ADHD Diagnosis & Psychostimulant Use in the United States

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INTRODUCTION

Amphetamines and methylphenidates are types of synthetic psychostimulants that have an array of effects on the Central Nervous System (CNS). The CNS mainly includes the brain and the spinal cord. Psychostimulants are defined as producing a transient increase in psychomotor activity, or a drug that produces such effects similar to amphetamines, methylphenidates, or caffeine (1). In recent years, the prescription of psychostimulants from the amphetamine and methylphenidate families have become the most popular treatment for learning and attention conditions like attention deficit hyperactivity disorder (ADHD) (2). The heightened diagnosis of ADHD and other learning related disabilities in the past decade has created a significant increase in the number of prescription psychostimulants being administered as a treatment method for the disorder (2). The increase in the number of individuals prescribed psychostimulants as a treatment for ADHD has also caused a surge in the number of individuals illegally obtaining the drugs for illicit use. Common psychostimulants used as medications to treat ADHD include Ritalin, Concerta (methylphenidate), and Adderall (dextroamphetamine-amphetamine) (3). Psychostimulants target the dopaminergic pathway to induce an overstimulation of brain structures, causing a "calming and "focusing" effect, making them effective in treating individuals who suffer from ADHD (4). Individuals who do not have ADHD but take psychostimulants experience an intense increase in focus, stamina, and wakefulness for extended periods of time; for this reason, these drugs have become increasingly misused by individuals who do not have ADHD but are seeking to gain increased performance in school, at work, or in athletics (5).

Attention Deficit Hyperactivity Disorder (ADHD)

According to The Centers for Disease Control, there is no individual test that can indisputably determine if an individual has and should be treated for ADHD (4). However, medical professionals use *The American Psychiatric Association's Diagnostic and Statistical Manual-5th edition* (DSM-IV) as a guide to determine if an individual possesses symptoms necessary to be diagnosed with ADHD (4). According to the DSM-IV a diagnosis of ADHD implies the presence of hyperactive-impulsive or inattentive symptoms present before age 7 years that caused impairment. Furthermore, the symptoms must cause clinically significant impairment, (e.g., in social, academic, or occupational functioning), and be present in two or more settings, (e.g., school (or work) and at home) (6). Adequate diagnosis of the disorder requires the use not only of medical but of special psychological, educational, and social resources. The severity of the ADHD and the treatment preferences of the doctor are both factors that influence the type and amount of medication prescribed to a patient. Treatment of ADHD with psychostimulants helps to improve symptoms in addition to the patient's self-esteem, thinking ability, and social and family interactions; psychostimulants can significantly improve the quality of life from those who suffer from ADHD (4).

Psychostimulant Pathway & Structure

Psychostimulants like Adderall, Concerta and Ritalin work by affecting the normal function of signaling neurotransmitters called monoamines, which include norepinephrine and dopamine (13). Dopamine and norepinephrine are monoamines synthesized in brain tissues. These molecules are associated with pleasure, movement and attention, more commonly known as "the reward pathway" (13). Dopamine and norepinephrine are released from the presynaptic cell into the synaptic gap where they bind with receptors on the postsynaptic cell and causes stimulation; the result is the transport of a signal along a neuronal pathway to act on a region of the brain (14).

Chemical Names: Amphetamine; Amfetamine; Desoxynorephedrine; Phenamine; 1-phenylpropan-2-amine; 1-Phenyl-2-aminopropane	Citation: (15)
Molecular Formula	$C_9H_{13}N$
Molecular Weight	135.20622 g/mol
Structure	

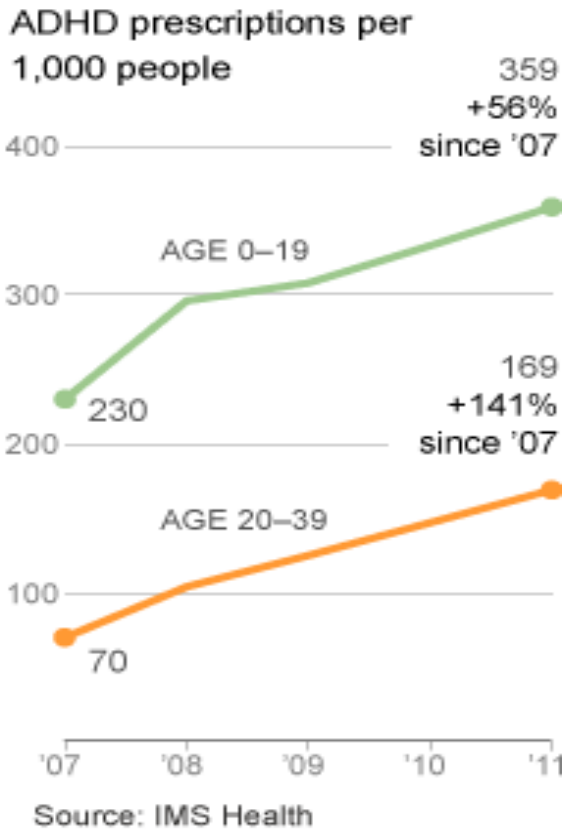
Medications prescribed to treat ADHD either over stimulate the presynaptic cell to increase release of dopamine into the synaptic gap or inhibit of the reuptake of dopamine from the synaptic gap by the postsynaptic cell (14). Each of these disruptions in the normal pathway causes an overstimulation of receptors and result in a significant increase of dopamine and norepinephrine induced stimulation in the brain.

Long-term and short-term effects of psychostimulants

The increased levels of dopamine and norepinephrine can cause an array of psychological effects such an increased focus and attention, increased wakefulness, and even a state of euphoria or a high. On a physiological level the stimulants can act to increase blood pressure and heart rate, constrict blood vessels, increase blood glucose, and open up breathing passages. Overdose of the medications can lead to elevated body temperature, and an irregular heartbeat that could cause seizures or a heart attack (13). After extended use of psychostimulants, the body can develop a dependency or an addiction to the psychostimulants. This can lead to withdrawal symptoms like fatigue, depression and irregular sleep patterns. Binge use or overdose of the stimulants can lead to psychological problems like feelings of aggression, hostility and loss of contact with reality (13). Extended use of the psychostimulants can result in altered cell signaling pathways, or even structural differences in the density of the neuronal cell populations found in the brain (14). This process often leads to the process of desensitization, where in the neurons and the cells of the brain become desensitized to the consistently high levels of dopamine. This desensitization of the neurons in the brain causes a decline in the number of receptors for dopamine in the postsynaptic cell and lead to a decrease in the sensitivity of these remaining receptors (17). Individuals who are not diagnosed with ADHD and misuse prescription stimulants are at a higher chance of becoming desensitized and eventually becoming addicted. After desensitization occurs, the dosage and potency of the psychostimulant in use most increase in order to achieve the same effect as previous to the desensitization.

Over diagnosis?

According to the Centers for Disease Control, approximately 11% of children 4-17 years of age (6.4 million) have been diagnosed with ADHD as of 2011; the percentage of children with an ADHD diagnosis has continued to increase, from 7.8% in 2003 to 9.5% in 2007 and to 11.0% in 2011. (7) An increase in the number of individuals diagnosed with ADHD and other learning disabilities has resulted in more prescriptions of psychostimulants being administered; therefore, it has become easier for individuals seeking illegal access to psychostimulants to obtain them through those who have a legal prescription. Often times insurance pays for the prescription, so the profit from prescription sales is pocketed by the owner of the prescription, making sales of this drug extremely profitable. According to the New York Times “Young adults are by far the fastest-growing



segment of people taking ADHD medications. Nearly 14 million monthly prescriptions for the condition were written for Americans ages 20 to 39 in 2011, two and a half times the 5.6 million just four years before, according to the data company I.M.S. Health” (8).

Who misuses psychostimulants?

In recent years, the misuse of stimulants like Adderall, Concerta and Ritalin have increased significantly; individuals that are in positions that would benefit from enhanced focus, stamina and attention have become the top abusers of

psychostimulants. The drugs are most frequently misused by high school and college students as "study aids", helping them to maintain focus and energy for extended study or work periods. According to *The College Life Study,* almost two-thirds of the 1,253 survey participants (61.8%$_{wt}$) had been offered prescription stimulants for nonmedical use by their senior year of college, and of those individuals, 31.0%$_{wt}$ used the stimulants illegal (9). The National Collegiate Athletic Association (NCAA), Major League Baseball (MLB), National Football League (NFL) and The National Association for Stock Car Auto Racing (NASCAR) have banned their athletes from using stimulants without a physician administered prescription (10). According to official reports by the NFL, "In 2012, the NFL handed out suspensions to 19 players for a violation of the league's substance-abuse policy; in eight of those, the player was linked to Adderall or publicly blamed it for a failed test" (11). The MLB reports that in 2014, they issued 113 Therapeutic Use Exemptions (TUEs); these TUEs allow for the use of physician prescribed medication throughout the course of the season. Of the 113 TUEs one of them was for hypogonadism and the remaining 112 were for Attention Deficit Disorder (12). There are 30 teams in the MLB, each of which has 40 players on the roster; 112 players have TUEs for psychostimulants, meaning nearly 10 percent of the players in the MLB are taking some form of psychostimulant (12). Although there is no valid data on the direct misuse of psychostimulants in the workplace, there is significant evidence that usage has increased amongst this demographic in the United States. The federal Substance Abuse and Mental Health Services Administration found that emergency room visits related to nonmedical use of prescription stimulants among adults 18 to 34 tripled from 2005 to 2011, to almost 23,000 (20). The pressure of succeeding in the workplace has been the driving factor for many who misuse psychostimulants, as made apparent from this quote from a recently published article in The New York Times: "Elizabeth, a Long Island native in her late 20s, said that to not take Adderall while competitors did would be like playing tennis with a wood racket" (20).

Illicitly Obtaining Pyschostimulants

Although the process of obtaining a legal prescription for psychostimulants is well regulated by federal and state government, the process can be by-passed fairly easily in order to obtain the drugs without a physician administered prescription. In a study surveying the trends in the availability of drugs, the process of illegally obtaining Adderall or Ritalin was described as "fairly easy" or "very easy" by 47.0% of 12th graders (18). Although it may seem like academic enhancers are commonly misused and punishment for misuse might not be stiff, the truth is that illegal use of these prescription drugs carries serious penalties. Psychostimulants like Adderall, Ritalin, and Concerta are classified as schedule II narcotics. These drugs are characterized as such because of their high potential for abuse and severe dependence in addition to their currently accepted medical use (19). According to Code of Virginia § 18.2-248 possession of a schedule II controlled substance is a class 5 felony, and imprisonment of one to 10 years, or confinement in jail for up to 12 months and a fine of up to $2,500 (19). Furthermore, the Code of Virginia § 18.2-248 states that possession with intent to sell or distribute a schedule II drug is a felony conviction which carries an imprisonment from five to 40 years and a fine of up to $500,000 (19).

CONCLUSION

There has been a significant increase in the number of children and young adults diagnosed with ADHD in the past decade. Psychostimulants like amphetamines and methylphenidates have become the norm for treating ADHD. The increase in the number of prescriptions being administered to treat ADHD has lead to an increase in number of psychostimulants available for misuse. This misuse is not limited to high school and college students looking to gain an edge in the classroom; professional and amateur athletes have begun to utilize these stimulants as performance enhancers in athletic competitions. On a lesser scale, some individuals have begun to use psychostimulants in the workplace as a way to out work competitors by harnessing the drug's abilities for increased stamina, attention and focus. These prescription psychostimulants have highly addictive and dangerous properties when taken incorrectly, making misuse a dangerous habit. Psychostimulants have become one of the most widely used and abused prescriptions medications in the United States, which has lead to strict punishments for illegal possession, and distribution of these stimulants. When used correctly, psychostimulants can help individuals with ADHD or similar learning impairments to pay attention, control impulsive behavior and focus on tasks effectively, all of which contribute to becoming a better student. Still, the number of individuals who misuse of psychostimulants will continue to grow until the process of diagnosing ADHD and similar learning impairments become more uniform and specific. Use of these psychostimulants has become a necessary evil amongst those looking to obtain the successes that may be just out of reach; however, the obvious negative aspects of this dangerous habit far outweigh

any positives that could arise from the usage of these drugs.

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