

Adderall Abuse Among College Students

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Abstract

Background: At the national level, nonmedical use of prescription drugs is becoming an increasingly important part of the illicit drug use problem among college students. Approximately 2.5 million Americans are prescribed prescription stimulants such as Adderall or Ritalin to treat Attention Deficit Hyperactivity Disorder (ADHD). ADHD is a brain disorder that makes it difficult to concentrate and increases impulsive behavior. We reviewed the literature on Adderall abuse among college students to summarize the available data and identify evidence gaps.

Methods: We identified relevant literature on stimulants including Adderall abuse among students between 2004 and 2018 through a systematic and comprehensive search.

Results: We identified 32 articles which met our pre-defined eligibility criteria but we used 17 articles to write this review article. Over one quarter (28.1 percent) of college-aged young adults report having misused some type of prescription psychotherapeutic drug at least once in their lifetime.

Conclusions: In order to reduce the rate of amphetamine abuse among college students school administrators should implement prevention programs targeting students at risk. Additionally, physicians must become more vigilant in their prescribing practices to reduce inappropriate administration of these drugs. Finally, parents should set realistic standards for their children, especially for those with a heavy workload or schedule.

Keywords: *Stimulants; ADHD; Adderall; Ritalin; Cognitive enhancement; Motivation; Memory*

1. Introduction

Attention Deficit Hyperactivity Disorder (ADHD) is a brain disorder comprising of difficulties with inattention and/or hyperactivity-impulsivity that affects functioning. Approximately 2.5 million Americans are prescribed prescription stimulants to treat ADHD and Narcolepsy. The use of psycho-stimulant drugs for non-medical purposes has been prominent among college students who misuse it for enhancing their academic performance or for its euphoric effects.

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At the national level, nonmedical use of prescription drugs is becoming an alarming part of the illicit drug use problem among college students. This paper focuses on the well-documented problem of nonmedical use of prescription stimulants. Although some studies show that amphetamines cause enhancement in language-based learning and recognition, they are inconclusive in showing cognitive benefits such as in working memory. Whereas, factors such as increased motivation and focus may play a better role in academic performance. Nonetheless, stimulants continue to be abused by adolescents and young adults, making it necessary for their stricter monitoring by healthcare professionals. The rampant rise of stimulant abuse among college students over the past decade, mandates increased research in the area of illicit prescription stimulant use. Since studies are limited in this area, research can improve awareness as well as possible solutions for this epidemic.

Over 28% of college-aged young adults have admitted misusing some type of prescription psychotherapeutic drug at least once during their lifetime [1]. Since the mid-1990s there has been a substantial increase in the prevalence of drug abuse among U.S college students which became a significant public health concern [2]. It has been reported that the rate of prescription drug abuse risen from 9.3% in 1996 to 14.6% in 2006.

Among all of the common prescription drugs abused, stimulants are a concern due to the rising rates. It has been reported that Adderall was the most frequently misused prescription drug among college students in 2012 [3]. Stimulants, also referred to as amphetamines, are most commonly used for attention deficit/hyperactivity disorder (ADHD) and narcolepsy. Due to massive rate increases in stimulant misuse from 2005 to 2010, there has been a threefold increase in stimulant-related emergency room visits among college-aged young adults between the ages of 18-25 (TABLE 1 & 2) [4].

TABLE 1. Indication of Stimulants and its potential problems if abused or misused.

Stimulants	Used to treat	How they work in body	Potential problems if abused or misused
Dextroamphetamine, Methylphenidate, Amphetamine- dextroamphetamine, Dexmethylphenidate	Narcolepsy, ADHD	Speed up brain activity causing increased alertness, attention and energy that come with elevated blood pressure, increased heart rate and breathing.	Can lead to dangerous increases in blood pressure, which places added strain on the heart. Dangerous increases in heart rate and respiration are also possible.

TABLE 2. Name of Stimulants.

Name of the Stimulants (Generic)	Brand Name
Dextroamphetamine	Dexedrine
Methylphenidate	Ritalin, Concerta
Amphetamine-dextroamphetamine	Adderall
Dexmethylphenidate	Focalin

At a national level, non-medical related use of prescription drugs has been a significant factor in the illicit drug misuse problem among college students. Regardless of the increased awareness of prescription drug abuse nationwide, the diversion

and misuse of prescription amphetamines will remain a serious issue in college students. However, the question remains if majority of students already understand the health risks and academic consequences of using these drugs.

2. Is Adderall a Necessary Evil?

One in six college students abuse ADHD medication in hopes of performing well academically. These medications are categorized as stimulants and include Adderall, Concerta and Ritalin among others; legally, they fall under Schedule II controlled substances among cocaine and methamphetamine [5]. Due to its controlled nature, nonmedical college students must find students with prescriptions on campus, in order to obtain the medication (TABLE 3). A recent study showed that among 81 college students with ADHD, 62% distributed the medication to students without prescriptions [6].

TABLE 3. Negative and positive effects of Adderall.

Negative Effects	Positive Effects
<ul style="list-style-type: none"> • Gastro Intestinal: Lack of appetite resulting weight loss, Nausea, dry mouth, upset stomach, malnutrition • Neurological: Dizziness, Paranoia, Insomnia, incomplete thoughts, seizures, extremely fast or slowed speech, anxiety, restlessness, mania, hearing voices, hallucinations, psychosis, decrease cognitive function • Personality Changes: Aggressive behaviors, such as violent outburst or risk taking, great mood swings look like Bipolar disorder, depression and relationship problems • Cardio-Vascular: Increase in blood pressure, pounding and irregular heartbeat, chest pain, cardiac dysrhythmias, heart attack and stroke • Circulatory issues (including finger numbness and discoloration). • Respiratory: Difficulty in breathing • Organ damage • Addiction • Sudden Death 	<ul style="list-style-type: none"> • Increased focus and concentration • Increased mood level • Increased alertness and cognitive function • Ability to function with clarity • Reduction of hyperactivity • Decreased exhaustion

Despite the legal risk that the given students put themselves into, they invest in the drug due to its advertisement as the “smart pill” that enhances academic performance. A smart pill is supposed to be a drug that increases cognitive abilities regardless of the person having a cognitive impairment or not. Romanian neuroscientist Coneliu Giurgea, who in the 1960s, said that a smart pill should be created to increase the intelligence of the general population, first proposed the idea; said drug would be able to accomplish this by affecting neurotransmitter levels, neurogenesis, and by increasing blood flow to the brain [7]. “Cognitive enhancement” can be generally defined as the use of prescription drugs that boost memory or attention, in order to increase level of productivity [8].

Common misconceptions also include that its use amongst neurotypical individuals is benign [9]. While Adderall can create a state of hyper focus among students without ADHD, it can produce a range of unwanted physical side effects such as headaches, loss of appetite, elevated blood pressure, and insomnia [10]. Even though this desired state could momentarily

benefit students in an academic setting, Adderall's ability to truly enhance cognitive functions among neurotypical individuals is vastly debated.

The remainder of this paper will explore the prevalence of stimulant abuse among college students, and examine whether drugs like Adderall truly enhances cognition, or if other factors are at play.

3. Frequency of Stimulant Use for Cognitive Enhancement

The pervasiveness of stimulant use among students happens to be a popular Western phenomenon. Franke, Bonertz, Christmann et al aimed to assess the prevalence of stimulant use exclusively for cognitive enhancement, and factors associated with it [11]. Participants included 1035 students from vocational and grammar schools. 424 were male, 611 were female, and their ages ranged from 18-21 years old with a mean age of 19.32 years old. There were also 512 university students; 198 were males, 314 were females, with ages ranging from 20-48 years old, with a mean age of 24 years old. The university students studied medicine, pharmacy, or economics.

The participants were administered a written questionnaire during class, to be collected at the end of lecture, in order to ensure the highest possible response rate. The questionnaire included questions regarding a diagnosis for ADHD or a prescription for stimulant medications to make sure that students who were not neurotypical were not included in the sample. In order to provide clear directions, participants were given a formal definition for cognitive enhancement: the use of prescription stimulants or illicit drugs by healthy subjects to improve cognitive abilities such as concentration, vigilance, or memory [11].

Memory is a process of storing and retrieving information and experiences. While this Information once received goes into our memory through our senses. Different levels of memory have been described which represent individual systems within the brain [12]

Scientists have described one such type of memory as working memory. This is also called as short-term memory which keeps the information current in our brain for short periods of time so that we can use this information for the task at hand [13]. Whereas long-term memory is memory that is stored as permanent information to retrieve later. Long-term memory is a huge store of knowledge along with a record of prior events [13].

The questionnaire started with inquiries about demographics, such as gender, type of school, grade level, and grades. "Good" grades ranged from an A+ to a B+, while "bad" grades ranged from a C- to an E-. Next, they were asked about whether or not they knew of the option to use prescription or illicit drugs as a means to enhance cognition. Furthermore, they were asked about the specific substances they used, frequency of use, age of first use, as well as their source.

Results concluded that a third of the participants were aware of the use of prescription drugs, while two-thirds of them knew about the use of illicit drugs. Pharmacy students were better informed about prescription drugs than the other students and medicine students were better informed about the use of illicit substances in the context of cognitive enhancement. For prescription drug use, the lifetime prevalence was 1.29%, the past-year prevalence was 0.26%, and the past-month use was

0.06%. Among grammar and vocational school students, lifetime and past-month prevalence was higher among participants with bad grades. This could indicate a relationship between stimulant drug use and bad grades, even though the direction cannot be determined. Students could possibly be taking the drugs to improve cognitive functions, or stimulant use in general can correlate to poor academic performance. Fraternity and sorority membership also related to a 6.67% increase in prescription use. For illicit drug use, there was a lifetime prevalence of 2.6%, a past-year prevalence of 0.97%, and a past-month prevalence of 0.26%. Overall, illicit drug use was higher than prescription drug use.

Common sources for the drugs included friends and relatives. Amphetamines were typically obtained via a “dealer” or illegally through a pharmacy. The mean age for first time prescription use was 17.46 years, while the mean age for first time illicit drug use was 17.09 years [11].

A second study conducted by looked at the use of methylphenidate (Ritalin) and amphetamines (Dexedrine) among the general adolescent population in the Atlantic Provinces of Canada [14]. There were a total of 12,990 students who participated, including both medical and non-medical users. The data was collected from the 2002 Student Drug Use Survey in the Atlantic Provinces. The Ontario Child Health Study Hyperactivity Scale was used to screen for ADHD and to distinguish between the medical and non-medical participants.

Statistical analysis of the data showed that 6% of the sample tested positive for ADHD. Within this percentage, 9.2% were prescribed a methylphenidate. Even then, 6.6% of the sample used the drugs without a prescription. How the drug is obtained can be highlighted by the fact that 26% of prescribed users distributed their medication among nonmedical classmates. This, in turn, creates a 1.5-fold increase in risk of stimulant abuse among non-medical adolescents.

4. The Effects of Stimulants on Learning

The next focus will be on the alleged cognitive enhancement that accompanies the use of stimulants by neurotypical individuals. A study conducted by studied the relationship between D- Amphetamine (AMPH) use (an active ingredient in Adderall) and learning language [15]. AMPH has been successful in a number of studies regarding motor and language recovery after a stroke. Due to a risk of cardiovascular irregularities as a result of AMPH, patients who suffered from strokes were excluded from the study. Female subjects were excluded due to the potentially hazardous effects of AMPH on pregnancy. Participants included 40 healthy males ranging from 20-33 years old. The experimental group received the amphetamine pill, while the control group received a placebo pill. The pills were administered 90 minutes before the language training, which took during five consecutive days.

An intensive word-learning model was used to study the neural mechanisms of learning a language. The measure included 183 verbal pseudo-words, 50 of which were selected in order to ensure limited associations with existing words. The 50 words were then randomly paired with drawings of objects; each subject had to learn a different combination of pairings. The participants were trained during five consecutive days for 30 minutes, during which they were presented with 400 trials of coupled pictures, with a five-minute break at the halfway mark. The ultimate task was to determine if a given pairing of picture and pseudo word was correct or incorrect. On the final day, the participants were asked to translate the pseudo-words into their native language. The German names of the objects were verbally presented in pairs with the pseudo-words. For

example, the German word for candle ('Kerze') was presented together with the pseudo-word 'binu.' By pressing a button, the subjects had to indicate if the German word was the proper translation for the corresponding pseudo-word. This task tested whether or not the participants had explicit access to the meanings of the pseudo-words. Results indicated that the experimental group significantly outperformed the control group. Group differences happened to grow as the training days progressed. Although both groups were able to successfully transfer the visual material to spoken material, participants in the experimental group continued to score better than those in the control group [15].

Another study designed by Mintzer and Griffiths looked at the effects of D- Amphetamines to possibly reverse the temporary amnesia that occurs among patients who take Benzodiazepines such as Ativan (lorazepam) and Xanax (alprazolam) [16]. Eight adult volunteers took place in this study. Seven of them were women, and their ages ranged from 18 to 39 years, the mean age being 23 years. During a total of nine sessions, participants were told that they would receive drugs varying from placebo substances, sedatives, anxiolytics, stimulants, and weight loss medications. They were unaware as to which drug, they received. The experimental measures included memory tasks that focused on episodic and working memory.

Episodic memory was tested for using free recall tests and recognition. The stimulus included an exclusive set of 140 nouns, equaling a total of 1,260 nouns spread among nine sessions. These words were then divided in two, half of them according to the mean frequency of the word in the language, and the other half for the word length. Within each subset, 35 words were man-made objects, and 35 were natural objects. During the experimental phase, the participants were shown a set of 70 words one at a time on a computer screen for two seconds. They were also asked to categorize the words according to its artificial or natural quality. Two hours after completing the experimental phase, the participants were presented with a set of 140 words, half of which had appeared previously. They were then asked to rate their confidence based on the familiarity of the words on a six-point confidence scale.

Working memory was tested using the n-back test, which requires participants to determine whether a particular sequence matches a previous sequence that appeared "n" items ago [17]. For the purposes of this study, n equals to 0, 1, 2, or 3 items back. For each n back, a string of 60 consonant letters, excluding L, W, and Y, were shown consecutively on the screen for 0.5 seconds.

In order to prevent perceptual matching, upper- and lower-case letters were intermixed. Participants were the asked to indicate "yes" whenever the current stimulus matched a letter "n" times back in the sequence, or to click "no" if it didn't appear at all. For example, participants in a 2-back task would say "yes" during the presentation of the final M in a sequence: mFM. Capacity of memory increases as "n" increases; therefore, the 0-back task served as a control condition that tested only for focus and attention.

Results concluded that the use of AMP by itself did not significantly improve working memory, or performance during the experimental phase of the episodic memory task. Nonetheless, it did produce a significant different on the recognition memory task [16]. Overall, the combination of both studies shows that while Adderall may aid in the enhancement of some aspects of learning, it is not a reliable study aid.

5. Is It a Matter of Cognition or Motivation?

Common usage of cognition dates back to 15th Century when it was typically defined as “a getting to know, acquaintance, notion, knowledge...” [18,19].

However, the more recent developing science of cognition has defined it in terms of tasks (e.g., perceiving a stimulus). This means cognition is primarily acquiring, transforming, and utilizing information structures in service of goals or drive, such as optimizing life situations. For example, attention given unconsciously to subtle anger expressed in someone’s face might facilitate decision making to avoid the person [20].

On the other hand, the Latin root of motivation means "to move". This means that motivational scientists and psychologists study what moves people to act and why people think and do what they do [21].

Some researchers attribute Adderall’s popularity to its ability to increase motivation rather than its ability to enhance cognitive functions. Ilieva and Farah of the University of Pennsylvania wanted to find out whether Adderall had an influence on cognitive abilities or on motivation [22]. Specifically, the objective was to quantitatively test the prediction that the motivational enhancements experienced by users is as pronounced as or more pronounced than the cognitive enhancements. For the purposes of this study, cognition was defined as the process of encoding, storing, and manipulating information. Therefore, participants were tested on their abilities regarding memory, attention, and their executive function. Memory was defined as the voluntary intention to use their cognitive abilities in the performance of a task. Moreover, their level of interest, enjoyment, and wanting to complete a task were looked at. The context of using stimulants as a means to elevate motivation partially comes from the fact that there is a relationship between depression and the use of medications such as Adderall to overcome emotional barriers that may hinder academic performance [17].

Participants in this study included 40 University of Pennsylvania undergraduate students. None of them had a history of ADHD, but had used stimulants at least once. The range of use was as follows: 10 participants used a stimulant just once, 5 used them on two occasions, 7 used them on three to five occasions, 7 used them on six to nine occasions, 4 used them on ten to nineteen occasions, 2 used them on 20-39 occasions, and 5 used them on 40 or more occasions. Participants were gathered from a pool of psychology students who were receiving course credit.

The students completed an online survey that focused on past use and the perceived effects. Enhancement use was measured as the number of times a stimulant was used in the past month, past academic year, and in one’s lifetime. The students then had to rate how helpful they found the medication to be on a 7-point scale, for a set of 14 psychological functions. The functions measuring cognitive abilities included: memory, creativity, intelligence, ability to multitask, abstract thinking, speed of thinking, and focused attention. The functions measuring amount of motivation were: mood, energy, alertness, anxiety relief, overall motivation, and task enjoyment.

Results showed that participants found the stimulants to overall enhance both motivational and cognitive functions. In spite of that, there was a significant difference between the level of enhancement between motivation and cognition, suggesting that the pills helped more with motivation than they did with cognition [23].

6. Conclusion

College students tend to misuse these prescription drugs for a host of reasons including, self-medication, social and recreational use, and the enhancement of academic functioning. The misuse of amphetamines is often fueled by the false perception that these drugs can increase alertness, concentration, memory, and cognition leading to academic success. A comprehensive review of existing literature shows that despite its prevalence, Adderall does not definitively aid in cognitive enhancement. The misuse of these prescription drugs constitutes a significant public health problem among college students. Strategies to combat and reduce the rate of amphetamine abuse among college students require informing students that the misuse of these drugs is dangerous and should be avoided especially when used for unnecessary self-medication, academic reasons, and for social or recreational use. It is also important to raise awareness among students with legitimate prescriptions that the administration of these Schedule II drugs are illegal and dangerous. Policies should also be incorporated for the safe and secure disposal for unused drugs on college campuses.

Finally, a comprehensive educational approach that involves students, parents, educators, and physicians is needed to decrease amphetamine use on college campuses. Students should be educated about the dangers of amphetamine misuse and provided healthier alternative for coping with stress from tough schedules and heavy workloads. Popular myths about the relative harmlessness of using these drugs should be dispelled, and students should be made aware of the ramifications of the illegal use of prescription drugs. In addition, parents should take a prominent role in educating their children about the risks of amphetamine misuse and help to reduce the pressure on their children to achieve unrealistic high standards in their academics.

The growing use of Adderall among nonmedical college students also begs the question of whether or not the education system assigns an unfair amount of schoolwork. Ultimately, this could push them to consider illegal and potentially hazardous means such as seeking out amphetamines. Even if the drugs do not help the students perform well in school, they would still be under the impression of increasing their cognitive functions due to accomplishing more in a short period of time. In order to provide safe learning environments in campus, it could help to educate students on the false promises of Adderall's cognitive enhancement abilities, and to also reconsider the way the youth is educated. School administrators and educators must take responsibility to implement effective prevention programs, limit the culture of academic excellence and social pressure, identify students misusing or at the risk of drug misuse and provide referrals to treatment centers, support groups, and rehab facilities.

As for the gatekeepers of these drugs, physicians must be more vigilant in healthy prescribing practices and ensure that their patients are well informed of the medications they are taking. Physicians who treat clients with mental illnesses should also be alert about treating symptoms the proper way, and to educate clients about their condition as well as the risks of taking medications that fall outside the treatment plan. Mental illness such as depression serve as a significant contributing factor in non-medical Adderall use, since approximately 36.4% of college students tend to suffer from depression [23]. By using psycho-stimulants, students with depression can tackle physical symptoms such as lethargy and lack of motivation in order to induce a sense of accomplishment. Through psychoeducation, clients can better understand the benefits of their treatment and how each component works towards alleviating symptoms.

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