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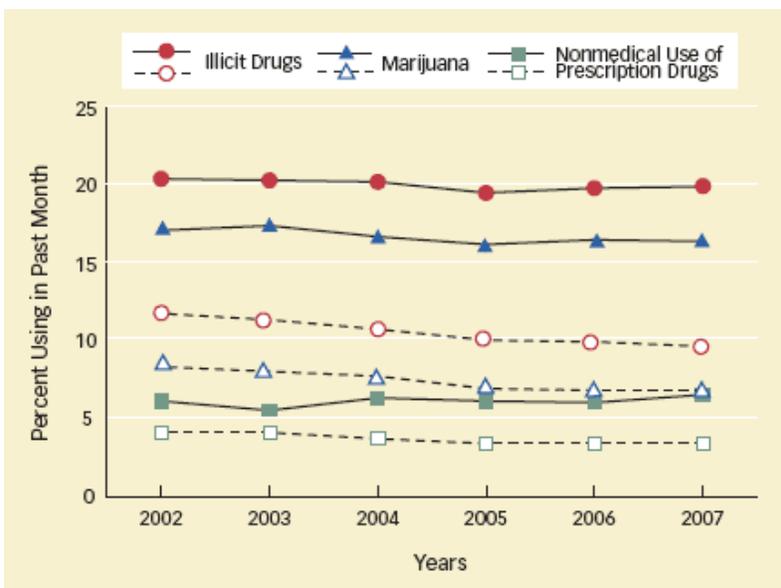
## Fewer Young Adults Abuse Cocaine and Methamphetamine, National Survey Finds

Tearoff  
Vol. 22, No. 2 (December 2008)

The percentage of young adults who said they were abusing cocaine or methamphetamine dropped substantially from 2006 to 2007, according to the 2007 National Survey on Drug Use and Health (NSDUH), published in September 2008. Overall drug abuse, however, remained constant: According to the survey, an estimated 19.9 million Americans age 12 and over used an illicit drug in the previous month. That rate has held steady since 2002.

### ILLICIT DRUG USE AMONG YOUTHS AND YOUNG ADULTS

Youths (age 12 to 17) have lower rates of drug use than young adults (age 18 to 25). Youth rates (open symbols, broken lines) have fallen gradually, while the young adult (filled symbols, solid lines) rates have remained level.



As in past years, young adults (aged 18-25) reported the highest rates of substance abuse. About 20 percent said they abused one or more illicit drugs; 16.4 percent said they abused marijuana, which topped the list of abused drugs in this cohort. Abuse rates for marijuana and most of the other drugs have changed little in the past 6 years. However, the decline in abuse of the stimulants cocaine and methamphetamine in this group runs counter to that pattern. In 2007, for example, 1.7 percent of the young adults reported cocaine abuse, a 23 percent decline from the previous year. Methamphetamine abuse in this age group dropped by a third, to 0.4 percent.

By contrast, 12- to 17-year-olds have reported a steady decline in overall illicit

drug use, from 11.6 percent in 2002 to 9.5 percent in 2007. Driving the decline in this cohort has been an 18 percent drop in marijuana use, from 8.2 percent in 2002 to 6.7 percent in 2007. Inhalants are the only drug category that showed no decline among adolescents over that 6-year period, although rates for some drugs have leveled off since 2005.

Rates of drug abuse tend to decline steadily after the age of 25. However, as more baby boomers (people born between 1946 and 1964) enter the 50-59 age range, illicit drug use in that group has risen, jumping from 2.7 percent in 2002 to 5 percent in 2007. "Illicit drug use has historically been more prevalent in the baby boomer cohort. As its members age into the 50-59 age category, the prevalence increases relative to prior cohorts in this age group," says Dr. Marsha Lopez of NIDA's Division of Epidemiology, Services and Prevention Research.

Marijuana remains the most commonly used illicit drug across the survey, with an estimated 14.4 million past-month users. In 2007, roughly 2.1 million people smoked marijuana for the first time, and a similar number started using prescription painkillers for nonmedical purposes; these drugs drew more initiates last year than any other. Of the estimated 6.9 million people who used prescription psychotherapeutic drugs nonmedically, 5.2 million chose painkillers, representing a 16 percent rise in nonmedical use of these drugs since 2004. On a positive note, the 2007 survey found a significant 1-year decline in the nonmedical use of prescribed stimulants.

In 2007, as in previous years, men reported higher rates of past-month illicit drug use than women (10.4 percent versus 5.8 percent). Among ethnic groups, American Indians/Alaska natives had the highest rate of illicit drug use (12.6 percent) of any racial/ethnic group, followed by multiracial individuals (11.8 percent), African-Americans (9.5 percent), whites (8.2 percent), Hispanics (6.6 percent), and Asians (4.2 percent). No group had a significant change from the previous year.

The trends determined by NSDUH for adolescents and young adults are generally consistent with those reported by the NIDA-funded Monitoring the Future survey. (For more information, see NIDA Notes, Volume 21, Number 5, March 2008, page 15). The survey, based on the responses of 67,500 participants, is available online at [www.oas.samhsa.gov/NSDUHlatest.htm](http://www.oas.samhsa.gov/NSDUHlatest.htm). Hard copies can be ordered free by calling (800) 729-6686.

## SOURCE

Substance Abuse and Mental Health Services Administration, 2008. Results from the 2007 *National Survey on Drug Use and Health: National Findings* (Office of Applied Studies, DHHS Publication No. SMA 08-4343). Rockville, MD: SAMHSA.

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Research Findings  
Vol. 22, No. 2 (December 2008)

## Long-Term Cocaine Self-Administration Depresses Brain Activity

**Neural activity of monkeys diminishes in regions linked with cognition and emotion.**

By **LORI WHITTEN**, *NIDA Notes* Staff Writer

Chronic exposure to cocaine depresses neural activity. Initially, the effect shows up mostly in the brain's reward areas. With longer exposure, however, neural depression spreads to circuits that form cognitive and emotional memories and associations, according to NIDA-funded research by Drs. Thomas J.R. Beveridge and Linda J. Porrino and colleagues at the Wake Forest University School of Medicine.

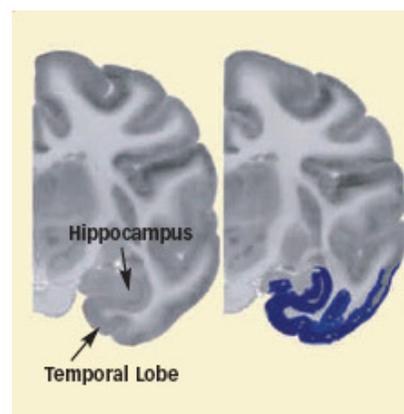
### WIDER EFFECTS WITH LONGER EXPOSURE

The researchers trained 14 male monkeys to press a lever for a reward. Six monkeys received banana-flavored food morsels, and eight received an infusion of cocaine (either 0.03 mg/kg or 0.3 mg/kg). Each monkey received up to 30 portions of food or infusions of cocaine daily for either 5 or 100 days. The 100-day trial, much longer than most other studies of drug use in primates, closely mimicked chronic cocaine abuse among people. For monkeys in the high-dose group, each session ended when they self-administered a dose equivalent to a person taking roughly 0.5-1.0 gram of cocaine per day. The researchers estimate that their experiment models a person heavily abusing cocaine daily for roughly 1 year.

After each monkey's final session, Dr. Porrino's team mapped its rate of cerebral glucose metabolism—the primary indicator of cerebral energy expenditure. The researchers injected a radiolabeled form of glucose (2-[<sup>14</sup>C]deoxyglucose; 2-DG) and, using autoradiography, obtained images that showed how much fuel different brain areas were utilizing (see image). Greater glucose metabolism indicates greater neural activity.

### LONG-TERM COCAINE EXPOSURE BLUNTS TEMPORAL LOBE ACTIVITY IN MONKEYS

Blue coloring in these images represents areas of the temporal lobe that are less active after cocaine self-administration than after food self-administration. After 5 days of cocaine self-administration (left image), a monkey still shows normal activity in the temporal lobe area. In contrast, a monkey that self-administered cocaine for 100 days (right image) demonstrates lowered activity.



All the monkeys that had self-administered cocaine showed some localized depression of glucose metabolism. In the monkeys that self-administered cocaine daily for just 5 days, neural depression was largely restricted to pleasure and motivation areas, especially the reward circuit and areas that process expectations of rewards.

In the 100-day test, animals that had received the high dose of the drug revealed less neural activity in 40 of the 77 brain regions analyzed as compared with animals that had received only food morsels ([see table](#)). The high-dose monkeys incurred a 16 percent drop, on average, in overall cerebral glucose metabolism. The low dose of cocaine depressed metabolism in 14 of the regions, but not overall.

The tests suggest that with longer exposure to cocaine, reductions in neural activity expand within and beyond the pleasure and motivation centers, says Dr. Porrino. "Within the structure called the striatum, the blunting of activity spreads from the nucleus accumbens, a reward area, to the caudate-putamen, which controls behavior based on repetitive action," she says. Long-term cocaine use also depressed memory and information-processing areas.

The findings accord well with those of human imaging studies, which have found general depression in cerebral blood flow among chronic cocaine abusers compared with nonabusers. By using animals, however, Dr. Porrino eliminated two sources of uncertainty in those clinical studies: differences in metabolic rates that may have predated cocaine abuse and abuse of drugs other than cocaine. "My team can directly attribute to cocaine the depressed brain metabolism observed in the study," says Dr. Porrino.

"Our 100-day experimental protocol for rhesus monkeys gives a good picture of what might happen in the brains of cocaine abusers," she says. "Some addiction researchers believe that the shift in activity within the striatum may, in part, underlie the progression from voluntary drug taking to addiction. Moreover, human imaging research has linked drug craving with the amygdala and insula, temporal lobe areas depressed by cocaine in our study."

<b>COCAINE SELF-ADMINISTERED BY MONKEYS FOR 100 DAYS DEPRESSES NEURAL ACTIVITY IN SPECIFIC BRAIN AREAS.</b>		
<b>Name of area</b>	<b>Selected roles in behavior</b>	<b>Depression of metabolic activity* (percentage)</b>
Nucleus accumbens (ventral striatum)	Processes reward and motivation	16-31
Caudate-putamen (dorsal striatum)	Controls behaviors based on repetitive action	10-23
Hypothalamus	Controls eating, fighting, mating, and sleep	18-22
Insula	Translates body signals into subjective feelings	17-19
Hippocampus	Consolidates memories and influences mood	15-23
Amygdala	Forms emotional and motivational memories, e.g., linking a cue and a drug to produce craving	13-19
Temporal cortex areas	Processes emotional and cognitive information, e.g., recognition and short-term memory	17-22

\* Animals self-administering cocaine at either dose were compared with animals self-administering food.

"The reduced activity of the temporal lobe indicates that this structure is somehow compromised," says Dr. Nancy Pilotte of NIDA's Division of Basic Neuroscience and Behavioral Research. "Some of these regions mediate the ability to connect emotionally, and cocaine's blunting of them may induce a flattened affect similar to depression symptoms that are common among chronic cocaine abusers."

"Dr. Porrino and her colleagues have identified key brain structures affected by long-term cocaine exposure and have provided a valuable set of observations that could serve as a basis for future research," Dr. Pilotte says. For example, she adds, researchers might now focus on those regions when gauging the effectiveness of potential medications for cocaine addiction or when measuring recovery after abstinence.

## SOURCES

Beveridge, T.J.R., et al. Chronic cocaine self-administration is associated with altered functional activity in the temporal lobes of nonhuman primates. *European Journal of Neuroscience* 23(11):3109-3118, 2006. [[Abstract](#)]

Porrino, L.J., et al. The effects of cocaine: A shifting target over the course of addiction. *Progress in Neuropsychopharmacology and Biological Psychiatry* 31(8):1593-1600, 2007. [[Abstract](#)]

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## Chronic Cocaine Abusers Have Occult Insomnia in Early Abstinence

Research Findings  
Vol. 21, No. 5 (March 2008)

**Patients in early treatment may not recognize their own sleep impairment or its impact on their performance.**

**BY LORI WHITTEN, *NIDA Notes* Staff Writer**

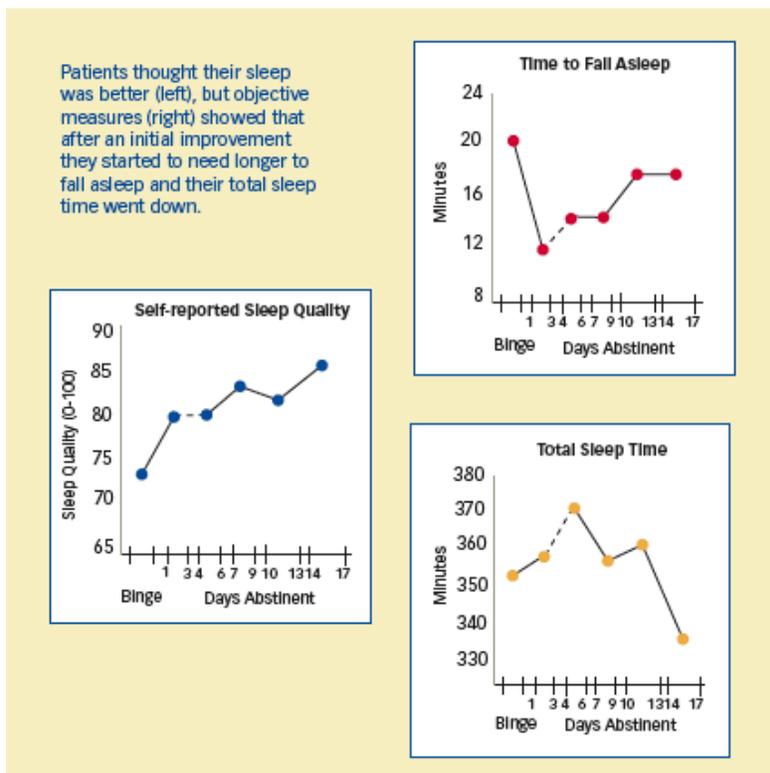
Chronic cocaine abusers may feel they are sleeping better and better during early abstinence, but objective measures show the opposite happens. A team of NIDA-funded addiction and sleep researchers at the Yale and Harvard Schools of Medicine found evidence of insomnia, with learning and attentional deficits, on days of taking the drug and after 2.5 weeks of abstinence. The researchers believe cocaine may impair the brain's ability to gauge its own need for sleep, and patients' ability to benefit from early treatment may suffer as a result.

"Problems in memory and attention are linked with increased treatment dropout and likely affect patients' ability to 'take in' lessons from drug abuse counseling," says Dr. Robert Malison of Yale, a co-investigator on the study. If the results are confirmed, clinicians and patients may want to consider addressing sleep disorders in early therapy, perhaps with the use of medications or behavioral treatments.

The researchers recruited 10 men and two women aged 24 to 49 who, on average, had abused cocaine for 17 years and had used \$500 worth of the drug per week. All the participants declined an offer of drug abuse treatment. Urine tests indicated that cocaine was the only drug any of them had abused during the week before the study.

At the outset of the study, participants self-administered cocaine from a pump under physician oversight, building up to a dose of 32 mg/kg of body weight over 1.5 hours, then repeating this dose essentially at will, but no less than 5 minutes apart, for another 1.5 hours. Subsequently, they self-administered the higher dose with the same minimal restriction for 2 hours on each of three consecutive days, either on days 4-6 or 18-20. This schedule simulated chronic cocaine abusers' typical bingeing pattern of drug abuse and allowed researchers to monitor each participant's sleep and cognitive performance for 17 days after a binge.

### **OBJECTIVE MEASURES BELIE PATIENTS' IMPRESSIONS OF SLEEP IMPROVEMENT**



Research staff made sure the participants stayed awake from 7:45 AM to 9:30 PM, and let them sleep through the night. At night, the participants wore Nightcap sleep monitors, a bandana-like device that records eye and body movements that indicate whether someone is awake, asleep and dreaming, or sleeping dreamlessly. On most nights participants also wore polysomnographic (PSG) devices that continuously assessed brain activity with electroencephalography (EEG) and measured eye and muscle movements associated with different sleep stages. Combining the information gathered by these measures with participants' responses to daily questionnaires on their sleep experience and with cognitive testing, the researchers demonstrated that the participants had:

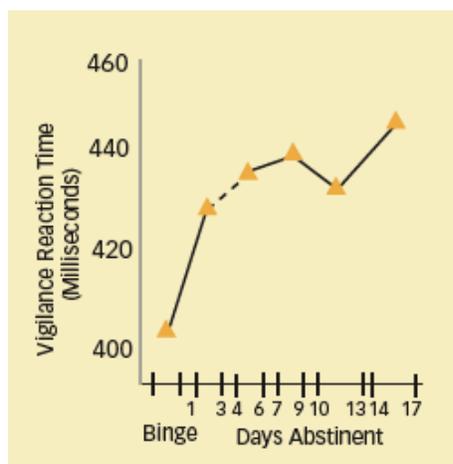
- *Sleep deficits*—After 14 to 17 days of abstinence, the study group exhibited sleep deficits on several measures, relative to healthy, age-matched peers who participated in prior studies. For example, they had less total sleep time (336 versus 421-464 minutes) and took longer to fall asleep (19 versus 6-16 minutes).
- *Declines in sleep quantity and quality*—The time participants took to fall asleep and their total time asleep transiently improved during the first week of abstinence, but then reverted to the patterns recorded on days of cocaine taking. On abstinence days 14-17, participants took an average of 20 minutes to fall

#### **ALERTNESS IMPAIRMENTS PARALLEL SLEEP DEFICITS**

In the Digital Vigilance Test, participants were required to press a button when they saw a target number on the right side of the screen while viewing a rapidly changing number sequence in the middle of the screen. Poor performance on the task corresponded with sleep deficits at 14-17 days of abstinence.

asleep (from a low of 11) and slept for 40 minutes less than their minimum. Slow-wave sleep—a deep sleep that often increases following sleep deprivation—rose during the binge and on abstinence days 10-17.

- *Lack of awareness of their sleep problems*—In contrast to the evidence of objective measures, the study participants reported steadily improving sleep from the beginning to the end of their days of abstinence.
- *Impairments in learning and attention*—As with sleep quality, participants' performance on tests of alertness and motor-skills learning initially improved and then deteriorated. On abstinence day 17, they registered their lowest scores on alertness and ability to learn a new motor skill.



### INCREASED RISK OF RELAPSE

"Unlike most people with chronic insomnia, including alcoholics, cocaine abusers do not perceive sleep problems and may not ask clinicians for treatment to improve sleep," says Dr. Malison. The problem often goes unaddressed and persists as a result, and the accompanying impairments in attention and learning may affect how well they respond to drug abuse treatment (see "[Cocaine Abusers' Cognitive Deficits Compromise Treatment Outcomes](#) (Archives)"). Clinical studies have shown that poor objective sleep during the first 2 weeks of abstinence predicts relapse to alcohol 5 months after treatment.

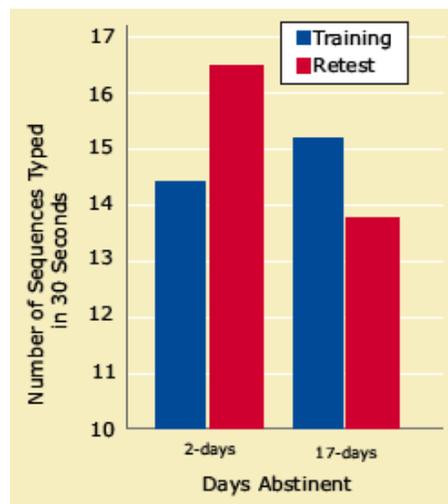
In fact, the insidious nature of cocaine-related insomnia may directly trigger relapse, suggests Dr. Peter Morgan, lead investigator of the study. "Addicted people may take cocaine to improve sleep-related cognitive functioning deficits—unaware that they are abusing, in part, to 'solve' these problems."

Dr. Morgan adds, "Cocaine abusers who recognize their cognitive problems often report that it takes them 6 months to a year to turn the corner—a clinical observation that points to the need for longer term studies of sleep and treatment outcomes among this population." In addition to studies with larger numbers of participants, the investigators say there is a need to investigate possible gender differences in cocaine-related sleep problems. Dr. Morgan and his team are currently testing two medications, tiagabine and modafinil, to see if they can improve cocaine abusers' sleep and restore cognitive performance.

"Experts believe that not getting enough sleep is an unmet public health

### PERFORMANCE DECLINES WITH SLEEP QUALITY

In the Motor-Sequence Task, participants typed a five-digit sequence of four keys with their non-dominant hand, a skill that improves after a night's sleep. Cocaine abusers showed improvement after two but not 17 days of abstinence.



problem in the general population. These findings highlight this important problem in cocaine abusers," says Dr. Harold Gordon of NIDA's Division of Clinical Neuroscience and Behavioral Research.

#### **SOURCE**

Morgan, P.T., et al. Sleep, sleep-dependent procedural learning and vigilance in chronic cocaine users: Evidence for occult insomnia. *Drug and Alcohol Dependence* 82(3):238-249, 2006. [[Abstract](#)]

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