

## Marijuana

Marijuana is the most commonly used illicit drug in the United States. A dry, shredded green/brown mix of flowers, stems, seeds, and leaves of the hemp plant *Cannabis sativa*, it usually is smoked as a cigarette (joint, nail), or in a pipe (bong). It also is smoked in blunts, which are cigars that have been emptied of tobacco and refilled with marijuana, often in combination with another drug. Use also might include mixing marijuana in food or brewing it as a tea. As a more concentrated, resinous form it is called hashish and, as a sticky black liquid, hash oil. Marijuana smoke has a pungent and distinctive, usually sweet-and-sour odor. There are countless street terms for marijuana including pot, herb, weed, grass, widow, ganja, and hash, as well as terms derived from trademarked varieties of cannabis, such as Bubble Gum®, Northern Lights®, Juicy Fruit®, Afghani #1®, and a number of Skunk varieties.

The main active chemical in marijuana is THC (delta-9-tetrahydrocannabinol). The membranes of certain nerve cells in the brain contain protein receptors that bind to THC. Once securely in place, THC kicks off a series of cellular reactions that ultimately lead to the high that users experience when they smoke marijuana.

### **Extent of Use** ———

There were an estimated 2.6 million new marijuana users in 2001. This number is similar to the numbers of new users each year since 1995, but above the number in 1990 (1.6 million). In 2002, over 14 million Americans age 12 and older used marijuana at least once in the month prior to being surveyed, and 12.2 percent of past year marijuana users used marijuana on 300 or more days in the past 12 months. This translates into 3.1 million people using marijuana on a daily or almost daily basis over a 12-month period<sup>(1)</sup>.

The percentage of youth age 12 to 17 who had ever used marijuana declined slightly from 2001 to 2002 (21.9 to 20.6 percent). Among adults age 18 to 25, the rate increased slightly from 53.0 percent to 53.8 percent in 2002. The percentage of young adults age 18 to 25 who had ever used marijuana was 5.1 percent in 1965, but increased steadily to 54.4 percent in 1982. Although the rate for young adults declined somewhat from 1982 to 1993, it did not drop below 43 percent and actually increased to 53.8 percent by 2002<sup>(1)</sup>.

Forty-two percent of youth age 12 or 13 and 24.1 percent age 16 or 17 perceived

smoking marijuana once a month as a great risk. Slightly more than half of youth age 12 to 17 indicated that it would be fairly or very easy to obtain marijuana, but only 26.0 percent of 12- or 13-year-olds indicated the same thing. However, 79.0 percent of those age 16 or 17 indicated that it would be fairly or very easy to obtain marijuana<sup>(1)</sup>.

Prevalence of lifetime, past year, and past month marijuana use declined among students in 8th, 10th, and 12th grades in 2003. However, the declines in 12-month prevalence reached statistical significance only in 8th-graders; past year use has declined by nearly one-third since 1996<sup>(2)</sup>. All three grades showed an increase in perceived risk for regular marijuana use. This finding represents a welcome turnaround in this perception, which has been in decline in all grades over the past 1 or 2 years<sup>(3)</sup>.

In 2002, marijuana was the third most commonly abused drug mentioned in drug-related hospital emergency department (ED) visits in the continental United States. Marijuana mentions rose significantly (24%) from 2000 to 2002, but showed no significant increase since 2001. Taking changes in population into account, marijuana mentions increased 139 percent from 1995 to 2002<sup>(4)</sup>.

### **Effects on the Brain**

Scientists have learned a great deal about how THC acts in the brain to produce its

many effects. When someone smokes marijuana, THC rapidly passes from the lungs into the bloodstream, which carries the chemical to organs throughout the body, including the brain.

In the brain, THC connects to specific sites called cannabinoid receptors on nerve cells and influences the activity of those cells. Some brain areas have many cannabinoid receptors; others have few or none. Many cannabinoid receptors are found in the parts of the brain that influence pleasure, memory, thought, concentration, sensory and time perception, and coordinated movement<sup>(5)</sup>.

The short-term effects of marijuana can include problems with memory and learning; distorted perception; difficulty in thinking and problem solving; loss of coordination; and increased heart rate. Research findings for long-term marijuana use indicate some changes in the brain similar to those seen after long-term use of other major drugs of abuse. For example, cannabinoid (THC or synthetic forms of THC) withdrawal in chronically exposed animals leads to an increase in the activation of the stress-response system<sup>(6)</sup> and changes in the activity of nerve cells containing dopamine<sup>(7)</sup>. Dopamine neurons are involved in the regulation of motivation and reward, and are directly or indirectly affected by all drugs of abuse.

### **Effects on the Heart**

One study has indicated that a user's risk of heart attack more than quadruples in the first hour after smoking marijuana<sup>(8)</sup>. The researchers suggest that such an effect might occur from marijuana's effects on blood pressure and heart rate and reduced oxygen-carrying capacity of blood.

### **Effects on the Lungs**

A study of 450 individuals found that people who smoke marijuana frequently but do not smoke tobacco have more health problems and miss more days of work than nonsmokers<sup>(9)</sup>. Many of the extra sick days among the marijuana smokers in the study were for respiratory illnesses.

Even infrequent use can cause burning and stinging of the mouth and throat, often accompanied by a heavy cough. 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 illness, a heightened risk of lung infections, and a greater tendency to obstructed airways<sup>(10)</sup>. Smoking marijuana increases the likelihood of developing cancer of the head or neck, and the more marijuana smoked the greater the increase<sup>(11)</sup>. A study comparing 173 cancer patients and 176 healthy individuals produced strong evidence that marijuana smoking doubled or tripled the risk of these cancers.

Marijuana use also has the potential to promote cancer of the lungs and other parts of the respiratory tract because it contains irritants and carcinogens<sup>(12, 13)</sup>. In fact, marijuana smoke contains 50 to 70 percent more carcinogenic hydrocarbons than does tobacco smoke<sup>(14)</sup>. It also produces high levels of an enzyme that converts certain hydrocarbons into their carcinogenic form—levels that may accelerate the changes that ultimately produce malignant cells<sup>(15)</sup>. Marijuana users usually inhale more deeply and hold their breath longer than tobacco smokers do, which increases the lungs' exposure to carcinogenic smoke. These facts suggest that, puff for puff, smoking marijuana may increase the risk of cancer more than smoking tobacco.

### **Other Health Effects**

Some of marijuana's adverse health effects may occur because THC impairs the immune system's ability to fight off infectious diseases and cancer. In laboratory experiments that exposed animal and human cells to THC or other marijuana ingredients, the normal disease-preventing reactions of many of the key types of immune cells were inhibited<sup>(16)</sup>. In other studies, mice exposed to THC or related substances were more likely than unexposed mice to develop bacterial infections and tumors<sup>(17, 18)</sup>.

### **Effects of Heavy Marijuana Use on Learning and Social Behavior**

Depression<sup>(19)</sup>, anxiety<sup>(20)</sup>, and personality disturbances<sup>(21)</sup> have been associated with

marijuana use. Research clearly demonstrates that marijuana has potential to cause problems in daily life or make a person's existing problems worse. Because marijuana compromises the ability to learn and remember information, the more a person uses marijuana the more he or she is likely to fall behind in accumulating intellectual, job, or social skills. Moreover, research has shown that marijuana's adverse impact on memory and learning can last for days or weeks after the acute effects of the drug wear off<sup>(22, 23)</sup>.

Students who smoke marijuana get lower grades and are less likely to graduate from high school, compared with their non-smoking peers<sup>(24, 25, 26, 27)</sup>. A study of 129 college students found that, for heavy users of marijuana (those who smoked the drug at least 27 of the preceding 30 days), critical skills related to attention, memory, and learning were significantly impaired even after they had not used the drug for at least 24 hours<sup>(28)</sup>. The heavy marijuana users in the study had more trouble sustaining and shifting their attention and in registering, organizing, and using information than did the study participants who had used marijuana no more than 3 of the previous 30 days. As a result, someone who smokes marijuana every day may be functioning at a reduced intellectual level all of the time.

More recently, the same researchers showed that the ability of a group of long-term heavy marijuana users to recall

words from a list remained impaired for a week after quitting, but returned to normal within 4 weeks<sup>(29)</sup>. Thus, it is possible that some cognitive abilities may be restored in individuals who quit smoking marijuana, even after long-term heavy use.

Workers who smoke marijuana are more likely than their coworkers to have problems on the job. Several studies associate workers' marijuana smoking with increased absences, tardiness, accidents, workers' compensation claims, and job turnover. A study of municipal workers found that those who used marijuana on or off the job reported more "withdrawal behaviors"—such as leaving work without permission, daydreaming, spending work time on personal matters, and shirking tasks—that adversely affect productivity and morale<sup>(30)</sup>. In another study, marijuana users reported that use of the drug impaired several important measures of life achievement including cognitive abilities, career status, social life, and physical and mental health<sup>(31)</sup>.

### **Effects on Pregnancy**

Research has shown that babies born to women who used marijuana during their pregnancies display altered responses to visual stimuli, increased tremulousness, and a high-pitched cry, which may indicate neurological problems in development<sup>(32)</sup>. During infancy and preschool years, marijuana-exposed children have been observed to have more behavioral problems than unexposed children and

poorer performance on tasks of visual perception, language comprehension, sustained attention, and memory<sup>(33, 34)</sup>. In school, these children are more likely to exhibit deficits in decision-making skills, memory, and the ability to remain attentive<sup>(35, 36, 37)</sup>.

### **Addictive Potential**

Long-term marijuana use can lead to addiction for some people; that is, they use the drug compulsively even though it interferes with family, school, work, and recreational activities. Drug craving and withdrawal symptoms can make it hard for long-term marijuana smokers to stop using the drug. People trying to quit report irritability, sleeplessness, and anxiety<sup>(38)</sup>. They also display increased aggression on psychological tests, peaking approximately one week after the last use of the drug<sup>(39)</sup>.

### **Genetic Vulnerability**

Scientists have found that whether an individual has positive or negative sensations after smoking marijuana can be influenced by heredity. A 1997 study demonstrated that identical male twins were more likely than non-identical male twins to report similar responses to marijuana use, indicating a genetic basis for their response to the drug<sup>(40)</sup>. (Identical twins share all of their genes.)

It also was discovered that the twins' shared or family environment before age 18 had no detectable influence on their response to marijuana. Certain environ-

mental factors, however, such as the availability of marijuana, expectations about how the drug would affect them, the influence of friends and social contacts, and other factors that differentiate experiences of identical twins were found to have an important effect.

### **Treating Marijuana Problems**

The latest treatment data indicate that, in 2000, marijuana was the primary drug of abuse in about 15 percent (236,638) of all admissions to treatment facilities in the United States. Marijuana admissions were primarily male (76 percent), White (57 percent), and young (46 percent under 20 years old). Those in treatment for primary marijuana use had begun use at an early age; 56 percent had used it by age 14 and 92 percent had used it by 18<sup>(41)</sup>.

One study of adult marijuana users found comparable benefits from a 14-session cognitive-behavioral group treatment and a 2-session individual treatment that included motivational interviewing and advice on ways to reduce marijuana use. Participants were mostly men in their early thirties who had smoked marijuana daily for more than 10 years. By increasing patients' awareness of what triggers their marijuana use, both treatments sought to help patients devise avoidance strategies. Use, dependence symptoms, and psychosocial problems decreased for at least 1 year following both treatments; about 30 percent of users were abstinent during the last 3-month followup period<sup>(42)</sup>.

Another study suggests that giving patients vouchers that they can redeem for goods—such as movie passes, sporting equipment, or vocational training—may further improve outcomes<sup>(43)</sup>.

Although no medications are currently available for treating marijuana abuse,

recent discoveries about the workings of the THC receptors have raised the possibility of eventually developing a medication that will block the intoxicating effects of THC. Such a medication might be used to prevent relapse to marijuana abuse by lessening or eliminating its appeal.

### Percentage of 8th-Graders Who Have Used Marijuana: Monitoring the Future Study, 2003

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
<b>Ever Used</b>	16.7%	19.9%	23.1%	22.6%	22.2%	22.0%	20.3%	20.4%	19.2%	17.5%
<b>Used in Past Year</b>	13.0	15.8	18.3	17.7	16.9	16.5	15.6	15.4	14.6	12.8
<b>Used in Past Month</b>	7.8	9.1	11.3	10.2	9.7	9.7	9.1	9.2	8.3	7.5
<b>Daily Use in Past Month</b>	0.7	0.8	1.5	1.1	1.1	1.4	1.3	1.3	1.2	1.0

### Percentage of 10th-Graders Who Have Used Marijuana: Monitoring the Future Study, 2003

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
<b>Ever Used</b>	30.4%	34.1%	39.8%	42.3%	39.6%	40.9%	40.3%	40.1%	38.7%	36.4%
<b>Used in Past Year</b>	25.2	28.7	33.6	34.8	31.1	32.1	32.2	32.7	30.3	28.2

<b>Cont.</b>										
	<b>1994</b>	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>
<b>Used in Past Month</b>	15.8	17.2	20.4	20.5	18.7	19.4	19.7	19.8	17.8	17.0
<b>Daily Use in Past Month</b>	2.2	2.8	3.5	3.7	3.6	3.8	3.8	4.5	3.9	3.6

<b>Percentage of 12th-Graders Who Have Used Marijuana Monitoring the Future Study, 2003</b>							
	<b>1979</b>	<b>1991</b>	<b>1992</b>	<b>1993</b>	<b>1994</b>	<b>1995</b>	<b>1996</b>
<b>Ever Used</b>	60.4%	36.7%	32.6%	35.3%	38.2%	41.7%	44.9%
<b>Used in Past Year</b>	50.8	23.9	21.9	26.0	30.7	34.7	35.8
<b>Used in Past Month</b>	36.5	13.8	11.9	15.5	19.0	21.2	21.9
<b>Daily Use in Past Month</b>	10.3	2.0	1.9	2.4	3.6	4.6	4.9
	<b>1997</b>	<b>1998</b>	<b>1999</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>
<b>Ever Used</b>	49.6%	49.1%	49.7%	48.8%	49.0%	47.8%	46.1%
<b>Used in Past Year</b>	38.5	37.5	37.8	36.5	37.0	36.2	34.9
<b>Used in Past Month</b>	23.7	22.8	23.1	21.6	22.4	21.5	21.2
<b>Daily Use in Past Month</b>	5.8	5.6	6.0	6.0	5.8	6.0	6.0

These data are from the 2003 Monitoring the Future (MTF) Survey, funded by National Institute on Drug Abuse, National Institutes of Health, DHHS, and conducted by the University of Michigan's Institute for Social Research. The survey has tracked 12th-graders' illicit drug use and related attitudes since 1975; in 1991, 8th- and 10th-graders were added to the study. The latest data are online at [www.drugabuse.gov](http://www.drugabuse.gov).

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<sup>1</sup> NSDUH (formerly known as the National Household Survey on Drug Abuse) is an annual survey conducted by the Substance Abuse and Mental Health Services Administration. Copies of the latest survey are available from the National Clearinghouse for Alcohol and Drug Information at 1-800-729-6686.

<sup>2</sup> These data are from the 2003 Monitoring the Future Survey, funded by the National Institute on Drug Abuse, National Institutes of Health, DHHS, and conducted by the University of Michigan's Institute for Social Research. The survey has tracked 12th-graders' illicit drug use and related attitudes since 1975; in 1991, 8th- and 10th-graders were added to the study. The latest data are online at [www.drugabuse.gov](http://www.drugabuse.gov).

<sup>3</sup> These data are from the 2003 Monitoring the Future Survey.

<sup>4</sup> These data are from the annual Drug Abuse Warning Network, funded by the Substance Abuse and Mental Health Services Administration, DHHS. The survey provides information about emergency department visits that are induced by or related to the use of an illicit drug or the nonmedical use of a legal drug. The latest data (2002) are available at 1-800-729-6686 or online at [www.samhsa.gov](http://www.samhsa.gov).

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