

## Stimulant ADHD Medications: Methylphenidate and Amphetamines

Stimulant medications (e.g., methylphenidate and amphetamines) are often prescribed to treat individuals diagnosed with attention-deficit hyperactivity disorder (ADHD). ADHD is characterized by a persistent pattern of inattention and/or hyperactivity-impulsivity that is more frequently displayed and more severe than is typically observed in individuals at a comparable level of development. This pattern of behavior usually becomes evident in the preschool or early elementary years, and the median age of onset of ADHD symptoms is 7 years. For many individuals, ADHD symptoms improve during adolescence or as age increases, but the disorder can persist into adulthood. In the United States, ADHD is diagnosed in an estimated 8 percent of children ages 4–17 and in 2.9–4.4 percent of adults.<sup>1,2,3</sup>

### How Do Prescription Stimulants Affect the Brain?

All stimulants work by increasing dopamine levels in the brain—dopamine is a brain chemical (or neurotransmitter) associated with pleasure, movement, and attention. The therapeutic effect of stimulants is achieved by slow and steady increases of dopamine, which are similar to the natural production of

the chemical by the brain. The doses prescribed by physicians start low and increase gradually until a therapeutic effect is reached. However, when taken in doses and routes other than those prescribed, stimulants can increase brain dopamine in a rapid and highly amplified manner—as do most other drugs of abuse—disrupting normal communication between brain cells, producing euphoria, and increasing the risk of addiction.

### What Is the Role of Stimulants in the Treatment of ADHD?

Treatment of ADHD with stimulants, often in conjunction with psychotherapy, helps to improve the symptoms of ADHD, as well as the self-esteem, cognition, and social and family interactions of the patient. The most commonly prescribed medications include amphetamines (e.g., Adderall—a mix of amphetamine salts) and methylphenidate (e.g., Ritalin and Concerta—a formulation that releases medication in the body over a period of time). These medications have a paradoxically calming and “focusing” effect on individuals with ADHD. Researchers speculate that because methylphenidate amplifies the release of dopamine, it can improve attention and

focus in individuals who have dopamine signals that are weak.<sup>4</sup>

One of the most controversial issues in child psychiatry is whether the use of stimulant medications to treat ADHD increases the risk of substance abuse in adulthood. Research thus far suggests that individuals with ADHD do not become addicted to their stimulant medications when taken in the form and dosage prescribed by their doctors. Furthermore, several studies report that stimulant therapy in childhood does not increase the risk for subsequent drug and alcohol abuse disorders later in life.<sup>5,6,7</sup> More research is needed, however, particularly in adolescents treated with stimulant medications.

## Why and How Are Prescription Stimulants Abused?

Stimulants have been abused for both “performance enhancement” and recreational purposes (i.e., to get high). For the former, they suppress appetite (to facilitate weight loss), increase wakefulness, and increase focus and attention. The euphoric effects of stimulants usually occur when they are crushed and then snorted or injected. Some abusers dissolve the tablets in water and inject the mixture. Complications from this method of use can arise because insoluble fillers in the tablets can block small blood vessels.

## What Adverse Effects Does Prescription Stimulant Abuse Have on Health?

Stimulants can increase blood pressure, heart rate, body temperature, and decrease sleep and appetite, which can lead to malnutrition and its consequences. Repeated use of stimulants can lead to feelings of hostility and paranoia. At high doses, they can lead to serious cardiovascular complications, including stroke.

Addiction to stimulants is also a very real consideration for anyone taking them without medical supervision. This most likely occurs because stimulants, when taken in doses and routes other than those prescribed by a doctor, can induce a rapid rise in dopamine in the brain. Furthermore, if stimulants are used chronically, withdrawal symptoms—including fatigue, depression, and disturbed sleep patterns—can emerge when the drugs are discontinued.

## How Widespread Is Prescription Stimulant Abuse?

### *Monitoring the Future Survey<sup>†</sup>*

Each year, the Monitoring the Future (MTF) survey assesses the extent of drug use among 8th-, 10th-, and 12th-graders nationwide. For amphetamines and methylphenidate, the survey measures only past-year use, which refers to use

at least once during the year preceding an individual's response to the survey. Use outside of medical supervision was first measured in the study in 2001; nonmedical use of stimulants has been falling since then, with total declines between 25 percent and 42 percent at each grade level surveyed. MTF data for 2008 indicate past-year nonmedical use of Ritalin by 1.6 percent of 8th-graders, 2.9 percent of 10th-graders, and 3.4 percent of 12th-graders.

Since its peak in the mid-1990s, annual prevalence of amphetamine use fell by one-half among 8th-graders to 4.5 percent and by nearly one-half among 10th-graders to 6.4 percent in 2008. Amphetamine use peaked somewhat later among 12th-graders and has fallen by more than one-third to 6.8 percent by 2008. Although general nonmedical use of prescription stimulants

is declining in this group, when asked, "What amphetamines have you taken during the last year without a doctor's orders?" 2.8 percent of all 12th-graders surveyed in 2007 reported they had used Adderall. Amphetamines rank third among 12th-graders for past-year illicit drug use.

## Other Information Sources

For more information on treating ADHD, visit the Web site for the National Institute of Mental Health, National Institutes of Health, at [www.nimh.nih.gov](http://www.nimh.nih.gov).

For street terms searchable by drug name, street term, cost and quantities, drug trade, and drug use, visit [www.whitehousedrugpolicy.gov/streetterms/default.asp](http://www.whitehousedrugpolicy.gov/streetterms/default.asp).

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## Data Source

<sup>†</sup> These data are from the 2008 Monitoring the Future survey, funded by the National Institute on Drug Abuse, National Institutes of Health, Department of Health and Human Services, and conducted annually by the University of Michigan's Institute for Social Research. The survey has tracked 12th-graders' illicit drug use and related attitudes since 1975; in 1991, 8th- and 10th-graders were added to the study. The latest data are online at [www.drugabuse.gov](http://www.drugabuse.gov).

## References

<sup>1</sup> Centers for Disease Control and Prevention. Mental health in the United States: Prevalence of diagnosis and medication treatment for attention-deficit/hyperactivity disorder—United States, 2003. *Morb Mortal Wkly Rep* 54(34):842–847, 2005.

<sup>2</sup> Kessler RC, Adler L, Barkley R, et al. The prevalence and correlates of adult ADHD in the United States: Results from the National Comorbidity Survey Replication. *Am J Psychiatry* 163(4):716–723, 2006.

<sup>3</sup> Faraone SV, Biederman J. *Prevalence of Adult ADHD in the United States*. Paper presented at the American Psychiatric Association annual meeting, New York, 2008.

<sup>4</sup> Volkow ND, Fowler JS, Wang G, Ding Y, Gatley SJ. Mechanism of action of methylphenidate: Insights from PET imaging studies. *J Attention Disorders* 6(Suppl. 1):S31–S43, 2002.

<sup>5</sup> Wilens TE, Faraone SV, Biederman J, Gunawardene S. Does stimulant therapy of attention-deficit/hyperactivity disorder beget later substance abuse? A meta-analytic review of the literature. *Pediatrics* 111(1):179–185, 2003.

<sup>6</sup> Mannuzza S, Klein RG, Truong NL, et al. Age of methylphenidate treatment initiation in children with ADHD and later substance abuse: Prospective follow-up into adulthood. *Am J Psychiatry* 165(5):604–609, 2008. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/18381904?dopt=Abstract>.

<sup>7</sup> Biederman J, Monuteaux MC, Spencer T, Wilens TE, MacPherson HA, Faraone SV. Stimulant therapy and risk for subsequent substance use disorders in male adults with ADHD: A naturalistic controlled 10-year follow-up study. *Am J Psychiatry* 165(5):597–603, 2008. Available at: <http://ajp.psychiatryonline.org/cgi/content/abstract/appi.ajp.2007.07091486v1>.