shown in the following graphics:

Marijuana Use Prevalence Among Youth 2019



Source: Center for Behavioral Health Statistics and Quality. (2020). *Results from the 2019 National Survey on Drug Use and Health: Detailed tables*. Rockville, MD: Substance Abuse and Mental Health Services Administration. Retrieved from <https://www.samhsa.gov/data/>

Increases in Past Month Marijuana Use Across All Age Groups (2016 compared to 2020)



Source: Miech, R. A., Johnston, L. D., O'Malley, P. M., Bachman, J. G., Schulenberg, J. E., & Patrick, M. E. (2021). *Monitoring the Future national survey results on drug use, 1975–2020: Volume I, Secondary school students*. Ann Arbor: Institute for Social Research, The University of Michigan. Available at <http://monitoringthefuture.org/pubs.html#monograph>

It is also important to look at how past month use increases across the age groups, from 7 percent among 8th graders to 17 percent among 10th graders and up to 21 percent among 12th graders.¹⁶ These data suggest that prevention at younger ages is critical to reducing marijuana use among older adolescents.

Prevalence of Marijuana Use by Specific Population Groups

Nationally, the prevalence of youth marijuana use varies across demographic groups. In the general population, males report higher rates of marijuana use compared to females. However, among 12- to 17-year-olds, female

and male youth report lifetime, past year, and past month marijuana use at comparable rates nationwide.⁷

Rates of marijuana use also vary by race and ethnicity. American Indian/Alaska Native youth reported the highest rates of lifetime, past year, and past month marijuana use, while Asian youth reported the lowest. A breakdown of marijuana use prevalence by race and ethnicity is shown in the graphic that follows below.⁶

For past month use, youth who identify as sexual and gender minorities are 1.6 times more likely to report recent marijuana use than heterosexual youth⁴² and marijuana use is 2.5 times higher among transgender compared to cisgender youth.⁴³ These differences persist in adulthood, and lesbian, gay, bisexual, transgender, and queer (LGBTQ) youth are more likely to be diagnosed with a marijuana use disorder as adults.⁴⁴ Research suggests this difference may be due to greater exposure to stressful life events, discrimination, and stigma among LGBTQ youth as compared to their heterosexual peers.^{42, 44-45}

Among sexual minority youth (i.e., whose sexual orientation, gender identity, or sexual characteristics are different from the presumed majority of the population), those assigned male at birth demonstrate greater rates of recent and lifetime marijuana use, despite comparable rates between male and female youth at the national level.⁴⁶ These data underscore the importance of culturally specific marijuana prevention strategies for populations who experience disparities in marijuana use prevalence.

Harms Associated With Youth Marijuana Use

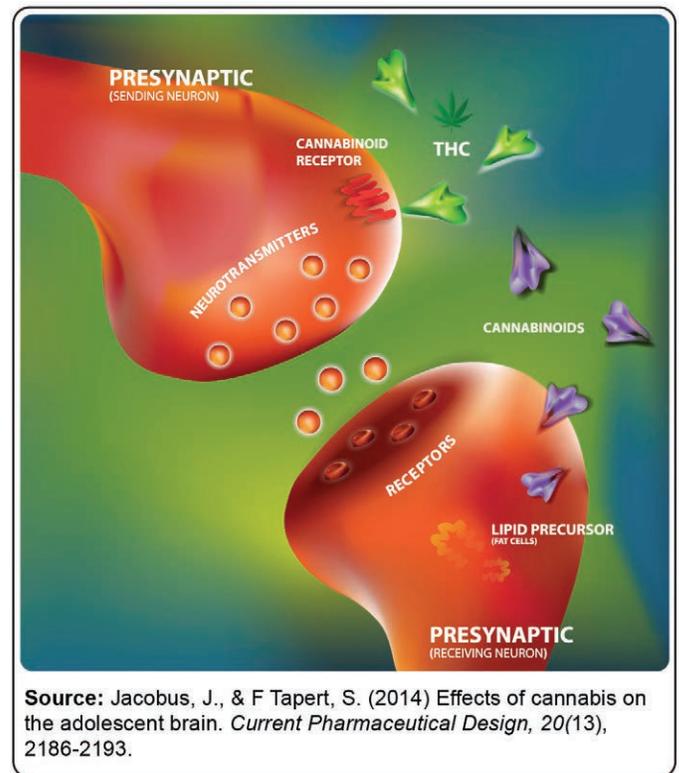
Youth may experience substantial harm resulting from marijuana use, especially heavy and chronic use. Frequent or intensive (e.g., daily or near-daily) marijuana use is strongly associated with higher risks of experiencing many adverse health and social outcomes.¹¹

Effects of Marijuana Use on the Brain

Human brain development continues well into an individual's twenties and several genetic and environmental factors can influence this process.⁴⁷ Findings from animal studies show chemicals (e.g., cannabinoids) in marijuana bind to the brain's own endocannabinoid system, disrupting the body's normal levels of naturally occurring cannabinoids.²⁴ The important role of the endocannabinoid system in neurodevelopment may explain why youth are particularly susceptible to the effects of marijuana. Exposure to marijuana during this time can alter the brain's normal communication mechanisms and epigenetic (how behaviors and environment can cause changes that affect the way genes work) development.⁴⁷ THC attaches to cannabinoid receptors in the brain, like a key to a lock, which in part activates the brain's reward pathway, resulting in the intoxicating effects when people use marijuana.

In addition to intoxication, flooding the brain with large amounts of THC may impact normal functions for short or long periods of time, including:

- Learning, memory, and other cognitive processes critical to learning
- Pleasure/reward
- Appetite
- Motion/motor control
- Sleep
- Reproduction/fertility



Other possible effects can include altered senses, changes in mood, and hallucinations.⁴⁸⁻⁴⁹

THC can also result in disruption of cognitive processes that are important for academic performance and activities like driving and sports.^{50,51} In some studies, chronic, long-term marijuana use has been associated with altered brain structure and impaired cognitive functioning.⁵⁰ There is debate about the clinical significance of these changes and whether they reverse with abstinence. Collectively, these studies suggest a potential risk associated with adolescent marijuana use related to brain development.⁵² It is important to note that much of this information comes from preclinical studies, meaning more research with larger populations is needed.

Short- and Long-Term Adverse Effects of Marijuana Use

Common Short-Term Adverse Effects

- Brief periods of: increased heart rate; altered sense of time; increased anxiety/paranoia; slow reaction time; problems with balance and coordination; impaired driving; increased appetite; difficulty with thinking and problem solving; memory impairment.¹ The likelihood of adverse effects increases with increasing doses of marijuana.⁵³

Less Common Short-Term Adverse Effects

- Increased heart rate, which may increase the risk of a heart attack; nausea and vomiting;⁵⁴ panic attacks; psychosis (losing touch with reality); hallucinations (seeing or hearing things that are not really there); delusions (believing something that is not true).⁵⁵

Long-Term Effects

- Lung and breathing problems (particularly when smoked and often among those who also smoke cigarettes), though these problems often manifest later in life; stroke, poor academic performance;⁵⁶ truancy;⁵⁷ increased risk for social anxiety;⁵⁸ suicidal ideation,² attempts, and completion.⁵⁹
- Babies exposed to marijuana during pregnancy are exposed to similar harms. Specifically, prenatal marijuana use is associated with poor birth outcomes such as low birth weight and brain development delays, which may have longer term effects on the adolescent brain.⁶⁰⁻⁶¹
- Chronic marijuana use is also associated with a condition called “cannabinoid hyperemesis syndrome,” characterized by repeated and severe instances of nausea and vomiting.⁵⁴

Marijuana Use Disorder

- People who begin using marijuana at or before the age of 18 are 4 to 7 times more likely to develop a marijuana use disorder than adults who did not use under age 18.⁶² Three in 10 people who used marijuana developed a marijuana use disorder between 2012 and 2013.⁶³
- Those who have a marijuana use disorder may experience withdrawal symptoms (anxiety, insomnia, depression),⁶⁴ which may create acute discomfort and an incentive to continue marijuana use.⁶⁵

- Most individuals who seek treatment for marijuana use disorder fail to achieve sustained abstinence (one study reported 8 percent of their sample had sustained abstinence); rates of successful quitting are comparable to those for individuals who use tobacco.⁶⁶⁻⁶⁷ Other substance use disorders show success rates between 20 and more than 50 percent, though research suggest an average of approximately 18 percent sustained abstinence.⁶⁸

Psychotic Symptoms and Disorders

- Marijuana use is associated with higher risk and worsening outcomes of later psychotic disorder, such as schizophrenia, for those with the disorder, but causality remains unclear.^{2, 29}
- Youth who have psychoses or psychotic symptoms and who use marijuana typically have an earlier age of first-episode psychosis.⁶⁹
- Evidence supports that stopping marijuana use can reduce the onset and occurrence of psychotic symptoms.⁷⁰

Personal Harms

- Frequent marijuana use between the ages of 14 to 21 is associated with lower high school completion and college graduation,⁷¹ subsequent lower income at age 25, and lower levels of relationship and life satisfaction.⁷²
- Daily or near-daily marijuana use is associated with financial difficulties, antisocial behavior in the workplace, and more interpersonal relationship conflict. This is particularly true among those who reported a longer history of marijuana use and development of a marijuana use disorder.⁷³⁻⁷⁴
- Recent studies suggest marijuana use is associated with higher rates of depression and suicide, especially among youth.⁷⁵⁻⁷⁷
- Initiation of marijuana use before the age of 18 is also a predictor of opioid use disorder in adulthood.⁷⁸
- Marijuana has been found to be contaminated with bacteria, viruses, and metals that can negatively impact health, particularly among immunocompromised youth.⁷⁹

The fat-soluble nature of THC is why a person can test THC-positive for days, and sometimes weeks, after use. This is also why blood levels of THC are not a reliable way of indicating impairment from marijuana the way blood alcohol content is used to measure impairment from alcohol.

Practically, this means there is not currently a mechanism to test marijuana impairment, which presents challenges for workplace policies and driving under the influence. Research is being done to develop devices to address this challenge.

Overdoses

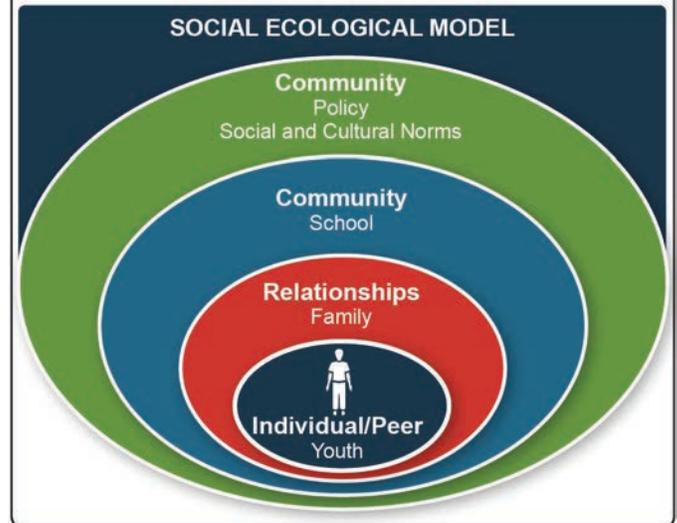
- THC does not typically shut down core bodily functions like breathing as other substances such as opioids may. With uncommon exceptions of some severe pediatric ingestions, there are no reports of fatal overdoses directly tied to marijuana use.⁸⁰
- Uncomfortable side effects can result from excess consumption of edibles, use of high potency products, or accidental ingestion. These result in a variety of effects from psychosis to anxiety, and large increases in marijuana-associated emergency room visits.⁸¹⁻⁸²

Risk and Protective Factors for Youth Marijuana Use

Several factors place some youth at higher risk of initiating and continuing marijuana use, while other factors protect them from adopting this behavior. Both types of factors are present at multiple levels across the socio-ecological model (SEM), including those with a direct effect on an individual as well as indirect neighborhood and community factors. Additionally, these risk and protective factors can, and should, be considered within the context of social determinants of health, which recognize the broader social and community context of marijuana use across each of the SEM levels.⁸³

What is the Socio-Ecological Model?

The socio-ecological model (SEM) defines the complex relationship between individual/peer, family, school, and community factors that protect or put individuals at risk.⁶⁸ This guide uses a version of this model to frame the discussion of risk and protective factors for marijuana use, as well as the marijuana use prevention strategies discussed in **Chapter 2**.



Individual and Peer Risk and Protective Factors

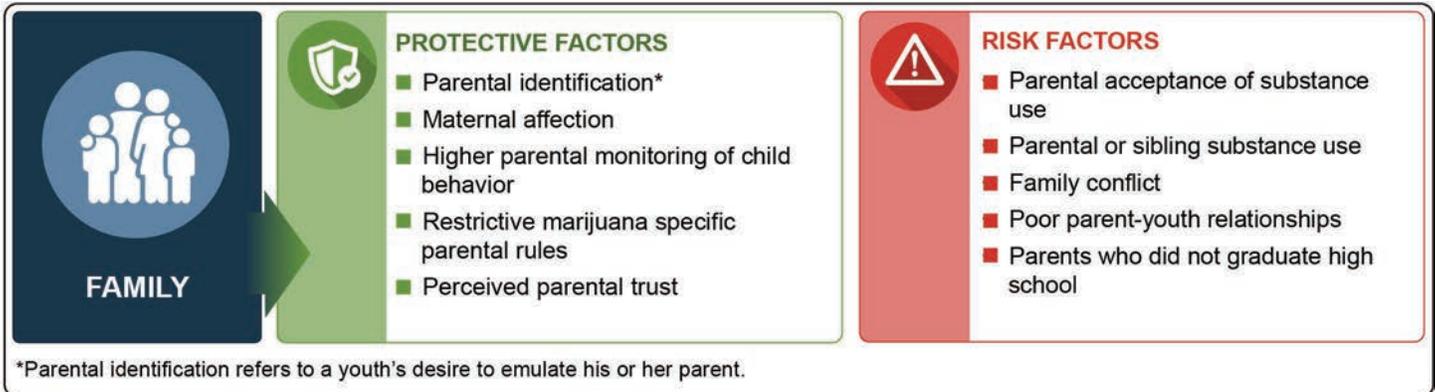
At the individual level, risk factors include current behavior, such as sensation seeking and aggression, whereas protective factors include having college aspirations and self-confidence to say no to substances. As with other SUDs, neurobiology and genetics contribute to marijuana use and use disorders.⁸⁴⁻⁸⁵ Recent studies show distinction between genetic heritability to marijuana use and developing a marijuana use disorder.⁸⁶ Youth thinking that their peers are using marijuana is associated with their own decisions to use. However, perceived level of peer use among students aged 12 to 17 is greater than the actual rate of use among peers.⁶ Alternatively, peer disapproval can be a protective factor.⁸⁷ A large percentage of students also reported that they believe close friends would strongly disapprove or somewhat disapprove of trying marijuana (78 percent) or using marijuana once a month or more (79 percent).^{6,7}



Family Risk and Protective Factors

Family factors associated with increased risk of youth marijuana use include home environments characterized by family conflict and poor relationships with parents/caregivers.⁸⁸⁻⁸⁹ Parental use and beliefs about marijuana use also strongly influence youth behavior; youth whose parents have ever used marijuana are about three times more likely to use marijuana than youth whose parents have never used marijuana. Youth whose parents do not believe marijuana use is risky are 1.5 times more likely to use when compared with youth whose parents hold more negative beliefs.⁹⁰⁻⁹¹

Conversely, families can play a protective role in preventing youth marijuana use by fostering a supportive family environment and monitoring and prohibiting youth marijuana use. Positive family factors such as identifying with one’s parents/caregiver, maternal affection displayed toward child, and perceived parental trust have been found to play a protective role in preventing youth marijuana use.⁹¹⁻⁹² No tolerance rules around youth marijuana use and greater parental monitoring are also associated with decreased marijuana use.⁹³

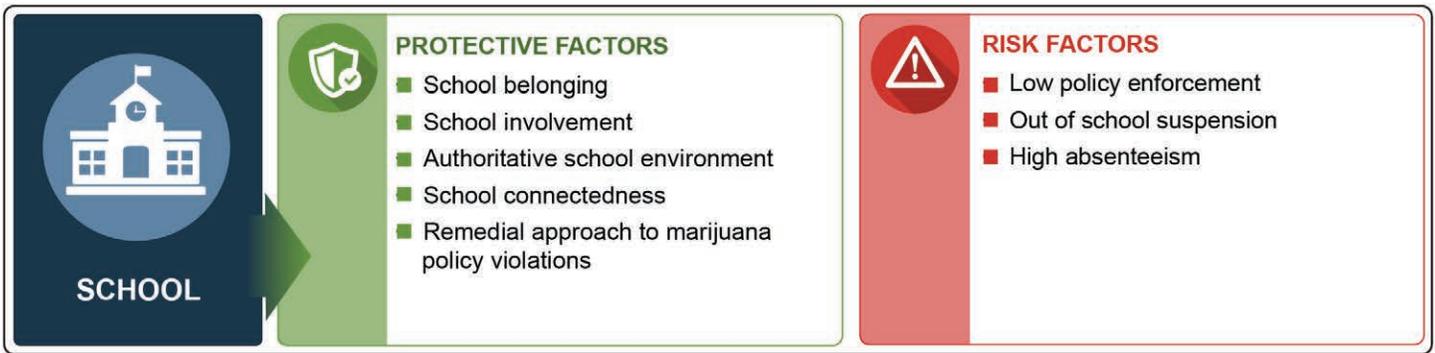


School Risk and Protective Factors

Rates of marijuana use vary at the school level, and research has identified a variety of related factors associated with marijuana use among students.⁹⁴⁻⁹⁷ Authoritative school environments characterized by fair disciplinary practices and mutual respect between teachers and students have shown lower levels of marijuana use among students.⁹⁷⁻⁹⁸ Less predictable school environments where rules are not clearly articulated nor consistently enforced tend to have higher rates of use.⁹⁸⁻⁹⁹ A school’s substance use disciplinary

policies also influence marijuana use; more remedial approaches to violations, such as counseling, have been found to result in less marijuana use when compared with more punitive measures, such as expulsion.⁹⁹

It is also important to consider students’ relationships to the school environment in understanding marijuana use risk. The level of connection students feel to their school, fellow students, and academics is associated with student marijuana use.⁹⁶ Researchers hypothesize that greater school connectedness creates a sense of shared identity and belonging that reduces the role of marijuana



use in achieving social status, thereby decreasing students' likelihood of using marijuana.^{96,100} A student's involvement in school activities, such as clubs and sports, also serves as a protective factor.^{95,101-102}

Community Risk and Protective Factors

The laws and ordinances that govern a neighborhood, city, county, state, or tribal community have a direct effect on a youth's ability to access and use substances. In the case of marijuana, community-level risk factors

include the availability of the product (either medically or illegally), product marketing (primarily relevant in states where marijuana is legal at the state or local level for non-medical or medical use), community disorganization, economic deprivation, and other social determinants of health.^{83,103-105} For each of these risk factors, the opposite can be considered important as a protective factor that can reduce or prevent youth marijuana use.



Challenges to Prevention Efforts

This guide focuses on prevention interventions for youth marijuana use, considering the different regulatory structures that currently exist in the country, including states where the sale of marijuana remains illegal and states where recreational or medical use is considered legal. The rapidly evolving policy landscape at the state level poses significant challenges for preventing marijuana use by youth. Greater public acceptance, declining perception of risk, increasing availability, product diversification, pervasive marketing, and other trends may contribute to an increase in youth marijuana use.

The Controlled Substances Act (CSA)¹⁰⁴ places all substances regulated under federal law into five schedules. Under the CSA, marijuana is a Schedule I substance, meaning it has a high potential for misuse.¹⁰⁵

According to federal regulations, marijuana is considered a controlled substance, as defined by the Controlled Substances Act (CSA);¹⁰⁶ however, many state regulations vary from the CSA.¹⁰⁷ As of February 2021, legislation to allow the medical use of marijuana has been passed in 36 states plus the District of Columbia, Guam, Puerto Rico, and the U.S. Virgin

Islands. Legislation permitting the legalized, non-medical use of marijuana for adults age 21 and older has been passed in 17 states and territories.¹⁰⁸

As a result, legally produced marijuana is not considered a controlled substance by states that allow use for medical and/or non-medical purposes, but it remains subject to violations that may result in federal prosecution.^{107,109-110} Many states still have penalties for possession of marijuana by youth under the legal age.

States vary widely in how they regulate legalized marijuana. Every state with some form of legalized marijuana use for non-medical purposes thus far has banned sales to persons under 21 years old. Other restrictions on legalized marijuana may include:

- Limits on the amount of marijuana an individual can purchase each day or possess
- Restrictions on advertisements, potency, or product design
- Requirements for quality standards and health warnings
- Limits on the number or types of businesses allowed to sell the product
- Restrictions on whether delivery from the retailer is allowed¹³

The term “legalization” is often used rather broadly. However, at the state level, marijuana can be divided into four distinct legal categories:

1. Non-medical legalization
2. Medical legalization
3. Decriminalization
4. Illegal¹¹¹

The table that follows below briefly describes each of these terms.¹¹²

Even within states which have legalized, considerable local variation may exist between cities or counties that allow legal sale and those that do not.³⁶

Despite the variation in public policy and regulation, stakeholders can implement prevention programs and strategies to reduce risk and increase protective factors associated with youth marijuana use. These activities may target the individual or community environment. The next chapter provides information on what constitutes an evidence-based intervention and provides examples of prevention programs and policies that have demonstrated decreases in substance use, and, specifically, marijuana initiation and use among youth.



Non-Medical Legalization	Medical Legalization	Decriminalized	Illegal
The possession of marijuana is permitted for both medical and/or non-medical purposes by the state. Non-medical use is limited to adults aged 21 and older. Also referred to as “recreational and adult use.”	The possession of marijuana is permitted by the state when recommended for medical purposes only.	Decriminalization can be full or partial and means that lesser marijuana violations, such as possession of small amounts, will typically be civil infractions or misdemeanors and will not result in imprisonment.	The possession of marijuana is not permitted for any purpose and is subject to both state and federal prosecution.
It is important to note that these categories may not be mutually exclusive in every state. For example, a state may have decriminalized marijuana while it is still illegal.			

Professional Organization Statements on Marijuana and Youth



American Academy of Pediatrics (AAP): “In states that have legalized marijuana for recreational purposes, the AAP strongly recommends strict enforcement of rules and regulations that limit access and marketing and advertising to youth... Although the AAP does not condone state laws that allow the sale of marijuana products, in states where recreational marijuana is currently legal, pediatricians should advocate that states regulate the product as closely as possible to tobacco and alcohol, with a minimum age of 21 years for purchase. Revenue from this regulation should be used to support research on the health risks and benefits of marijuana.”³



American Academy of Child and Adolescent Psychiatry (AACAP): “Marijuana-related policy changes, including legalization, may have significant unintended consequences for children and adolescents. AACAP supports (a) initiatives to increase awareness of marijuana’s harmful effects on adolescents, (b) improved access to evidence-based treatment for adolescents with marijuana-related problems, and (c) careful monitoring of the effects of marijuana-related policy changes on child and adolescent mental health. Finally, AACAP strongly advocates for the involvement of the medical and research community in these critical and highly impactful policy-related discussions.”⁸



American Society of Addiction Medicine: “Public health efforts through evidence-based prevention programs should be strengthened to discourage people from using cannabis products due to their known potential harms. Given the particular risks to children and adolescents, cannabis products should not be distributed to anyone under the age of 21... States or jurisdictions that decide to legalize cannabis production, distribution, or sale should only do so within a strong public health-based regulatory framework that minimizes the harms related to legalization. These should include best public health practices established for tobacco control, and components which have been identified as important for minimizing harmful use of tobacco or alcohol.”¹¹



American Public Health Association: “With more states legalizing retail sales of marijuana and a dearth of national research on cannabis policy, [APHA] recommends state and local governments that regulate cannabis to develop and enforce policies that control access and use by youth and other vulnerable populations. Calls on all lawmakers to develop funding and monitoring mechanisms to expunge cannabis-related records, decrease arrests, support community re-entry and community development. Encourages state and local governments to work with health departments to prevent and treat cannabis abuse and dependence. Urges agencies to develop and expand the evidence base on the health effects of cannabis, as well as on the public health and safety outcomes related to its commercial regulation.”¹³

Reference List

- ¹ National Institute on Drug Abuse. (2019). *Marijuana DrugFacts*. <https://www.drugabuse.gov/publications/drugfacts/marijuana>
- ² National Academies of Sciences, Engineering, and Medicine. (2017). *The health effects of cannabis and cannabinoids: The current state of evidence and recommendations for research*. National Academies Press. <https://doi.org/10.17226/24625>
- ³ Mikos, R. A., & Kam, C. D. (2019). Has the “M” word been framed? Marijuana, cannabis, and public opinion. *PLoS One*, *14*(10). <https://doi.org/10.1371/journal.pone.0224289>
- ⁴ National Hispanic Caucus of State Legislators. (2017). *Providing a legal framework when jurisdictions decide to decriminalize, commercialize and tax cannabis*. <https://nhcsl.org/resources/resolutions/2017/2017-12/>
- ⁵ Ammerman, S., Ryan, S., & Adelman, W. P. (2015). The impact of marijuana policies on youth: Clinical, research, and legal update. *Pediatrics*, *135*(3), e769-e785. <https://doi.org/10.1542/peds.2014-4147>
- ⁶ Substance Abuse and Mental Health Services Administration. (2020). *Key substance use and mental health indicators in the United States: Results from the 2019 National Survey on Drug Use and Health*. <https://www.samhsa.gov/data/sites/default/files/reports/rpt29393/2019NSDUHFFRPDFWHTML/2019NSDUHFFR090120.htm>
- ⁷ Center for Behavioral Health Statistics and Quality. (2020). *Results from the 2019 National Survey on Drug Use and Health: Detailed tables*. <https://www.samhsa.gov/data/sites/default/files/reports/rpt29394/NSDUHDetailedTabs2019/NSDUHDetailedTabs2019.pdf>
- ⁸ American Academy of Child and Adolescent Psychiatry. (2017). *Marijuana legalization*. https://www.aacap.org/AACAP/Policy_Statements/2014/aacap_marijuana_legalization_policy.aspx
- ⁹ Casadio, P., Fernandes, C., Murray, R. M., & Di Forti, M. (2011). Cannabis use in young people: The risk for schizophrenia. *Neuroscience & Biobehavioral Reviews*, *35*(8), 1779-1787. <https://doi.org/10.1016/j.neubiorev.2011.04.007>
- ¹⁰ Price, C., Hemmingsson, T., Lewis, G., Zammit, S., & Allebeck, P. (2009). Cannabis and suicide: Longitudinal study. *Br J Psychiatry*, *195*(6), 492-497. <https://doi.org/10.1192/bjp.bp.109.065227>
- ¹¹ American Society of Addiction Medicine. (2020). *Public policy statement on cannabis*. <https://www.asam.org/advocacy/find-a-policy-statement/view-policy-statement/public-policy-statements/2020/10/13/cannabis>
- ¹² Lisdahl, K. M., Wright, N. E., Medina-Kirchner, C., Maple, K. E., & Shollenbarger, S. (2014). Considering cannabis: The effects of regular cannabis use on neurocognition in adolescents and young adults. *Current Addiction Reports*, *1*(2), 144-156. <https://dx.doi.org/10.1007%2Fs40429-014-0019-6>
- ¹³ American Public Health Association. (2020, October 25). *New public health policy statements adopted at APHA 2020*. <https://www.apha.org/news-and-media/news-releases/apha-news-releases/2020/2020-apha-policy-statements>
- ¹⁴ Hsiao, P., & Clavijo, R. I. (2018). Adverse effects of cannabis on male reproduction. *Eur Urol Focus*, *4*(3), 324-328. <https://doi.org/10.1016/j.euf.2018.08.006>
- ¹⁵ Payne, K. S., Mazur, D. J., Hotaling, J. M., & Pastuszak, A. W. (2019). Cannabis and Male Fertility: A Systematic Review. *J Urol*, *202*(4), 674-681. <https://doi.org/10.1097/ju.0000000000000248>
- ¹⁶ Miech, R. A., Johnston, L. D., O'Malley, P. M., Bachman, J. G., Schulenberg, J. E., & Patrick, M. E. (2021). *Monitoring the Future national survey results on drug use, 1975–2020: Volume I, secondary school students*. http://www.monitoringthefuture.org/pubs/monographs/mtf-vol1_2020.pdf
- ¹⁷ National Institute on Drug Abuse. (2019, December 18). *Monitoring the Future 2019 survey results: Overall findings*. <https://www.drugabuse.gov/drug-topics/trends-statistics/infographics/monitoring-future-2019-survey-results-overall-findings>
- ¹⁸ Levar, N., Francis, A. N., Smith, M. J., Ho, W. C., & Gilman, J. M. (2018). Verbal memory performance and reduced cortical thickness of brain regions along the uncinate fasciculus in young adult cannabis users. *Cannabis Cannabinoid Res*, *3*(1), 56-65. <https://dx.doi.org/10.1089%2Fcan.2017.0030>

- 19 Sagar, K. A., & Gruber, S. A. (2018). Marijuana matters: reviewing the impact of marijuana on cognition, brain structure and function, & exploring policy implications and barriers to research. *Int Rev Psychiatry*, 30(3), 251-267. <https://dx.doi.org/10.1080/09540261.2018.1460334>
- 20 U.S. Food and Drug Administration. (2020). *FDA and cannabis: Research and drug approval process*. <https://www.fda.gov/news-events/public-health-focus/fda-and-cannabis-research-and-drug-approval-process>
- 21 Spaderna, M., Addy, P. H., & D'Souza, D. C. (2013). Spicing things up: Synthetic cannabinoids. *Psychopharmacology*, 228(4), 525-540. <https://doi.org/10.1007/s00213-013-3188-4>
- 22 National Institute on Drug Abuse. (2020). *DrugFacts: Synthetic cannabinoids (K2/Spice)*. <https://www.drugabuse.gov/publications/drugfacts/synthetic-cannabinoids-k2spice>
- 23 Cash, M. C., Cunnane, K., Fan, C., & Romero-Sandoval, E. A. (2020). Mapping cannabis potency in medical and recreational programs in the United States. *PLoS One*, 15(3), e0230167. <https://doi.org/10.1371/journal.pone.0230167>
- 24 National Institute on Drug Abuse. (2020). *Marijuana research report: How does marijuana produce its effects?* <https://www.drugabuse.gov/publications/research-reports/marijuana/how-does-marijuana-produce-its-effects>
- 25 Smart, R., Caulkins, J. P., Kilmer, B., Davenport, S., & Midgette, G. (2017). Variation in cannabis potency and prices in a newly legal market: Evidence from 30 million cannabis sales in Washington state. *Addiction*, 112(12), 2167-2177. <https://doi.org/10.1111/add.13886>
- 26 Burgdorf, J. R., Kilmer, B., & Pacula, R. L. (2011). Heterogeneity in the composition of marijuana seized in California. *Drug Alcohol Depend*, 7(1), 59-61. <https://dx.doi.org/10.1016%2Fj.drugalcdep.2010.11.031>
- 27 ElSohly, M., Chandra, S., Radwan, M., Majumdar, C., & Church, J. (2021). A comprehensive review of cannabis potency in the United States in the last decade. *Biol Psychiatry Cogn Neurosci Neuroimaging*, 6(6), 603-606. <https://doi.org/10.1016/j.bpsc.2020.12.016>
- 28 Van der Pol, P., Liebrechts, N., Brunt, T., Van Amsterdam, J., De Graaf, R., Korf, D. J., Van den Brink, W., & Can Laar, M. (2014). Cross-sectional and prospective relation of cannabis potency, dosing and smoking behaviour with cannabis dependence: An ecological study. *Addiction*, 109(7), 1101-1109. <https://doi.org/10.1111/add.12508>
- 29 Di Forti, M., Quattrone, D., Freeman, T. P., Tripoli, G., Gayer-Anderson, C., Quigley, H., Rodriguez, V., Jongsma, H. E., Ferraro, L., La Cascia, C., La Barbera, D., Tarricone, I., Berardi, D., Szöke, A., Arango, C., Tortelli, A., Velthorst, E., Bernardo, M., Del-Ben, C. M.,... Murray, R. M. (2019). The contribution of cannabis use to variation in the incidence of psychotic disorder across Europe (EU-GEI): A multicentre case-control study. *The Lancet Psychiatry* 6(5), 427-436. [https://doi.org/10.1016/s2215-0366\(19\)30048-3](https://doi.org/10.1016/s2215-0366(19)30048-3)
- 30 Volkow, N., & Sharpless, N. (2021, May 10). *Establishing 5mg of THC as the standard unit for research*. National Institute on Drug Abuse. <https://www.drugabuse.gov/about-nida/noras-blog/2021/05/establishing-5mg-thc-standard-unit-research>
- 31 Seaman, E. L., Stanton, C. A., Edwards, K. C., & Halenar, M. J. (2020). Use of tobacco products/devices for marijuana consumption and association with substance use problems among U.S. young adults (2015–2016). *Addictive Behaviors*, 102, 106133. <https://doi.org/10.1016/j.addbeh.2019.106133>
- 32 Patrick, M. E., Miech, R. A., Kloska, D. D., Wagner, A. C., & Johnston, L. D. (2020). Trends in marijuana vaping and edible consumption from 2015 to 2018 among adolescents in the US. *JAMA Pediatrics*, 174(9), 900-902. <https://doi.org/10.1001/jamapediatrics.2020.0175>
- 33 O'Connor, S., Méndez, S., Bess, J., Cooper, B., Cordova-Sanchez, A., Harris, D., & Jeong, C. (2016). *Concerning cannabis-infused edibles: Factors that attract children to foods*. Cannabis Law & Policy Project, University of Washington School of Law. <https://lcb.wa.gov/publications/Marijuana/Concerning-MJ-Infused-Edibles-Factors-That-Attract-Children.pdf>
- 34 Metzner, C., & Kraus, L. (2008). The impact of alcopops on adolescent drinking: A literature review. *Alcohol & Alcoholism*, 43(2), 230-239. <https://doi.org/10.1093/alcalc/agm148>
- 35 Grotenhermen, F. (2003). Pharmacokinetics and pharmacodynamics of cannabinoids. *Clin Pharmacokinet*, 42(4), 327-360. <https://doi.org/10.2165/00003088-200342040-00003>
- 36 Silver, L. D., Naprawa, A. Z., & Padon, A. A. (2020). Assessment of incorporation of lessons from tobacco control in city and county laws regulating legal marijuana in California. *JAMA Network Open*, 3(6), e208393-e208393. <https://doi.org/10.1001/jamanetworkopen.2020.8393>

- 37 Ramamurthi, D., Chau, C., & Jackler, R. K. (2018). JUUL and other stealth vaporisers: Hiding the habit from parents and teachers. *Tob Control*. <https://doi.org/10.1136/tobaccocontrol-2018-054455>
- 38 Liu J., Ramamurthi, D., & Halpern-Felsher, B. (2021). Inside the adolescent voice: A qualitative analysis of the appeal of different tobacco products. *Tobacco Induced Diseases*, 19(February), 15. <https://doi.org/10.18332/tid/132856>
- 39 Ambrose, B. K., Day, H. R., Rostron, B., Conway, K. P., Borek, N., Hyland, A., & Villanti, A. C. (2015). Flavored tobacco product use among US youth aged 12-17 years, 2013-2014. *Journal of the American Medical Association*, 314(17), 1871-1873. <https://doi.org/10.1001/jama.2015.13802>
- 40 Villanti, A. C., Johnson, A. L., Ambrose, B. K., Cummings, K. M., Stanton, C. A., Rose, S. W., Feirman, S. P., Tworek, C., Glasser, A. M., Pearson, J. L., Cohn, A. M., Conway, K. P., Niaura, R. S., Bansal-Travers, M., & Hyland, A. (2017). Flavored tobacco product use in youth and adults: Findings from the first wave of the PATH study (2013-2014). *American Journal of Preventive Medicine*, 52(2), 139-151. <https://doi.org/10.1016/j.amepre.2017.01.026>
- 41 Berg, C. J. (2016). Preferred flavors and reasons for e-cigarette use and discontinued use among never, current, and former smokers. *International Journal of Public Health*, 61(2), 225-236. <https://doi.org/10.1007%2Fs00038-015-0764-x>
- 42 Marshal, M. P., Friedman, M. S., Stall, R., King, K. M., Miles, J., Gold, M. A., Bukstein, O. G., & Morse, J. Q. (2008). Sexual orientation and adolescent substance use: A meta-analysis and methodological review. *Addiction*, 103(4), 546-556. <https://doi.org/10.1111/j.1360-0443.2008.02149.x>
- 43 Day, J. K., Fish, J. N., Perez-Brumer, A., Hatzenbuehler, M. L., & Russell, S. T. (2017). Transgender youth substance use disparities: Results from a population-based sample. *Journal of Adolescent Health*, 61(6), 729-735. <https://doi.org/10.1016/j.jadohealth.2017.06.024>
- 44 Krueger, E. A., Fish, J. N., & Upchurch, D. M. (2020). Sexual orientation disparities in substance use: Investigating social stress mechanisms in a national sample. *Am J Prev Med*, 58(1), 59-68. <https://doi.org/10.1016/j.amepre.2019.08.034>
- 45 Katz-Wise S. L., Sarda, V., Austin, S. B., & Harris, S. K. (2021). Longitudinal effects of gender minority stressors on substance use and related risk and protective factors among gender minority adolescents. *PLoS One*, 16(6). <https://doi.org/10.1371/journal.pone.0250500>
- 46 Watson, R. J., Fish, J. N., McKay, T., Allen, S. H., Eaton, L., & Puhl, R. M. (2020). Substance use among a national sample of sexual and gender minority adolescents: Intersections of sex assigned at birth and gender identity. *LGBT Health*, 7(1), 37-46. <https://dx.doi.org/10.1089%2Flgbt.2019.0066>
- 47 Jacobus, J., & Tapert, S. F. (2014). Effects of cannabis on the adolescent brain. *Current Pharmaceutical Design*, 20(13), 2186-2193.
- 48 D'Souza, D. C., Sewell, R. A., & Ranganathan, M. (2009). Cannabis and psychosis/schizophrenia: Human studies. *European Archives of Psychiatry and Clinical Neuroscience*, 259(7), 413-431. <https://doi.org/10.1007/s00406-009-0024-2>
- 49 U.S. Department of Health and Human Services. (2019). *U.S. Surgeon General's advisory: Marijuana use and the developing brain*. <https://www.hhs.gov/surgeongeneral/reports-and-publications/addiction-and-substance-misuse/advisory-on-marijuana-use-and-developing-brain/index.html>
- 50 Albaugh, M. D., Ottino-Gonzalez, J., Sidwell, A., Lepage, C., Juliano, A., Owens, M. M., Chaarani, B., Spechler, P., Fontaine, N., Rioux, P., Lewis, L., Jeon, S., Evans, A., D'Souza, D., Radhakrishnan, R., Banaschewski, T., Bokde, A. L. W., Quinlan, E. B., Conrod, P.,... Garavan, H. (2021). Association of cannabis use during adolescence with neurodevelopment. *JAMA Psychiatry*, e211258. <https://doi.org/10.1001/jamapsychiatry.2021.1258>
- 51 D'Souza, D. C., Radhakrishnan, R., Naganawa, M., Ganesh, S., Nabulsi, N., Najafzadeh, S., Ropchan, J., Ranganathan, M., Cortes-Briones, J., Huang, Y., Carson, R. E., & Skosnik, P. (2020). Preliminary in vivo evidence of lower hippocampal synaptic density in cannabis use disorder. *Mol Psychiatry*. <https://doi.org/10.1038/s41380-020-00891-4>
- 52 Panlilio, L. V., & Justinova, Z. (2018). Preclinical studies of cannabinoid reward, treatments for cannabis use disorder, and addiction-related effects of cannabinoid exposure. *Neuropsychopharmacology*, 43(1), 116-141. <https://doi.org/10.1038/npp.2017.193>
- 53 Freeman, T., & Winstock, A. (2015). Examining the profile of high-potency cannabis and its association with severity of cannabis dependence. *Psychological medicine*, 45(15), 3181-3189. <https://doi.org/10.1017/s0033291715001178>
- 54 Galli, J. A., Sawaya, R. A., & Friedenber, F. K. (2011). Cannabinoid Hyperemesis Syndrome. *Curr Drug Abuse Rev*, 4(4), 241-249. <https://doi.org/10.2174/1874473711104040241>

- 55 Ferner, R. (2018). Disposition of toxic drugs and chemicals in man 11th edition. *Clinical Toxicology*, 56(3), 234. <https://doi.org/10.1080/15563650.2017.1388920>
- 56 Tu, A. W., Ratner, P. A., & Johnson, J. L. (2008). Gender differences in the correlates of adolescents' cannabis use. *Substance Use and Misuse*, 43(10), 1438-1463. <https://dx.doi.org/10.1080%2F10826080802238140>
- 57 Henry, K. L., Thornberry, T. P., & Huizinga, D. H. (2009). A discrete-time survival analysis of the relationship between truancy and the onset of marijuana use. *Journal of Studies on Alcohol and Drugs*, 70(1), 5-15. <https://doi.org/10.15288/jsad.2009.70.5>
- 58 Marmorstein, N. R., White, H. R., Loeber, R., & Stouthamer-Loeber, M. (2010). Anxiety as a predictor of age at first use of substances and progression to substance use problems among boys. *Journal of Abnormal Child Psychology*, 38(2), 211-224. <https://dx.doi.org/10.1007%2Fs10802-009-9360-y>
- 59 Carvalho, A. F., Stubbs, B., Vancampfort, D., Kloiber, S., Maes, M., Firth, J., Kurdyak, P. A., Stein, D. J., Rehm, J., & Koyanagi, A. (2019). Cannabis use and suicide attempts among 86,254 adolescents aged 12–15 years from 21 low-and middle-income countries. *European Psychiatry*, 56(1), 8-13. <https://doi.org/10.1016/j.eurpsy.2018.10.006>
- 60 Hall, W. (2014). What has research over the past two decades revealed about the adverse health effects of recreational cannabis use? *Addiction*, 110(1), 19-35. <https://doi.org/10.1111/add.12703>
- 61 Paul, S. E., Hatoum, A. S., & Fine, J. D. (2020). Associations between prenatal cannabis exposure and childhood outcomes. *JAMA Psychiatry*, 78(1), 64-76. <https://doi.org/10.1001/jamapsychiatry.2020.2902>
- 62 Winters, K. C., & Lee, C.-Y. S. (2008). Likelihood of developing an alcohol and cannabis use disorder during youth: Association with recent use and age. *Drug and Alcohol Dependence*, 92(1-3), 239-247. <https://dx.doi.org/10.1016%2Fj.drugalcdep.2007.08.005>
- 63 Hasin, D. S., Saha, T. D., Kerridge, B. T., Goldstein, R. B., Chou, S. P., Zhang, H., Jung, J., Pickering, R. P., Ruan, W. J., Smith, S. M., Huang, B., & Grant, B. F. (2015). Prevalence of marijuana use disorders in the United States between 2001-2002 and 2012-2013. *JAMA Psychiatry*, 72(12), 1235-1242. <https://doi.org/10.1001/jamapsychiatry.2015.1858>
- 64 Budney, A. J., & Hughes, J. R. (2006). The cannabis withdrawal syndrome. *Curr Opin Psychiatry*, 19(3), 233-238. <https://doi.org/10.1097/01.yco.0000218592.00689.e5>
- 65 Allsop, D. J., Copeland, J., Norberg, M. M., Fu, S., Molnar, A., Lewis, J., & Budney, A. J. (2012). Quantifying the clinical significance of cannabis withdrawal. *PLoS One*, 7(9), e44864. <https://doi.org/10.1371/journal.pone.0044864>
- 66 Hughes, J. R., Naud, S., Budney, A. J., Fingar, J. R., & Callas, P. W. (2016). Attempts to stop or reduce daily cannabis use: An intensive natural history study. *Psychol Addict Behav*, 30(3), 389-397. <https://doi.org/10.1037/adb0000155>
- 67 Budney, A. J., Roffman, R., Stephens, R. S., & Walker, D. (2007). Marijuana dependence and its treatment. *Addict Sci Clin Pract*, 4(1), 4-16. <https://dx.doi.org/10.1151%2Fascp07414>
- 68 White, W. (2012). *Recovery/remission from substance use disorders: An analysis of reported outcomes in 415 scientific reports, 1868-2011*. Philadelphia Department of Behavioral Health and Intellectual disAbility Services, Great Lakes Addiction Technology Transfer Center. https://www.naadac.org/assets/2416/whitewl2012_recoveryremission_from_substance_abuse_disorders.pdf
- 69 Large, M., & Sharma, S. (2011). Cannabis use and earlier onset of psychosis: A systematic meta-analysis. *Arch Gen Psychiatry*, 68(6), 555-561. <https://doi.org/10.1001/archgenpsychiatry.2011.5>
- 70 Kuepper, R., Van Os, J., Lieb, R., Wittchen, H., Höfler, M., & Henquet, C. (2011). Continued cannabis use and risk of incidence and persistence of psychotic symptoms: 10 year follow-up cohort study. *BMJ*, 342, d738. <https://doi.org/10.1136/bmj.d738>
- 71 Silins, E., Horwood, L. J., Patton, G. C., Fergusson, D. M., Olsson, C. A., Hutchinson, D. M., Spry, E., Toumbourou, J. W., Degenhardt, L., Swift, W., Cofey, C., Tait, R. J., Letcher, P. Copeland, J., & Mattick, R. P. (2014). Young adult sequelae of adolescent cannabis use: An integrative analysis. *The Lancet Psychiatry*, 1(4), 286-293. [https://doi.org/10.1016/s2215-0366\(14\)70307-4](https://doi.org/10.1016/s2215-0366(14)70307-4)
- 72 Fergusson, D. M., & Boden, J. M. (2008). Cannabis use and later life outcomes. *Addiction*, 103(6), 969-976. <https://doi.org/10.1111/j.1360-0443.2008.02221.x>

- 73 Cerdá, M., Moffitt, T. E., Meier, M. H., Harrington, H., Houts, R., Ramrakha, S., Hogan, S., Poulton, R., & Caspi, A. (2016). Persistent cannabis dependence and alcohol dependence represent risks for midlife economic and social problems: A longitudinal cohort study. *Clinical Psychological Science*, 4(6), 1028-1046. <https://doi.org/10.1177/2167702616630958>
- 74 Esposito, M. H., Lee, H., Hicken, M. T., Porter, L. C., & Herting, J. R. (2017). The consequences of contact with the criminal justice system for health in the transition to adulthood. *Longit Life Course Stud*, 8(1), 57-74. <https://doi.org/10.14301/lcls.v8i1.405>
- 75 Gobbi, G., Atkin, T., Zytynski, T., Wang, S., Askari, S., Boruff, J., Ware, M., Marmorstein, N., Cipriani, A., Dendukuri, N., & Mayo, N. (2019). Association of cannabis use in adolescence and risk of depression, anxiety, and suicidality in young adulthood: A systematic review and meta-analysis. *JAMA Psychiatry*, 76(4), 426-434. <https://doi.org/10.1001/jamapsychiatry.2018.4500>
- 76 Fontanella, C. A., Steelesmith, D. L., Brock, G., Bridge, J. A., Campo, J. V., & Fristad, M. A. (2021). Association of cannabis use with self-harm and mortality risk among youths with mood disorders. *JAMA Pediatrics*, 175(4), 377-384. <https://doi.org/10.1001/jamapediatrics.2020.5494>
- 77 Han, B., Compton, W. M., Einstein, E. B., & Volkow, N. D. (2021). Associations of suicidality trends with cannabis use as a function of sex and depression status. *JAMA Network Open*, 4(6), e2113025. <https://dx.doi.org/10.1001%2Fjamanetworkopen.2021.13025>
- 78 Wadekar, A. S. (2020). Understanding opioid use disorder (OUD) using tree-based classifiers. *Drug and Alcohol Dependence*, 208, 107839. <https://doi.org/10.1016/j.drugalcdep.2020.107839>
- 79 Montoya, Z., Conroy, M., Vanden Heuvel, B., Pauli, C. S., & Park, S.-H. (2020). Cannabis contaminants limit pharmacological use of cannabidiol. *Frontiers in Psychiatry*, 11, 571832. <https://dx.doi.org/10.3389%2Ffphar.2020.571832>
- 80 Calabria, B., Degenhardt, L., Hall, W., & Lynskey, M. (2010). Does cannabis use increase the risk of death? Systematic review of epidemiological evidence on adverse effects of cannabis use. *Drug Alcohol Depend*, 29(3), 318-330. <https://doi.org/10.1111/j.1465-3362.2009.00149.x>
- 81 Crane, N. A., Schuster, R. M., Fusar-Poli, P., & Gonzalez, R. (2013). Effects of cannabis on neurocognitive functioning: Recent advances, neurodevelopmental influences, and sex differences. *Neuropsychol Rev*, 23(2), 117-137. <https://doi.org/10.1007/s11065-012-9222-1>
- 82 Monte, A. A., Shelton, S. K., Mills, E., Saben, J., Hopkinson, A., Sonn, B., Devivo, M., Chang, T., Fox, J., Brevik, C., Williamson, K., & Abbott, D. (2019). Acute illness associated with cannabis use, by route of exposure: An observational study. *Annals of Internal Medicine*, 170(8), 531-537. <https://doi.org/10.7326/m18-2809>
- 83 Hyshka, E. (2013). Applying a social determinants of health perspective to early adolescent cannabis use—An overview. *Drugs: Education, Prevention and Policy*, 20(2), 110-119. <https://doi.org/10.3109/09687637.2012.752434>
- 84 Hindocha, C., Freeman, T. P., Schafer, G., Gardner, C., Bloomfield, M. A. P., Bramon, E., Morgan, C. J. A., & Curran, H. V. (2020). Acute effects of cannabinoids on addiction endophenotypes are moderated by genes encoding the CB1 receptor and FAAH enzyme. *Addiction Biology*, 25(3), e12762. <https://doi.org/10.1111/adb.12762>
- 85 Burgdorf, C. E., Jing, D., Yang, R., Huang, C., Hill, M. N., Mackie, K., Milner, T. A., Pickel, V. M., Lee, F. S., & Rajadhyaksha, A. M. (2020). Endocannabinoid genetic variation enhances vulnerability to THC reward in adolescent female mice. *Science Advances*, 6(7). <https://doi.org/10.1126/sciadv.aay1502>
- 86 Johnson, E. C., Demontis, D., Thorgeirsson, T. E., Walters, R. K., Polimanti, R., Hatoum, A. S., Sanchez-Roige, S., Paul, S. E., Wendt, F. R., Clark, T., Lai, D., Reginsson, G. W., Zhou, H., He, J., Baranger, D. A. A., Gudbjartsson, D. F., Wedow, R., Adkins, D. E., Adkins, A. E., ... Agrawal, A. (2020). A large-scale genome-wide association study meta-analysis of cannabis use disorder. *Lancet Psychiatry*, 7(12), 1032-1045. [https://doi.org/10.1016/s2215-0366\(20\)30339-4](https://doi.org/10.1016/s2215-0366(20)30339-4)
- 87 Stephens, P. C., Sloboda, Z., Stephens, R. C., Teasdale, B., Grey, S. F., Hawthorne, R. D., & Williams, J. (2009). Universal school-based substance abuse prevention programs: Modeling targeted mediators and outcomes for adolescent cigarette, alcohol and marijuana use. *Drug and Alcohol Dependence*, 102(1-3), 19-29. <https://doi.org/10.1016/j.drugalcdep.2008.12.016>
- 88 Hollist, D. R., & McBroom, W. H. (2006). Family structure, family tension, and self-reported marijuana use: A research finding of risky behavior among youths. *Journal of Drug Issues*, 36(4), 975-998.
- 89 Rusby, J. C., Light, J. M., Crowley, R., & Westling, E. (2018). Influence of parent–youth relationship, parental monitoring, and parent substance use on adolescent substance use onset. *Journal of Family Psychology*, 32(3), 310-320. <https://dx.doi.org/10.1037%2Ffam0000350>

- ⁹⁰ Kandel, D. B. (2001). *Parental influences on adolescent marijuana use and the baby boom generation: Findings from the 1979-1996 national household surveys on drug abuse*. U.S. Department of Health and Human Services, Substance Abuse and Mental Health Services Administration. <https://files.eric.ed.gov/fulltext/ED466906.pdf>
- ⁹¹ Brook, J. S., Brook, D. W., Arencibia-mireles, O., Richter, L., & Whiteman, M. (2001). Risk factors for adolescent marijuana use across cultures and across time. *The Journal of Genetic Psychology, 162*(3), 357-374. <https://doi.org/10.1080/00221320109597489>
- ⁹² Borawski, E. A., Ievers-Landis, C. E., Lovegreen, L. D., & Trapl, E. S. (2003). Parental monitoring, negotiated unsupervised time, and parental trust: the role of perceived parenting practices in adolescent health risk behaviors. *Journal of Adolescent Health, 33*(2), 60-70. [https://doi.org/10.1016/s1054-139x\(03\)00100-9](https://doi.org/10.1016/s1054-139x(03)00100-9)
- ⁹³ Vermeulen-Smit, E., Verdurmen, J., Engels, R., & Vollebergh, W. (2015). The role of general parenting and cannabis-specific parenting practices in adolescent cannabis and other illicit drug use. *Drug and Alcohol Dependence, 147*, 222-228. <https://doi.org/10.1016/j.drugalcdep.2014.11.014>
- ⁹⁴ Schaps, E., & Solomon, D. (2003). The role of the school's social environment in preventing student drug use. *The Journal of Primary Prevention, 23*(3), 299-328. <https://doi.org/10.1023/A:1021393724832>
- ⁹⁵ Ethier, K. A., Harper, C. R., & Dittus, P. J. (2018). School environment is related to lower health and safety risks among sexual minority middle and high school students. *Journal of Adolescent Health, 62*(2), 143-148. <https://doi.org/10.1016/j.jadohealth.2017.08.024>
- ⁹⁶ Vogel, M., Rees, C. E., McCuddy, T., & Carson, D. C. (2015). The highs that bind: School context, social status and marijuana use. *Journal of Youth and Adolescence, 44*(5), 1153-1164. <https://doi.org/10.1007/s10964-015-0254-8>
- ⁹⁷ Cornell, D., & Huang, F. (2016). Authoritative school climate and high school student risk behavior: A cross-sectional multi-level analysis of student self-reports. *Journal of Youth and Adolescence, 45*(11), 2246-2259. <https://doi.org/10.1007/s10964-016-0424-3>
- ⁹⁸ Sznitman, S. R., & Romer, D. (2014). Student drug testing and positive school climates: Testing the relation between two school characteristics and drug use behavior in a longitudinal study. *Journal of Studies on Alcohol and Drugs, 75*(1), 65-73. <https://doi.org/10.15288/jsad.2014.75.65>
- ⁹⁹ Evans-Whipp, T. J., Plenty, S. M., Catalano, R. F., Herrenkohl, T. I., & Toumbourou, J. W. (2015). Longitudinal effects of school drug policies on student marijuana use in Washington state and Victoria, Australia. *American Journal of Public Health, 105*(5), 994-1000. <https://dx.doi.org/10.2105%2FAJPH.2014.302421>
- ¹⁰⁰ Mulla, M. M., Bogen, K. W., & Orchowski, L. M. (2020). The mediating role of school connectedness in the associations between dating and sexual violence victimization and substance use among high school students. *Prev Med, 139*, 106197. <https://doi.org/10.1016/j.ypmed.2020.106197>
- ¹⁰¹ U.S. Department of Justice. (2000). *Promising strategies to reduce substance abuse: An OJP Issues and Practices Report*. <https://www.ojp.gov/pdffiles1/ojp/183152.pdf>
- ¹⁰² Fletcher, A., Bonell, C., Sorhaindo, A., & Rhodes, T. (2009). Cannabis use and 'safe' identities in an inner-city school risk environment. *International Journal of Drug Policy, 20*(3), 244-250. <https://doi.org/10.1016/j.drugpo.2008.08.006>
- ¹⁰³ Education Development Center. (2017). *CAPT decision-support tools: Preventing youth marijuana use: Factors associated with use - using prevention research to guide prevention practice*. Substance Abuse and Mental Health Services Administration. <http://www.ca-cpi.org/docs/Resources/SAMHSA/Preventing-Youth-Marijuana-Use.pdf>
- ¹⁰⁴ Van den Bee, M. B. M., & Pickworth, W. B. (2005). Risk factors predicting changes in marijuana involvement in teenagers. *JAMA Psychiatry, 62*(3), 311-319. <https://doi.org/10.1001/archpsyc.62.3.311>
- ¹⁰⁵ Thornton, R. L., Glover, C. M., Cené, C. W., Glik, D. C., Henderson, J. A., & Williams, D. R. (2016). Evaluating strategies for reducing health disparities by addressing the social determinants of health. *Health Affairs, 35*(8), 1416-1423. <https://doi.org/10.1377/hlthaff.2015.1357>
- ¹⁰⁶ National Conference of State Legislators. (2020, April 16). *State industrial hemp statutes*. <https://www.ncsl.org/research/agriculture-and-rural-development/state-industrial-hemp-statutes.aspx>
- ¹⁰⁷ Cole, J. M. (2013, August 29). *Memorandum for all United States attorneys: Guidance regarding marijuana enforcement*. U.S. Department of Justice. <https://www.justice.gov/iso/opa/resources/3052013829132756857467.pdf>
- ¹⁰⁸ National Conference of State Legislators. (2021, August 23). *State medical marijuana laws*. <https://www.ncsl.org/research/health/state-medical-marijuana-laws.aspx>

- ¹⁰⁹ Ogden, D. W. (2009, October 19). *Memorandum for selected United States attorneys: Investigations and prosecutions in states authorizing the medical use of marijuana*. U.S. Department of Justice Archives. <https://www.justice.gov/archives/opa/blog/memorandum-selected-united-state-attorneys-investigations-and-prosecutions-states>
- ¹¹⁰ Lampe, J. R. (2019, October 9). *The Controlled Substance Act (CSA): A legal overview for the 116th Congress*. Congressional Research Service. <https://sgp.fas.org/crs/misc/R45948.pdf>
- ¹¹¹ Maxwell, J. C., & Mendelson, B. (2016). What do we know about the impact of the laws related to marijuana? *Journal of Addiction Medicine, 10*(1), 3-12. <https://dx.doi.org/10.1097%2FADM.0000000000000188>
- ¹¹² Svrakic, D. M., Lustman, P. J., Mallya, A., Lynn, T. A., Finney, R., & Svrakic, N. M. (2012). Legalization, decriminalization & medicinal use of cannabis: A scientific and public health perspective. *MO Med, 109*(2), 90-98. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6181739/>



What Research Tells Us

Substance use prevention programs seek to promote positive youth development and build social-emotional, refusal, self-efficacy, and other skills to reduce marijuana initiation and use. Environmental strategies aim to change or influence community conditions, systems, and policies. The interventions included in this chapter should not be considered in isolation. Prevention interventions are most effective when they are coordinated to complement and reinforce one another over time.¹

The programs and strategies included were selected after conducting a comprehensive environmental scan and in collaboration with subject matter experts. Eligible programs and policies were required to meet the following criteria:

- Be clearly defined and replicable
- Address the target outcome of reduction or prevention of marijuana use among youth (middle and high school students)
- Be currently in use
- Have accessible implementation supports

This chapter presents substance use prevention programs that show promise in reducing youth marijuana use or that are effective in reducing substance use in general. A table of prevention programs, with information on their intent, target populations, and key outcomes, is included. The chapter also discusses community interventions and environmental strategies. Although the environmental strategies presented are grounded in the tobacco and/or

alcohol literature, some may also be effective in helping reduce youth marijuana use. States like New York, California, and Colorado are already in the early stages of implementing some of the interventions discussed.

Comprehensive Approaches to Prevention

Prevention is most effective when interventions are matched to the target population's level of risk and needs. To determine risk and needs, community coalitions and prevention organizations conduct a community needs assessment using available data to identify gaps in preventive efforts and the risk and protective factors that influence substance use. Prevention interventions fall into three broad categories:²

1. **Universal prevention interventions** take the broadest approach and are designed to reach all individuals within a particular population by reducing risk factors and promoting protective factors. Universal prevention interventions may include policies/environmental strategies and programs that target individuals in schools, whole communities, or workplaces. Universal prevention interventions are likely to have the broadest impact in affecting populations of varied risk levels at once.³
2. **Selective prevention interventions** target biological, psychological, or social risk factors that are more prominent among groups at high

risk than among the wider population. They may also seek to increase protective factors. The audience for these interventions is often families, parents, or young people, or some combination. Examples include prevention education for youth groups or peer support groups for young adults with a family history of SUD.

- 3. Indicated prevention interventions** target individuals who are already involved in risky behavior, such as substance use, that puts them at risk for SUD. These interventions include referrals to support services for youth who screen positive for substance use or violate substance use policies, or screening and consultation for families of youth admitted to hospitals with potential alcohol-related injuries.

Community coalitions can be essential partners active in selecting and implementing interventions within each of these categories. A strong prevention plan for a community combines programs and environmental strategies across the three categories to reach people with different risk levels and ensure a comprehensive prevention approach.

Research Opportunity

This evidence review identified research studies for alcohol, tobacco, and marijuana. Although the body of research around youth prevention with marijuana-related outcomes is growing, clinicians continue to face the challenge of limited evidence, particularly from well-designed randomized controlled trials (RCTs), when selecting programs to address youth marijuana use. The field would benefit from more research on youth marijuana use, prevention programs and environmental strategies, and the effectiveness of those strategies among diverse populations (inclusive of race, ethnicity, age, and sex).

Youth Substance Use Prevention Programs With Marijuana-Related Outcomes

There is an extensive body of literature demonstrating the effectiveness of substance use prevention programs for reducing youth tobacco, alcohol, and other drug use. Many of these interventions focus on positive youth development and building social-emotional, refusal, self-efficacy, and similar skills. The evidence behind these interventions has been reviewed extensively, including in the [Blueprints for Healthy Youth Development](#) and the [Surgeon General's Report on Alcohol, Drugs, and Health](#).

Programs with a strong evidence base were further evaluated on whether they had been replicated, included fidelity supports, were in use or had been recently updated, and were not prohibitively expensive. These criteria were selected to ensure that diverse stakeholders across a variety of settings could feasibly implement the programs included in this guide. These programs are potential options for families, schools, and communities seeking to prevent youth substance use.

Although some programs are designed to reduce youth marijuana use specifically, most are designed to address substance use in general. The programs listed in the table that are specifically designed to prevent marijuana use currently have limited research available; however, they may be promising in specifically preventing marijuana use among youth.



Promising Marijuana Use Prevention Interventions	Description	Primary Age and/or Grades	Expected Outcomes
Teen Marijuana Check-Up	<p>A brief motivational enhancement intervention publicized as a non-pressured and confidential opportunity for the teen marijuana smoker to “take stock” of his/her use. The intervention is designed for in-school implementation and intended to elicit the teen’s voluntary participation.</p> <p>Cost: It is estimated that the program costs approximately \$100 per participant.</p>	Grades 9 to 12	Reductions in quantity and frequency of marijuana use. ⁴
Cannabis/Marijuana Awareness and Prevention Toolkit	<p>A theory-based and evidence-informed curriculum designed to be implemented by educators, parents, and/or community-based organizations. The curriculum is aimed at preventing middle and high school students from using marijuana.</p> <p>Cost: This program is available for free.</p>	Middle and High School Students	Prevention of marijuana use (studies currently in progress).
SPORT	<p>A single-session screening and brief intervention designed to promote positive healthy behaviors, such as engaging in physical exercise, while also preventing substance use. The creators of SPORT recently developed a new program “Marijuana Prevention Plus Wellness.” This program is adopted from the original evidence-based SPORT program and is designed specifically to prevent marijuana use.⁵</p> <p>Cost: The module costs \$499 per program (separate programs for high school, middle school, adolescent).</p>	Ages 8 to 18; Elementary, Middle, and High School Students ⁵	Prevention of marijuana use and promotion of healthy behaviors, such as engaging in physical activity. ⁵

Broader substance use prevention programs may also have an impact on marijuana use in youth, either by addressing common risk and protective factors for marijuana or other substance use, or because they have a component of their larger program addressing marijuana use.

Each of the programs listed in the table below has demonstrated an impact on broader substance use-related outcomes and may have components that address marijuana specifically.

Additional detail on the evidence behind each of these programs can be found in the [Surgeon General’s Report on Alcohol, Drugs, and Health](#).



Substance Use Prevention Interventions	Description	Primary Age and/or Grades	Expected Outcomes
Family-Focused			
<u>Familias Unidas</u>	<p>A program designed for Hispanic youth and families that targets risk factors, such as poor adolescent communication, and protective factors, such as parental involvement.⁶</p> <p>Cost: The Implementation Package costs \$50,000 to train 10 participants. There are additional costs for more trainees.</p>	Ages 12 to 18; Middle and High School Students ⁶	Prevent substance use and risky sexual behaviors. ⁶
<u>Guiding Good Choices</u>	<p>A five-session curriculum that supports parents in reducing the risk that their child will engage in substance use. Children attend one session that teaches substance use resistance skills. Parents attend the remaining four sessions and learn skills needed to reduce the risk that their child will engage in substance use.⁷</p> <p>Cost: A one-time group leader training is required. A 3-day on-site training for up to 12 participants is \$4,200 plus travel. The Core Program Kit costs \$881. Family Guides cost \$13.99 per family.</p>	Ages 11 to 14; Middle School Students ⁷	Reduce drug use and related behavioral problems. ⁷ Reduction in use and related behavioral problems, as found in a study with schools blocked on school size and a proportion of students in lower income households. ⁷
<u>Strengthening Families Program</u>	<p>A program that reduces substance use and behavior problems among youth by engaging youth and their families in skills training sessions. Sessions are designed to enhance protective factors, such as family relationships, parenting skills, and youth social and emotional skills.⁸</p> <p>Cost: Estimates for the total program for one course of 10 families is \$13,800, plus an additional \$2,200 for 6 and 12 month boosters.</p>	Ages 10 to 14; Middle and High School Students ⁸	Reduce risk factors for later alcohol and drug use, mental health problems, and delinquency. ⁸
School-Focused			
<u>All Stars</u>	<p>A student-centered program designed to delay the onset of risky behaviors among youth. The curriculum includes group activities, games, art projects, video making, small group discussions, partner work, and a parent component.⁹</p> <p>Cost: A package ranges from \$4-10 per student; teachers' manuals are \$100 each.</p>	Ages 10 to 19; Elementary, Middle, and High School Students ⁹	Delay the onset of risky behaviors. Specific behaviors targeted by the program include use of tobacco, marijuana, opioids, and inhalants, fighting and bullying, and early sexual activity. ⁹

Substance Use Prevention Interventions	Description	Primary Age and/or Grades	Expected Outcomes
<u>Keepin' It Real</u>	<p>A substance use prevention and social and emotional competency enhancing program, in which lessons are based on real stories of adolescents and designed to be highly interactive. There are three versions of the program: multicultural, rural, and Spanish.¹⁰</p> <p>Cost: It is \$300 to purchase the program, plus \$7 per student.</p>	Ages 11 to 19; Middle and High School Students ¹⁰	<p>Prevent substance use.</p> <p>Enhance social and emotional competencies.¹⁰</p>
<u>LifeSkills Training</u>	<p>A classroom-based universal prevention program that teaches personal self-management, social, and information and resistance skills related to drug use.¹¹</p> <p>Cost: Full curriculum sets range from \$265-\$645 for one teacher's manual and 30 student guides depending on grade level.</p>	Ages 9 to 19; Elementary, Middle, and High School Students. ¹¹	Prevent substance use and violent behaviors. ¹¹
<u>Good Behavior Game</u>	<p>Also called the PAX Good Behavior Game, this program is a set of strategies to help students learn important self-management skills while collaborating to make their classroom a peaceful and productive learning environment.¹²</p> <p>Cost: Each staff person implementing the program is required to purchase the standard kit (\$199 per kit) or the PLUS kit (\$249 per kit). Training ranges from \$2,500-\$13,000 depending on number of training days needed.</p>	Ages 5 to 11; Elementary School Students ¹²	<p>Increase capacity for self-regulation.</p> <p>Improve academic performance.</p> <p>Reduce alcohol and other illicit drug use.</p> <p>Improvement in health outcomes.¹³</p>
<u>PreVenture</u>	<p>Prevents substance use among at-risk youth by introducing motivational pathways and coping skills tailored to each youth's personality profile.¹⁴</p> <p>Cost: There is no cost to participate, but facilitators must be trained (\$780) and their certification renewed each year (\$120).</p>	Ages 13 to 19; High School Students ¹⁴	Promote positive mental health outcomes and prevent substance use, including delayed initiation and reduced frequency of marijuana use. ¹⁴
<u>Project Alert</u>	<p>Designed to instill negative attitudes and beliefs about drug use, while also equipping youth with the skills needed to say no to drugs. The program curriculum takes the form of short, fast-paced lessons that can be easily incorporated into the school day.¹⁵</p> <p>Cost: This program is available for free.</p>	Ages 11 to 14; Middle School Students ¹⁵	<p>Reduce substance use.</p> <p>Foster anti-drug attitudes and beliefs.</p> <p>Improve drug resistance skills.¹⁵</p>

Substance Use Prevention Interventions	Description	Primary Age and/or Grades	Expected Outcomes
<u>Project Towards No Drug Abuse</u>	<p>A drug prevention program designed for at-risk youth, providing instruction in motivation activities to not use drugs, skills in self-control, communication, and resource acquisition, and decision-making strategies.¹⁶</p> <p>Cost: Initial training and technical assistance costs \$2,100 plus trainer travel costs for a two-day training for up to 25 teachers. An additional \$200 per teacher's manual and \$12 per student workbook.</p>	Ages 14 to 19; High School Students ¹⁶	Prevent problem behaviors, including alcohol, tobacco, and other drug use by positively affecting youth's decision-making, motivational factors, and skills such as social self-control. ¹⁶
Community-Focused			
<u>Communities that Care*</u>	<p>A program that guides communities through a five-stage process, beginning with catalyzing community members and assessing a community's risks and strengths. The goals of the program are to promote healthy youth development, improve youth outcomes, and reduce problem behaviors.¹⁷</p> <p>Cost: Estimated costs for the first year of the program are \$127,000 and include training and technical assistance, a coordinator, and a youth survey.</p>	Ages 10 to 17; Middle and High School Students ¹⁷	Prevent problem behaviors, including substance use and delinquency. ¹⁷
PROSPER* <i>PROMoting Partnerships to Enhance Resilience</i>	<p>An evidence-based delivery system designed to strengthen families, build youth skills, and reduce youth substance use, as well as other problem behaviors. Community teams composed of representatives from community service agencies, parents, youth, and other community members implement the system.¹⁸</p> <p>Cost: Estimated costs for the first year of the program are \$149,000 and include implementation plans, trainings, staff, access to the data system, and data collection.</p>	Ages 10 to 14; Middle School Students ¹⁸	Prevent problem behaviors, including substance use. Promote positive youth development and strong families. ¹⁸
<p>*Note that these programs can be considered processes for selecting and implementing the most appropriate substance use interventions for specific communities. They are often defined as frameworks to support the successful implementation of prevention programs in communities.</p>			

Community-Level Interventions/ Environmental Strategies

Community-level interventions focus on the entire population or a specific population segment within a country, state, county, or city. Environmental strategies attempt to change social norms and attitudes, systems, and economic conditions to influence behavior and reduce marijuana use.

States considering legalizing marijuana may want to establish a minimum purchasing and use age of at least 21, comparable to the legal age to purchase alcohol and tobacco. This is of particular importance when considering that marijuana remains illegal at the federal level and research continues to demonstrate its negative impacts on the developing brain.

Laws, policies, and ordinances are examples of community-level, environmental interventions. There are several evidence-based prevention policies stakeholders can consider for preventing marijuana use in states where non-medical or medical marijuana use is legal. Given the increasing number of states that have legalized marijuana for adult use, many local and state governments are grappling with how to best regulate a newly legal marijuana market. Stakeholders can implement each of the environmental strategies discussed in this chapter at the state and/or local level, depending on the specific laws of each state. Community coalitions and state and local public health officials should be involved in determining which environmental strategies are most appropriate and supporting the implementation of those strategies.

This chapter provides insight into some of the options communities are implementing to prevent and reduce youth marijuana use. It draws on evidence from alcohol and tobacco use prevention efforts and examples from states implementing these strategies as part of their marijuana retail system. When available, the guide separately presents the evidence related to marijuana.

Currently, evidence on the impact of these environmental strategies to prevent youth marijuana use is limited because legalization of marijuana is relatively new.

States and localities are only recently able to regulate marijuana's sale, purchase, and marketing.

The environmental strategies discussed here are a sample of evidence-based approaches that may reduce youth marijuana use. Many are based on evidence from alcohol and tobacco studies showing that reducing access to and the availability of substances significantly impacts youth use of those substances. The policies described in this guide include regulating the price, number and characteristics of retail outlets that sell marijuana, specific products permitted to be sold, and content and placement of marijuana marketing.

Environmental strategies in this guide are summarized in the table below.



Strategy	Characteristics	Expected Outcomes
Regulation of the price of marijuana	<ul style="list-style-type: none"> Increasing taxes (either by weight, THC content, or price). Banning price promotions (such as coupons, two for one deals, and happy hours). 	<ul style="list-style-type: none"> Decrease in youth marijuana use. Decrease in use of high potency marijuana products.¹⁹ This study uses administrative records from the Washington State Liquor and Cannabis Board.¹⁹
Regulation of marijuana retail outlets	<ul style="list-style-type: none"> Limiting number and locations of retailers through licensing or zoning. Limiting hours/days of sale. Banning those under the age of 21 in dispensaries. Regulating where marijuana and related products can be sold. 	<ul style="list-style-type: none"> Decrease in youth marijuana use, as reported in a study that includes data from a cross-section of 6th, 8th, and 11th graders in 35 Oregon counties.²⁰
Regulation of marijuana product manufacturing and packaging	<ul style="list-style-type: none"> Banning marijuana products with added synthetic flavors and odors. Banning THC-infused edibles likely to attract children and youth, such as candies, cookies, and beverages. Banning THC-infused alcohol and tobacco products. Requiring plain product packaging. Requiring transparency on product labels, including THC and CBD content and ingredients. Require prominent graphic marijuana warning labels with varied and rotating messaging. 	<ul style="list-style-type: none"> Reduction in youth marijuana initiation. Reduction in youth marijuana use and use disorder. Reduction in use of flavored edibles. Increased health knowledge. Increased motivation to quit. Reduced brand awareness and identification. Reduction in product appeal. Increase in understanding of the risks of marijuana.²¹⁻²³
Limitations on marijuana advertising and marketing	<ul style="list-style-type: none"> Banning marijuana advertising on television, radio, billboards, and social media. If not banned, limiting advertising with youth audiences. Removing marketing, promotion, and advertising dollars from admissible business expenses for state income tax calculations. Funding public health media campaigns. Prohibiting health and therapeutic claims. 	<ul style="list-style-type: none"> Increase in understanding the risks of marijuana. Reduction in positive perceptions of marijuana use. Decrease in youth marijuana use. Reduction in advertising by marijuana retailers.²⁴⁻²⁵ The Davis study uses data from 6th through 12th graders in seven communities.²⁵

Price and Taxation of Marijuana

Like alcohol and tobacco, the cost of marijuana can be controlled by raising the price of the product through taxes and establishing a price floor (i.e., minimum price). Youth and young adults are particularly responsive to tax increases because they generally have limited disposable income; therefore, high prices deter purchase and use.²⁶⁻²⁸ Based on studies about youth alcohol and tobacco use, increasing the cost of marijuana products by taxing them may be an effective marijuana use prevention and reduction intervention,²⁹⁻³⁰ though research on the effects of marijuana taxes on youth use are not currently available.³¹

Raising alcohol and tobacco taxes is recommended as one of the best ways to reduce use, particularly among youth.³²⁻³³ For example, increasing the price of cigarettes by 10 percent reduces adult smoking by only 2 percent, young adult (ages 20 to 25) smoking by 4 percent, and youth (ages 12 to 17) smoking by approximately 7 percent.³⁴ Data from 43 states found that for every dollar increase in the cigarette tax, there was a 2 percent reduction in smoking among 14- and 15-year-olds.³⁵ This study uses data from the 1999-2013 Youth Risk Behavior Surveys.³⁵ Similarly, a 10 percent increase in alcohol prices would be expected to result in a 3 to 10 percent decrease in alcohol consumption across the population.^{36 32-33}

Revenue from increasing marijuana taxes may be earmarked specifically for prevention, treatment, counter-marketing, and research and evaluation to help continue efforts to protect the health and safety of youth. This revenue should supplement the funds that are already earmarked for these activities. For example:

- California uses tax revenue for a youth prevention, education, and treatment fund, as well as childcare and community reinvestment.
- Colorado uses tax revenue for education programs.
- Massachusetts uses tax revenue for public safety programs.
- Oregon uses tax revenue for drug misuse prevention and treatment programs.
- Maine plans to use its tax revenues for public health and public safety programs.³⁷

Importantly, any price strategy implemented should automatically account for inflation each year for the tax to not lose value over time.

In addition to taxation, banning price promotions, such as buy one get one free deals, happy hours, bulk purchases, or gifting marijuana products when non-marijuana products are sold and vice versa, can also help reduce youth marijuana use. This strategy has been shown effective in preventing use and misuse of alcohol and tobacco. For example, youth who live in counties with more coupons and price promotions are more likely to be current smokers than youth who live in counties with fewer coupons and price promotions.³⁸⁻³⁹ The Kim study uses data from a representative sample of licensed tobacco retailers in New York.³⁹

Implementation Examples

- California has established a separate tax per ounce on marijuana flowers and leaves.⁴⁰
- Illinois⁴¹ and New York⁴² tax marijuana based on level of THC content.
- Washington has implemented a 37 percent excise tax on retail price, and bans discounts on marijuana, including coupons and sale/clearance products.⁴³

Regulation of Retail Outlets Through Licensing and/or Zoning

There are two primary ways a jurisdiction or state can potentially limit the number and location of marijuana retailers: licensing and zoning.⁴⁴

Licensing regulates and affords certain rights to businesses and can be used to limit the number of marijuana establishments. Zoning rules are legal guides that determine where businesses can operate and determine where marijuana establishments can be located.⁴⁴

Licensing and zoning authority generally depends on the regulatory structure of the state and localities; and licensing can often be controlled through a public health entity, such as a local or state public health department. A state's regulatory structure, specifically the state's marijuana laws, will likely dictate how much authority localities have in passing licensing, zoning, or other ordinances. Licensing is often done at the state level but can also be combined with local licensing. Zoning is one of the strategies most frequently implemented by local city and county governments to regulate access to marijuana in response to their specific local data.

These policies should be considered in tandem. For example, pairing a zoning ordinance with density caps on retailers can help avoid clustering of numerous outlets within one small area, which has shown adverse effects for youth alcohol use,⁴⁵⁻⁴⁶ and can help prevent marijuana establishments from being disproportionately located in low income areas.⁴⁷ For marijuana outlets, a government-controlled distribution system may have the greatest potential to protect public health, as is the case for alcohol in 17 states and several other jurisdictions.⁴⁸⁻⁴⁹

Implementation Examples

- Washington⁵⁰ and Oregon⁵¹ do not allow marijuana outlets within 1,000 feet of any school or other sensitive areas.
- Nevada limits retail licensing based on population size at the county level. For example, a county with a population between 100,000 and 699,999 may have up to 20 licensed retailers, whereas counties with 55,000 to 99,999 people may have four, and counties with populations of less than 55,000 may license two retailers.⁵²



Restricting Youth Access to Marijuana in Retail Establishments

States and jurisdictions can limit marijuana retailer hours and the manner of marijuana delivery to reduce youth access. The Community Preventive Services Task Force^a recommends limiting the hours of alcohol sale in on-premise settings based on evidence that it reduces excessive alcohol consumption and related harms.^{29, 53} Local and state governments can take a similar approach in regulating marijuana and some have already done so.

^a The Community Preventive Services Task Force is an independent panel of public health and prevention experts who come together to provide evidence-based findings and recommendations on community-based health promotion and disease prevention interventions.

Additionally, allowing youth into marijuana establishments may create numerous challenges, including requiring age verification at the point of sale in addition to the point of entry, and normalizing marijuana use for youth. Allowing access to marijuana establishment only to people 21 and older can help prevent these challenges.

Relatedly, states have reduced youth exposure to marijuana products by mandating that only marijuana is sold in explicitly licensed dispensaries and establishments; other products, such as sodas, snacks, alcohol, or tobacco are not to be sold in these establishments. Similarly, prohibiting marijuana sales in grocery stores and other retail establishments will decrease availability of, and youth access to, the product.

Implementation Examples

- Colorado has restricted the hours that marijuana retailers can be open from 8 a.m. to midnight.⁵⁴
- All states currently require anyone entering marijuana establishments to be at least 21 years old, except for those with a medical recommendation.

Banning Products and Packaging That Attract Youth

Marijuana products with added synthetic flavors and odors (such as fruit and candy) may be particularly attractive to youth. These products, typically flavored for inhalation, include vapes and flavored wrappers for combusted products like blunts. Additionally, strains and products may be named as if they were flavored (e.g., mango vapes, Cherry Pie, Pineapple Haze, Peanut Butter Cup) even if they are not, which may be just as effective at attracting youth. THC-infused foods and beverages, such as candies, cookies, sodas, and teas may also have packaging that mimics existing food or beverage products commonly marketed to youth. States that have legalized non-medical marijuana have considered banning these products. Products attractive to youth should be prohibited using clear, detailed, and enforceable regulations.



Additionally, marijuana products with high potency pose increased health risk to youth,⁵⁵⁻⁵⁶ including increase in frequency of use, likelihood of marijuana dependence, and risk of an anxiety disorder and psychosis.⁵⁷⁻⁵⁸ Regulating the products that are sold and how they are packaged may help prevent youth initiation or reduce current use. Research on flavored tobacco bans found a decrease in adolescent tobacco use after passage of this policy, including reductions in the probability of being a smoker and the number of cigarettes smoked.⁵⁹

Implementation Examples

- Contra Costa County, California has prohibited flavored marijuana products for combustion or inhalation and banned vaping products to protect youth.⁶⁰ Michigan, Oregon,⁶¹ and four California cities have banned THC-infused beverages.⁶¹
- Connecticut limits flower potency to 30 percent THC and concentrates to 60 percent, and prohibits the addition of flavors, terpenes, and other additives to marijuana unless pre-approved.⁶²

Regulating Marijuana Packaging

Marijuana product packaging with cartoon images or imagery appeals to youth. For example, children are drawn to food packaging that includes color, novel shapes, products that smell sweet, fruity, or like candy, and cartoons or promotional characters.⁶³ The imagery on products serves as brand identification for youth and as marketing at in-store displays.²² Efforts to reduce youth-appealing marketing and the implementation of plain packaging laws for tobacco products have led to reductions in youth tobacco use.⁶⁴⁻⁶⁵

The Dunlop study used data from adult smokers in New South Wales, Australia.⁶⁴ Packaging can be regulated to reduce youth access by requiring it to be tamper-resistant, child-resistant, opaque, and resealable. They can be made less attractive to children and youth by restricting names, flavors, images of people, animals, cartoon figures, bright colors, logos, and branding,⁶⁶ and prohibiting products and packaging that imitate non-marijuana products (such as candy, chips, or granola bars).²²

Additionally, marijuana packaging, particularly on edibles, can be mandated to include nutrition facts and serving sizes, ingredient lists, expiration dates, and lot numbers. Regulations can explicitly prohibit false statements or health claims on packaging labels.

Finally, clear and large warning labels identifying the harms of marijuana use should be placed on the marijuana packaging, as is done with both tobacco and alcohol products.

Implementation Examples

- Alaska and Massachusetts have mandated opaque, plain packaging for marijuana products.⁶⁷⁻⁶⁸ Hawaii has done the same for medical marijuana.⁶⁹
- Indiana, Utah, Texas, and Florida require a QR code that allows consumers to look up batch numbers, potency, and other ingredients.⁷⁰⁻⁷³
- Canada requires prominent rotating warning labels on a yellow background. For example: “WARNING: Adolescents and young adults are at greater risk of harms from cannabis. Daily or near-daily use over a prolonged period of time can harm brain development and function.”⁷⁴
- California requires that all marijuana products include a warning label. The label must read: “WARNING: This product can expose you to marijuana smoke, which is known to the state of California to cause cancer, birth defects, and other reproductive harm.”⁷⁵

Limiting Marijuana Advertising and Marketing

There is a substantial body of literature that shows that increased exposure to alcohol and tobacco marketing leads to increases in youth use of these products;⁷⁶⁻⁷⁸ similar findings are emerging in marijuana marketing, as well.⁷⁹

A recent report found that 69 percent of U.S. consumers do not understand the difference between THC and CBD.⁶⁵ Additionally, technical names for THC analogs (e.g., Delta-8, Delta-10, and THC-O acetate) can further confuse consumers. Transparency on marijuana product labels can help consumers distinguish between CBD products that do and do not have THC elements, preventing potentially harmful levels of THC in the bloodstream, particularly among youth.⁶⁴⁻⁶⁵

Reducing youth exposure to marijuana marketing may help prevent or reduce marijuana use among youth and young adults. Strategies include banning advertising on television, radio, billboards, and social media, and limiting advertising with youth audiences, such as advertising on billboards or other forms of media. For example, advertising can be prohibited in venues where more than 10 or 15 percent of the audience are youth between the ages of 12 and 20.⁸⁰⁻⁸¹

SOCIAL MEDIA

While paid advertisements for marijuana products are prohibited on social media platforms, such as Facebook, Instagram, and Twitter, there is still substantial marijuana marketing through other channels, such as social media influencers sharing posts of the product. Influencers are people who have built a reputation for their knowledge on a specific product or lifestyle, and who will often share brands or products with their followers, encouraging them to purchase those products. Studies have found that pro-marijuana content is prevalent on social media frequently seen by youth and young adults.⁸³ One in three youth in states with legal recreational marijuana have been found to engage (such as liking or following) with marijuana brands on social media.⁸⁴ This engagement poses a challenge to parents, communities, and stakeholders, as exposure to marijuana marketing is linked with increased use.⁸⁵

The role of state and local governments in regulating advertising on social media is challenging. States such as Rhode Island have taken innovative approaches to reduce marijuana marketing by third parties on social media, requiring that if any third party uses a marijuana brand's trademark, brand, name, location, or other characteristics on social media, the company must notify the Department of Business Regulation. The marijuana company must also send a cease-and-desist notice to the third party.⁸⁶

Additionally, parents and community coalitions can work directly with social media platforms to discourage marketing of these products by third parties.

Additional strategies include reducing misleading information about the harmfulness of marijuana products by prohibiting health-related claims on any marijuana advertisements, and removing marijuana marketing, promotion, and advertising dollars from admissible business expenses for tax purposes.

Implementation Examples

- Colorado has instituted a policy that retail marijuana establishments cannot advertise on television, radio, print media, or websites where more than 30 percent of the audience is under the age of 21.⁸² Other states may consider lower thresholds, such as 10 to 15 percent.
- Mono County and the city of Palm Springs in California do not allow health or therapeutic claims on marijuana products or their marketing.

Funding Public Health Media Campaigns

To counteract the marketing and advertising campaigns of the marijuana industry, states and communities can develop public health media campaigns to promote science-based messages about youth marijuana use, leading to reductions in youth use and shifts away from positive attitudes.

These campaigns are most effective when used in conjunction with other environmental strategies, such as taxes.²¹ Public health prevention campaigns, such as the Truth Campaign, that discuss the harms of certain products have been effective in preventing and reducing youth substance use.²⁵

Reference List

- ¹ McMorris, B. J., Hemphill, S. A., Toumbourou, J. W., Catalano, R. F., & Patton, G. C. (2007). Prevalence of substance use and delinquent behavior in adolescents from Victoria, Australia and Washington State, United States. *Health Educ Behav*, 34(4), 634-650. <https://doi.org/10.1177%2F1090198106286272>
- ² Institute of Medicine. (1994). *Reducing risks for mental disorder: Frontiers for preventive intervention research* (P. J. Mrazek, & R. J. Haggerty, Eds.). The National Academic Press. <https://pubmed.ncbi.nlm.nih.gov/25144015/>
- ³ Frieden, T. R. (2010). A framework for public health action: The health impact pyramid. *American Journal of Public Health*, 100(4), 590-595. <https://dx.doi.org/10.2105%2FAJPH.2009.185652>
- ⁴ Budney, A. J., Roffman, R., Stephens, R. S., & Walker, D. (2007). Marijuana dependence and its treatment. *Addict Sci Clin Pract*, 4(1), 4-16. <https://dx.doi.org/10.1151%2Fascp07414>
- ⁵ Prevention Plus Wellness. (2021). *Marijuana prevention plus wellness*. <https://preventionpluswellness.com/products/sport-marijuana-awareness-program>
- ⁶ University of Miami Miller School of Medicine Department of Public Health. (n.d.). *Familias Unidas*. <https://familias-unidas.info/>
- ⁷ Blueprints for Healthy Youth Development. (2018). *Guiding Good Choices (GGC)*. <https://www.blueprintsprograms.org/guiding-good-choices-ggc/>
- ⁸ Kumpfer, K. (2020). *Strengthening Families Program*. <https://strengtheningfamiliesprogram.org/>
- ⁹ All Stars. (2021). *All Stars Core*. <https://www.allstarsprevention.com/all-stars-core.html>
- ¹⁰ Real Prevention. (n.d.). *Keepin' it real*. <https://real-prevention.com/keepin-it-real/>
- ¹¹ Botvin LifeSkills Training. (n.d.). *Program Structure*. <https://www.lifeskillstraining.com/program-structure/>
- ¹² Blueprints for Healthy Youth Development. (2021). *Good Behavior Game*. <https://www.blueprintsprograms.org/programs/20999999/good-behavior-game/>
- ¹³ PAXIS Institute. (2021). *PAX Good Behavior Game*. <https://www.paxis.org/pax-good-behavior-game>
- ¹⁴ Venture Lab. (n.d.). *Prevention*. <https://www.conrodventurelab.com/projets/prevention>
- ¹⁵ Project Alert. (2021). *Substance abuse prevention for grades 7 & 8*. <https://www.projectalert.com/>
- ¹⁶ University of Southern California Institute for Prevention Research. (2021). *Project Towards No Drug Abuse*. <https://tnd.usc.edu/>
- ¹⁷ University of Washington. (2021). *The Center for Communities that Care*. <https://www.communitiesthatcare.net/>
- ¹⁸ Prosper. (2021). *PROSPER Partnerships*. <http://helpingkidsprosper.org/>
- ¹⁹ Hansen, B., Miller, K., & Weber, C. (2017). The taxation of recreational marijuana evidence from Washington state. *NBER Working Paper Series*, 23632. https://www.nber.org/system/files/working_papers/w23632/revisions/w23632.rev0.pdf
- ²⁰ Paschall, M. J., & Grube, J. W. (2021). Recreational marijuana availability in Oregon and use among adolescents. *Am J Prev Med*, 58(2), 63-69. <https://dx.doi.org/10.1016%2Fj.amepre.2019.09.020>
- ²¹ Wakefield, M. A., Loken, B. & Hornik, R. C. (2010). Use of mass media campaigns to change health behaviour. *The Lancet*, 376(9748), 1261-1271. [https://dx.doi.org/10.1016%2F0140-6736\(10\)60809-4](https://dx.doi.org/10.1016%2F0140-6736(10)60809-4)
- ²² Orenstein, D. G., & Glantz, S. A. (2018). Regulating cannabis manufacturing: Applying public health best practices from tobacco control. *Journal of Psychoactive Drugs*, 50(1), 19-32. <https://dx.doi.org/10.1080%2F02791072.2017.1422816>
- ²³ National Center for Chronic Disease Prevention and Health Promotion (US) Office on Smoking and Health. (2012). *Preventing tobacco use among youth and young adults: A report of the Surgeon General*. <https://www.ncbi.nlm.nih.gov/books/NBK99237/>
- ²⁴ Jacobs, L. G. (2017). Regulating marijuana advertising and marketing to promote public health: Navigating the constitutional minefield. *Lewis & Clark Review*, 21(4), 1081-1133.

- 25 Davis, K. C., Farrelly, M. C., Messeri, P., & Duke, J. (2009). The impact of national smoking prevention campaigns on tobacco-related beliefs, intentions to smoke and smoking initiation: Results from a longitudinal survey of youth in the United States. *Int. J. Environ. Res. Public Health*, 6(2), 722-740. <https://dx.doi.org/10.3390%2Fijerph6020722>
- 26 Van Ours, J. C. (2007). Cannabis use when it's legal. *Addictive Behaviors*, 32(7), 1441-1450. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=670141
- 27 Pacula, R. L., & Lundberg, R. (2014). Why changes in price matter when thinking about marijuana policy: A review of the literature on the elasticity of demand. *Public Health Review*, 35(2), 1-18. <https://dx.doi.org/10.1007%2FBF03391701>
- 28 Gruber, J., & Zinman, J. (2001). Youth smoking in the U.S.: Evidence and implications. In J. Gruber (Ed.), *Risky behavior among youths: An economic analysis* (pp. 69-120). University of Chicago Press. <https://www.nber.org/system/files/chapters/c10687/c10687.pdf>
- 29 Community Preventive Services Task Force. (2009). *Alcohol - Excessive consumption: Maintaining limits on hour of sale*. <https://www.thecommunityguide.org/findings/alcohol-excessive-consumption-maintaining-limits-hours-sale>.
- 30 Wagenaar, A. C., Tobler, A. L., & Komro, K. A. (2010). Effects of alcohol tax and price policies on morbidity and mortality: A systematic review. *Am J Public Health*, 100(11), 2270-2278. <https://dx.doi.org/10.2105%2FAJPH.2009.186007>
- 31 Chaloupka, F. J., Yureki, A., & Fong, G. T. (2012). Tobacco taxes as a tobacco control strategy. *Tobacco Control*, 21, 172-180. <https://doi.org/10.1136/tobaccocontrol-2011-050417>
- 32 World Health Organization. (2017). *Tobacco taxes in WHO member states*. https://www.who.int/tobacco/global_report/2017/technical_note_III.pdf
- 33 Chisholm, D., Doran, C., Shibuya, K., & Rehm, J. R. (2006). Comparative cost-effectiveness of policy instruments for reducing the global burden of alcohol, tobacco and illicit drug use. *Drug and Alcohol Review*, 25, 552-563. <https://doi.org/10.1080/09595230600944487>
- 34 Chaloupka, F. J., & Warner, K. E. (1999). The Economics of Smoking. *NBER Working Paper Series*, 7047. [10.3386/w7047](https://doi.org/10.3386/w7047)
- 35 Hawkins, S. S., Bach, N., & F. Baum, C. (2016). Impact of tobacco control policies on adolescent smoking. *Journal of Adolescent Health*, 58(6), 679-685. <https://dx.doi.org/10.1016%2Fj.jadohealth.2016.02.014>
- 36 Elder, R., Lawrence, B., Aneeqah, Ferguson, Naimi, T. S., Brewer, R. D., Chattopadhyay, S. K., Toomey, T. L., & Fielding, J. E. (2010). The effectiveness of tax policy interventions for reducing excessive alcohol consumption and related harms. *Am J Prev Med*, 38(2), 217-229. <https://dx.doi.org/10.1016%2Fj.amepre.2009.11.005>
- 37 Urban Institute. (2021). *Marijuana taxes*. <https://www.urban.org/policy-centers/cross-center-initiatives/state-and-local-finance-initiative/state-and-local-backgrounders/marijuana-taxes#:~:text=Marijuana%20purchases%20are%20also%20subject,and%20%240.35%20per%20marijuana%20seed>.
- 38 Pacula, R. L., Kilmer, B., Wagenaar, A. C., Frank J. Chaloupka, & Jonathan P. Caulkins. (2014). Developing public health regulations for marijuana: Lessons from alcohol and tobacco. *Am J Public Health*, 104(6), 1012-1028. <https://dx.doi.org/10.2105%2FAJPH.2013.301766>
- 39 Kim, A. E., Loomis, B. R., Busey, A. H., Farrelly, M. C., Willett, J. G., & Juster, H. R. (2013). Influence of retail cigarette advertising, price promotions, and retailer compliance on youth smoking-related attitudes and behaviors. *Journal of Public Health Management and Practice*, 19(6), E1-9. <https://doi.org/10.1097/phh.0b013e3182980c47>
- 40 California Department of Tax and Fee Administration. (2020). *Tax guide for cannabis businesses*. <https://www.cdtfa.ca.gov/industry/cannabis.htm>
- 41 Illinois Revenue. (n.d.). *Cannabis taxes*. <https://www2.illinois.gov/rev/research/taxinformation/other/Pages/Cannabis-Taxes.aspx>
- 42 Newman, G., & Peleg, S. (2021). Tax issues and the New York Regulation and Taxation Act. *The National Law Review*, XI(90). <https://www.natlawreview.com/article/tax-issues-and-new-york-marijuana-regulation-and-taxation-act>
- 43 Washington State Liquor and Cannabis Board. (2020). *Marijuana Tax Reporting Guide*. <https://lcb.wa.gov/taxreporting/marijuana-tax-reporting-guide>
- 44 ChangeLab Solutions and National Policy & Legal Analysis Network. (2012). *Healthy planning policies: A compendium from California general plans*. https://www.changelabsolutions.org/sites/default/files/Healthy_Planning_Policies_Compendium_FINAL_%28CLS-20120530%29_090925.pdf
- 45 Grubestic, T. H., & Pridemore, W. A. (2011). Alcohol outlets and clusters of violence. *International Journal of Health Geographics*, 10, 30. <https://dx.doi.org/10.1186%2F1476-072X-10-30>

- 46 Reboussin, B. A., Song, E.-Y., & Wolfson, M. (2011). The impact of alcohol outlet density on the geographic clustering of underage drinking behaviors within census tracts. *Alcoholism: Clinical and Experimental Research*, 35(8), 1541-1549. <https://dx.doi.org/10.1111%2Fj.1530-0277.2011.01491.x>
- 47 Trangenstein, P. J., Sadler, R. C., Morrison, C. N., & Jernigan, D. H. (2020). Looking back and moving forward: The evolution and potential opportunities for the future of alcohol density measurement. *Addiction Research & Theory*, 29(2), 117-128. <https://doi.org/10.1080/16066359.2020.1751128>
- 48 Silver, L. D., Naprawa, A. Z., & Padon, A. A. (2020). Assessment of incorporation of lessons from tobacco control in city and county laws regulating legal marijuana in California. *JAMA Network Open*, 3(6), e208393-e208393. <https://doi.org/10.1001/jamanetworkopen.2020.8393>
- 49 Hahn, R. A., Middleton, J. C., Elder, R., Brewer, R., Fielding, J., Naimi, T. S., Toomey, T. L., Chattopadhyay, S., Lawrence, B., & Campbell, C. A. (2012). Effects of alcohol retail privatization on excessive alcohol consumption and related harms: A community guide systematic review. *Am J Prev Med*, 42(4), 418-427. <https://doi.org/10.1016/j.amepre.2012.01.002>
- 50 Municipal Research and Services Center (MRSC). (2019). *Marijuana Regulation in Washington State*. <http://mrsc.org/getdoc/8cd49386-c1bb-46f9-a3c8-2f462dcb576b/Marijuana-Regulation-in-Washington-State.aspx>
- 51 Oregon Health Authority. (n.d.) *Medical Marijuana Dispensary Directory*. <https://www.oregon.gov/oha/ph/diseasesconditions/chronicdisease/medicalmarijuanaprogram/pages/dispensary-directory.aspx>
- 52 State of Nevada. (2020). 2020 Nevada Revised Statutes, Chapter 678B- Licensing and Control of Cannabis. <https://law.justia.com/codes/nevada/2020/chapter-678b/>
- 53 Community Preventive Services Task Force. (2008). *Alcohol - Excessive consumption: Maintaining limits on days of sale*. <https://www.thecommunityguide.org/findings/alcohol-excessive-consumption-maintaining-limits-days-sale>.
- 54 State of Colorado. (n.d.). *Laws about marijuana use*. <https://www.colorado.gov/pacific/marijuana/laws-about-marijuana-use#:~:text=Limited%20hours%20of%20sale%3A,you%20head%20to%20a%20retailer>
- 55 U.S. Department of Health and Human Services. (2019). *U.S. Surgeon General's advisory: Marijuana use and the developing brain*. <https://www.hhs.gov/surgeongeneral/reports-and-publications/addiction-and-substance-misuse/advisory-on-marijuana-use-and-developing-brain/index.html>
- 56 Stuyt, E. (2018). The problem with the current high potency THC marijuana from the perspective of an addiction psychiatrist. *Missouri Medicine*, 115(6), 482-486.
- 57 Di Forti, M., Morgan, C., Dazzan, P., Pariante, C., Mondelli, V., Marques, T. R., Handley, R., Luzi, S., Russo, M., Paparelli, A., Butt, A., Stilo, S. A., Wiffen, B., Powell, J., & Murray, R. M. (2009). High-potency cannabis and the risk of psychosis. *Br J Psychiatry*, 195(6), 488-491.
- 58 Hines, L. A., Freeman, T. P., Gage, S. H., Zammit, S., Hickman, M., Cannon, M., Munafo, M., MacLeod, J., & Heron, J. (2020). Association of high-potency cannabis use with mental health and substance in adolescence *JAMA Psychiatry*, 77(10), 1044-1051. <https://dx.doi.org/10.1001%2Fjamapsychiatry.2020.1035>
- 59 Courtemanche, C. J., Palmer, M. K., & Pesko, M. F. (2017). Influence of the flavored cigarette ban on adolescent tobacco use. *Am J Prev Med*, 52(5), e139-e146. <https://dx.doi.org/10.1016%2Fj.amepre.2016.11.019>
- 60 Getting It Right From the Start. (2021). *Examples of what your neighbors are doing to protect youth, public health, and social equity*. https://gettingitrightfromthestart.org/wp-content/uploads/2021/02/Best-Practices-in-Action-Map_2-2-21.pdf
- 61 Oregon Liquor Control Commission. (2020). *Non-cannabis additives in inhalable cannabinoid products: Rationale for rulemaking*. https://www.oregon.gov/olcc/Docs/commission_agendas/2020/Non-Cannabis-Additives-in-Inhalable-Cannabinoid-Products.pdf
- 62 Visit New England. (2021). *Marijuana in Connecticut*. <https://www.visitconnecticut.com/state/marijuana-in-connecticut/>
- 63 University of Washington. (2016). Factors that might attract children to marijuana edibles. *Science Daily*. <https://www.sciencedaily.com/releases/2016/08/160825141908.htm>
- 64 Dunlop, S. M., Dobbins, T., Young, J. M., Perez, D., & Currow, D. C. (2014). Impact of Australia's introduction of tobacco plain packs on adult smokers' pack-related perceptions and responses: results from a continuous tracking survey. *BMJ Open*, 4(12), e005836. <https://dx.doi.org/10.1136%2Fbmjopen-2014-005836>

- 65 Hammond, D., Wakefield, M., & Durkin, E. B. (2013). Tobacco packaging and mass media campaigns: Research needs for Articles 11 and 12 of the WHO Framework Convention on Tobacco Control. *Nicotine Tob Res*, 15(4), 817-831. <https://doi.org/10.1093/ntr/nts202>
- 66 Story, M., & French, S. (2004). Food advertising and marketing directed at children and adolescents in the US. *Int J Behav Nutr Phys Act*, 1(1), 3. <https://doi.org/10.1186/1479-5868-1-3>
- 67 State of Alaska. (2021). Section 3 Alaska Administrative Code § 306.345 - Packaging and labeling. <https://casetext.com/regulation/alaska-administrative-code/title-3-commerce-community-and-economic-development/part-19-alcoholic-beverage-control-board/chapter-306-marijuana-control/article-3-retail-marijuana-stores/section-3-aac-306345-packaging-and-labeling>
- 68 Massachusetts Cannabis Control Commission 935 Mass. Reg. 500.150 - Edibles (2021). <https://casetext.com/regulation/code-of-massachusetts-regulations/department-935-cmr-cannabis-control-commission/title-935-cmr-500000-adult-use-marijuana/section-500150-edibles>
- 69 Hawaii Administrative Rules, Medical Marijuana Dispensaries, Publ. L. No. 11-850-92 - Packaging and labeling for retail sale (2015). <https://health.hawaii.gov/opppd/files/2015/06/11-850.pdf>
- 70 Indiana Code § 24-4-21-4 (2018). Packaging requirements. <https://law.justia.com/codes/indiana/2018/title-24/article-4/chapter-21/section-24-4-21-4/>
- 71 Utah Publ. L. No. R68-26-5 - Label Requirements (2020). <https://ag.utah.gov/wp-content/uploads/2020/11/R68-26.pdf>
- 72 Texas Publ. L. No. §300.402 - Packaging and Labeling Requirements (2020). <https://www.law.cornell.edu/regulations/texas/25-Tex-Admin-Code-300-402>
- 73 State of Florida. (2019). Florida State Senate Bill No. CS/CS/SB 1020: State hemp program. <https://www.flsenate.gov/Session/Bill/2019/01020>
- 74 Government of Canada. (2019). *Cannabis health warning messages*. <https://www.canada.ca/en/health-canada/services/drugs-medication/cannabis/laws-regulations/regulations-support-cannabis-act/health-warning-messages.html>
- 75 State of California. (1986) Safe Drinking Water and Toxic Enforcement Act, Proposition 65. <https://oehha.ca.gov/proposition-65>
- 76 Jernigan, D., Noel, J., Landon, J., Thornton, N., & Lobstein, T. (2017). Alcohol marketing and youth alcohol consumption: A systematic review of longitudinal studies published since 2008. *Addiction*, 12(Suppl 1), 7-20. <https://doi.org/10.1111/add.13591>
- 77 Sargent, J. D., Cukier, S., & Babor, T. F. (2020). Alcohol marketing and youth drinking: Is there a causal relationship, and why does it matter? *Journal of Studies on Alcohol and Drugs, Supplement*, Suppl 19, 5-12. <https://dx.doi.org/10.15288%2Fjsads.2020.s19.5>
- 78 Soneji, S., Barrington-Trimis, J. L., & Wills, T. A. (2017). Association between initial use of e-cigarettes and subsequent cigarette smoking among adolescents and young adults: A systematic review and meta-analysis. *JAMA Pediatrics*, 171(8), 788-797. <https://dx.doi.org/10.1001%2Fjamapediatrics.2017.1488>
- 79 Ayers, J. W., Caputi, T. L., & Leas, E. C. (2019). The need for federal regulation of marijuana marketing. *JAMA*, 321(22), 2163-2164. <https://doi.org/10.1001/jama.2019.4432>
- 80 Jernigan, D. H. (2011). Framing a public health debate over alcohol advertising: The Center on Alcohol Marketing and Youth 2002–2008. *Journal of Public Health Policy*, 32, 165-179. <https://doi.org/10.1057/jphp.2011.5>
- 81 U.S. Department of Health and Human Services. (2015). *E-cigarette use among youth and young adults: A report of the Surgeon General*. https://e-cigarettes.surgeongeneral.gov/documents/2016_SGR_Full_Report_non-508.pdf
- 82 Colorado Marijuana Rules, Publ. L. No. 1 CCR 212-3 (2020). <https://www.sos.state.co.us/CCR/GenerateRulePdf.do?ruleVersionId=9303&fileName=1%20CCR%20212-3>
- 83 Moreno, M. A. (2019) Study: Higher Social Media Engagement with Marijuana Marketing Linked to Higher Rates of Use. *School of Medicine and Public Health University of Wisconsin-Madison*. <https://www.med.wisc.edu/news-and-events/2019/october/megan-moreno-marijuana-marketing-and-usage/>
- 84 Cavazos-Rehg, P., Krauss, M., & Bierut, L. J. (2016) Marijuana-Related Posts on Instagram *Prevention Science*, 17, 710-720. <https://pubmed.ncbi.nlm.nih.gov/27262456/>
- 85 Krauss, M., Sowles, S. J., Sehi, A., et al. (2017) Marijuana advertising exposure among current marijuana users in the U.S. *Drug and Alcohol Dependence*, 174, 192-200. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5436304/>
- 86 State of Rhode Island and Providence Plantations. (2020). Office of Cannabis Regulation - Advertising Guide. Department of Business Regulation, State of Rhode Island. https://dbr.ri.gov/documents/news/medical_marijuana/Advertising.pdf