

HEADS UP REAL NEWS ABOUT DRUGS AND YOUR BODY

WELCOME TO *Heads Up: Real News About Drugs and Your Body*, a drug education program designed to bring you the latest science-based facts about drugs, addiction, and your health so that you can make smart, informed choices about your life.

Through research, scientists have determined that the teen brain is still developing and this makes it particularly vulnerable to the effects of drugs. That's why it is important to know the facts about drugs and their consequences.

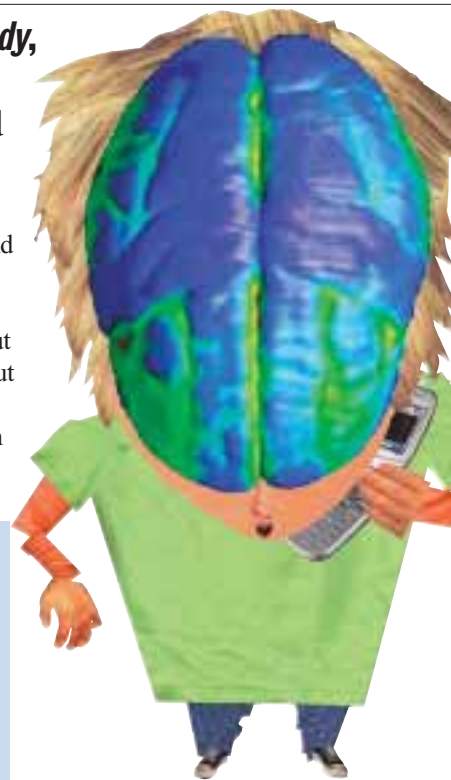
In the articles you're about to read, you'll learn that addiction is a disease and find out the effects that drug addiction may have on a teen's brain and body. You'll also read about the deadly connection between teens, drug abuse, and AIDS and find out that items in most households, like inhalants and prescription drugs, pose real dangers for teens when abused. The final article in the book explores how researchers have discovered an important connection between how the brain is involved in obesity and drug addiction.

Heads Up! The teen brain is a work under construction. Get the facts so you can make good decisions for your brain, your body, and your life.

To order additional copies of this *Heads Up Student Edition* at no charge, call 800-729-6686 and refer to NCADI MS977.

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The teen brain is still developing, so it is particularly vulnerable to the effects of drugs. The prefrontal cortex, which an adult uses to make decisions, is still developing in a teen.



Drug Addiction Is a Disease

Why the Teen Brain Is Vulnerable

- ◆ When Ryan Curry was 17, he woke each morning to find himself shaking, his sheets soaked in cold sweat. His body craved OxyContin, a prescription painkiller.
- ◆ When she was 16, Judy (who does not want her last name to be used) beat up her mother and spent her days breaking into houses and stealing. She was taking a powerful narcotic: heroin.
- ◆ Daniel Oerum was pale and skinny as a 17-year-old. “My teeth were rotting out,” he says. Daniel was using MDMA, also known as Ecstasy.

These teens were featured in last year's edition of Heads Up: Real News About Drugs and Your Body. What do all these teens have in common?



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These teens were all suffering from *drug addiction*, a chronic relapsing disease that is characterized by compulsive drug-seeking and abuse and long-lasting chemical changes in the brain. No one knows how many times a person can use a drug before his or her brain is changed and the user is on the path to addiction. Everyone is different, but genetic makeup probably plays a role. Once a user becomes addicted to the drug, he or she craves it, even more than a person craves food or friendship. Without a dose of the drug, the natural chemical levels in a drug abuser's brain are low. The abuser then feels flat, lifeless, and depressed.

There have been many different approaches to the problem of drug abuse and many different beliefs about the causes of addiction. The scientists at the National Institute on Drug Abuse (NIDA) have been studying this for 30 years. Today, as a result of research studies, clinical trials, and new tools like neuroimaging, scientists know that drug addiction is a disease. With continuing advances in technology, such as fMRI and PET scans, and current research under way, scientists are learning that adolescent brains are more susceptible than adults' to the effects of drugs.

HEADS UP: TEENAGERS ARE MORE AT RISK

You know that as a teen you are at a different stage of development than at any other age, and that physiologically you are not yet an adult. Your brain is one reason why. During adolescence, the brain is still developing. Drugs interfere with that natural development. "Research indicates that exposure to drugs of abuse in adolescence may be a period of significantly increased vulnerability to drugs' effects because of all the changes occurring in the brain," says Nora D. Volkow, M.D., director of NIDA.

Your body and brain have been developing and maturing since you were born. Small children learn to balance and walk easily because the part of their brain called the *cerebellum* matures. You learned to talk, read, and write as your *parietal lobes* developed.

As teens, changes are still happening in your brain. Most important, the *prefrontal cortex* is rapidly changing; it will not be mature until your late teens or early 20s. When scientists look at scans of an adolescent brain, it looks much like an adult's, except for this section. The prefrontal cortex is the part of the brain that, when fully developed, you will use to make decisions that require judgment and consideration of long-term consequences. Because the prefrontal cortex is still maturing in teens, a brain system that matures earlier—the limbic system— influences their decisions more than it would influence an adult's decisions.

The limbic system is a group of linked brain structures that

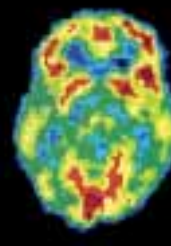
Cutting Edge

See the Brain in Action

How is it possible to watch the brain at work? With new brain scan technology, researchers can view a person's brain as he or she answers questions or plays games. One example of brain scan technology is functional magnetic resonance imaging, or fMRI. This type of scan shows where the brain is using oxygen. Brain cells need oxygen for energy; when cells are using oxygen, they're working. To create an image using fMRI, a force is set up between two powerful magnets; blood with oxygen changes the magnetic field differently than blood without oxygen. The contrast reveals the areas of the brain that are working. fMRI is very useful for studying how drugs change the structure of the brain.

• MRI scan of brain

• PET scan of brain



Another window into the working brain is positron emission tomography, or PET scan. PET scans measure brain activity. To create a PET scan, scientists inject a slightly radioactive compound, a radiotracer, into the bloodstream. Through use of a computer, this radiotracer enables scientists to see where in the brain glucose (sugar) is being used. This indicates active areas of the brain. More glucose is used by more active areas of the brain, which means that the active areas are more visible than the less active areas. With PET, scientists can see which areas of the brain are active, and compare that level of activity to other areas of the brain.

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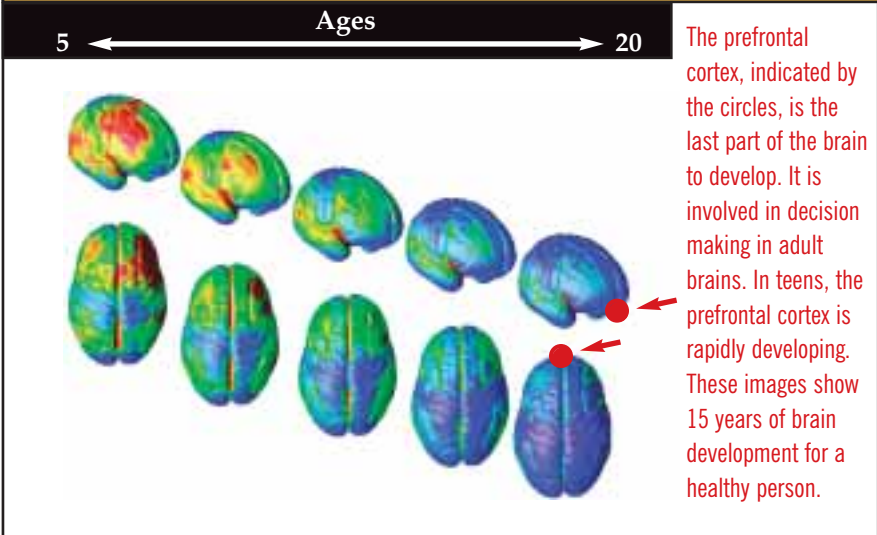
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together are responsible for feelings, emotional reactions, and drive or motivation. A well-developed limbic system is probably one reason why teens love new things and love them intensely. When you hear a song for the first time or taste a new kind of pizza, you'll remember the good feelings and seek out similar ones because your limbic system creates a memory. The limbic system is one of the oldest in the brain: you don't have to think about many of your emotional reactions—such as your heart beating faster when you see your crush in the hallway or your mouth watering at the thought of pizza—because your limbic system is directly wired to the *brain stem* and *cerebrum*.

HEADS UP: DRUGS CHANGE HOW THE TEEN BRAIN WORKS

Scientists have known for years that the limbic system is the primary system affected by drugs of abuse. Normally, brain cells in the limbic system respond to pleasurable

Why Are Teens Vulnerable?



© 2004 National Academy of Sciences, U.S.A. Gogtay, Nitin, Giedd, Jay N., et al. "Dynamic mapping of human cortical development during childhood through early adulthood." PNAS USA. 2004 May 25; 101(21): 8,174-8,179. Epub 2004 May 17, p. 8,178, fig. 3.

experiences by using a natural brain chemical called *dopamine* to carry messages, which we experience as feelings. Dopamine is considered a neurotransmitter, or a chemical in the brain that acts as a messenger between two brain cells. Drugs of abuse interfere with this delicate communication system and create floods of dopamine and intense feelings. The limbic system adapts to drug use in two ways: First, the brain senses the excess neurotransmitters and begins to produce less of the chemical, so that without drugs, the

abuser has a hard time creating natural feelings. He or she needs drugs just to feel normal. Second, the limbic system creates a memory of the drug and a drive for it. That drive to seek out drugs—an intense appetite for something the addict knows is unhealthy—is the disease we call addiction.

HEADS UP: DRUGS ALSO CHANGE HOW THE TEEN BRAIN DEVELOPS

Scientists recently discovered that drugs do more than change how the

Wake-Up Call Understanding the Science of Addiction Keeps Teens in the Know

The teen years have always been a time of growth and exploration. Now more than ever, teen years are also a time of stress. Overscheduling, performance pressure from parents and peers, and worries about the future can make adolescence a pressure cooker. You face these pressures every day. When you know the scientific facts of how you are growing and developing as a

teen, you have the information you need to make smart choices. That means that you will understand the kinds of positive things you can do to relieve stress while not harming your body. You might cook a meal together with friends or spend time with friends at the beach or hiking. Relieving stress in a positive way will help protect you from becoming a victim of drugs.





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limbic system works. Taken during adolescence, drugs actually change how the brain develops. "Recent animal studies provide evidence that drugs affect the developing brain differently than they do the matured brain," says Dr. Volkow.

In studies sponsored by NIDA, scientists are learning why many adult addicts started using drugs in adolescence. For example, new studies show how vulnerable the teen brain is to nicotine, the highly addictive drug in cigarettes.

• **One example: Teen smokers are addicted more quickly than adults.**

Animal studies have shown that teens crave cigarettes after smoking fewer cigarettes than adults. At Duke University in Durham, North Carolina, Dr. Edward Levin and his colleagues introduced nicotine to two groups of rats equivalent in ages to adolescent and adult humans. He found that adolescent rats wanted more nicotine more quickly than adult rats. "This finding suggests that those who begin smoking during adolescence are at greater risk for increased smoking over the long term," writes Dr. Levin.

• **And...teen smokers are more likely to be addicted as adults.**

At Duke University, Dr. Levin also found that, compared to rats that never had nicotine, animals that had nicotine as adolescents wanted more as adults. "Self-administration of nicotine during teenage years, when the brain is still developing, may cause some of the developmental

processes to proceed inappropriately, in effect sculpting the brains of these adolescents in ways that facilitate the addiction process," writes Dr. Levin.

• **What teens do when they are teens impacts the adult body.** At the University of Miami, researchers Dr. Sari Izenwasser and Dr. Stephanie Collins found that rats that had been exposed to nicotine as adolescents were more sensitive to cocaine as adults, putting them more at risk for cocaine abuse. "This suggests that early nicotine use may create an increased risk of addiction for young people who subsequently use cocaine," writes Dr. Izenwasser.

HEADS UP: KNOWLEDGE IS THE KEY TO PREVENTION

What stops kids from becoming drug users? NIDA research shows that education really works. As part of a recent experiment, a group of

seventh-grade teachers taught their students a series of 45-minute lessons about the dangers of drugs, how to say no, and how to stand up for themselves. Over the next year, scientists compared the kids who got the lessons with similar kids who didn't. The educated kids had much lower rates of drug use than the others. This proves that when kids know the facts, they make smart decisions. Reliable Web sites such as www.teens.drugabuse.gov, www.health.org, and www.scholastic.com/HEADSUP have a wealth of information about drugs and their effects on the brain and body. For help with a drug problem, go to www.findtreatment.samhsa.gov to access information about a treatment center near you or call the National hotline at 1-800-662-HELP. Check out future issues of this magazine for more articles in the series **Heads Up: Real News About Drugs and Your Body**.

Facts for Real Life

Q: IF YOU BECOME ADDICTED TO DRUGS, IS IT HOPELESS, OR CAN YOUR BRAIN RECOVER?

A: It's tough to overcome addiction. Some of the brain changes caused by addiction to certain drugs are permanent. But drug addiction is treatable. People in treatment for drug addiction learn special techniques for controlling their behavior and sometimes take medications designed to compensate for the brain changes caused by addiction. Researchers have found that time is important when it comes to treating addiction. Patients who stay in treatment more than three months have better outcomes than those in short-term treatment.



Teens, Drugs and AIDS

Teens who abuse drugs face a risk of getting AIDS and (get this!) of passing it on to the friends they love.



World AIDS Day takes place every year on December 1. On that day, people all over the planet focus on the challenge of trying both to cure and control its spread.

When you think about what a terrible disease AIDS (acquired immunodeficiency syndrome) is and the huge number of lives it has claimed—a mind-boggling 20 million in 24 years—it seems that every day ought to be World AIDS Day. As a teenager, you might ask, What does this have to do with me? You may not know it, but young people are one of the populations at risk for infection with HIV (human immunodeficiency virus, the virus that causes AIDS). Between 1998 and 2000—

the most recent years for AIDS-related statistics—about one out of every six new HIV infections were in people between the ages of 13 and 25. We'll say it again—*between the ages of 13 and 25!*

And here's another thing you may not realize—it's a fact that can help keep you and your friends safe from AIDS: According to a 2004 report from NIDA, behavior associated with drug abuse is now the *single largest factor* in the spread of HIV infection in the U.S. Nearly 300,000 Americans over the age of 12 who were diagnosed with AIDS between 1998 and 2002 could attribute it, directly or indirectly, to drug abuse. "Drug abuse is inextricably linked with the spread of infectious diseases



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Drug Abuse,

The Deadly Connection

such as HIV/AIDS...and hepatitis C,” says NIDA director Nora D. Volkow, M.D.

How big a problem is AIDS among young people today? In the U.S., about 20,000 individuals between the ages of 13 and 25 become infected with HIV every year. Let’s break that down for you: About 55 young people *each day* contract HIV, a virus that will sap their defenses against illness and possibly take their lives. It’s a very big problem. Soon, you’ll find out how and why the disease of drug addiction helps set the stage for the disease of AIDS. But first you have to understand exactly what AIDS is and how it spreads.

HEADS UP: THE FACTS ABOUT HIV AND HEPATITIS C AIDS and hepatitis C, another viral disease associated with drug abuse, are both blood-borne illnesses. That means the disease-causing viruses are spread when blood or bodily fluids from an infected person come into contact with the bloodstream of a healthy person. This can happen when injection drug users share needles or when an infected person has sex with an

uninfected person without using a latex condom, which physically stops transmission of viruses.

Once in the body, HIV and hepatitis C begin to cripple and kill cells. The viruses latch on to healthy cells and implant their own genetic material, causing the cells to churn out new copies of HIV or hepatitis C. The cells then die.

HIV attacks cells in the immune system, the body’s disease-fighting department. As the illness progresses, patients lose their natural ability to fight off germs, and they fall prey to diseases that are not normally a threat to healthy people. People are considered to have AIDS when the level in their bloodstream of CD4, an immune cell, drops below a certain point. Before that happens, though, a person with HIV can live for years without any symptoms—and can pass the virus to others without realizing it. The Centers for Disease Control and Prevention (CDC) estimate that a quarter of the 850,000 to 950,000 infected people in the U.S. don’t know they have HIV. **There is no vaccine for AIDS and no vaccine for HIV.** The hepatitis C virus infects cells in a person’s liver and can live

Cutting Edge

Disease Detectives

When the problems of drug abuse, addiction, and related diseases are solved in the future, it will be thanks to teams of scientists working long and hard on research and solutions. Teens today can contribute by working toward careers that will put them at the center of the action. Here are some possibilities.



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IMMUNOLOGISTS AND VIROLOGISTS investigate mechanisms by which viruses defeat the body’s defenses and cause illness. In one promising line of inquiry, researchers are searching for methods to activate the body’s own immune system to fight germs in new ways.

MOLECULAR ENGINEERS are specialized chemical engineers who create molecules. This emerging scientific speciality is important in the area of pharmaceutical research, where drugs are being designed to hopefully one day stop HIV, hepatitis C, and other viruses that attack the human body.

PUBLIC HEALTH SPECIALISTS include a wide range of professionals who are concerned about health behaviors of the public. From nutritionists and prevention specialists to research coordinators and biomedical scientists, these professionals want to help people choose behaviors that can lower their risk of drug addiction, HIV, and other diseases.



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silently in the body for years. Just like with HIV, people can transmit hepatitis C without knowing they have it. Hepatitis C attacks the liver and can cause liver cancer and other life-threatening liver diseases. There is no cure and no vaccine, but a small percentage of the people who get hepatitis C fight it off with the body's defenses. According to the CDC, about 4 million Americans are infected with the virus.

HEADS UP: DRUGS, AIDS, AND BAD DECISIONS

Why is drug abuse so closely linked to the spread of AIDS and other blood-borne diseases like hepatitis C? The most obvious answer is injection drugs. According to Dr. Volkow, "Injection drug use has directly and indirectly accounted for more than one-third of AIDS cases in the United States." It is also the leading cause of hepatitis C.

Injection drug use refers to when drugs are injected with a needle into the veins or tissue. The most common drugs injected are heroin, cocaine, and certain steroids. Since early in the AIDS epidemic, injection-drug abusers have had a high rate of HIV infection. They are at risk of sharing unsterilized needles with others, and when they do so, they are also at risk of sharing infected blood left behind in the needle and syringe. That's one way the virus is spread.

Many teens (and adults) who inject drugs know the risks, but do it anyway. Why? Scientists have found that drug addiction is a brain disease in which drugs of abuse change the way the brain functions. For example, the brain's prefrontal cortex is particularly sensitive to addiction—but it also plays an important role in judgment, decision making, and inhibiting or putting the brakes on behaviors. This means that because of their addiction, some injection-drug abusers may not realize that their ability to make decisions is

impaired. On one level they may know that needle-sharing could result in the spread of HIV and other diseases, yet on another level they may not be able to use proper judgment or to inhibit actions that could lead to long-term risks for themselves or others.

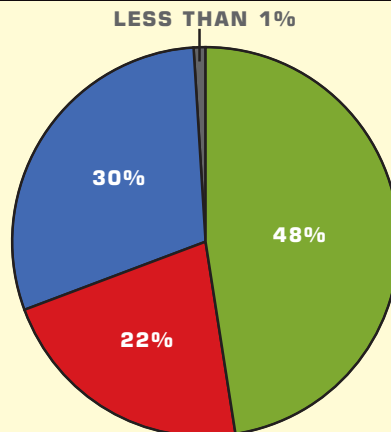


HEADS UP: THE BEHAVIOR CONNECTION

Fortunately, injection-drug use among teens is relatively rare. According to the CDC, only about 1 in 50 high school students say they've ever injected an illegal drug. However, choosing to share a contaminated needle clearly isn't the only drug-related bad judgment call that can lead to AIDS or hepatitis C. What else can? The effects of drugs on thinking and good judgment can cause teens to take all kinds of risks—and we don't

Wake-Up Call **How HIV/AIDS Spread**

This chart shows how injection-drug use spreads AIDS far beyond just the drug abusers themselves. Based on 2002 data, it breaks down the broad category of AIDS-infected people whose infection resulted directly or indirectly from injection-drug use. What percentage of infected people became infected without any direct contact with injection drugs?



How HIV/AIDS Spread, 2002

48 PERCENT were males who injected drugs of abuse.

22 PERCENT were females who injected drugs of abuse.

30 PERCENT were males and females who had sex partners who injected drugs of abuse.

LESS THAN 1 PERCENT were children born to mothers who injected drugs or had sex partners who did.

mean risks such as big-wave surfing or extreme snowboarding. Sexual risks top the list.

In a 1999 NIDA-sponsored study, researchers at the University of Kentucky in Lexington surveyed 952 young adults ages 19 to 21 who had been surveyed in eighth grade. Researchers found that those who started using alcohol and marijuana when they were young practiced riskier sexual behavior than those who did not, putting them at higher risk for HIV. The study defined risky sexual behavior as “sex with different partners” and “inconsistent use of safe-sex practices,” meaning the young adults didn’t always use latex condoms.

Another, much larger 1998 study based on data collected from 8,450 young people by the CDC had similar findings. Teens who abused drugs or alcohol were more likely to have had two sex partners in the past month—which the study defined as risky sexual behavior that increases the chance of contracting HIV.

HEADS UP: A BODY ON DRUGS CAN'T FIGHT BACK

Not only do drugs cause teens to take stupid risks that can lead to infections with dangerous viruses, drug abuse can lower your immunity, making it more likely that you’ll get HIV, hepatitis C, and other diseases to which you might be exposed. Want proof?

One NIDA-sponsored study showed that cocaine use cuts a certain type of immune response by more than half. Researcher John H. Halpern, with colleagues at McLean Hospital and Harvard Medical School, measured levels of a key

immune-system fighter cell. They found that for four hours after drug exposure, the body produced *less than half* the fighter cells it did when cocaine wasn’t present. “Even if the blunted immune response lasts only a few hours, it makes it more likely that an infection like HIV or just a common cold can take hold,” says Dr. Halpern.



HEADS UP: KNOWLEDGE IS POWER

In 2005, when 38 million people worldwide are estimated to have been infected with HIV, it’s hard to fathom that just 25 years ago nobody knew what AIDS was. It was so rare, it didn’t have a name. It started slowly at first, then progressed with frightening speed—HIV spread from person to person until AIDS became a worldwide epidemic.

Through knowledge, you as a teen have real power when it comes to AIDS. Your peer group is at risk. By choosing to avoid drugs, you’re

also helping to protect yourself and the people you love from the diseases of both drug addiction and AIDS. You know the facts. AIDS simply can’t survive without people making bad decisions—decisions that result in new people becoming infected with HIV.

If you’re a teen who’s suffering from drug abuse, there are solutions, and you can get help. For help with a drug problem, go to www.findtreatment.samhsa.gov to access information about a treatment center near you, or call the National hotline at 1-800-662-HELP. NIDA studies show that people in treatment for injection-drug abuse are up to six times less likely to become infected with HIV than those not in treatment. “There is hope” for people battling addiction, says Dr. Volkow. “Recovery is possible and is happening.”

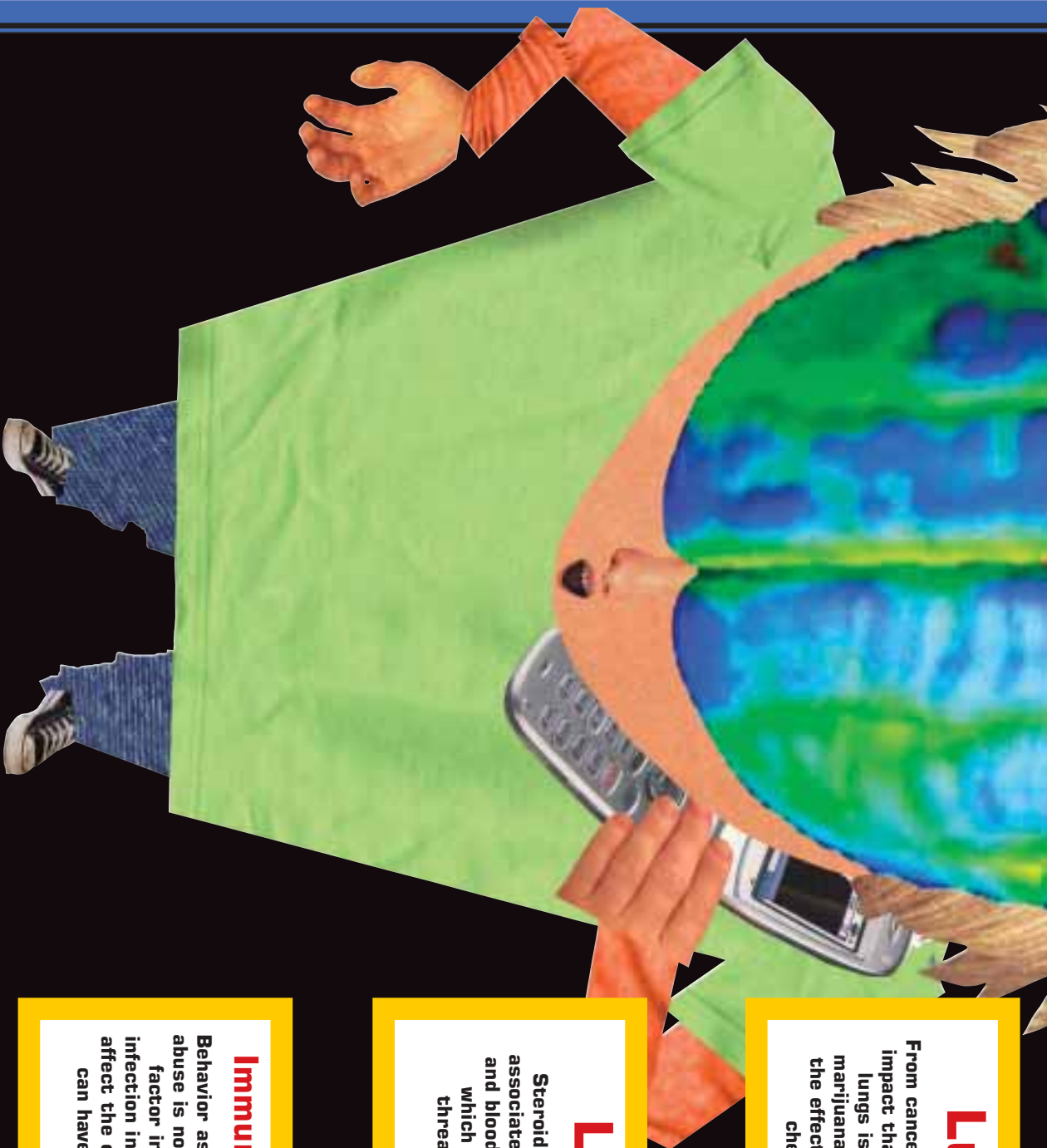
*In the first installment of this series, you learned about the disease of addiction and why teenagers’ brains are uniquely susceptible to the effects of drug abuse. Today, you found out how drug abuse and the disease of addiction can lead to the spread of AIDS and hepatitis C. Check future issues of this magazine for the next **Heads Up: Real News About Drugs and Your Body.***

Facts for Real Life

Q: DO YOU HAVE TO BE ADDICTED TO DRUGS TO GET DISEASES LIKE AIDS AND HEPATITIS C?

A: Absolutely not. It’s true that those who are addicted *are* at much higher risk. That’s because they use drugs compulsively and repeatedly without regard for negative consequences. Even so, sharing equipment for injection-drug abuse **EVEN ONCE** can cause infection, and so can a single episode of unprotected sex with an infected person.





Lungs

From cancer to black lung, the impact that drugs have on the lungs is serious. Tobacco and marijuana users' lungs turn black from the effects of tar, one of thousands of chemicals in these drugs.



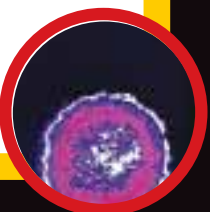
Liver

Steroid abuse has been associated with liver tumors and blood-filled cysts—either of which can rupture, causing life-threatening internal bleeding.



Immune System

Behavior associated with drug abuse is now the single largest factor in the spread of HIV infection in the United States. Drugs affect the decision-making process, which can have life-altering consequences.



The Teen Brain: Under Construction

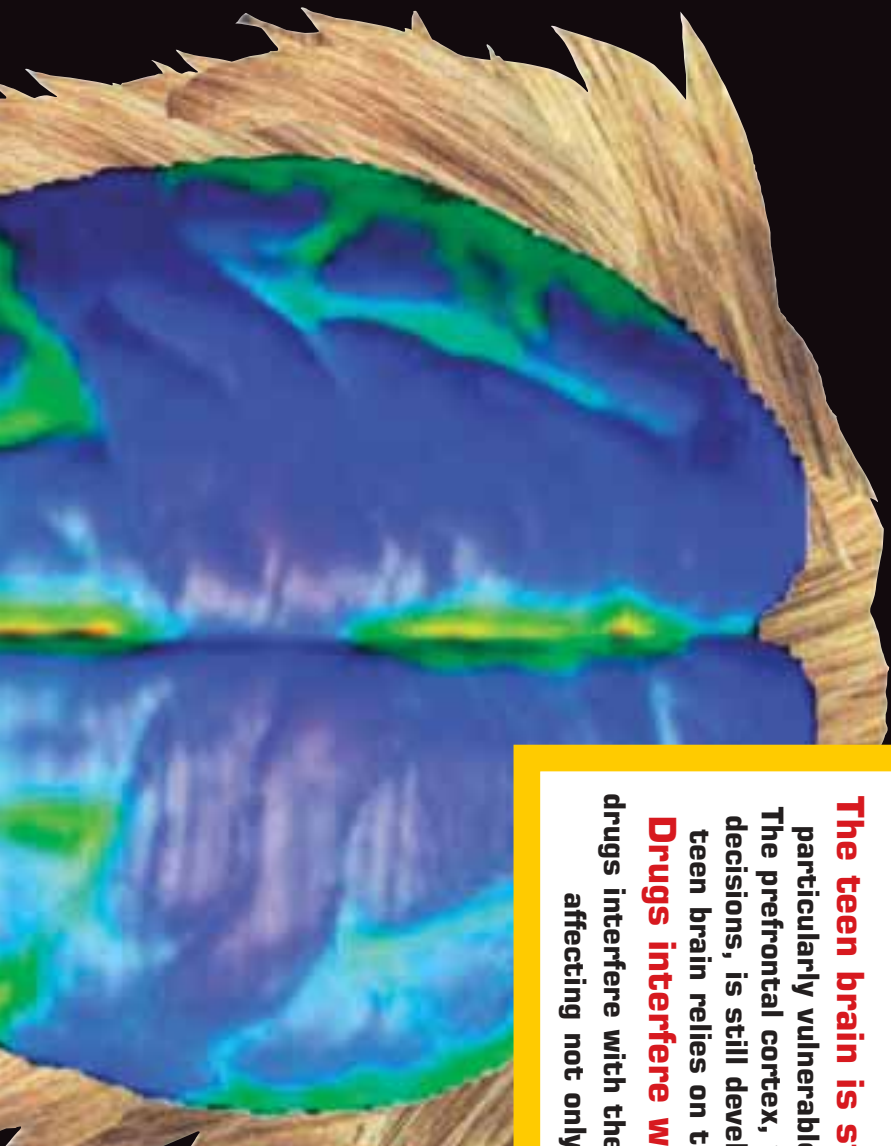
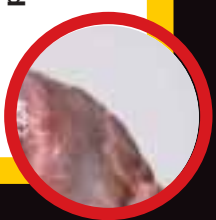
Brain

The teen brain is still developing, so it is particularly vulnerable to the effects of drugs. The prefrontal cortex, which an adult uses to make decisions, is still developing in a teen. Because of this, the teen brain relies on the limbic system to make decisions. **Drugs interfere with the limbic system.** Additionally, drugs interfere with the **teen brain's** natural development, affecting not only the brain, but the entire body.



Heart

With effects that range from blocked blood flow to disrupted heart rhythms, the abuse of drugs such as inhalants, steroids, cocaine, or methamphetamine can result in a heart attack—even in a very fit athlete.





**HEADS UP
REAL NEWS
ABOUT DRUGS
AND YOUR BODY**

Abuse of Inhalants and Prescription Drugs: **Real Danger for Teens**

Overall drug use among teens is down, except for three dangerous substances.

Listen up. There's some good news, and bad news, about teens and drugs.

First, the good news: Drug use among teens has decreased. A 2004 NIDA-sponsored study called "Monitoring the Future" found that the number of U.S. students in grades 8, 10, and 12 who said they'd used drugs in the past month dropped a whopping 17 percent compared to 2001. In real numbers, that means about 600,000 fewer teens use drugs now than in 2001—that's a whole lot of kids making the smart choice to protect their brains and bodies.

Okay. Now for the bad news. The same survey found one category of substances—inhalants—is bucking the trend. Inhalant abuse is on the upswing among teens—especially young teens—and the dangers are very real. Inhalants are

found in a variety of common products (nail polish remover, gasoline, aerosols, whipped cream canisters, computer spray cleaners) that produce chemical vapors. When they are inhaled, there can be serious, long-term health consequences. The percentage of 8th-graders who said they'd ever tried inhalants jumped from 15.8 percent in 2003 to 17.3 percent in 2004.

In addition to an increase in inhalant use, there was no decrease in the use of two prescription drugs: OxyContin® and Vicodin®. Both are pain relievers that, when used improperly, can be deadly. The same NIDA study reports that there was a significant increase between 2002 and 2004 in the use of OxyContin. That means that there are many teens who still do not understand the serious health consequences of these drugs.



Inhalants Addiction

ers

Read on to find out the facts on why inhalants, Vicodin, and OxyContin are dangerous to your brain and body, and why the smart choice is never to try these substances—NOT EVEN ONCE.

HEADS UP: INHALANTS ARE NEVER HARMLESS

The super-toxic ingredients in inhalants harm your mind and body in dozens of ways. “I can’t really remember a lot of things,” said one girl who’d abused inhalants. “I’ll forget what I said two seconds ago. It frustrates me a lot.” But memory problems like this—likely the result of inhalant damage to brain cells—are the tip of the iceberg.

Inhalants affect the brain in a similar way to central nervous system depressants, such as alcohol and sedatives, but they can have deadly and irreversible effects. Toluene, the active ingredient in many inhalants—including glue, spray paint, and nail polish remover—strips the protective sheath off nerve cells in the brain and central nervous system and literally shrinks the brain. Other

inhalants, such as benzene (found in gasoline) cause bone marrow damage similar to that seen in a fatal disease called aplastic anemia. No inhalants are safe.

In short, as you can see, these drugs can cause major damage. Want more evidence? A NIDA-sponsored study, conducted by Dr. Neil Rosenberg of the University of Colorado Health Sciences Center, found that long-term abusers of a class of inhalants called solvents (toluene is a solvent) scored far below average on tests that measured the ability to learn and make associations.

HEADS UP: WITH INHALANTS, JUST ONE TRY CAN BE DEADLY

Long-term inhalant abuse is clearly dangerous. But what about trying inhalants even once? “Even in an otherwise healthy person, a single session of abusing highly concentrated amounts of certain inhalants can lower oxygen levels enough to cause asphyxiation or disrupt heart rhythms and cause death from cardiac arrest,” says

Cutting Edge

Learning the Truth About
Teens and Drugs



How do we learn about teen drug trends? Surveys, mainly. NIDA’s 2004 “Monitoring the Future” study, which is the basis for this article, surveyed 49,474 students. Below, Dr. Lloyd Johnston, who has run the annual survey since it began thirty years ago, explains how it works.

Q: HOW DO YOU PICK STUDENTS?

A: We survey 8th-, 10th-, and 12th-graders. The schools are chosen randomly. We make sure we have a representative mix of communities.

Q: HOW LONG IS THE SURVEY?

A: One class period.

Q: WHY IS IT IMPORTANT?

A: As the survey title implies, we think the way young people are today is an indication of how the country will be in the future.

Q: DO YOU KNOW WHETHER STUDENTS TELL THE TRUTH?

A: When we started, I was a bit of a skeptic myself, but in all the tests we’ve put the data to, there’s a high level of truth-telling. In the survey itself, we ask, “If you had used marijuana, would you admit to it on this survey?” And students tend to say “yes.”

Q: DO YOU DO ANYTHING TO ENSURE HONEST ANSWERS?

A: We assure students the survey is confidential. Also, the questionnaires are distributed by our staff, not school staff. They are never in the hands of school personnel. And we ask the teachers not to circulate in the classrooms so there’s no chance for them to look over students’ shoulders.

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HEADS UP REAL NEWS ABOUT DRUGS AND YOUR BODY

Dr. Nora Volkow, Director of NIDA. Unfortunately, there is even a term for this manner of dying: *Sudden Sniffing Death*.

The tragic story of David Manlove shows the dangers.

David—a popular 16-year-old from Indianapolis, Indiana—never dreamed he'd fall victim to an inhalant. But he did.

On the morning of July 9, 2001, David went to swim in a friend's backyard pool. At lunchtime, he and another friend slipped away and bought a can of computer cleaner.

Back at the pool, David and this friend began diving underwater and inhaling the aerosol cleaner; they

thought the water pressure would intensify the high. "The girls they were with tried to tell them not to do it, but they continued," says Kim Manlove, David's father.

After two or three dives, David just didn't return to the surface. "They pulled him out very quickly," Kim says, but David wasn't breathing. He never again regained consciousness. "His heart just froze up," Kim says. "The toluene in the



David Manlove, 1984–2001

aerosol causes the rhythm of the heart to be disrupted."

To kids who think this could never happen to them, Kim says: "It can happen, because it happened to us and it happened to Dave. He was like any kid.

He had hopes. He had dreams. He wanted to be an orthopedic surgeon. Yet, in one instant, he was gone."

Now David's parents share his story in hopes of preventing future tragedies.

Some people think that because inhalants are easy to get and simple to use they're less dangerous than street drugs, or even prescription drugs. But, as you've learned here, that's false. To stay safe, the smart and only choice is not to try inhalants—NOT EVEN ONCE.

HEADS UP: VICODIN AND OXYCONTIN—NEW AND DEADLY

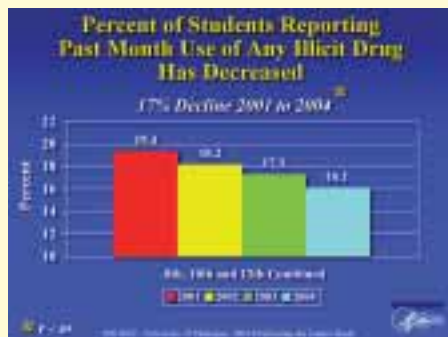
Vicodin and OxyContin are prescription medications designed to relieve pain. Their active ingredients—hydrocodone in Vicodin and oxycodone in OxyContin—belong to a class of drugs called opioids. "When used as prescribed, opioid medications can be very effective," says Dr. Volkow, "but when abused—used without a prescription and in a form and dosage different from what a doctor would prescribe—they can have serious health consequences, including death from overdose." Also, they can be addicting when abused.

Wake-Up Call Understanding Teen Drug Use Statistics

The bar graph from the "Monitoring the Future" study shows the downward trend in drug use among teens between 2001 and 2004. The line graph illustrates the alarming jump in inhalant use among 8th-graders. Statisticians, epidemiologists, and other researchers pore over charts like these to determine trends in teen drug use. They use the information to draw conclusions, predict future trends, and devise new ways to battle drug abuse.

Imagine that you're a researcher looking at these statistics. What conclusions do you draw? What explanations do you offer for the data? What are your recommendations for the

future? Do you need more information? Go to www.nida.nih.gov/Newsroom/04/2004MTFFactSheets.pdf to find out more.



These two painkillers are relatively new on the drug-abuse scene; it wasn't until 2002 that NIDA began tracking their use by teens. Even so, by 2004, 9.3 percent of 12th-graders surveyed said they'd abused Vicodin at least once in the past year. Five percent said they'd used OxyContin at least once. This is not a huge number—after all, 9 out of 10 kids *aren't* trying Vicodin and 19 out of 20 *aren't* trying OxyContin—but even one is too many, given the dangers.

PRESCRIPTION FOR DISASTER

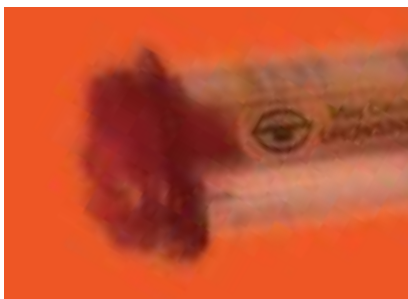
Opioids—the class of drugs that Vicodin and OxyContin belong to—kill pain by binding to opioid receptors, which are located mainly in the brain and spinal cord. When an opioid binds to an opioid receptor, it sets off a series of chemical events in the brain leading to the relief of pain.

For people who abuse opioids, the key event is a release of the neurotransmitter dopamine in the areas of the brain that control pleasure. This leads to the euphoria that abusers experience. But opioid abuse eventually changes the brain in fundamental and long-lasting ways. As a result, the euphoria subsides and need for the drug overtakes normal desires—such as for friendship, fun, and even food. The brain changes make it difficult or impossible for people to quit using the drugs on their own. Taken together, these changes amount to what we know as the disease of addiction.

HOW PAINKILLERS CAN KILL

On top of the danger of addiction—the key risk of long-term abuse of Vicodin and

OxyContin—the drugs also carry serious short-term risks, even for people who abuse the drugs just once. Vicodin, OxyContin, and other opiates can slow or stop breathing if used incorrectly. Heads up—not breathing can kill you. And if you take OxyContin or Vicodin with another substance that can also slow respiration—such as alcohol or antihistamines—the risk of death is even greater. That's because the substances can magnify



each other's effects.

It is important that teens understand that taking Vicodin or OxyContin while drinking alcohol can be especially deadly. But most important, remember this: If you don't have a prescription and are not under a doctor's care, don't try Vicodin or OxyContin—NOT

EVEN ONCE. Some teens think that if a pill comes in a prescription bottle it's safe to take—for anyone at any time. Nothing could be further from the truth.

STAYING SMART

The drop in overall teen drug use shows that most teens understand the dangers of drug abuse. With such news, it might be tempting to stop talking about teen drug abuse. But one life cut short or compromised by drugs is one too many, and teens need to stay in the know to make smart choices.

For help with a drug problem or to find treatment centers near you, go to www.findtreatment.samhsa.gov or call the national hotline at 1-800-662-HELP.

In this installment of Heads Up: Real News About Drugs and Your Body, you learned about three deadly substances that show alarming usage rates among teens: inhalants, OxyContin, and Vicodin. Watch for the next installment of Heads Up.

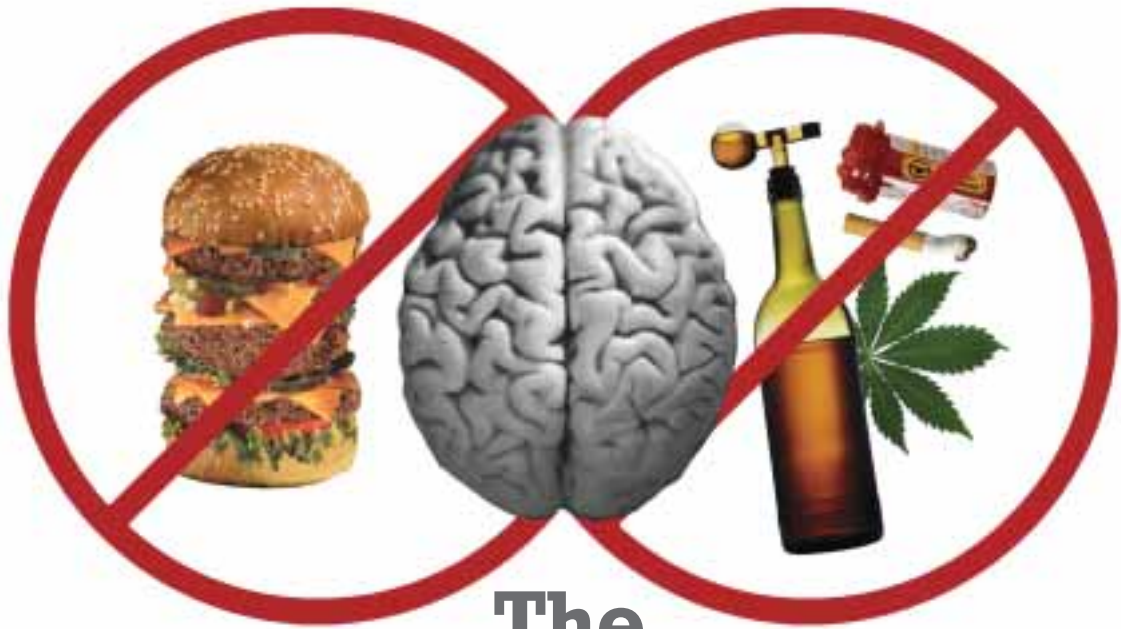
Facts for Real Life

Q: IS IT EVER OKAY TO TAKE A MEDICATION PRESCRIBED FOR SOMEONE ELSE?

A: No. A doctor writes a prescription based on the patient's medical history and symptoms. The doctor asks questions such as, "Are you allergic to any medications?" and "Are you currently taking any other medicines?" These questions help the doctor decide which medications to prescribe and which ones not to prescribe. Then, when a prescription is picked up from a pharmacy, the pharmacist gives instructions for taking the medication and any warnings that might be necessary. When a friend gives you a pill—whether it's to cure a sore throat or to get you high—none of that happens. The consequences can be deadly.



Two Teen Health Dangers: Obesity & Drug Addiction



The Brain Link

Researchers have discovered an amazing connection between how the brain is involved in obesity and drug addiction.

Ask experts to name the biggest health threats for teens today, and these two answers will rise to the top: obesity and drug addiction.

Are you surprised by the first answer? You shouldn't be.

More and more teens weigh far too much, and the problem is growing. It's no joke. Check out these numbers: 16 percent of young people between the ages of 12 and 19 are overweight,

according to a 1999–2002 federal study by the Centers for Disease Control and Prevention. That's more than triple what the rate was between 1976 and 1980. The same study revealed that an additional 15 percent of teens are at risk of becoming overweight.

What's so bad about being overweight or obese? For starters, it can cause diabetes, a life-shortening disease in which the body loses its ability to

metabolize sugar. It can also lead to asthma and can cause heart disease. Most obese people just aren't healthy, overall.

HEADS UP: A WILD CONNECTION

What do you think? Could the health threats of drug addiction and obesity be connected? If you're like most people, you probably think, "No way." Well, you—and most people—are wrong!

Think about it. People addicted to drugs and those who suffer from obesity have at least one thing in common. It can be extremely hard for them to stop doing things that they know are harming them. For the drug abuser, it's taking drugs. For the obese person, it's usually excessive eating (although there are other factors as well, as we'll learn). NIDA researchers decided to find out if and how the two disorders could be related. Their amazing new findings indicate that there is a link. If you think back to what you've learned from earlier articles in this series, you can probably guess what the link is. Got it? It's dopamine and the brain.

Researchers are discovering that obesity (like drug addiction) is, at least in part, a brain disease.

HEADS UP: SEE SCIENCE IN ACTION!

How did researchers find the obesity-addiction link? They started by reviewing what they already knew: Dopamine is a brain chemical that stimulates pleasurable feelings. When dopamine binds to special structures in your brain—called D2 receptors—it activates the brain's reward circuits. The end result? You feel good.

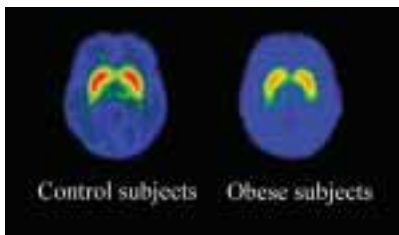
For some time now, researchers have known that people who are addicted to alcohol, cocaine, and other drugs tend to have a lower-than-average number of D2 receptors in their brains. That makes sense when you think about it. If you have a shortage of D2 receptors, it's harder for you to feel good. It's harder for dopamine to find a D2 receptor to bind to, so it

takes more dopamine for you to feel pleasure. As it happens, most drugs of abuse cause a flood of dopamine in the brain. Taking drugs makes people feel better—in the immediate short term.

Researchers also knew that eating can stimulate the production of dopamine in the brain. Could it be that obese people suffer from a shortage of D2 receptors? They might need to overeat to get feelings of pleasure from food.

Using PET scanners to look inside the brains of obese and non-obese people, researchers Nora Volkow, M.D., who is now the director of NIDA, and Gene-Jack Wang, M.D., found that obese people do have lowered numbers of D2 receptors. In fact, Drs. Volkow and Wang's research at Brookhaven National Laboratory in New York showed that the more obese the person, the lower the number of D2 receptors. "The low number of receptors in obese people might be causing them to overeat," says Dr. Wang. "They might be doing it to compensate for reduced stimulation in their brain's reward circuits."

Dr. Volkow adds, "An individual who has low sensitivity to normal



These composite brain-scan images show that obese individuals have significantly fewer dopamine receptors than control subjects. Dopamine receptors transmit pleasurable feelings from basic activities such as eating. Low levels of these receptors have also been found in people addicted to drugs of abuse. The reduced reward experienced by people with this deficiency may make them more likely to engage in addictive behaviors.



By using their knowledge of addiction and how the brain works, Dr. Volkow and her colleagues had an idea: Maybe obese people have low numbers of D2 dopamine receptors in their brains—just like drug addicts. How did the researchers test their theory? They used the scientific method. The scientific method—which scientists in all disciplines have followed for hundreds of years—has four steps.

- 1. OBSERVE** Researchers observed that D2 receptor levels are lower than normal in many drug abusers.
- 2. QUESTION** Researchers raised the question of whether obese people, whose behavior can be described as "addictive," might also have low D2 levels.
- 3. PREDICT** Researchers came up with a hypothesis: People suffering from obesity will have lower D2 levels than people whose weight is normal.
- 4. TEST** Researchers took PET scans of obese adults to see how many D2 receptors they had.

The researchers validated the experiment by testing a control group—a similarly made up group of non-obese people. Accurate results from the obese group are only obtainable by looking at the results from the control group. The researchers also made sure the experiment was quantitative. In other words, they made exact measurements. (It wouldn't have been enough to say, "There were oodles of D2 receptors in that thin woman's brain.") Finally, the experiment was valid because it was set up in a way that was replicable—it could be repeated and tested by other scientists.



HEADS UP REAL NEWS ABOUT DRUGS AND YOUR BODY

stimuli learns behaviors, such as abusing drugs or overeating, that will activate them.”

HEADS UP: ADDICTION MAY CAUSE THE DAMAGE

Just because obese people and drug addicts share a shortage of D2 receptors, does that mean their disorders are caused by the lack of receptors? Not necessarily. It’s a classic “chicken-and-egg” question. In other words, which comes first—the addictive behavior or the D2 shortage? Maybe the addictive behavior causes the shortage. Or . . . maybe the shortage causes the behavior?

Dr. Wang says an experiment with animals indicates that “having plenty of D2 receptors does protect against drug abuse and obesity.” So, that’s some evidence that the D2 shortage causes the behavior. The experiment Dr. Wang is talking about worked like this: Panayotis K. Thanos, a Brookhaven National Laboratory researcher, trained rats to regularly take alcohol, then introduced additional D2 receptors into their brains. As soon as the receptors took hold, the rats’ consumption of alcohol decreased. Dr. Wang says researchers have had similar findings involving cocaine and food.

Case closed? Not exactly. Scientists also know that the flood of dopamine in the brain that drug abuse causes can overstimulate the reward pathways—and cause a reduction in D2 receptors in abusers’

brains. “In the end, people who become addicted could be much worse off biologically than when they started,” says Joseph Frascella, Ph.D., of NIDA’s Division of Treatment Research and Development.

HEADS UP: CHECK OUT THE DIFFERENCES

Of course, there are major differences between drug addiction and obesity. For one, according to Dr. Wang, obesity is not all about the brain. “You have to consider a person’s metabolism and other genetic issues,” he says. “The brain chemistry is just part of the picture.” Dr. Wang adds that it’s not accurate to describe an obese person as a “food addict.” Rather, one should say that overeating is an “addictive behavior.”

Also, drug addiction seems to

Wake-Up Call **How Much Is Too Much?**

What’s the difference between being overweight and “just a bit chunky”? The Centers for Disease Control and Prevention has very strict definitions of weight-related terms. They’re not based on how a person looks in jeans, they’re calculated using height, weight, and—for people under 21—age and gender.

If you’re worried that you have a weight problem, you should talk to a health professional. He or she will likely determine your body mass index (BMI) using this formula:

$$\text{BMI} = \frac{\text{(Weight in Pounds)}}{\text{((Height in Inches) x (Height in Inches))}} \times 703$$

With your BMI and a specially made chart, the health professional can determine what percentile your BMI falls into. The percentile shows how your BMI compares with that of other teens of the same gender and age.

- BMI value at or above the 95th percentile is considered overweight.
- BMI value between the 85th and 95th percentiles is considered at risk for becoming overweight.
- BMI value between the 6th and 84th percentiles is considered healthy.
- BMI value below the 6th percentile is considered underweight.

As you may have noticed, there is no “obese” category for teens. That’s because, unlike adults, young people’s bodies are growing and changing. Once you reach adulthood, your body levels off. But teens who are overweight not only face health problems, they are also at higher risk for becoming obese as adults.



As BMI increases in adults, so does risk of the following:

- premature death
- diabetes
- cardiovascular disease
- high blood pressure
- arthritis
- certain cancers

If it turns out that you do have a weight problem, you and your parents can talk with your health professional about what actions you can take to improve your health.

cause more wide-ranging brain damage than obesity. For example, in people who are addicted to drugs, the drop in D2 receptors is often accompanied by a loss in functioning of the prefrontal cortex—the part of the brain responsible for judgment and impulse control. “In obesity, we didn’t see any problems in the prefrontal cortex,” says Dr. Wang. This probably explains why obese people, though compulsive when it comes to eating, have more control over their behavior than drug abusers.



“Yes!” says Dr. Wang. “Exercise has been found to increase dopamine release and to raise the number of dopamine receptors,” he says. “This suggests that obese people might be

able to lose weight.” He feels that exercise can be helpful for recovering addicts, as well.

Dr. Wang also notes that animal studies have revealed that group interactions can increase D2 receptor levels.

So, exercising and spending time with family and friends can help you keep your mind and body healthy—and help you avoid developing addictive behaviors.

That’s all good to know. But according to Dr. Wang, perhaps the most important way the research can help is by giving people an understanding of their own behavior. It helps remove the mystery and stigma that surround addictive behaviors. “When you know the reason why,” says Dr. Wang, “it makes everything much easier.”

able to boost their dopamine response through exercise instead of eating—which is just one more reason to exercise if you are trying

HEADS UP: KNOWLEDGE IS POWER

NIDA scientists have made amazing discoveries about the connection between drug addiction and obesity. Although these discoveries are fascinating, can they help people? Yes, definitely. This new information can help people addicted to drugs, obese people, and healthy teens who want to avoid drug addiction or obesity.

How? First, the research shows us that having a healthy supply of D2 receptors in the brain can help stave off addictive behaviors. So, anything that increases D2 levels could be a valuable weapon in the battle against drug abuse and obesity. With this in mind, NIDA researchers are looking to develop new medications.

But is there anything safe and available now that can boost the level of D2 receptors in your brain?

Facts for Real Life

Q. Why is the number of overweight teens growing so rapidly?

A. Nobody knows for sure. It could be that today’s teens are less physically active than those a generation ago. It may be that people are eating bigger portions of food than ever before. Dr. Volkow thinks one factor is the increasing ease with which people can get food today. Researchers are finding that there’s a region of the brain—called the dorsal striatum—that is programmed to draw people to food even when they’re not hungry. “This system was once very important for survival,” says Dr. Volkow. “It was important to want food whenever you could get it, because you never knew when it was going to be around.” In the contemporary United States, though, where there are fast-food outlets and convenience stores on every corner, “the system doesn’t serve any purpose anymore,” says Dr. Volkow. Now, with food so easy to get, people who follow their brains’ instructions to eat, eat, eat are not staving off starvation—they’re growing overweight.





HEADS UP REAL NEWS ABOUT DRUGS AND YOUR BODY

Glossary

Power words to keep you in the know

Here are definitions of some terms that appear in *Heads Up: Real News About Drugs and Your Body*, as well as some other words that you may run across if you keep reading and learning about drug abuse, addiction, and the brain.

Addiction: A chronic, relapsing disease characterized by compulsive drug-seeking and abuse and long-lasting chemical changes in the brain.

AIDS (Acquired Immunodeficiency Syndrome): A condition characterized by a defect in the body's natural immunity to diseases. Individuals who suffer from it are at risk for severe illnesses that are usually not a threat to anyone whose immune system is working properly.

Amphetamine: Stimulant drugs whose effects are very similar to those of cocaine.

Central nervous system: The brain and spinal cord.

Cerebellum: A portion of the brain that helps regulate posture, balance, and coordination.

Cerebral cortex: Region of the brain responsible for cognitive functions including reasoning, mood, and perception of stimuli.

Chronic: Refers to a disease or condition that persists over a long period of time.

Cocaine: A highly addictive stimulant derived from the coca plant.

Depressants: Drugs that relieve anxiety and produce sleep, including barbiturates and alcohol.

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

Ecstasy (MDMA): A chemically modified amphetamine that has hallucinogenic as well as stimulant properties.

fMRI (Functional Magnetic Resonance Imaging): Type of scan that shows where the brain is using oxygen by using magnetic fields to measure changes in oxygen as blood passes through the brain.

Hallucinogens: A diverse group of drugs that alter perceptions, thoughts, and feelings. Hallucinogenic drugs include LSD, mescaline, MDMA (ecstasy), PCP, and psilocybin (magic mushrooms).

Hippocampus: An area of the brain crucial for learning and memory.

HIV (Human Immunodeficiency Virus): The virus that causes AIDS (see definition above).

Illicit: Refers to any drug that is illegal or used illegally.

Inhalant: Any drug administered by breathing in its vapors. Inhalants commonly are organic solvents, such as glue and paint thinner, or anesthetic gases, such as ether and nitrous oxide.

Injection: A method of administering a substance such as a drug into the skin, subcutaneous tissue, muscle, blood vessels, or body cavities, usually by means of a needle.

Limbic system: A set of brain structures that generates feelings, emotions, and motivations. It is also important in learning and memory.

LSD (lysergic acid diethylamide): A hallucinogenic drug that acts on the receptor for the neurotransmitter serotonin.

Medication: A drug that is used to treat an illness or disease according to established medical guidelines.

Myelin: Fatty material that surrounds and insulates axons of most neurons.

Neuron (nerve cell): A unique type of cell found in the brain and body that is specialized to process and transmit information.

Neurotransmitter: A chemical produced by neurons to carry messages to other neurons.

Parietal lobe: One of the four subdivisions of the cerebral cortex; it is involved in sensory processes, attention, and language.

PET (Positron Emission Tomography): A scan that measure a brains' activity by using a slightly radioactive compound to identify where brain glucose (sugar) is being used in the brain.

Pre-frontal cortex: The region of the brain responsible for impulse control and decision making.

Prescription drug: see Medication

Stimulants: A class of addictive drugs that speed up the body's central nervous and circulatory systems. Stimulants include cocaine, methamphetamine, and Ritalin.

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