Research Shows Consequences of Drug Abuse on the Teenage Brain

By Don Vereen

Research on drug abuse and addiction tells us that drug abuse is a preventable behavior and drug addiction is a treatable brain disease. This ongoing research provides a clearer picture than ever before of the consequences of drug use. Whether young people use drugs to self-medicate such ills as depression or anxiety or they are curious about what a peer says about how a drug makes them feel, repeated drug use actually changes their brains.

The most disturbing thing about these brain changes caused by drug abuse is that they occur in young people at a time when their brains are still developing. The critical areas in the brain used for making judgments and comprehending complex concepts like safety and freedom are not fully developed at age 15. These areas in the brain's frontal lobes (the area just behind the forehead and above the eyes) do not develop completely until people are in their 20s. These critical areas are also the same areas affected directly by drugs of abuse.

A young person may recover quickly from a single or occasional use of a drug, but repeated use may result in brain changes that are long lasting. In addition, vulnerability to these brain changes as well as the ability to recover from them appear to have genetic underpinnings that we are just beginning to understand.

Because of advances in neuroimaging technologies, we can now “see” how the human brain functions and how this relates to thinking, feeling, and behaving. Chronic exposure to drugs of abuse disrupts the way critical brain structures interact to control behavior—behavior specifically related to drug abuse. Drug addiction erodes a person’s self-control and ability to make sound decisions, while sending intense impulses to take drugs. This combination drives addiction—with the abuser seeking out and taking drugs compulsively.

Thanks to the research completed so far, we have a clearer understanding of just what it is we need to prevent. These brain changes make it clear why we must do our best to prevent drug use among adolescents and apply the research-based principles of prevention.

Restoring the brain and reinstating healthy behaviors, including strong family and peer relationships, educational achievement, and employment success are the ultimate goals of drug treatment. Early treatment is optimal. Preventing any drug use is best.

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Nora Volkow, M.D., is the director of the National Institute on Drug Abuse (NIDA). The Challenge interviewed Dr. Volkow recently to discuss the research being conducted on drug abuse and its consequences on adolescent brains. The interview has been condensed for print. The full text can be found online at www.thechallenge.org.

Q: NIDA spends a great deal of money on research studies to better understand and prevent drug abuse among children and adolescents. Why is so much attention placed on this period of the lifespan?

A: Adolescents warrant increased attention because they are at heightened risk for drug abuse, they may suffer more severe consequences, and childhood and early adolescence represent times when targeted prevention efforts may have the most impact. NIDA-supported research has shown that the earlier drug abuse is initiated, the more likely an individual will become addicted. In fact, addiction is called a developmental disease because it typically begins during the critical teen years when the brain is still developing—not to fully mature until a person is in his or her 20s. This heightened risk adolescents face, therefore, is far more than just a result of social angst or the opportunity to use drugs, though these factors certainly play a role. Rather, adolescents face increased risk because these environmental factors occur during a time of great change in the brain.

Q: The most commonly used drugs among young people are alcohol, tobacco, and marijuana. Can use of these drugs during childhood and adolescence negatively affect brain functioning? If so, what are the long-term implications of such effects?

A: We have learned from our animal and human studies that observe behaviors, a proxy measure for brain activity, that there are differences between adolescents and adults with regard to the effects of drugs. For example, findings from NIDA-sponsored animal studies suggest that adolescent rats become “addicted” to nicotine more readily, as they self-administered more often and in higher total doses per session than rats first exposed to nicotine as adults. This early exposure in rats also led to changes in a specific brain receptor that is important in promoting nicotine’s rewarding effects. Similar behavioral findings are emerging from our clinical research. Studies show that adolescents that smoke are more likely to become dependent on nicotine compared with adults and are also more likely than non-smoking adolescents to use other drugs. Findings, such as these, suggest that not only may smoking be more addictive if it is initiated during adolescence, but that it may heighten response to other addictive drugs.

Q: Methamphetamine use has garnered a lot of attention in the popular media. In 2004, 6.2 percent of high school seniors reported having used this drug at least once. How much use of methamphetamine is necessary before deleterious effects on the brain are apparent?

A: The short answer to your question is that no amount of methamphetamine is “safe.” The extent of the negative effects to the brain and how quickly those effects occur is based on many individual factors, such as genetics, environment, age, gender, amount and duration of use, and route of administration. Each of these factors, individually as well as combined, contributes to the harmful effects of any drug abused. Thus, it is possible that the consequences from the same amount of methamphetamine may differ significantly across individuals, thereby making it difficult, if not impossible, to quantify an amount of exposure at which the brain suffers long-term effects.

Q: What other drugs should school staff be aware of?

A: In addition to methamphetamine, alcohol, nicotine, and marijuana, school staff should also be aware of the potential for adolescents to abuse inhalants, prescription drugs, and steroids. In the cases of inhalants and some prescription drugs, the substances are being used in a manner that is dissociated from their intended...
purposes, and, therefore, people often do not recognize their potential for abuse. Just as adults often do not consider their cleaning solutions under the kitchen sink to be potential substances of abuse, the items in their medicine cabinet also are overlooked. With recent data showing that one in 10 12th-graders reported nonmedical use of Vicodin within the past year, it is clearly time that we move past the perception that the non-medical use of physician-prescribed drugs is not dangerous.

Unlike traditional illicit drugs, prescription drugs can be abused in order to enhance performance or improve appearance. This opens the door for teens that might not otherwise abuse substances, and yet, their need to lose weight or heighten their concentration in preparation for an exam, may lead them to adopt a “by any means necessary” approach. This challenges our notion of what an adolescent substance abuser is, and calls on school staff to learn to recognize the warning signs in students they might otherwise not consider at risk for drug abuse. The same holds true for those adolescents at risk for abusing anabolic steroids.

Q: Research suggests that drug abuse involves multiple factors, including biology, environment, and interactions between the two. One salient environmental influence on children and adolescents is the school context. What are the most important factors in the school environment that either protect or put youths at risk for drug use?

A: Risk factors can occur at different stages of a child’s life, in different settings. Early onset risk factors can place children on developmental paths that lead to adolescent drug abuse and related problem behaviors. Within schools, several individual, peer, and environmental factors can place adolescents at risk for drug abuse: inappropriate classroom behavior, such as aggression and impulsivity; academic failure; poor social coping skills; and association with peers involved in high-risk behaviors, including drug abuse.

Not all risk factors, however, stem from the students themselves; in fact, misperceptions about the extent and acceptability of drug-abusing behaviors in school held by school staff and the public in general, also can create an environment that increases drug-abuse risk. For example, the belief that most adolescents use drugs when, in fact, most do not, can lead to ambiguous or poorly enforced drug-abuse policies.

Q: What are the three most important steps a school can take to help prevent drug abuse?

A: Three steps that schools can take are:

1. Use science-based, proven prevention approaches that are developmentally appropriate and reinforced over time (e.g., provide booster sessions).
2. Implement interventions early, especially with children at early risk for aggression. Research has shown that early intervention can reduce problem behaviors and change negative developmental paths.
3. Create a school environment that emphasizes pro-social activity and responsibility for students, teachers, and administrators, and that provides parent-family support.


NIDA also maintains a Web site for teens that provides accurate information about drugs of abuse: http://www.teens.drugabuse.gov.

NIDA and Others Collect Brain Data

NIDA has joined with other National Institutes of Health (NIH) centers to embark on the world’s first large-scale longitudinal study to collect behavioral and brain MRI (magnetic resonance imaging) data on 500 children, ages 0–18 years. Once completed, results will provide baseline normative structural development information and corresponding behavioral measures to the wider scientific community.

This database will be an invaluable resource to examine, by comparison to normal brain data, how drugs of abuse affect brain development and how age of exposure and gender matter. Ultimately, this information should facilitate earlier identification of various disorders or vulnerabilities, thereby helping to develop targeted interventions that can be implemented early, before drug abuse takes hold and changes the trajectory of a young person’s life.
Encouraging Parents to Work With Schools to Keep Students Drug Free

Parent messages to their children and school policies for their students about alcohol and drug use should be consistent and firm—drug use is not acceptable. The best way parents can help schools provide strong antidrug policies is to be involved as well. Schools can encourage parent involvement using strategies such as the following:

- Invite parents to learn about the current policies regarding alcohol and drugs. If there is no policy, ask parents to help establish one.
- Encourage parents to become familiar with drug education at the school. Drug education should be taught by trained staff members using age-appropriate methods and be based on current research.
- Suggest that parents talk with their children about the drug education program and go over materials together.
- Talk to parents about school assessments on student drug use and how the results are used.
- Explain how the school deals with students who are caught abusing drugs. Does the school offer referrals or resources to those who need treatment?
- Discuss any drug prevention program being used in the school and whether it is being evaluated for success. Research indicates that some of the most effective programs emphasize the value of certain life skills, such as coping with anxiety, being assertive, and feeling comfortable socially. When these lessons are combined with drug education, students confronted with the prospect of drug use are better equipped to resist.


Know the Warning Signs of Teen Drug Use

Drug use is associated with a variety of negative consequences, including increased risk of serious drug use later in life, school failure, and poor judgment, which may put teens at risk for accidents, violence, unplanned and unsafe sex, and suicide. Parents and educators can help through open communication and recognition of developing problems. Warning signs may include:

**Physical Signs**
- fatigue
- repeated health complaints
- red and glazed eyes
- lasting cough

**Emotional Signs**
- personality change
- sudden mood changes
- irritability
- low self-esteem
- poor judgment
- depression
- general lack of interest

**Family-related Signs**
- starting arguments
- negative attitude
- breaking rules
- withdrawing from family
- secretiveness

**School-related Signs**
- decreased interest
- negative attitude
- drop in grades
- many absences
- truancy
- discipline problems

**Social Signs**
- new friends who make poor decisions and are not interested in school or family activities
- problems with the law
- changes to less conventional styles in dress and music

Some of these warning signs may be indicators of other problems. Seeking professional help to rule out physical causes is a good first step to address potential problems.

Prevention programs in schools focus on children's social and academic skills, including enhancing peer relationships, self-control, coping skills, social behavioral skills, and drug-offer refusal skills. School-based prevention programs should be integrated within the school's own goal of enhanced academic performance. Evidence is emerging that a major risk for school failure is a child's inability to read by the third or fourth grade, and school failure is strongly associated with drug abuse. Integrated programs strengthen students' bonding to school and reduce their likelihood of dropping out. Most prevention curricula include a normative education component designed to correct the misperception that many students are abusing drugs (p. 19).

Many research-based prevention interventions in schools include curricula that teach the behavioral and social skills described above. The Life Skills Training Program exemplifies one universal classroom program that is provided to middle-schoolers. The program teaches drug-use resistance, self-management, and general social skills in a three-year curriculum, with the third year being a booster session offered when students enter high school. ATLAS (Athletes Training and Learning to Avoid Steroids) is a selective program for male high school athletes. It is designed to reduce risk factors for use of anabolic steroids and other drugs, while providing healthy nutrition and strength-training information. Coaches, peer teammates, and parents are part of the program.

An indicated intervention that reaches high school students, Project Towards No Drug Abuse focuses on students who have failed to succeed in school and are engaged in drug abuse and other problem behaviors. The program seeks to rebuild students’ interest in school and their future, correct their misperceptions about drug abuse, and strengthen protective factors, including positive decisionmaking and commitment.

Recent research suggests caution when grouping high-risk teens in peer group interventions for drug abuse prevention. Such groups have been shown to produce negative effects, as participants appear to reinforce substance abuse behaviors over time. Research is examining how to prevent such effects, with a particular focus on the role of adults and positive peers (p. 20).

Principles for Effective Programs
- Prevention programs can be designed to intervene as early as preschool to address risk factors for future drug abuse, such as aggressive behavior, poor social skills, and academic difficulties (p. 3).
- Prevention programs for middle or junior high and high school students should increase academic and social competence (p. 3).
- Prevention programs aimed at general populations during key transition points, such as the transition to middle school, can produce beneficial effects even among high-risk families and children (p. 4).
The U.S. Department of Education’s Office of Safe and Drug-Free Schools announces the following grant competitions for 2007. For detailed information about each grant program, including eligibility requirements and application availability and deadline dates, contact the staff member listed with each announcement.

**Grants to Reduce Alcohol Abuse**
This program assists local education agencies (LEAs) in the development and implementation of innovative and effective alcohol-abuse prevention programs for secondary school students.
Contact: Amalia Cuervo at amalia.cuervo@ed.gov or Phyllis Scattergood at phyllis.scattergood@ed.gov

**Grants for School-based Student Drug-Testing Programs**
This program awards grants to LEAs to implement student drug-testing programs and to provide early intervention for students who are using drugs.
Contact: Sigrid Melus at sigrid.melus@ed.gov or Kandice Kostic at kandice.kostic@ed.gov

**Emergency Response and Crisis Management Grants Program**
This program supports emergency response planning at the district and school levels. Grantees are required to address all four phases of crisis planning: prevention and mitigation, preparedness, response, and recovery.
Contact: Sara Strizzi at sara.strizzi@ed.gov

**Safe Schools-Healthy Students Initiative**
This program supports the development of community-wide approaches to create safe and drug-free schools and promote healthy childhood development. LEAs must partner with local law enforcement, public mental health, and juvenile justice agencies. This program is jointly funded and administered by the departments of Education, Justice, and Human Services.
Contact: Karen Dorsey at karen.dorsey@ed.gov

**Alcohol and Other Drug Prevention Models on College Campuses**
The goals of this competition are to identify models of effective alcohol and other drug prevention programs at institutions of higher education and disseminate information about these programs to other colleges and universities where similar efforts may be adopted.
Contact: Richard Lucey at richard.lucey@ed.gov or Ruth Tringo at ruth.tringo@ed.gov

**Foundations for Learning Grants**
This program provides funds to LEAs and other agencies for programs to help eligible children become ready for school.
Contact: Earl Myers at earl.myers@ed.gov

**Grants for the Integration of Schools and Mental Health Systems**
This program supports activities that increase student access to quality mental health care by developing innovative programs that promote cooperative services between school systems and local mental health systems.
Contact: Dana Carr at dana.carr@ed.gov

**Cooperative Education Exchange Program**
This program supports development of curricula and teacher training programs in civics, government, and economic education. Outreach to participating eligible countries is encouraged to exchange ideas and experiences in civics, government, and economics.
Contact: Rita Foy Moss at rita.foy.moss@ed.gov

For information about funding opportunities in fiscal year 2007, see the U.S. Department of Education’s Forecast of Funding Opportunities, located online at http://www.ed.gov/fund/grant/find/edlit-forecast.html.
Research Findings

Youth Violence and Illicit Drug Use


Data collected during the 2002, 2003, and 2004 NSDUHs shows:

- Youths aged 12 to 17 who used an illicit drug in the past year were almost twice as likely to have engaged in a violent behavior as those who did not use an illicit drug (49.8 vs. 26.6 percent; p. 1).
- Adolescents who were not attending or enrolled in school at the time of the survey were more likely to have engaged in violent behavior than those who were attending or enrolled in school (39.9 vs. 31.4 percent; p. 3).
- Rates of past-year violent behavior were higher among youths aged 13, 14, and 15 than those younger or older (p. 1).

http://www.oas.samhsa.gov/2k6/youthViolence/youthViolence.htm

Girls and Drugs—A New Analysis: Recent Trends, Risk Factors and Consequences

Executive Office of the President, Office of National Drug Control Policy, February 2006

Analysis of recent trends in drug and alcohol use among girls shows that in 2004 more girls than boys started using alcohol, cigarettes, and marijuana. Teen girls also outnumber boys in their misuse of prescription drugs. Teen girls are vulnerable to unique risk factors shown to lead to substance use:

- Depression, anxiety, and concerns about appearance and weight;
- Risky sexual behavior;
- Early puberty;
- Psychiatric and conduct disorders;
- Physical and sexual abuse;
- Stress and low self-esteem; and
- Peer pressure.

http://www.mediacampaign.org/pdf/girls_and_drugs.pdf

National Survey of American Attitudes on Substance Abuse XI: Teens and Parents

The National Center on Addiction and Substance Abuse (CASA) at Columbia University, August 2006

Survey results indicate one-third of all teens and nearly half of 17-year-olds attend house parties where parents are present and teens are drinking, smoking marijuana, or using other drugs. The annual back-to-school assessment conducted by CASA also reveals that teens who attend parties where no parents are present are 16 times likelier to say alcohol is available, 15 times likelier to say illegal and prescription drugs are available, and 29 times likelier to say marijuana is available, compared to teens who say parents are always present at the parties they attend (p. ii).


Resources

NIDA InfoFacts: Science-based Facts on Drug Abuse and Addiction

*National Institute on Drug Abuse (NIDA), 2004–06*

These reports discuss the physical effects of drug abuse and the health effects of specific drugs: tobacco, club drugs, crack and cocaine, ecstasy, heroin, inhalants, LSD, marijuana, methamphetamine, prescription drugs, PCP, Ritalin, Rohypnol and GHB (gamma hydroxybutyric acid), and steroids.

Free online at http://www.nida.nih.gov/Infofacts/InfofaxIndex.html.

Mind Over Matter [Grades 5–9]

*National Institute on Drug Abuse (NIDA), 1998–2005*

The Mind Over Matter series is designed to encourage young people in grades 5 through 9 to learn about the effects of drug abuse on the body and the brain. The series includes eight sections devoted to teaching students about the brain’s responses to specific drugs: marijuana, opiates, inhalants, hallucinogens, steroids, stimulants, nicotine, and methamphetamine.

Free online at http://teens.drugabuse.gov/mom/index.asp or order free copies from the National Clearinghouse for Alcohol and Drug Information (NCADI) at 1-800-729-6686.

Brain Power! The NIDA Junior Scientist Program [Grades K–5]

*National Institute on Drug Abuse (NIDA), 2005*

These science curriculum materials educate elementary school students on the effects of drugs on the brain. Programs are available for children in grades K–1, grades 2–3, and grades 4–5.

Order free copies from the National Clearinghouse for Alcohol and Drug Information (NCADI) at 1-800-729-6686 or access the online versions at:

http://www.drugabuse.gov/JSP2/JSP.html [grades K–1]
http://www.drugabuse.gov/JSP/JSP.html [grades 2–3]

The Brain: Understanding Neurobiology Through the Study of Addiction [Grades 9–12]

*National Institute on Drug Abuse (NIDA), 2004*

This interactive, science-based curriculum supplement for high school students and teachers includes a CD-ROM with video and activities. This curriculum provides current, research-based information on various aspects of drug abuse and addiction, including neurobiology, behavioral components, and treatment.

Access the free Web version and download print materials at http://science-education.nih.gov/Customer.nsf/HSAddiction.htm or order a free copy from the NIH Office of Science Education at 301-402-2469.
Questions and Comments

“I would like to see more information included that shows that school nurses (RNs) are key players in the educational success of students. During my 30 years as a school nurse, I have seen how we are making a difference in the lives and education of children from our “holistic” approach (nursing, education, community health, research, etc). As a nurse, I have been able to impact the health and safety of children by finding resources and making appropriate referrals to reduce or remediate many health-related barriers to their education. Many times I have worked with teachers to help them understand a child’s disabilities or encourage use of alternatives that would allow the child to feel successful; often, for the first time in the child’s life.”

—Shirley R., Arizona

Health resources are vital to schools. We appreciate the nurse professionals who work in schools to help keep our students safe and healthy and strive to highlight meaningful information for all school staff.

... “I’m program coordinator for a school-based mentoring program that serves five school districts in Ohio. We match adult volunteers with students to work on problem-solving skills and goal building. The problem is that we make progress only to return the child home to an environment that takes us back five steps. Is there a support program for parents that encourages them to learn about parenting styles?”

—Cathy D., Ohio

Commitment to school is a protective factor for young people, as is having a supportive relationship with a caring adult—even if it’s not a parent. So your program is adding a buffering effect for these students who may have poor home supervision or family conflict. However, adding a parental component would promote more protection for these students.

There are several programs to help parents establish clear expectations, manage conflict, and communicate more effectively. These include Guiding Good Choices, Incredible Years, and the Strengthening Families Program. Programs are developed for various age groups and are delivered in group settings over a course of several sessions.

Providing transportation, food, and child care can help encourage parent participation.

Answer is condensed. The full text can be found online at http://www.thechallenge.org.

Send questions, comments, or suggestions to The Challenge via e-mail at informationcnl@thechallenge.org.