MARIJUANA’S Effects on Brain, Body & Behavior

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Marijuana is the Most Commonly Used Illicit Drug in the U.S.

- Over 104 million Americans have tried it at least once
- An estimated 2.4 million Americans used it for the first time in 2009

Tetrahydrocannabinol (THC) Active Ingredient in Marijuana

Use of Specific Illicit Drugs in Lifetime Among Persons 12 or Older, 2009

Natural and Drug Reinforcers Increase Dopamine in NAc

Drugs of abuse increase DA in the Nucleus Accumbens, which is believed to trigger the neuroadaptions that result in addiction.

Long Term Effects of Marijuana

Addiction: About 9% of users may become dependent, 1 in 6 who start use in adolescence, 25-50% of daily users

Estimated Prevalence of Dependence Among Users

<table>
<thead>
<tr>
<th>Substance</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tobacco</td>
<td>32</td>
</tr>
<tr>
<td>Alcohol</td>
<td>15</td>
</tr>
<tr>
<td>Cannabis</td>
<td>9</td>
</tr>
<tr>
<td>Cocaine</td>
<td>17</td>
</tr>
<tr>
<td>Stimulant</td>
<td>11</td>
</tr>
<tr>
<td>Analgesics</td>
<td>8</td>
</tr>
<tr>
<td>Psychedelics</td>
<td>5</td>
</tr>
<tr>
<td>Heroin</td>
<td>23</td>
</tr>
</tbody>
</table>

*Nonmedical Use

Source: Anthony JC et al., 1994
Cannabinoids in Brain

**Plasma membrane**

**Cannabinoid Receptors**
- CB1
- CB2

**Endogenous Cannabinoid Ligands**
- Anandamide
- 2-Arachidonoylglycerol (2-AG)
Cannabinoid Receptors in Human Brain

Van Loere et al., 2007.
Cannabinoid Receptors Are Located Throughout the Brain and Regulate:

- Brain Development
- Memory and Cognition
- Motivational Systems
- & Reward
- Appetite
- Immunological Function
- Reproduction
- Movement Coordination
- Pain Regulation
- & Analgesia
ADDICTION IS A DEVELOPMENTAL DISEASE
it starts in adolescence and childhood

Age at tobacco, at alcohol and at cannabis use dependence as per DSM IV

Drug Use Outcomes in Twin Pairs (n = 234) Discordant for Cannabis Use Before Age 17

Brain abnormalities associated with long-term heavy cannabis use

Tracings of left (yellow) and right (blue) amygdalae and left (red) and right (green) hippocampi.

Hippocampal (A) and amygdalar (B) volumes were smaller in cannabis users than in non using control subjects.

High Rates of Comorbid Mood & Anxiety Disorders Among Respondents with Marijuana Dependence (NESARC)

![Bar chart showing high rates of comorbid mood and anxiety disorders among respondents with marijuana dependence compared to the general population.](chart_image)
Adolescent Cannabis Use Increases the Risk for Adult Psychosis in Genetically Vulnerable Individuals

Changes in Brain Glucose Metabolism During Marijuana Intoxication

Cerebellar activity is impaired during intoxication

Potency: Increased THC Content in Seized Marijuana, 1983-2009

Sources: The University of Mississippi Potency Monitoring Project
Emergency Department Visits Involving Selected Drugs: 2008

Source: SAMHSA, 2008 DAWN.
Increased Marijuana Treatment Admissions 1993 and 2007

Source: SAMHSA, TEDS 1993 & 2007
Percentage of U.S. 12th Grade Students Reporting Past Month Use of Cigarettes & Marijuana, 1975 to 2009

Source: The Monitoring the Future study, the University of Michigan
Changes in Attitude Lead to Changes in Use
Marijuana Use and Perceived Risk among 12th Graders, 1975 to 2009

Source: The Monitoring the Future study, the University of Michigan
Marijuana: Facts for Teens Revised

Marijuana: Facts Parents Need to Know Revised

For More Info Visit NIDA’s Website @ www.drugabuse.gov

From the director:

By the time they graduate from high school, about 42 percent of teens will have tried marijuana. Although current use among U.S. teens has dropped dramatically in the past decade (to a prevalence of about 14 percent in 2008), this decline has stalled during the past several years. These data are from the Monitoring the Future study, which has been tracking drug use among teens since 1975. Still, the World Health Organization rates the United States first among 17 European and North American countries for prevalence of marijuana use. And more users start every day. In 2000, an estimated 2.2 million Americans used marijuana for the first time; greater than half were under age 18.

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

Marijuana—often called pot, grass, potleaf, 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 (Timberlake 2009). Marijuana also is used to brew tea and sometimes is mixed into foods.
Relationships Between Total Words Recalled and Quantity, Frequency, Duration and Age of Onset of Regular Cannabis Use

Source: Solowij N et al. Psychopharmacology (Berl.) 2011 Feb 17 [Epub ahead of print].
Brain Glucose Metabolism in Controls and Marijuana Abusers

Cerebellar metabolism is decreased in Marijuana Abusers

Depression Symptoms at Age 10 by Trimester of Prenatal Marijuana Exposure

Mean Number of Symptoms

First

Second

Third

Abstainer

Light

Moderate

Heavy

p<.01

p=ns

p <.05

Gray et al., 2005.
Prosper Multisite Community Study: Less MJ & Inhalants 1.5 Yrs Past Baseline

Past Year Use

<table>
<thead>
<tr>
<th></th>
<th>Intervention</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marijuana Use</td>
<td>2.8</td>
<td>4.8</td>
</tr>
<tr>
<td>Inhalant Use</td>
<td>3.6</td>
<td>5.8</td>
</tr>
</tbody>
</table>

Effects of THC and Lofexidine in a Human Laboratory Model of Marijuana Withdrawal and Relapse

Marijuana Craving

Sleep Latency (objective)

Marijuana Relapse: Money Spent on Self-Administration

Areas where Adolescents with Heavy Marijuana Use (n=15) Showed Decreased Connectivity Compared to Non Drug Users (n=15)

Decreased axial diffusivity is depicted the right superior temporal gyrus (first column), the left posterior internal capsule/thalamic radiations (second column).

Ashtari et al., J Psychiatr Res. 43(3):189-204 2009.
Differences in Gray Matter Density Between Adolescence and Young Adulthood

Differences between: 16 year olds (adolescents) and 23-30 year olds (young adults)