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Commonly Abused Drugs

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Substances: Category and Name	Examples of *Commercial* and Street Names	DEA Schedule*/ How Administered**	*Acute Effects*/Health Risks
Tobacco			
Nicotine	Found in cigarettes, cigars, bidis, and smokeless tobacco (snuff, spit tobacco, chew)	Not scheduled/smoked, snorted, chewed	*Increased blood pressure and heart rate*/chronic lung disease; cardiovascular disease; stroke; cancers of the mouth, pharynx, larynx, esophagus, stomach, pancreas, cervix, kidney, bladder, and acute myeloid leukemia; adverse pregnancy outcomes; addiction
Alcohol			
Alcohol (ethyl alcohol)	Found in liquor, beer, and wine	Not scheduled/swallowed	*In low doses, euphoria, mild stimulation, relaxation, lowered inhibitions; in higher doses, drowsiness, slurred speech, nausea, emotional volatility, loss of coordination, visual distortions, impaired memory, sexual dysfunction, loss of consciousness*/increased risk of injuries, violence, fetal damage (in pregnant women); depression; neurologic deficits; hypertension; liver and heart disease; addiction; fatal overdose
Cannabinoids			
Marijuana	Blunt, dope, ganja, grass, herb, joint, bud, Mary Jane, pot, reefer, green, trees, smoke, sinsemilla, skunk, weed	I/smoked, swallowed	*Euphoria; relaxation; slowed reaction time; distorted sensory perception; impaired balance and coordination; increased heart rate and appetite; impaired learning, memory; anxiety; panic attacks; psychosis*/cough; frequent respiratory infections; possible mental health decline; addiction
Hashish	Boom, gangster, hash, hash oil, hemp	I/smoked, swallowed	
Opioids			
Heroin	*Diacetylmorphine:* smack, horse, brown sugar, dope, H, junk, skag, skunk, white horse, China white; cheese (with OTC cold medicine and antihistamine)	I/injected, smoked, snorted	*Euphoria; drowsiness; impaired coordination; dizziness; confusion; nausea; sedation; feeling of heaviness in the body; slowed or arrested breathing*/constipation; endocarditis; hepatitis; HIV; addiction; fatal overdose
Opium	*Laudanum, paregoric:* big O, black stuff, block, gum, hop	II, III, V/swallowed, smoked	
Stimulants			
Cocaine	*Cocaine hydrochloride:* blow, bump, C, candy, Charlie, coke, crack, flake, rock, snow, toot	II/snorted, smoked, injected	*Increased heart rate, blood pressure, body temperature, metabolism; feelings of exhilaration; increased energy, mental alertness; tremors; reduced appetite; irritability; anxiety; panic; paranoia; violent behavior; psychosis*/weight loss; insomnia; cardiac or cardiovascular complications; stroke; seizures; addiction **Also, for cocaine**—nasal damage from snorting **Also, for methamphetamine**—severe dental problems
Amphetamine	*Biphetamine, Dexedrine:* bennies, black beauties, crosses, hearts, LA turnaround, speed, truck drivers, uppers	II/swallowed, snorted, smoked, injected	
Methamphetamine	*Desoxyn:* meth, ice, crank, chalk, crystal, fire, glass, go fast, speed	II/swallowed, snorted, smoked, injected	
Club Drugs			
MDMA (methylenedioxymethamphetamine)	Ecstasy, Adam, clarity, Eve, lover's speed, peace, uppers	I/swallowed, snorted, injected	***MDMA**—mild hallucinogenic effects; increased tactile sensitivity, empathic feelings; lowered inhibition; anxiety; chills; sweating; teeth clenching; muscle cramping*/sleep disturbances; depression; impaired memory; hyperthermia; addiction ***Flunitrazepam**—sedation; muscle relaxation; confusion; memory loss; dizziness; impaired coordination*/addiction ***GHB**—drowsiness; nausea; headache; disorientation; loss of coordination; memory loss*/unconsciousness; seizures; coma
Flunitrazepam***	*Rohypnol:* forget-me pill, Mexican Valium, R2, roach, Roche, roofies, roofinol, rope, rophies	IV/swallowed, snorted	
GHB***	*Gamma-hydroxybutyrate:* G, Georgia home boy, grievous bodily harm, liquid ecstasy, soap, scoop, goop, liquid X	I/swallowed	
Dissociative Drugs			
Ketamine	*Ketalar SV:* cat Valium, K, Special K, vitamin K	III/injected, snorted, smoked	*Feelings of being separate from one's body and environment; impaired motor function*/anxiety; tremors; numbness; memory loss; nausea ***Also, for ketamine**—analgesia; impaired memory; delirium; respiratory depression and arrest; death* ***Also, for PCP and analogs**—analgesia; psychosis; aggression; violence; slurred speech; loss of coordination; hallucinations* ***Also, for DXM**—euphoria; slurred speech; confusion; dizziness; distorted visual perceptions*
PCP and analogs	*Phencyclidine:* angel dust, boat, hog, love boat, peace pill	I, II/swallowed, smoked, injected	
Salvia divinorum	Salvia, Shepherdess's Herb, Maria Pastora, magic mint, Sally-D	Not scheduled/chewed, swallowed, smoked	
Dextromethorphan (DXM)	Found in some cough and cold medications: Robotripping, Robo, Triple C	Not scheduled/swallowed	
Hallucinogens			
LSD	*Lysergic acid diethylamide:* acid, blotter, cubes, microdot, yellow sunshine, blue heaven	I/swallowed, absorbed through mouth tissues	*Altered states of perception and feeling; hallucinations; nausea* ***Also, for LSD and mescaline**—increased body temperature, heart rate, blood pressure; loss of appetite; sweating; sleeplessness; numbness; dizziness; weakness; tremors; impulsive behavior; rapid shifts in emotion* ***Also, for LSD**—Flashbacks, Hallucinogen Persisting Perception Disorder* ***Also, for psilocybin**—nervousness; paranoia; panic*
Mescaline	Buttons, cactus, mesc, peyote	I/swallowed, smoked	
Psilocybin	Magic mushrooms, purple passion, shrooms, little smoke	I/swallowed	
Other Compounds			
Anabolic steroids	*Anadrol, Oxandrin, Durabolin, Depo-Testosterone, Equipoise:* roids, juice, gym candy, pumpers	III/injected, swallowed, applied to skin	***Steroids**—no intoxication effects*/hypertension; blood clotting and cholesterol changes; liver cysts; hostility and aggression; acne; in adolescents—premature stoppage of growth; in males—prostate cancer, reduced sperm production, shrunken testicles, breast enlargement; in females—menstrual irregularities, development of beard and other masculine characteristics ***Inhalants** (varies by chemical)—stimulation; loss of inhibition; headache; nausea or vomiting; slurred speech; loss of motor coordination; wheezing*/cramps; muscle weakness; depression; memory impairment; damage to cardiovascular and nervous systems; unconsciousness; sudden death
Inhalants	*Solvents (paint thinners, gasoline, glues); gases (butane, propane, aerosol propellants, nitrous oxide); nitrites (isoamyl, isobutyl, cyclohexyl):* laughing gas, poppers, snappers, whippets	Not scheduled/inhaled through nose or mouth	

Substances: Category and Name	Examples of *Commercial* and Street Names	DEA Schedule*/ How Administered**	*Acute Effects*/Health Risks
Prescription Medications			
CNS Depressants Stimulants Opioid Pain Relievers	For more information on prescription medications, please visit http://www.nida.nih.gov/DrugPages/PrescripDrugsChart.html.		

** Schedule I and II drugs have a high potential for abuse. They require greater storage security and have a quota on manufacturing, among other restrictions. Schedule I drugs are available for research only and have no approved medical use; Schedule II drugs are available only by prescription (unrefillable) and require a form for ordering. Schedule III and IV drugs are available by prescription, may have five refills in 6 months, and may be ordered orally. Some Schedule V drugs are available over the counter.*

*** Some of the health risks are directly related to the route of drug administration. For example, injection drug use can increase the risk of infection through needle contamination with staphylococci, HIV, hepatitis, and other organisms.*

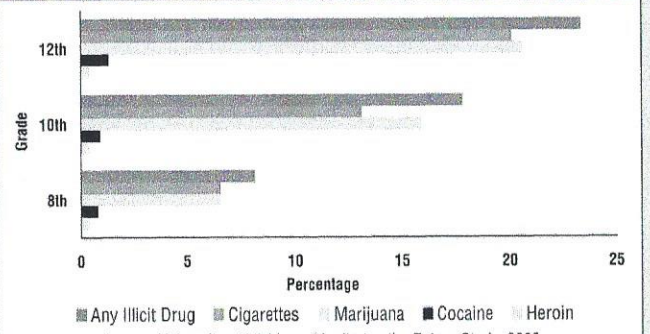
**** Associated with sexual assaults.*

Principles of Drug Addiction Treatment

More than three decades of scientific research show that treatment can help drug-addicted individuals stop drug use, avoid relapse and successfully recover their lives. Based on this research, 13 fundamental principles that characterize effective drug abuse treatment have been developed. These principles are detailed in *NIDA's Principles of Drug Addiction Treatment: A Research-Based Guide.* The guide also describes different types of science-based treatments and provides answers to commonly asked questions.

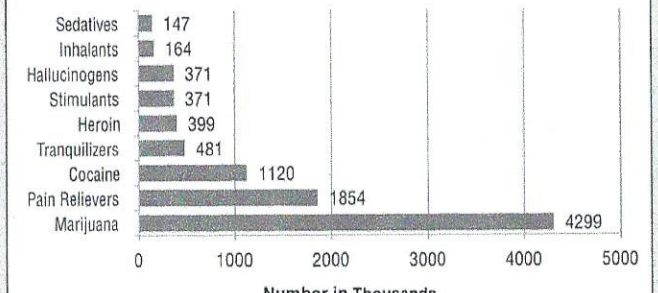
1. **Addiction is a complex but treatable disease that affects brain function and behavior.** Drugs alter the brain's structure and how it functions, resulting in changes that persist long after drug use has ceased. This may help explain why abusers are at risk for relapse even after long periods of abstinence.
2. **No single treatment is appropriate for everyone.** Matching treatment settings, interventions, and services to an individual's particular problems and needs is critical to his or her ultimate success.
3. **Treatment needs to be readily available.** Because drug-addicted individuals may be uncertain about entering treatment, taking advantage of available services the moment people are ready for treatment is critical. Potential patients can be lost if treatment is not immediately available or readily accessible.
4. **Effective treatment attends to multiple needs of the individual, not just his or her drug abuse.** To be effective, treatment must address the individual's drug abuse and any associated medical, psychological, social, vocational, and legal problems.
5. **Remaining in treatment for an adequate period of time is critical.** The appropriate duration for an individual depends on the type and degree of his or her problems and needs. Research indicates that most addicted individuals need at least 3 months in treatment to significantly reduce or stop their drug use and that the best outcomes occur with longer durations of treatment.
6. **Counseling—individual and/or group—and other behavioral therapies are the most commonly used forms of drug abuse treatment.** Behavioral therapies vary in their focus and may involve addressing a patient's motivations to change, building skills to resist drug use, replacing drug-using activities with constructive and rewarding activities, improving problemsolving skills, and facilitating better interpersonal relationships.
7. **Medications are an important element of treatment for many patients, especially when combined with counseling and other behavioral therapies.** For example, methadone and buprenorphine are effective in helping individuals addicted to heroin or other opioids stabilize their lives and reduce their illicit drug use. Also, for persons addicted to nicotine, a nicotine replacement product (nicotine patches or gum) or an oral medication (buproprion or varenicline), can be an effective component of treatment when part of a comprehensive behavioral treatment program.
8. **An individual's treatment and services plan must be assessed continually and modified as necessary to ensure it meets his or her changing needs.** A patient may require varying combinations of services and treatment components during the course of treatment and recovery. In addition to counseling or psychotherapy, a patient may require medication, medical services, family therapy, parenting instruction, vocational rehabilitation and/or social and legal services. For many patients, a continuing care approach provides the best results, with treatment intensity varying according to a person's changing needs.
9. **Many drug-addicted individuals also have other mental disorders.** Because drug abuse and addiction—both of which are mental disorders—often co-occur with other mental illnesses, patients presenting with one condition should be assessed for the other(s). And when these problems co-occur, treatment should address both (or all), including the use of medications as appropriate.
10. **Medically assisted detoxification is only the first stage of addiction treatment and by itself does little to change long-term drug abuse.** Although medically assisted detoxification can safely manage the acute physical symptoms of withdrawal, detoxification alone is rarely sufficient to help addicted individuals achieve long-term abstinence. Thus, patients should be encouraged to continue drug treatment following detoxification.
11. **Treatment does not need to be voluntary to be effective.** Sanctions or enticements from family, employment settings, and/or the criminal justice system can significantly increase treatment entry, retention rates, and the ultimate success of drug treatment interventions.
12. **Drug use during treatment must be monitored continuously, as lapses during treatment do occur.** Knowing their drug use is being monitored can be a powerful incentive for patients and can help them withstand urges to use drugs. Monitoring also provides an early indication of a return to drug use, signaling a possible need to adjust an individual's treatment plan to better meet his or her needs.
13. **Treatment programs should assess patients for the presence of HIV/AIDS, hepatitis B and C, tuberculosis, and other infectious diseases, as well as provide targeted risk-reduction counseling to help patients modify or change behaviors that place them at risk of contracting or spreading infectious diseases.** Targeted counseling specifically focused on reducing infectious disease risk can help patients further reduce or avoid substance-related and other high-risk behaviors. Treatment providers should encourage and support HIV screening and inform patients that highly active antiretroviral therapy (HAART) has proven effective in combating HIV, including among drug-abusing populations.

U.S. Teens Who Currently Use Illicit Drugs or Cigarettes (Past Month Use)



Source: University of Michigan, Monitoring the Future Study, 2009.

Dependence on or Abuse of Specific Illicit Drugs in Past Year Among Persons 12 or Older, 2009



Source: SAMHSA, 2009 NSDUH

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Substances: Category and Name	Examples of *Commercial* and Street Names	DEA Schedule*/How Administered	*Intoxication Effects*/Health Risks
Depressants			
Barbiturates	*Amytal, Nembutal, Seconal, Phenobarbital:* barbs, reds, red birds, phennies, tooies, yellows, yellow jackets	II, III, IV/injected, swallowed	*Sedation/drowsiness, reduced anxiety, feelings of well-being, lowered inhibitions, slurred speech, poor concentration, confusion, dizziness, impaired coordination and memory/*slowed pulse, lowered blood pressure, slowed breathing, tolerance, withdrawal, addiction; increased risk of respiratory distress and death when combined with alcohol *for barbiturates—euphoria, unusual excitement, fever, irritability/*life-threatening withdrawal in chronic users
Benzodiazepines	*Ativan, Halcion, Librium, Valium, Xanax, Klonopin:* candy, downers, sleeping pills, tranks	IV/swallowed	
Sleep Medications	*Ambien (zolpidem), Sonata (zaleplon), Lunesta (eszopiclone)*	IV/swallowed	
Opioids and Morphine Derivatives**			
Codeine	*Empirin with Codeine, Fiorinal with Codeine, Robitussin A-C, Tylenol with Codeine:* Captain Cody, Cody, schoolboy; (with glutethimide: doors & fours, loads, pancakes and syrup)	II, III, IV/injected, swallowed	*Pain relief, euphoria, drowsiness, sedation, weakness, dizziness, nausea, impaired coordination, confusion, dry mouth, itching, sweating, clammy skin, constipation/* slowed or arrested breathing, lowered pulse and blood pressure, tolerance, addiction, unconsciousness, coma, death; risk of death increased when combined with alcohol or other CNS depressants *for fentanyl*—80–100 times more potent analgesic than morphine *for oxycodone*—muscle relaxation/twice as potent analgesic as morphine; high abuse potential *for codeine*—less analgesia, sedation, and respiratory depression than morphine *for methadone*—used to treat opioid addiction and pain; significant overdose risk when used improperly
Morphine	*Roxanol, Duramorph:* M, Miss Emma, monkey, white stuff	II, III/injected, swallowed, smoked	
Methadone	*Methadose, Dolophine:* fizzies, amidone, (with MDMA: chocolate chip cookies)	II/swallowed, injected	
Fentanyl and analogs	*Actiq, Duragesic, Sublimaze:* Apache, China girl, dance fever, friend, goodfella, jackpot, murder 8, TNT, Tango and Cash	II/injected, smoked, snorted	
Other Opioid Pain Relievers: Oxycodone HCL Hydrocodone Bitartrate Hydromorphone Oxymorphone Meperidine Propoxyphene	*Tylox, Oxycontin, Percodan, Percocet:* Oxy, O.C., oxycotton, oxycet, hillbilly heroin, percs *Vicodin, Lortab, Lorcet:* vike, Watson-387 *Dilaudid:* juice, smack, D, footballs, dillies *Opana, Numorphan, Numorphone:* biscuits, blue heaven, blues, Mrs. O, octagons, stop signs, O Bomb *Demerol, meperidine hydrochloride:* demmies, pain killer *Darvon, Darvocet*	II, III, IV/chewed, swallowed, snorted, injected, suppositories	
Stimulants			
Amphetamines	*Biphetamine, Dexedrine, Adderall:* bennies, black beauties, crosses, hearts, LA turnaround, speed, truck drivers, uppers	II/injected, swallowed, smoked, snorted	*Feelings of exhilaration, increased energy, mental alertness/*increased heart rate, blood pressure, and metabolism, reduced appetite, weight loss, nervousness, insomnia, *seizures, heart attack, stroke* *for amphetamines—rapid breathing, tremor, loss of coordination, irritability, anxiousness, restlessness/*delirium, panic, paranoia, hallucinations, impulsive behavior, aggressiveness, tolerance, addiction *for methylphenidate*—increase or decrease in blood pressure, digestive problems, loss of appetite, weight loss
Methylphenidate	*Concerta, Ritalin:* JIF, MPH, R-ball, Skippy, the smart drug, vitamin R	II/injected, swallowed, snorted	
Other Compounds			
Dextromethorphan (DXM)	*Found in some cough and cold medications:* Robotripping, Robo, Triple C	not scheduled/swallowed	*Euphoria, slurred speech/*increased heart rate and blood pressure, dizziness, nausea, vomiting, confusion, paranoia, distorted visual perceptions, impaired motor function

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*** Taking drugs by injection can increase the risk of infection through needle contamination with staphylococci, HIV, hepatitis, and other organisms. Injection is a more common practice for opioids, but risks apply to any medication taken by injection.*

Facts About Prescription Drug Abuse

Medications can be effective when they are used properly, but some can be addictive and dangerous when abused. This chart provides a brief look at some prescribed medications that—when used in ways or by people other than prescribed—have the potential for adverse medical consequences, including addiction.

In 2010, approximately 16 million Americans reported using a prescription drug for nonmedical reasons in the past year; 7 million in the past month.

What types of prescription drugs are abused?

Three types of drugs are abused most often:

- Opioids—prescribed for pain relief
- CNS depressants—barbiturates and benzodiazepines prescribed for anxiety or sleep problems (often referred to as sedatives or tranquilizers)
- Stimulants—prescribed for attention-deficit hyperactivity disorder (ADHD), the sleep disorder narcolepsy, or obesity.

How can you help prevent prescription drug abuse?

- Ask your doctor or pharmacist about your medication, especially if you are unsure about its effects.
- Keep your doctor informed about all medications you are taking, including over-the-counter medications.
- Read the information your pharmacist provides before starting to take medications.
- Take your medication(s) as prescribed.
- Keep all prescription medications secured at all times and properly dispose of any unused medications.

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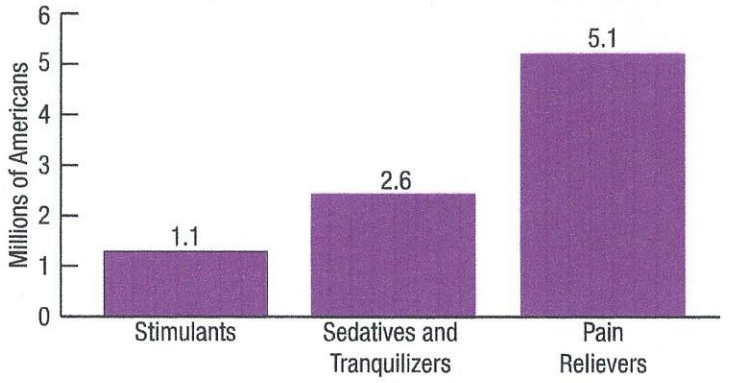
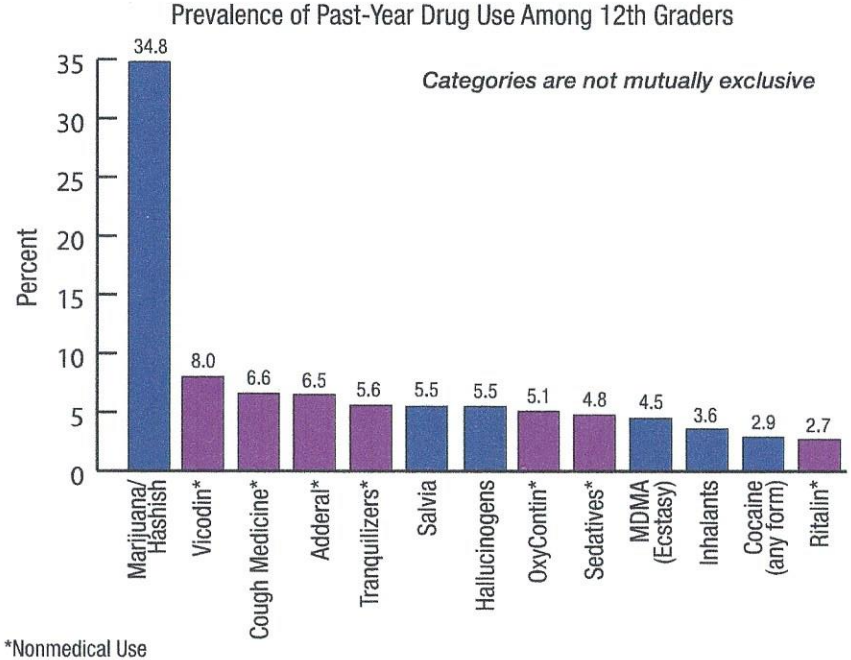
~7.0 Million Americans Reported Past-Month Use of Rx Drugs for Nonmedical Purposes in 2010



Source: Office of Applied Studies, Substance Abuse and Mental Health Services Administration, National Survey on Drug Use and Health, 2010

After Marijuana, Prescription and Over-the-Counter Medications* Account for Most of the Commonly Abused Drugs



*Nonmedical Use

Source: University of Michigan, 2010 Monitoring the Future Study

Revised October 2011

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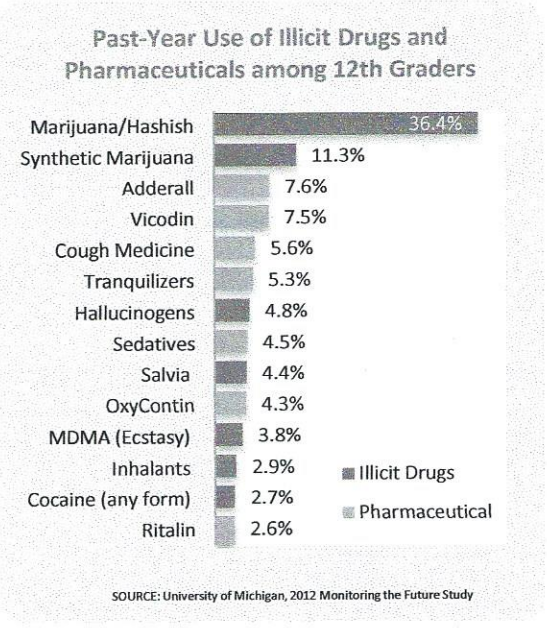
Prescription and Over-the-Counter Medications

Some medications have psychoactive (mind-altering) properties and, because of that, are sometimes abused—that is, taken for reasons or in ways or amounts not intended by a doctor, or taken by someone other than the person for whom they are prescribed. In fact, prescription and over-the-counter (OTC) drugs are, after marijuana (and alcohol), the most commonly abused substances by Americans 14 and older.



The classes of prescription drugs most commonly abused are: opioid pain relievers, such as Vicodin or Oxycontin; stimulants for treating Attention Deficit Hyperactivity Disorder (ADHD), such as Adderall, Concerta, or Ritalin; and central nervous system (CNS) depressants for relieving anxiety, such as Valium or Xanax.[1] The most commonly abused OTC drugs are cough and cold remedies containing dextromethorphan.

People often think that prescription and OTC drugs are safer than illicit drugs, but that's only true when they are taken exactly as prescribed and for the purpose intended. When abused, prescription and OTC drugs can be addictive and put abusers at risk for other adverse health effects, including overdose—especially when taken along with other drugs or alcohol.

How Are Prescription Drugs Abused?

Prescription and OTC drugs may be abused in one or more of the following ways:

Taking a medication that has been prescribed for somebody else. Unaware of the dangers of sharing medications, people often unknowingly contribute to this

[1] These are proprietary names of particular drug products. Generic versions may also exist.

form of abuse by sharing their unused pain relievers with their family members.

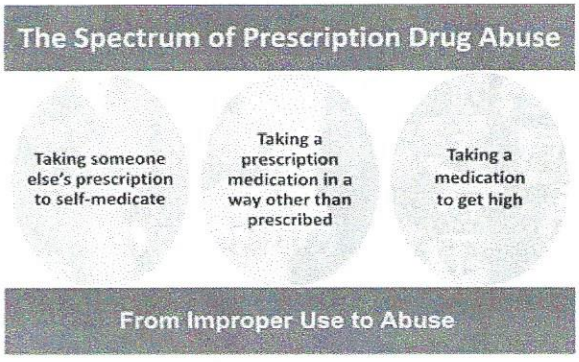
Most teenagers who abuse prescription drugs are given them for free by a friend or relative.

Taking a drug in a higher quantity or in another manner than prescribed. Most prescription drugs are dispensed orally in tablets, but abusers sometimes crush the tablets and snort or inject the powder. This hastens the entry of the drug into the bloodstream and the brain and amplifies its effects.

Taking a drug for another purpose than prescribed. All of the drug types mentioned can produce pleasurable effects at sufficient quantities, so taking them for the purpose of getting high is one of the main reasons people abuse them. ADHD drugs like Adderall are also often abused by students for their effects in promoting alertness and concentration.

How Do Prescription and OTC Drugs Affect the Brain?

Taken as intended, prescription and OTC drugs safely treat specific mental or physical symptoms. But when taken in



different quantities or when such symptoms aren't present, they may affect the brain in ways very similar to illicit drugs.

For example, stimulants such as Ritalin increase alertness, attention, and energy the same way cocaine does—by boosting the amount of the neurotransmitter dopamine. Opioid pain relievers like OxyContin attach to the same cell receptors targeted by illegal opioids like heroin. Prescription depressants produce sedating or calming effects in the same manner as the club drugs GHB and rohypnol, by enhancing the actions of the neurotransmitter GABA (gamma-aminobutyric acid). When taken in very high doses, dextromethorphan acts on the same glutamate receptors as PCP or ketamine, producing similar out-of-body experiences.

When abused, all of these classes of drugs directly or indirectly cause a pleasurable increase in the amount of dopamine in the brain's reward pathway. Repeatedly seeking to experience that feeling can lead to addiction.

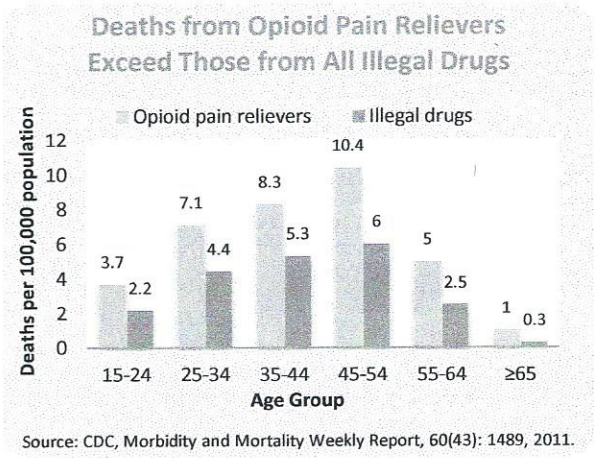
What Are the Other Health Effects of Prescription and OTC Drugs?

Stimulants can have strong effects on the cardiovascular system. Taking high doses of a stimulant can dangerously raise body temperature and cause irregular heartbeat or even heart failure or seizures. Also, taking some stimulants in high doses or repeatedly can lead to hostility or feelings of paranoia.

Opioids can produce drowsiness, cause constipation, and—depending upon the amount taken—depress breathing. The latter effect makes opioids particularly dangerous, especially when they are snorted or injected or combined with other drugs or alcohol.

CNS depressants slow down brain activity and can cause sleepiness and loss of coordination. Continued use can lead to physical dependence and withdrawal symptoms if discontinuing use.

Dextromethorphan can cause impaired motor function, numbness, nausea or vomiting, and increased heart rate and blood pressure. On rare occasions, hypoxic brain damage—caused by severe respiratory depression and a lack of oxygen to the brain—has occurred due to the combination of dextromethorphan with decongestants often found in the medication.

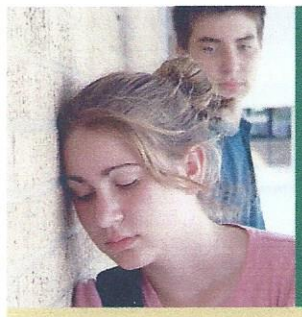


Source: CDC, Morbidity and Mortality Weekly Report, 60(43): 1489, 2011.

All of these drugs have the potential for addiction, and this risk is amplified when they are abused. Also, as with other drugs, abuse of prescription and OTC drugs can alter a person's judgment and decisionmaking, leading to dangerous behaviors such as unsafe sex and drugged driving.

Learn More

For more information on prescription and OTC drugs, visit http://www.drugabuse.gov/publications/research-reports/prescription-drugs



How does marijuana use affect school, work, and social life?
See page 7.

NIH National Institute on Drug Abuse

Research Report Series

Marijuana Abuse

from the director:

By the time they graduate from high school, about 46 percent of teens will have tried marijuana.[1] Although current use among U.S. teens dropped dramatically in the past decade (to a prevalence of about 15 percent in 2011), this decline has stalled during the past several years.[2] These data are from the Monitoring the Future survey, which has been tracking drug use among teens since 1975. Still, the World Health Organization ranks the United States first among 17 European and North American countries for prevalence of marijuana use. And more users start every day. In 2010, an estimated 2.4 million Americans used marijuana for the first time; greater than one-half were under age 18.[1]

The use of marijuana can produce adverse physical, mental, emotional, and behavioral effects. It can impair short-term memory and judgment and distort perception. Because marijuana affects brain systems that are still maturing through young adulthood, its use by teens may have a negative effect on their development. And contrary to popular belief, it can be addictive.

We hope that this Research Report will help make readers aware of our current knowledge of marijuana abuse and its harmful effects.

Nora D. Volkow, M.D.
Director
National Institute on Drug Abuse

What Is Marijuana?

Marijuana—often called *pot, grass, reefer, weed, herb, Mary Jane,* or *MJ*—is a greenish-gray mixture of the dried, shredded leaves, stems, seeds, and flowers of *Cannabis sativa*—the hemp plant. Most users smoke marijuana in hand-rolled cigarettes called *joints*, among other names; some use pipes or water pipes called *bongs*. Marijuana cigars, or *blunts*, are also popular. To make blunts, users slice open cigars, remove some of the tobacco, and mix the remainder with marijuana.[3] Marijuana also is used to brew tea and sometimes is mixed into foods.

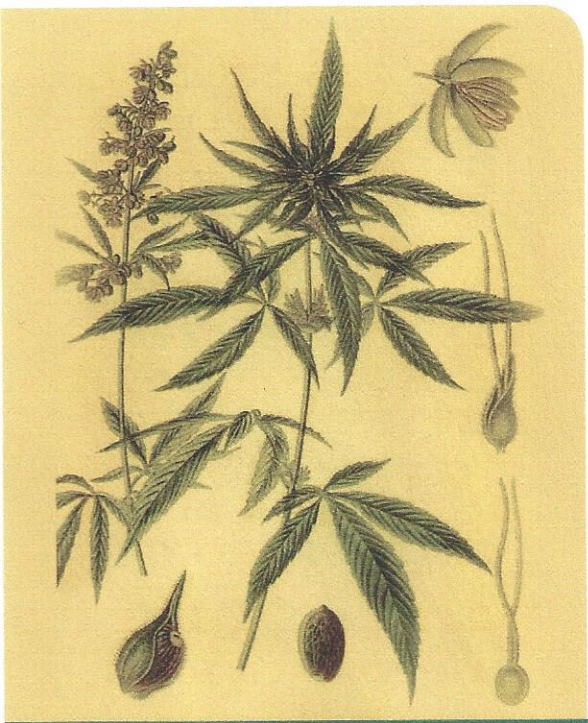
continued inside

Marijuana Abuse

What Is the Scope of Marijuana Use in the United States?

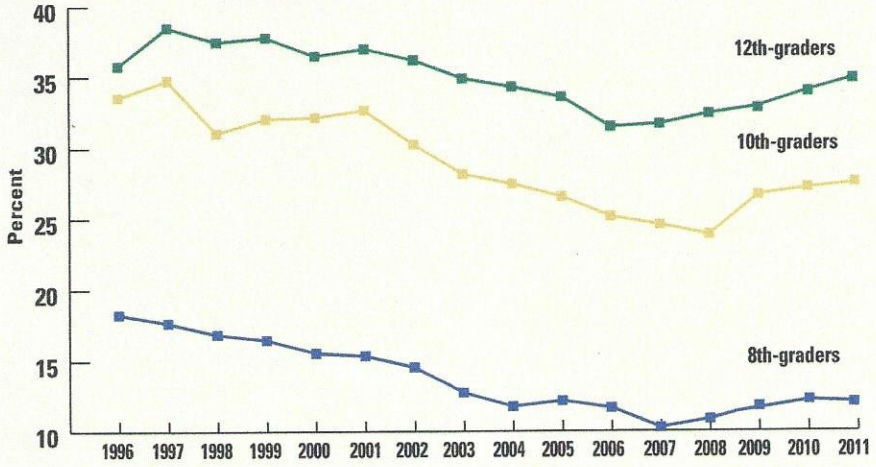
Marijuana is the most commonly used illicit drug (17.4 million past-month users) according to the 2010 National Survey on Drug Use and Health (NSDUH).[1] That year, marijuana was used by 76.8 percent of current illicit drug users (defined as having used the drug at some time in the 30 days before the survey) and was the *only* drug used by 60.1 percent of them.[1]

Marijuana use is widespread among adolescents and young adults. According to the Monitoring the Future Survey—an annual survey of attitudes and drug use among the Nation's middle and high school students—most measures of marijuana use decreased in the past decade among 8th-, 10th-, and 12th-graders. However, this decline has stalled in the past few years as attitudes have softened about marijuana's risks. In 2011, 12.5 percent of 8th-graders reported marijuana use in the past year, and 7.2 percent were current users. Among 10th-graders, 28.8 percent had used marijuana in the past year, and 17.6 percent were current users. Rates of use among 12th-graders were higher still: 36.4 percent had used marijuana during the year prior to the survey, and 22.6 percent were current users.[2]



The Drug Abuse Warning Network (DAWN), a system for monitoring the health impact of drugs, estimated that in 2009, marijuana was a contributing factor in over 376,000 emergency department (ED) visits in the United States, with about two-thirds of patients being male, and 12 percent between the ages of 12 and 17.[4]

Long-Term Trends in Annual* Marijuana Use Among 8th-, 10th-, and 12th-Graders

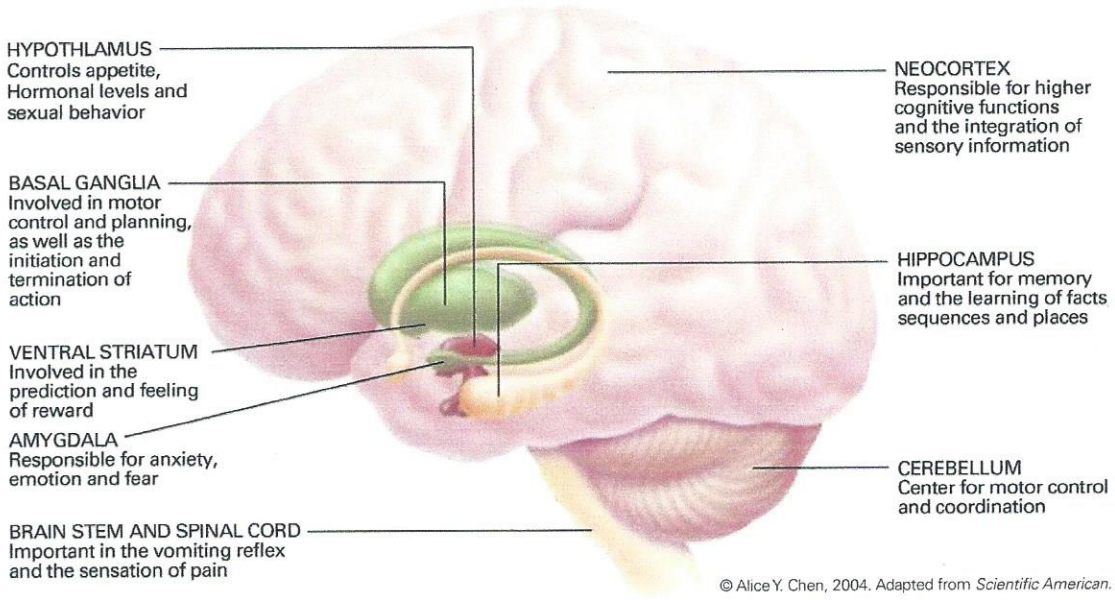


*use in the past 12 months
Source: University of Michigan, 2011 Monitoring the Future Survey.

How Does Marijuana Produce its Effects?

Delta-9-tetrahydrocannabinol (THC) is the main active ingredient in marijuana, responsible for many of its known effects. When marijuana is smoked, its effects begin almost immediately. THC rapidly passes from the lungs into the bloodstream, which carries the chemical to organs throughout the body, including the brain. The effects of smoked marijuana can last from 1 to 3 hours. If marijuana is consumed in foods or beverages, the effects appear later—usually in 30 minutes to 1 hour—but can last up to 4 hours. Smoking marijuana delivers significantly more THC into the bloodstream than eating or drinking the drug.

Marijuana's Effects on the Brain



When marijuana is smoked, its active ingredient, THC, travels throughout the body, including the brain, to produce its many effects. THC attaches to sites called cannabinoid receptors on nerve cells in the brain, affecting the way those cells work. Cannabinoid receptors are abundant in parts of the brain that regulate movement, coordination, learning and memory, higher cognitive functions such as judgment, and pleasure.

Scientists have learned a great deal about how THC acts in the brain. THC binds to specific sites called *cannabinoid receptors* (CBRs) located on the surface of nerve cells. These receptors are found in high-density in areas of the brain that influence pleasure, memory, thinking, concentration, movement, coordination, and sensory and time perception.

CBRs are part of a vast communication network known as the endocannabinoid system, which plays a critical role in normal brain development and function. In fact, THC effects are similar to those produced by naturally occurring chemicals found in the brain (and body) called *endogenous cannabinoids*. These chemicals help control many of the same mental and physical functions that may be disrupted by marijuana use.

When someone smokes marijuana, THC stimulates the CBRs artificially, disrupting function of the natural, or endogenous, cannabinoids. An overstimulation of these receptors in key brain areas produces the marijuana "high," as well as other effects on mental processes. Over time, this overstimulation can alter the function of CBRs, which, along with other changes in the brain, can lead to addiction and to withdrawal symptoms when drug use stops.

The THC content or potency of marijuana, as detected in confiscated samples over the past 30+ years, has been steadily increasing.[5] This increase raises concerns that the consequences of marijuana use could be worse than in the past, particularly among new users, or in young people, whose brains are still developing. We still do not know, however, whether cannabis users adjust for the increase in potency by using less or by smoking it differently. We also do not know all the consequences to the brain and body when exposed to higher concentrations of THC.

How Does Marijuana Use Affect Your Brain and Body?

Effects on the Brain

As THC enters the brain, it causes the user to feel euphoric—or high—by acting on the brain's reward system, which is made up of regions that govern the response to pleasurable things like sex and chocolate, as well as to most drugs of abuse. THC activates the reward

Marijuana users who have taken large doses of the drug may experience an acute psychosis, which includes hallucinations, delusions, and a loss of the sense of personal identity.

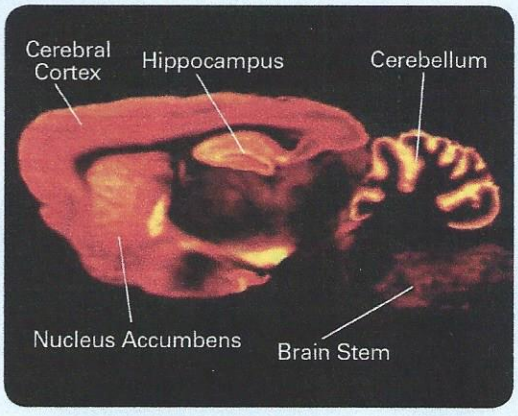
system in the same way that nearly all drugs of abuse do: by stimulating brain cells to release the chemical dopamine.

Along with euphoria, relaxation is another frequently reported effect in human studies. Other effects, which vary dramatically among different users, include heightened sensory perception (e.g., brighter colors), laughter, altered perception of time, and increased appetite. After a while, the euphoria subsides, and the user may feel sleepy or depressed. Occasionally, marijuana use may produce anxiety, fear, distrust, or panic.

Marijuana use impairs a person's ability to form new memories **(see below, "Marijuana, Memory, and the Hippocampus")** and to shift focus. THC also disrupts coordination and balance by binding to receptors in the cerebellum and basal ganglia—parts of the brain that regulate balance, posture, coordination, and reaction time. Therefore, learning, doing complicated tasks, participating in athletics, and driving are also affected.

Marijuana users who have taken large doses of the drug may experience an acute psychosis, which includes hallucinations, delusions, and a loss of the sense of personal identity. Short-term psychotic reactions to high concentrations of THC are distinct from longer-lasting, schizophrenia-like disorders that have been associated with the use of cannabis in vulnerable individuals. **(See section on the link between marijuana use and mental illness, page 6.)**

Our understanding of marijuana's long-term brain effects is limited. Research findings on how chronic cannabis use affects brain *structure,* for example, have been inconsistent. It may be that the effects are too subtle for reliable detection by current techniques. A similar challenge arises in studies of the effects of chronic marijuana use on brain *function.* Although imaging studies (functional MRI; fMRI) in chronic users do show some consistent alterations, the relation of these



Distribution of cannabinoid receptors in the rat brain. Brain image reveals high levels (shown in orange and yellow) of cannabinoid receptors in many areas, including the cortex, hippocampus, cerebellum, and nucleus accumbens (ventral striatum).

Marijuana, Memory, and the Hippocampus

Memory impairment from marijuana use occurs because THC alters how information is processed in the hippocampus, a brain area responsible for memory formation.

Most of the evidence supporting this assertion comes from animal studies. For example, rats exposed to THC in utero, soon after birth, or during adolescence, show notable problems with specific learning/memory tasks later in life. Moreover, cognitive impairment in adult rats is associated with structural and functional changes in the hippocampus from THC exposure during adolescence.

As people age, they lose neurons in the hippocampus, which decreases their ability to learn new information. Chronic THC exposure may hasten age-related loss of hippocampal neurons. In one study, rats exposed to THC every day for 8 months (approximately 30 percent of their life-span) showed a level of nerve cell loss (at 11 to 12 months of age) that equaled that of unexposed animals twice their age.

changes to cognitive functioning is less clear. This uncertainty may stem from confounding factors such as other drug use, residual drug effects (which can occur for at least 24 hours in chronic users), or withdrawal symptoms in long-term chronic users.

An enduring question in the field is whether individuals who quit marijuana, even after long-term, heavy use, can recover some of their cognitive abilities. One study reports that the ability of long-term heavy marijuana users to recall words from a list was still impaired 1 week after they quit using, but returned to normal by 4 weeks. However, another study found that marijuana's effects on the brain can build up and deteriorate critical life skills over time. Such effects may be worse in those with other mental disorders, or simply by virtue of the normal aging process.

Consequences of Marijuana Abuse

Acute (present during intoxication)

- Impairs short-term memory
- Impairs attention, judgment, and other cognitive functions
- Impairs coordination and balance
- Increases heart rate
- Psychotic episodes

Persistent (lasting longer than intoxication, but may not be permanent)

- Impairs memory and learning skills
- Sleep impairment

Long-term (cumulative effects of chronic abuse)

- Can lead to addiction
- Increases risk of chronic cough, bronchitis
- Increases risk of schizophrenia in vulnerable individuals
- May increase risk of anxiety, depression, and amotivational syndrome*

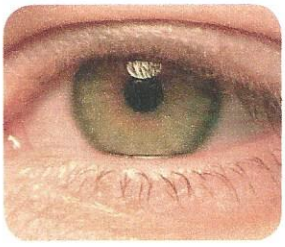
*These are often reported co-occurring symptoms/disorders with chronic marijuana use. However, research has not yet determined whether marijuana is causal or just associated with these mental problems.

Effects on General Physical Health

Within a few minutes after inhaling marijuana smoke, an individual's heart rate speeds up, the bronchial passages relax and become enlarged, and blood vessels in the eyes expand, making the eyes look red. The heart rate—normally 70 to 80 beats per minute—may increase by 20 to 50 beats per minute, or may even double in some cases. Taking other drugs with marijuana can amplify this effect.

Limited evidence suggests that a person's risk of heart attack during the first hour after smoking marijuana is four times his or her usual risk. This observation could be partly explained by marijuana raising blood pressure (in some cases) and heart rate and reducing the blood's capacity to carry oxygen. Such possibilities need to be examined more closely, particularly since current marijuana users include adults from the baby boomer generation, who may have other cardiovascular risks that may increase their vulnerability.

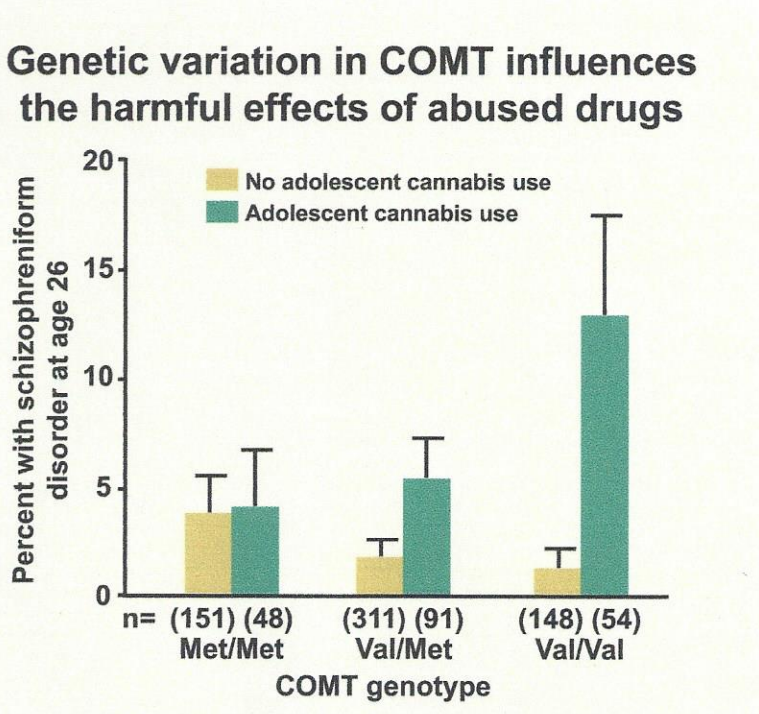
The smoke of marijuana, like that of tobacco, consists of a toxic mixture of gases and particulates, many of which are known to be harmful to the lungs. Someone who smokes marijuana regularly may have many of the same respiratory problems that tobacco smokers do, such as daily cough and phlegm production, more frequent acute chest illnesses, and a greater risk of lung infections. Even infrequent marijuana use can cause burning and stinging of the mouth and throat, often accompanied by a heavy



Within a few minutes after inhaling marijuana smoke, an individual's heart rate speeds up, the bronchial passages relax and become enlarged, and blood vessels in the eyes expand, making the eyes look red.

cough. One study found that extra sick days used by frequent marijuana smokers were often because of respiratory illnesses.[6]

In addition, marijuana has the *potential* to promote cancer of the lungs and other parts of the respiratory tract because it contains irritants and carcinogens—up to 70 percent more than tobacco smoke. It also induces high levels of an enzyme that converts certain hydrocarbons into their cancer-causing form, which could accelerate the changes that ultimately produce malignant cells. And since marijuana smokers generally inhale more deeply and hold their breath longer than tobacco smokers, the lungs are exposed longer to carcinogenic smoke. However, while several lines of evidence have suggested that marijuana use may lead to lung cancer, the supporting evidence is inconclusive.[8] The presence of an unidentified active ingredient in cannabis smoke having protective properties—if corroborated and properly characterized—could help explain the inconsistencies and modest findings.



The influence of adolescent marijuana use on adult psychosis is affected by genetic variables. This figure shows that variations in a gene can affect the likelihood of developing psychosis in adulthood, following exposure to cannabis in adolescence. The COMT gene governs an enzyme that breaks down dopamine, a brain chemical involved in schizophrenia. It comes in two forms: "Met" and "Val." Individuals with one or two copies of the Val variant have a higher risk of developing schizophrenic-type disorders if they used cannabis during adolescence (dark bars). Those with only the Met variant were unaffected by cannabis use.[7]

A significant body of research demonstrates negative effects of THC on the function of various immune cells, both in vitro in cells and in vivo with test animals. However, no studies to date connect marijuana's suspected immune system suppression with greater incidence of infections or immune disorders in humans. One short (3-week) study found marijuana smoking to be associated with a few statistically significant negative effects on the immune function of AIDS patients; a second small study of college students also suggested the possibility of marijuana having adverse effects on immune system functioning. Thus, the combined evidence from animal studies plus the limited human data available seem to warrant additional research on the impact of marijuana on the immune system. **(See also "The Science of Medical Marijuana," page 9.)**

Is There a Link Between Marijuana Use and Mental Illness?

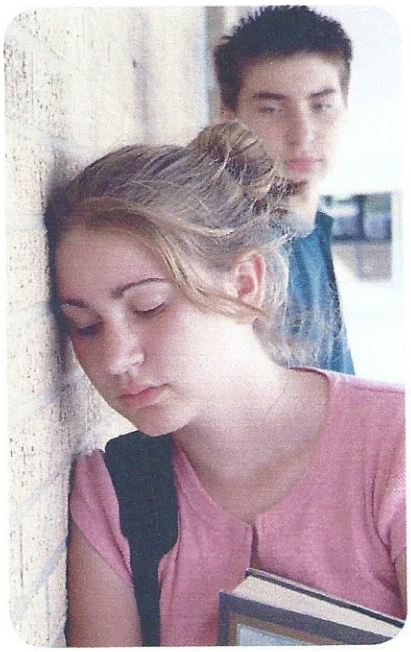
Research in the past decade has focused on whether marijuana use actually causes other mental illnesses. The strongest evidence to date suggests a link between cannabis use and psychosis.[9] For example, a series of large prospective studies that followed a group of people over time showed a relationship between marijuana use and later development of psychosis. Marijuana use also worsens the course of illness in patients with schizophrenia and can produce a

brief psychotic reaction in some users that fades as the drug wears off. The amount of drug used, the age at first use, and genetic vulnerability can all influence this relationship. One example is a study **(illustrated, page 6)** that found an increased risk of psychosis among adults who had used marijuana in adolescence and who also carried a specific variant of the gene for catechol-O-methyltransferase (COMT), an enzyme that degrades neurotransmitters such as dopamine and norepinephrine.[7]

In addition to the observed links between marijuana use and schizophrenia, other less consistent associations have been reported between marijuana use and depression, anxiety, suicidal thoughts among adolescents, and personality disturbances. One of the most frequently cited, albeit still controversial, is an amotivational syndrome, defined as a diminished or absent drive to engage in typically rewarding activities. Because of the role of the endocannabinoid system in regulating mood, these associations make a certain amount of sense; however, more research is needed to confirm and better understand these linkages.

Is Marijuana Addictive?

Long-term marijuana use can lead to addiction; that is, people have difficulty controlling their drug use and cannot stop even though it interferes with many aspects of their lives. It is estimated that 9 percent of people who use marijuana will become dependent on it.[10] The number goes up to about 1 in 6 in



those who start using young (in their teens) and to 25–50 percent among daily users.[11, 12] Moreover, a study of over 300 fraternal and identical twin pairs found that the twin who had used marijuana before the age of 17 had elevated rates of other drug use and drug problems later on, compared with their twin who did not use before age 17.[13]

According to the 2010 NSDUH, marijuana accounted for 4.5 million of the estimated 7.1 million Americans dependent on or abusing illicit drugs.[1] In 2009, approximately 18 percent of people aged 12 and older entering drug abuse treatment programs reported marijuana as their primary drug of abuse.[14]

Marijuana addiction is also linked to a withdrawal syndrome similar to that of nicotine withdrawal, which can make it hard to quit. People trying to quit report irritability, sleeping difficulties, craving, and anxiety. They also show increased aggression on psychological tests, peaking approximately 1 week after they last used the drug.

How Does Marijuana Use Affect School, Work, and Social Life?

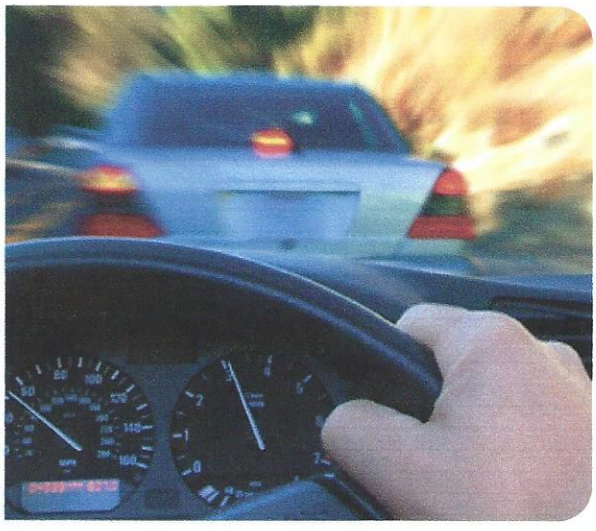
Research has shown that marijuana's negative effects on attention, memory, and learning can last for days or weeks after the acute effects of the drug wear off.[15] Consequently, someone who smokes marijuana daily may be functioning at a reduced intellectual level most or all of the time. Not surprisingly, evidence suggests that, compared with their nonsmoking peers, students who smoke marijuana tend to get lower grades and are more likely to drop out of high school.[16] A meta-analysis of 48 relevant studies—one of the most thorough performed to date—found cannabis use to be associated consistently with reduced educational attainment (e.g., grades and chances of graduating).[17] However, a *causal* relationship is not yet proven between cannabis use by young people and psychosocial harm.

That said, marijuana users themselves report poor outcomes on a variety of life satisfaction and achievement measures. One study compared current and former long-term heavy users of marijuana with a control group who reported smoking cannabis at least once in their lives but not more than 50 times. Despite similar education and income backgrounds, significant differences were found in educational attainment: fewer of the heavy users of cannabis completed college, and more had yearly household incomes of less than $30,000. When asked how marijuana

affected their cognitive abilities, career achievements, social lives, and physical and mental health, the majority of heavy cannabis users reported the drug's negative effects on all of these measures. In addition, several studies have linked workers' marijuana smoking with increased absences, tardiness, accidents, workers' compensation claims, and job turnover. For example, a study among postal workers found that employees who tested positive for marijuana on a pre-employment urine drug test had 55 percent more industrial accidents, 85 percent more injuries, and a 75-percent increase in absenteeism compared with those who tested negative for marijuana use.

Does Marijuana Use Affect Driving?

Because marijuana impairs judgment and motor coordination and slows reaction time, an intoxicated person has an increased chance of being involved in and being responsible for an accident.[18, 19] According to the National Highway Traffic Safety Administration, drugs other than alcohol (e.g., marijuana and cocaine) are involved in about 18 percent of motor vehicle driver deaths. A recent survey found that 6.8 percent of drivers, mostly under age 35, who were involved in accidents tested positive for THC; alcohol levels above the legal limit were found in 21 percent of such drivers.



Can Marijuana Use During Pregnancy Harm the Baby?

Animal research suggests that the body's endocannabinoid system plays a role in the control of brain maturation, particularly in the development of emotional responses. It is conceivable that even low concentrations of THC, when administered during the perinatal period, could have profound and long-lasting consequences for both brain and behavior.[20] Research has shown that some babies born to women who used marijuana during their pregnancies display altered responses to visual stimuli, increased tremulousness, and a high-pitched cry, which could indicate problems with neurological development. In school, marijuana-exposed children are more likely to show gaps in problemsolving skills, memory, and the ability to remain attentive. More research is needed, however, to disentangle the drug-specific factors from the environmental ones.[21]

Available Treatments for Marijuana Use Disorders

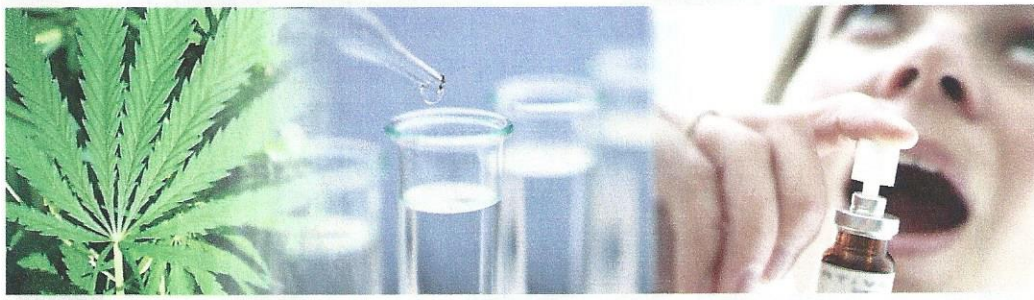
Marijuana dependence appears to be very similar to other substance dependence disorders, although the long-term clinical outcomes may be less severe. On average, adults seeking treatment for marijuana abuse or dependence have used marijuana nearly every day for more than 10 years and have attempted to quit more than six times. It is important to note that marijuana dependence is most prevalent among patients suffering from other psychiatric disorders, particularly among adolescent and young adult populations.[22] Also, marijuana abuse or dependence typically co-occurs with use of other drugs, such as cocaine and alcohol. Available studies indicate that effectively treating the mental health disorder with standard treatments involving medications and behavioral therapies may help reduce cannabis use, particularly among heavy users and those with more chronic mental disorders. Behavioral treatments, such as motivational enhancement therapy (MET), group or individual cognitive-behavioral therapy (CBT), and contingency management (CM), as well as family-based treatments, have shown promise.

Unfortunately, the success rates of treatment are rather modest. Even with the most effective treatment for adults, only about 50 percent of

enrollees achieve an initial 2-week period of abstinence, and among those who do, approximately half will resume use within a year. Across studies, 1-year abstinence rates have ranged between 10 and 30 percent for the various behavioral approaches. As with other addictions, these data suggest that a chronic care model should be considered for marijuana addiction, with treatment intensity stepped up or down based on need, comorbid addictions or other mental disorders, and the availability of family and other supports.

Currently, no medications are available to treat marijuana abuse, but research is active in this area. Most of the studies to date have targeted the marijuana withdrawal syndrome. For example, a recent human study showed that a combination of a cannabinoid agonist medication with lofexidine (a medication approved in the United Kingdom for the treatment of opioid withdrawal) produced more robust improvements in sleep and decreased marijuana withdrawal, craving, and relapse in daily marijuana smokers relative to either medication alone. Recent discoveries about the inner workings of the endogenous cannabinoid system raise the future possibility of a medication able to block THC's intoxicating effects, which could help prevent relapse by reducing or eliminating marijuana's appeal.

The Science of Medical Marijuana



The potential medicinal properties of marijuana have been the subject of substantive research and heated debate. Scientists have confirmed that the cannabis plant contains active ingredients with therapeutic potential for relieving pain, controlling nausea, stimulating appetite, and decreasing ocular pressure. As a result, a 1990 Institute of Medicine report concluded that further clinical research on cannabinoid drugs and safe delivery systems was warranted.

At that time, dronabinol (Marinol®) and nabilone (Cesamet®) were the only FDA-approved, marijuana-based medications that doctors could prescribe for the treatment of nausea in patients undergoing cancer chemotherapy and to stimulate appetite in patients with wasting syndrome due to AIDS. These pills contained synthetic versions of THC, the main active ingredient in marijuana. Today, 25 years after their approval, the development of Sativex® marks the arrival of the second generation of cannabis-based medications. This new product (currently available in the United Kingdom and Canada) is a chemically pure mixture of plant-derived THC and Cannabidiol, formulated as a mouth spray and approved for the relief of cancer-associated pain and spasticity and neuropathic pain in multiple sclerosis.

Scientists continue to investigate the medicinal properties of THC and other cannabinoids to better evaluate and harness their ability to help patients suffering from a broad range of conditions, while avoiding the adverse effects of smoked marijuana. These efforts are bound to improve our understanding of the cannabinoid system and help us bring to market a new generation of safe and effective medications.

Glossary

Addiction: A chronic, relapsing disease characterized by compulsive drug seeking and abuse despite adverse consequences. It is associated with long-lasting changes in the brain.

Basal Ganglia: Structures located deep in the brain that play an important role in the initiation of movements. These clusters of neurons include the caudate nucleus, putamen, globus pallidus, and substantia nigra. It also contains the nucleus accumbens, which is the main center of reward in the brain.

Cannabinoids and Cannabinoid Receptors: A family of chemicals that bind to specific (cannabinoid) receptors to influence mental and physical functions. Cannabinoids that are produced naturally by the body are referred to as endocannabinoids. They play important roles in development, memory, pain, appetite, among others. The marijuana plant *(Cannabis sativa)* contains delta-9-tetrahydrocannabinol (THC) that can disrupt these processes, if administered repeatedly and/or in high enough concentrations.

Carcinogen: Any substance that causes cancer.

Cerebellum: A large structure located in the back of the brain that helps control the coordination of movement by making connections to other parts of the CNS (pons, medulla, spinal cord, and thalamus). It also may be involved in aspects of motor learning.

Cerebral Cortex: The outermost layer of the cerebral hemispheres of the brain. It is largely responsible for conscious experience, including perception, emotion, thought, and planning.

Cognitive-Behavioral Therapy (CBT): A form of psychotherapy that teaches people strategies to identify and correct problematic behaviors in order to enhance self-control, stop drug use, and address a range of other problems that often co-occur with them.

Contingency Management (CM): A therapeutic management approach based on frequent monitoring of the target behavior and the provision (or removal) of tangible, positive rewards when the target behavior occurs (or does not). CM techniques have shown to be effective for keeping people in treatment and promoting abstinence.

Dopamine: A brain chemical, classified as a neurotransmitter, found in regions of the brain that regulate movement, emotion, motivation, and pleasure.

Hippocampus: A seahorse-shaped structure located within the brain that is considered an important part of the limbic system. One of the most studied areas of the brain, the hippocampus plays key roles in learning, memory, and emotion.

Hydrocarbon: Any chemical compound containing only hydrogen and carbon.

Motivational Enhancement Therapy (MET): A systematic form of intervention designed to produce rapid, internally motivated change. MET does not attempt to treat the person, but rather mobilize their own internal resources for change and engagement in treatment.

Psychosis: A mental disorder (e.g., schizophrenia) characterized by delusional or disordered thinking detached from reality; symptoms often include hallucinations.

Schizophrenia: A psychotic disorder characterized by symptoms that fall into two categories: (1) positive symptoms, such as distortions in thoughts (delusions), perception (hallucinations), and language and thinking and (2) negative symptoms, such as flattened emotional responses and decreased goal-directed behavior.

Schizophreniform Disorders: Similar to schizophrenia, but of shorter duration and possibly lesser severity.

THC: Delta-9-tetrahydrocannabinol; the main active ingredient in marijuana, which acts on the brain to produce its effects.

Ventral Striatum: An area of the brain that is part of the basal ganglia and becomes activated and flooded with dopamine in the presence of salient stimuli. The release of this chemical also occurs during physically rewarding activities such as eating, sex, and taking drugs, and is a key factor behind our desire to repeat these activities.

Withdrawal: Adverse symptoms that occur after chronic use of a drug is reduced or stopped.

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Where Can I Get More Scientific Information on Marijuana Abuse?

To learn more about marijuana and other drugs of abuse, or to order materials on these topics free of charge in English or Spanish, visit the NIDA Web site at **www.drugabuse.gov** or contact the *DrugPubs* Research Dissemination Center at 877-NIDA-NIH (877-643-2644; TTY/TDD: 240-645-0228).

NATIONAL INSTITUTE ON DRUG ABUSE
NIDA DRUGPUBS
RESEARCH DISSEMINATION CENTER

What's on the NIDA Web Site

- Information on Drugs of Abuse and Related Health Consequences
- NIDA Publications, News, and Events
- Resources for Health Care Professionals
- Funding Information
- International Activities

NIDA Web Sites

NIDA Home Page:
http://www.drugabuse.gov

NIDA Drug Facts:
http://www.drugabuse.gov/publications/term/160/DrugFacts

Easy-to-Read Drug Facts:
http://easyread.drugabuse.gov

NIDA/SAMHSA Blending Initiative:
http://www.drugabuse.gov/blending-initiative

For Physician Information

NIDAMED
www.drugabuse.gov/nidamed

Other Web Sites

Information on marijuana abuse is also available through the following Web site:

- Substance Abuse and Mental Health Services Administration Health Information Network: www.samhsa.gov/shin

NIH National Institute on Drug Abuse

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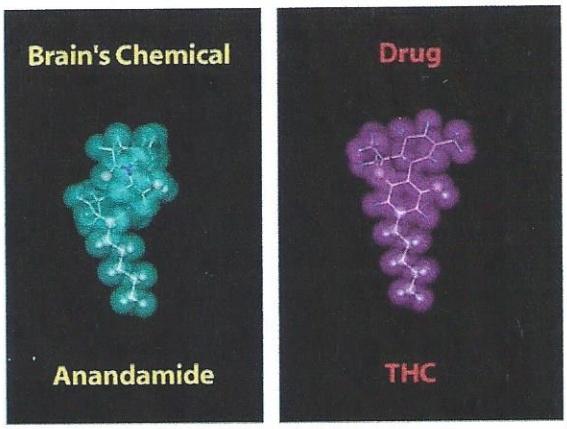
Marijuana

Marijuana is a dry, shredded green and brown mix of leaves, flowers, stems, and seeds from the hemp plant *Cannabis sativa*. In a more concentrated, resinous form, it is called hashish, and as a sticky black liquid, hash oil. The main psychoactive (mind-altering) chemical in marijuana is delta-9-tetrahydrocannabinol, or THC.

Marijuana is the most common illicit drug used in the United States. After a period of decline in the last decade, its use has generally increased among young people since 2007, corresponding to a diminishing perception of the drug's risks. More teenagers are now current (past-month) smokers of marijuana than of cigarettes, according to annual survey data.

How Is Marijuana Used?

Marijuana is usually smoked in hand-rolled cigarettes (joints) or in pipes or water pipes (bongs). It is also smoked in blunts—cigars that have been emptied of tobacco and refilled with a mixture of marijuana and tobacco. Marijuana smoke has a pungent and distinctive, usually sweet-and-sour, odor. Marijuana can also be mixed in food or brewed as a tea.



How Does Marijuana Affect the Brain?

When marijuana is smoked, THC rapidly passes from the lungs into the bloodstream, which carries the chemical to the brain and other organs throughout the body. It is absorbed more slowly when ingested in food or drink.

However it is ingested, THC acts upon specific molecular targets on brain cells, called cannabinoid receptors. These receptors are ordinarily activated by chemicals similar to THC called endocannabinoids, such as anandamide. These are naturally occurring in the body and are part of a neural communication network (the endocannabinoid system) that plays an important role in normal brain development and function.

The highest density of cannabinoid receptors is found in parts of the brain that

influence pleasure, memory, thinking, concentration, sensory and time perception, and coordinated movement. Marijuana overactivates the endocannabinoid system, causing the high and other effects that users experience. These include distorted perceptions, impaired coordination, difficulty with thinking and problem solving, and disrupted learning and memory.

Effects on Life

Research clearly demonstrates that marijuana has the potential to cause problems in daily life or make a person's existing problems worse. In fact, heavy marijuana users generally report lower life satisfaction, poorer mental and physical health, relationship problems, and less academic and career success compared to their peers who came from similar backgrounds. For example, marijuana use is associated with a higher likelihood of dropping out from school. Several studies also associate workers' marijuana smoking with increased absences, tardiness, accidents, workers' compensation claims, and job turnover.

Research has shown that, in chronic users, marijuana's adverse impact on learning and memory persists after the acute effects of the drug wear off; when marijuana use begins in adolescence, the effects may persist for many years. Research from different areas is converging on the fact that regular marijuana use by young people can have long-lasting negative impact on the structure and function of their brains.

A recent study of marijuana users who began using in adolescence revealed a profound deficit in connections between brain areas responsible for learning and memory. And a large prospective study (following individuals across time) showed that people who began smoking marijuana heavily in their teens lost as much as 8 points in IQ between age 13 and age 38; importantly, the lost cognitive abilities were not restored in those who quit smoking marijuana as adults. (Individuals who started smoking marijuana in adulthood did not show significant IQ declines.)

What Are the Other Health Effects of Marijuana?

Marijuana use can have a variety of adverse, short- and long-term effects, especially on cardiopulmonary and mental health.

Marijuana raises heart rate by 20-100 percent shortly after smoking; this effect can last up to 3 hours. In one study, it was estimated that marijuana users have a 4.8-fold increase in the risk of heart attack in the first hour after smoking the drug. This may be due to increased heart rate as well as the effects of marijuana on heart rhythms, causing palpitations and arrhythmias. This risk may be greater in older individuals or in those with cardiac vulnerabilities.

Marijuana and Driving

Because it seriously impairs judgment and motor coordination, marijuana also contributes to accidents while driving. A recent analysis of data from several studies found that marijuana use more than doubles a driver's risk of being in an accident. Further, the combination of marijuana and alcohol is worse than either substance alone with respect to driving impairment.

Marijuana smoke is an irritant to the lungs, and frequent marijuana smokers can have many of the same respiratory problems experienced by tobacco smokers, such as daily cough and phlegm production, more frequent acute chest ill-

ness, and a heightened risk of lung infections. One study found that people who smoke marijuana frequently but do not smoke tobacco have more health problems and miss more days of work than nonsmokers, mainly because of respiratory illnesses.

A number of studies have shown an association between chronic marijuana use and mental illness. High doses of marijuana can produce a temporary psychotic reaction (involving hallucinations and paranoia) in some users, and using marijuana can worsen the course of illness in patients with schizophrenia. A series of large prospective studies also showed a link between marijuana use and later development of psychosis. This relationship was influenced by genetic variables as well as the amount of drug used and the age at which it was first taken—those who start young are at increased risk for later problems.

Associations have also been found between marijuana use and other mental health problems, such as depression, anxiety, suicidal thoughts among adolescents, and personality disturbances, including a lack of motivation to engage in typically rewarding activities. More research is still needed to confirm and better understand these linkages.

Marijuana use during pregnancy is associated with increased risk of neurobehavioral problems in babies. Because THC and other compounds in marijuana mimic the body's own cannabinoid-like chemicals, marijuana use by pregnant mothers may alter the developing endocannabinoid system in the brain of the fetus. Consequences for the child may include problems with attention, memory, and problem solving.

Finally, marijuana use has been linked in a few recent studies to an increased risk of an aggressive type of testicular cancer in young men, although further research is needed to establish whether there is a direct causal connection.

Is Marijuana Addictive?

Is Marijuana Medicine?

Although many have called for the legalization of marijuana to treat conditions including pain and nausea caused by HIV/AIDS, cancer, and other conditions, the scientific evidence to date is not sufficient for the marijuana plant to gain FDA approval, for two main reasons.

First, there have not been enough clinical trials showing that marijuana's benefits outweigh its health risks in patients with the symptoms it is meant to treat. The FDA requires carefully conducted studies in large numbers of patients (hundreds to thousands) to accurately assess the benefits and risks of a potential medication.

Also, to be considered a legitimate medicine, a substance must have well-defined and measureable ingredients that are consistent from one unit (such as a pill or injection) to the next. This consistency allows doctors to determine the dose and frequency. As the marijuana plant contains hundreds of chemical compounds that may have different effects and that vary from plant to plant, its use as a medicine is difficult to evaluate.

However, THC-based drugs to treat pain and nausea are already FDA approved and prescribed, and scientists continue to investigate the medicinal properties of cannabinoids. For more information, see http://www.drugabuse.gov/publications/drugfacts/marijuana-medicine

Contrary to common belief, marijuana is addictive. Estimates from research suggest that about 9 percent of users become addicted to marijuana; this number increases among those who start young (to about 17 percent, or 1 in 6) and among daily users (to 25-50 percent). Thus, many of the nearly 7 percent of high-school seniors who (according to annual survey data) report smoking marijuana daily or almost daily are well on their way to addiction, if not already addicted (besides functioning at a suboptimal level all of the time).

Long-term marijuana users trying to quit report withdrawal symptoms including irritability, sleeplessness, decreased appetite, anxiety, and drug craving, all of which can make it difficult to remain abstinent. Behavioral interventions, including cognitive-behavioral therapy and motivational incentives (i.e., providing vouchers for goods or services to patients who remain abstinent) have proven to be effective in treating marijuana addiction. Although no medications are currently available, recent discoveries about the workings of the endocannabinoid system offer promise for the development of medications to ease withdrawal, block the intoxicating effects of marijuana, and prevent relapse.

Rising Potency

The amount of THC in marijuana samples confiscated by police has been increasing steadily over the past few decades. In 2012, THC concentrations in marijuana averaged nearly 15 percent, compared to around 4 percent in the 1980s. For a new user, this may mean exposure to higher concentrations of THC, with a greater chance of an adverse or uno predictable reaction. Increases in poo tency may account for the rise in emergency department visits involvo ing marijuana use. For experienced users, it may mean a greater risk for addiction if they are exposing themo selves to high doses on a regular bao sis. However, the full range of conseo quences associated with marijuana's higher potency is not well undero stood, nor is it known whether expeo rienced marijuana users adjust for the increase in potency by using less.

Learn More

For additional information on marijuana and marijuana abuse, please see http://www.drugabuse.gov/publications/research-reports/marijuana-abuse

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Spice (Synthetic Marijuana)

"Spice" refers to a wide variety of herbal mixtures that produce experiences similar to marijuana (cannabis) and that are marketed as "safe," legal alternatives to that drug. Sold under many names, including K2, fake weed, Yucatan Fire, Skunk, Moon Rocks, and others—and labeled "not for human consumption"—these products contain dried, shredded plant material and chemical additives that are responsible for their psychoactive (mind-altering) effects.

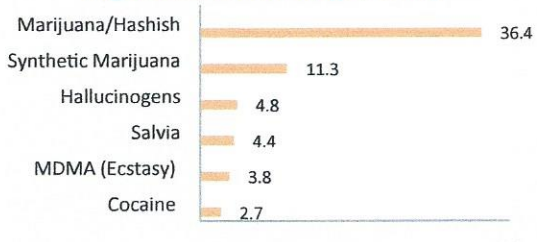
False Advertising

Labels on Spice products often claim that they contain "natural" psychoactive material taken from a variety of plants. Spice products do contain dried plant material, but chemical analyses show that their active ingredients are *synthetic* (or designer) cannabinoid compounds.

For several years, Spice mixtures have been easy to purchase in head shops and gas stations and via the Internet. Because the chemicals used in Spice have a high potential for abuse and no medical benefit, the Drug Enforcement Administration (DEA) has designated the five active chemicals most frequently found in Spice as Schedule I controlled substances, making it illegal to sell, buy, or possess them. Manufacturers of Spice products attempt to evade these legal restrictions by substituting different chemicals in their mixtures, while the DEA continues to monitor the situation and evaluate the need for updating the list of banned cannabinoids.

Spice products are popular among young people; of the illicit drugs most used by high-school seniors, they are second only to marijuana. (They are more popular among boys than girls—in 2012, nearly twice as many male 12th graders reported past-year use of synthetic marijuana as females in the same age group.) Easy access and the misperception that Spice products are "natural" and therefore harmless have likely contributed to their popularity. Another selling point is that the chemicals used in Spice are not easily detected in standard drug tests.

Past-Year Use of Illicit Drugs by High School Seniors (percent)



SOURCE: University of Michigan, 2012 Monitoring the Future Study

How Is Spice Abused?

Some Spice products are sold as "incense," but they more closely resemble potpourri. Like marijuana, Spice is abused mainly by smoking. Sometimes Spice is mixed with marijuana or is prepared as an herbal infusion for drinking.

K2, a popular brand of "Spice" mixture.

How Does Spice Affect the Brain?

Spice users report experiences similar to those produced by marijuana—elevated mood, relaxation, and altered perception—and in some cases the effects are even stronger than those of marijuana. Some users report psychotic effects like extreme anxiety, paranoia, and hallucinations.

So far, there have been no scientific studies of Spice's effects on the human brain, but we do know that the cannabinoid compounds found in Spice products act on the same cell receptors as THC, the primary psychoactive component of marijuana. Some of the compounds found in Spice, however, bind more strongly to those receptors, which could lead to a much more powerful and unpredictable effect. Because the chemical composition of many products sold as Spice is unknown, it is likely that some varieties also contain substances that could cause dramatically different effects than the user might expect.

What Are the Other Health Effects of Spice?

Spice abusers who have been taken to Poison Control Centers report symptoms that include rapid heart rate, vomiting, agitation, confusion, and hallucinations. Spice can also raise blood pressure and cause reduced blood supply to the heart (myocardial ischemia), and in a few cases it has been associated with heart attacks. Regular users may experience withdrawal and addiction symptoms.

We still do not know all the ways Spice may affect human health or how toxic it may be, but one public health concern is that there may be harmful heavy metal residues in Spice mixtures. Without further analyses, it is difficult to determine whether this concern is justified.

Learn More

For additional information on Spice, see http://www.emcdda.europa.eu/attachements.cfm/att_80086_EN_Spice%20Thematic%20paper%20—%20final%20version.pdf