Stimulant Use Disorders

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KEYWORDS

• Adolescents • Substance use • Stimulant use disorder • Methamphetamine • Diagnosis • Assessment

KEY POINTS

- Compared with other illicit substances, stimulants are not commonly used by adolescents; however, they represent a serious concern regarding substance use among youths.
- Methamphetamine use among adolescents and young adults is a serious health concern with potentially long-term physical, cognitive, and psychiatric consequences.
- Brain development and the effects of misusing stimulants align such that usage in adolescents may be more dangerous than during adulthood.

INTRODUCTION AND EPIDEMIOLOGY

Stimulants encompass a wide range of substances. Although many stimulants have unique properties, this article focuses on methamphetamine as a model of stimulant use in youths. Some information on cocaine and prescription stimulants is also discussed as they present a pertinent subgroup. Although illicit stimulants are not the most common drug of choice among adolescents, its impact on neurodevelopment, future substance use, and association with other high-risk behaviors make it important to consider. Data from the Substance Abuse and Mental Health Services Administration (SAMHSA) revealed that in 2013 there were 144,000 persons aged 12 years and older who had used methamphetamine for the first time within the past 12 months, with 18.9 years old as the average age of first use. SAMHSA identified 601,000 persons who used cocaine for the first time and 603,000 persons who tried nonprescribed stimulants. Although the trends in usage have remained relatively stable in the past decade, these numbers are still concerning for providers working with youths.[1]

Data from the Monitoring the Future Study assessed drug use among eighth, tenth, and twelfth graders. Statistics from 2014 indicate that lifetime use of methamphetamines as well as past-year use has declined in eighth and tenth graders. Unfortunately

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lifetime use and past-year usage increased from 2013 to 2014 for twelfth graders. With regard to cocaine use, there seems to be an overall downward trend in lifetime and past-year use across all 3 age groups since 2011. There are similar trends for other stimulants, such as cigarettes, smokeless tobacco, and crack cocaine. In reviewing past-year use of amphetamine and dextroamphetamine (Adderall) and methylphenidate hydrochloride (Ritalin), the trends are more variable. Adderall use among eighth graders is lower than it has been in the past 3 years; however, use has increased in tenth graders. For twelfth graders, lifetime Adderall use continues on a downward trend but current lifetime use is still higher than that recorded in 2011. Ritalin use seems to have a more consistent decline across all age groups over the past 3 years.[2]

BRIEF PHARMACOLOGY OF AMPHETAMINE, METHAMPHETAMINE, PRESCRIPTION STIMULANTS, AND COCAINE

Amphetamine

The primary pharmacologic use of amphetamine is for its central nervous system effects. It has US Food and Drug Administration approval for treatment of narcolepsy and attention-deficit/hyperactivity disorder (ADHD). Amphetamine acts on the neuronal dopamine transporter (DAT) and the vesicular monoamine transporter 2 (VMAT2), causing release of biogenic amines from their storage in vesicles at nerve terminals, resulting in increased availability. The toxicity of amphetamine is variable. Severe reactions can occur at doses of 30 mg, but doses as large as 400 to 500 mg are not necessarily lethal.[3]

Methamphetamine

Methamphetamine is closely related to amphetamine and ephedrine and belongs to a class called phenothylamines.[3] It can be produced from readily available over-the-counter cold medications, such as ephedrine and pseudoephedrine.[4] Methamphetamine is a sympathomimetic amine, with stimulant, anorexiant, euphoric, and hallucinogenic effects. It has been used for its stimulant properties to improve alertness and decrease fatigue. Current indications include ADHD, short-term treatment of obesity, and off-label use in the treatment of narcolepsy.[3]

Methamphetamine acts as an indirect agonist, causing the release of catecholamines from presynaptic nerve terminals. Being structurally similar to many monoamines it can act as a substitute at membrane bound transporters, including the DAT, noradrenaline transporter (NET), serotonin transport (SERT), and VMAT2. Methamphetamine reverses the function of VMAT2 and disrupts the natural pH gradient. This disruption releases monoamines from storage vesicles into the cytoplasm. DAT, NET, and SERT on the cell surface are reversed causing dopamine, norepinephrine, and serotonin to be released from the cytosol into the synapse. Methamphetamine also reduces monoamine metabolism by inhibiting monoamine oxidase and inhibits reuptake. Elevated levels of neurotransmitter can activate postsynaptic receptors resulting in adrenergic stimulation.[3,5] Substance use behavior, such as craving and reward, as well as psychiatric symptoms are due to methamphetamine's effects at dopamine receptors.[4]

Methamphetamine is lipophilic and can be administered and absorbed via numerous routes, including oral, pulmonary, nasal, intramuscular, intravenous, rectal, and vaginal.[3,6] Its onset of action varies depending on the route of administration. Effects can occur within seconds if methamphetamine is smoked or injected. If administered intranasally, the onset of action is approximately 5 minutes and if ingested orally about 20 minutes. The plasma half-life of methamphetamine ranges