The Adderall Epidemic: A Proposed Cyclic Relationship between ADHD Medication Use, Academic Performance, and Mental Distress

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Attention-deficit/hyperactivity disorder medications are used illicitly by undergraduate students, often to increase focus, memory, and attention in order to enhance their academic performance. Studies on such unprescribed use of psychostimulants suggest that these medications have countereffects and yield cognitive deficits. The purpose of this study was to examine the relationship between ADHD medication use and academic performance as indicated by individuals' reported grade point average (GPA). Moreover, this study aimed to establish a relationship between the aversive side effects associated with ADHD medication use on physical health, mental health, and academic performance. A total of 879 individuals completed an anonymous Google Form survey that was administered at colleges/universities in the U.S. using social media platforms. The survey included questions regarding frequency of ADHD medication use, symptoms experienced, perception of safety, GPA, and general demographic information. Our results indicate that the use of ADHD medication is significantly correlated with a self-reported low GPA as well as an increase in reported mental health side effects (including depression, anxiety, and panic attacks) and physical side effects (including sleep disturbances, fatigue, headaches, and weight loss). Conversely, belief in the efficacy of ADHD medications in aiding academic performance was negatively correlated with a self-reported high GPA. It thus appears that the use of non-prescription ADHD medications is not associated with increased academic performance. Furthermore, mental and physical symptoms related to illicit ADHD medication use are likely to contribute to the observed poor academic performance. It is therefore recommended that college student populations are educated on these findings to decrease illicit use of ADHD medications as study aids.

Abbreviations: ADHD – Attention Deficit Hyperactivity Disorder; DA – Dopamine; GPA – Grade Point Average

Keywords: stimulant; dopamine; substance use and abuse; GPA; mental health; college

Introduction

ADHD and the Mechanism of Adderall

Attention-deficit/hyperactivity disorder (ADHD) is a neurobehavioral condition characterized by inattention, hyperactivity, and impulsivity that can impair an individual's cognitive abilities (Castells et al., 2018). While the disorder primarily impacts children, its diagnosis has recently become more prevalent among adults (Volkow et al., 2009). ADHD is often associated with disruptions in the dopaminergic pathway in the brain, namely a deficiency of dopamine in the synapse (Volkow et al., 2009). Dopamine (DA) is a neurotransmitter and, more specifically, a catecholamine, which is a division of hormones associated with the reward and motivation pathway (Mishra et al., 2018). Thus, a disruption in its neural transmission often leads to an increased difficulty maintaining focus and completing tasks. Furthermore, studies have shown that subjects with ADHD exhibit similar

impairments in the brain as subjects with lesions of the prefrontal cortex. Individuals diagnosed with ADHD struggle with behavioral inhibition and working memory. While this is not the case for all subjects with ADHD the disorder is, overall, linked to an impairment in executive functioning due to dysfunction in the prefrontal cortex (Arnsten, 2006).

ADHD medications often attempt to remedy the lack of dopamine and thus alleviate the symptoms associated with the neurological disorder. There are two major divisions of ADHD medication: amphetamines and methylphenidates (Faraone, 2018). Adderall is a commonly prescribed amphetamine-based medication (Joyce et al., 2007). Vyvanse is another example of an amphetamine drug used to treat ADHD. Amphetamines are a class of drugs that increase the concentration of dopamine in the synapse through two principal mechanisms. They act on the dopamine transporters to increase the dopamine concentration in the synapse (Faraone, 2018). Extracellular amphetamine enters the axon terminal and induces dopamine efflux via the dopamine transporter, effectively reversing the normal direction of neurotransmitter flow through the transporter (Kahlig et al., 2005). Amphetamine, thus, redistributes dopamine to the cytosol from their vesicles to promote reverse transport (Sulzer et al., 1995). Additionally, amphetamines inhibit enzymes in the synapse responsible for catecholamine metabolism, further increasing its concentration (Castells et al., 2018). Common examples of methylphenidate include Ritalin and Concerta. Lower doses of Adderall have been shown to produce similar effects to higher doses of Ritalin, evidencing the potency of amphetamine-based medications (Pelham et al., 1999). Rather than promoting reverse transport at the dopamine transporter, methylphenidate blocks reuptake by the transporters to similarly increase dopamine levels in the synapse (Volkow et al., 2002). Postsynaptic receptors downregulate themselves to adjust to a hyperdopaminergic environment. Thus, once the user stops taking ADHD medication, withdrawal symptoms contributing to addiction can occur (Yanofski, 2011).

ADHD Medication Effects on the Central Nervous System

Most medications used to therapeutically treat ADHD are psychostimulants that yield both psychological and physiological effects. The psychological effects of ADHD medication use, as with other stimulants, manifest by acting on the central nervous system, specifically the brain. By increasing the concentration of monoamines in the synaptic cleft, either by blocking reuptake or blocking enzymatic degradation, ADHD medications yield effects on users with ADHD that differ from effects on those without ADHD. Users of ADHD medication who have been medically diagnosed with ADHD often report or experience an increase in attention span, ability to focus, and a marked decrease in impulsive behaviors (Advokat, 2009). Conversely, non-ADHD users experience a euphoric “high”, as is common with stimulant drugs, and often report increased motivation, making such drugs attractive for use as study aids (Ricci et al., 2020).

Continued use of ADHD medications can result in dysregulation of DA, along with other monoamines, and their receptors. Receptor downregulation and depletion of monoamine concentrations can lead to symptoms of anxiety, depression, decreased motivation, and even stimulant psychosis (Varga, 2012). Use of ADHD medication has a relatively high potential for abuse due to its reinforcing effects, some of which include the alleviation of the aforementioned symptoms associated with withdrawal or abstinence from drug use. The action of ADHD medication in the central nervous system yields psychological effects that can both positively and negatively reinforce its continued use.

Illicit Use of ADHD Medication on College Campuses

As college enrollment continues to rise and admissions become increasingly competitive, many students have turned to prescription stimulants in order to gain an advantage over their peers (Rolland and Smith, 2017). While most prevalent in college, illicit use of ADHD medications has been estimated by a study to be around 4.5% among high schoolers (McCabe et al., 2004). ADHD medications such as Adderall,

Ritalin, and Vyvanse have become the drugs of choice for those who seek to enhance their academic performance by pharmacological rather than conventional study methods. The non-prescription use of ADHD medication among college students has been tracked since 1937 (Arria et al., 2017). In 2015, 10.7% of college students used ADHD medication outside of a prescription, with other estimates putting this number as high as 33.8% (Arria et al., 2017). Adderall and other ADHD medications are displayed in various headlines across media outlets as "smart drugs" and their use as "smart doping" (Arria and Dupont, 2010). This has prompted the belief among many college students that taking these drugs without the direction of a medical professional is not a reason for concern and is largely benign (Arria and Dupont, 2010). However, a growing number of studies have shown that students who use prescription stimulants such as Adderall for nonmedical purposes have a lower grade point average than students who abstain from stimulants (Arria and Dupont, 2010). To compensate, they continue to consume ADHD medication to deal with the increasing levels of stress brought upon by their lackluster academics (Rolland and Smith, 2017).

Efficacy of ADHD Medication as a Study Aid

The nonmedical use of prescription stimulants, which include several common ADHD medications, as study aids is a ubiquitous practice among college students in the United States. However, its efficacy with illicit use in improving GPA, cognition, learning, and academic performance in general has not consistently proven to be significant or even present. A survey of second- and third-year college students conducted by Arria et al. (2017) failed to note any significant improvement in GPA upon initiation or continuation of non-prescription stimulant use. Further, the expectation to receive a non-prescription stimulant does not improve cognitive performance: individuals report feeling more stimulated having received placebo if told it was methylphenidate compared to a control group, though no significant difference in cognitive performance has been observed (Looby and Earleywine, 2011). This subjective feeling of stimulation can be perceived, often wrongly, by illicit users of ADHD medications as an enhancement of their ability to focus, retain information, and learn new material. While some studies suggest that stimulant use can enhance certain types of cognitive performance, this enhancement often comes with a cost, as increased errors are often observed along with an impairment of one's ability to master tasks of high complexity (Iversen, 2006; Fischman, 1984). Moreover, the effectiveness of ADHD medications when used illicitly as study aids can be attenuated by the phenomenon of state-dependent learning, which states that recall of information learned under the influence of a particular drug is most efficient when under the influence of that specific drug (Poling and Cross, 1993). Thus, information learned while under the influence of ADHD medication often cannot be effectively retrieved upon the dissipation of the drug's physiological and psychological effects (i.e. upon metabolism and elimination). Consequently, use of ADHD medications while studying can, in fact, be counterproductive in terms of enhancing understanding of the material and may contribute to the inefficacy of such drugs at increasing academic performance, especially when used illicitly.

Limitations of Past Work and Current Objectives

Previous research has focused disproportionately on the cognitive effects of ADHD medication on individuals diagnosed with ADHD (Weyandt et al., 2018). Moreover, the limited research done on illicit ADHD medication use has studied mental and physical side effects along with academic outcomes, but in isolation from each other. The mental and physical health side effects prompted by illicit use have not been linked to observed decreases in academic performance in past investigations. Therefore, the objective of this study is to test the hypothesis that a cyclic relationship between the illicit use of ADHD medication, its adverse side effects, and decreases in grade point average exists. This will be accomplished by investigating the individual correlational relationships between use, physical health, mental health, and self-reported GPA.

Methods

The study protocol was reviewed and approved by the Institutional Review Board at Binghamton University. Inclusion criteria were being 18 years or older and being enrolled in a US college. The anonymous survey was built in Google Forms and the link was sent through social media platforms requesting responses from US college students. Participants consented to the study by accessing the survey. For Binghamton University data collection, the survey was shared on social media and advertised at tabling events on campus. No compensation or incentive were provided for participation. A total of 879 college students completed the survey.

The survey included 40 questions assessing demographics, psychostimulant use, academic performance, and physical and mental health among others. In order to determine if there is a relationship between study drugs, mental health, and GPA, the survey asked both multiple choice and free response questions regarding demographics, prescribed and non-prescribed Adderall use, its effects, and perceptions. Demographic information was collected in this survey using questions asking participants about their gender, age, major, class year, GPA, college of enrollment, and ethnicity. Additionally, in order to reasonably discern the difference between prescribed and non-prescribed Adderall use, participants who indicated they had taken ADHD medication in the past were asked if this drug was ever formally prescribed to them by a medical professional. If not, additional questions were asked that inquired about the motive behind this unprescribed use. Answer choices for these questions were used to determine if unprescribed Adderall use resulted as a result of pressure to perform academically, weight management, etc. When looking at the effects of unprescribed ADHD medication usage, participants were asked various questions regarding how such use affected them academically, physically, and mentally. Finally, in regard to perceptions, participants were asked about the formal education they had received about Adderall and other drugs in the past. An example of a question from the survey was as follows: "If NOT prescribed by a licensed physician, what do you use these medications for? (If this does not apply to you, please skip): Improving academic performance, Weight management, Alertness and awakeness, In combination with other intoxicating substances for recreational purposes, Focus and concentration, Prefer not to say, I am prescribed for ADHD medication, Other." Several responses were recorded on a 6-point Likert-scale. In this survey, psychostimulants were defined as "but not limited to: Adderall, Ritalin, Concerta, or Vyvanse." The classification used to determine the ranges of GPA that qualified as high or low was based upon the GPA requirements for most graduate schools (Kuther, 2018). Using such criteria, a GPA below 3.0 was considered low whereas a GPA of 3.5 or greater was considered high. Data were analyzed by employing Pearson's Correlation Coefficient in SPSS 25.

Results

Physical and Mental Effects of ADHD Medication Use

Participants (n=879) reported several physical and mental side outcomes that had statistically significant correlations with daily non-prescription ADHD medication use (Table 1). There was no differentiation made between different ADHD medications. Adderall, Ritalin, Concerta, and Vyvanse were the drugs classified as ADHD medication in this study. Physical side effects reported included aggression, fatigue, headaches, and panic attacks. Daily ADHD medication users also reported symptoms affecting mental health including depression, inability to concentrate, irritability, lack of motivation, and paranoia ($p<0.01$) (Table 1).

GPA

Results showed a statistically significant ($p<0.05$) positive correlation between low GPA and daily and weekly use of ADHD medication, regardless of whether this medication was prescribed or not. There was also a positive correlation between low GPA and non-prescribed ADHD medication use in general (Table 2).

Table 1: Daily ADHD Medication Use and Associated Physical and Mental Outcomes (contd.)

Physical and Mental Characteristics of Daily Users of Non-prescribed ADHD Medication	
Lack of Motivation	.122*
Focus	-.107*
Anxiety	0.083*
Mood Swings	0.107**
Headaches	0.168**
Fatigue	0.183**
Sleep Difficulty	0.167**
Aggression	0.388**
Depression/Negative Affect	0.165**
Fatigue	0.175**
Headaches	0.233
Inability to concentrate	0.300
Irritability	0.277**
Lack of Motivation	0.130**
Panic Attacks	0.146**
Paranoia	0.187**

*=p<0.05 **=p<0.01

Table 2: Participants with a Low GPA and Variations of Adderall Use

Frequency of Use	
Unprescribed ADHD Medication Use	0.132*
Daily use of ADHD Medication	0.720*
Weekly use of ADHD Medication	0.086*

*=p<0.05 **=p<0.01

GPA and Associated Outcomes

As shown in Table 3 below, participants with a marked decrease in GPA (~ -1.0) after unprescribed ADHD medication use reported the inability to concentrate and weight loss ($p<0.01$). Participants who saw a marked decrease in GPA also reported daily use of nonprescribed ADHD medication ($p<0.05$). Those who saw a slight decrease in GPA (~ -0.5) after unprescribed use reported a lack of motivation and depression/negative affect ($p<0.01$).

Table 3: Characteristics of Participants with a Marked or Slight Decrease in GPA after Unprescribed ADHD Medication Use

Characteristics of Users with a Marked Decrease in GPA	
Daily Use	0.136*
Inability to Concentrate	0.187**
Weight Loss	0.231**
Characteristics of Users with a Slight Decrease in GPA	
Lack of Motivation	0.197**
Depression/Negative Affect	0.265**

*=p<0.05 **=p<0.01

Conversely, as shown in Table 4, there was a statistically significant negative correlation between participants with a high GPA and the belief that ADHD medication benefits one academically ($p<0.05$). Furthermore, there was also a negative correlation between having a high GPA and the reported outcomes of non-prescribed ADHD medication use of an inability to concentrate and suicidal thoughts ($p<0.05$). Finally, there was a positive correlation between high GPA and no unintended side effects ($p<0.05$).

Table 4: Characteristics of Participants with a High GPA

Characteristics and Side Effects	
Belief that ADHD medication benefits one academically	-0.71*
Inability to Concentrate	-0.088*
Suicidal Thoughts	-0.76*
No Unintended Side Effects	0.193*

*=p<0.05 **=p<0.01

Comorbid Use of Other Substances

As shown in Table 5, a relationship exists between the frequency of ADHD medication use and the use of other drugs. There exists a statistically significant positive relationship between the daily use of ADHD medication and the usage of cocaine ($p<0.01$) and marijuana ($p<0.05$). Furthermore, there was a statistically significant positive relationship between the

monthly use of ADHD medication and the usage of cocaine, marijuana, and alcohol ($p<0.01$).

Table 5: Relationship between the Frequency of ADHD Medication Use and the Use of Other Drugs

Frequency of ADHD Medication Use	Comorbidity	Significance
Once a day	Cocaine	.096**
Once a month	"	.289**
Once a day	Marijuana	.076*
Once a month	"	.215**
Once a day	Alcohol	.091
Once a month	"	.184**

*=p<0.05 **=p<0.01

The correlation in Table 6 shows a statistically significant positive relationship between the recreational use of ADHD medication and the use of prescription painkillers such as Oxycodone, Percocet, Vicodin, etc. ($p<0.05$).

Table 6: Relationship Between Recreational Use of ADHD Medication and Prescription Painkillers

Use of prescription painkillers (Oxycodone, Percocet, Vicodin, etc.)	.224*

*=p<0.05 **=p<0.01

Discussion

The purpose of this study was to investigate the relationship between both prescribed and illicit ADHD medication use and academic performance. Data were analyzed to assess the correlation of non-prescription medication use to focus and mental distress among college students. Increasing focus is often referenced as a reason for use. The main findings of this study were as follows: 1) ADHD medication use was highly correlated with adverse side effects including a reported lack of motivation, headaches, fatigue, weight loss, and difficulty sleeping, 2) ADHD medication use was negatively correlated with reported levels of focus, 3) Individuals who used ADHD medication without a prescription daily and weekly were more likely to report a low GPA, and 4) Individuals with a high GPA were less likely to believe that ADHD medication aids in academic performance. These correlational findings indicate that use of psychostimulant ADHD medication, both prescribed and illicit, may be related to a range of psychological and physical side effects that eventually contribute to a decrease in academic performance and ability to focus.

Inefficacy of ADHD Medication

The correlational results of this study indicate that the efficacy of unprescribed use of ADHD medications, particularly amphetamine and methylphenidate, at increasing cognition, memory, and learning is unsubstantial. Specifically, students reported a marked decrease in GPA following unprescribed daily ADHD medication use; they also noted an inability to concentrate. A literature review cites mounting evidence of the inefficacy of ADHD medication at promoting learning ability and academic performance in "adult college students *with* ADHD" as well as a lack of observed improvement in measures of 'planning' and 'distractibility' (Advokat and Scheithauer, 2013). Survey data from this study indicated that participants with a slight decrease in GPA (~-0.5) after unprescribed ADHD medication use also reported a lack of motivation.

Even occasional use of stimulants has been shown to yield academic performance deficits, an implication that is especially important to college students whose use of ADHD medication study drugs may be intermittent rather than consistent. This survey indicated a correlation between low GPA and both daily and weekly use of ADHD medication. Moreover, use of stimulants has proven to aid more in rote-memorization tasks rather than complex memory tasks, which is more likely to be tested on college examinations (Lakhan and Kirchgessner, 2012). This finding may contribute to the low GPA observed among illicit and non-illicit users of ADHD medication in this survey. In sum, the findings of this study parallel those of

the current literature in that they demonstrate a relationship between use of ADHD medication and its inefficacy in yielding increased levels of focus, memory, learning, and cognition among users.

Proposal of a Cyclic Relationship

The central objective of this study was to test the hypothesis of the existence of a cyclic relationship between ADHD medication use, academic performance, and negative side effects of stimulant use, whereby ADHD medication use is sustained. This relationship can be seen in Figure 1.

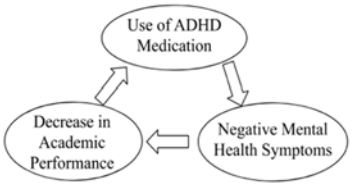

Figure 1: Proposed Cyclic Relationship Between ADHD Medication Use, Academic Performance and Mental Health

There are three principal relationships to examine. Firstly, those who use ADHD medication are more likely to experience a lack of motivation, sleep difficulty, fatigue, and other negative mental health symptoms as shown in Table 1. Existing literature has shown that mental effects associated with decreased dopamine levels of long-term use include anxiety, depression, and panic attacks (Brutvan et al., 2012; American Addiction Centers, 2020). A study conducted at the University of Nebraska indicated that those who reported illicit use of ADHD medication were more likely to suffer from anxiety and depression (Rolland and Smith, 2017). Symptoms of ADHD medication use can include decreased motivation, fatigue, appetite suppression, insomnia, dry mouth, and cravings for continued dosages of ADHD medication (Ahmann et al., 2001; Lakhan and Kirchgessner, 2012). The second relationship to examine is as follows: those who take ADHD medication daily are more likely to have a low GPA (Table 2). In one study by the University of Rhode Island, a negative correlation was found between those who used illicit ADHD medication and GPA (Weyandt et al., 2009). Researchers attributed this correlation to the fact that illicit use of ADHD medication provokes psychological distress within users, which can hamper academic performance (Weyandt et al., 2009). The third relationship to examine exists between mental health and academic performance. A study by Fröjd et al. (2008) on students ages 13-17 indicated that depression is associated with difficulties in concentration, self-reliant school performance and reading/writing, and perceived workload. Another study indicated the negative correlation between motivation and performance on standardized and academic assessments (Keogh et al., 2006). In addition, Begdache et al. (2019) reported a strong relationship between anxiety, low GPA, and ADHD drug abuse. Thus, these correlational relationships allow a cyclic relationship to be proposed in which those who have a low GPA take ADHD medication in order to help them improve their academic performance. Those who take the medication are more likely to experience negative mental health side effects, which in turn can lead to a decrease in GPA, which restarts the deleterious cycle. Therefore, students with a low GPA and/or poor mental health are at risk of illicit use of ADHD medication and of entering and remaining in the cycle.

On the other hand, students with a high GPA are less likely to believe that ADHD medication benefits one academically and are less likely to experience unintended side effects from the illicit use (Table 4). Furthermore, students with a high GPA are less likely to experience an inability to concentrate and suicidal thoughts. Given these findings, it is evident that students with a high GPA are less likely to follow this dangerous cycle because of their beliefs, ability to concentrate, and lack of suicidal thoughts. While data from this study and existing literature supports the suggestion of a causal relationship, ultimately, the data is correlational and does not confirm causality.

Significance and Educational Applicability of Findings

One of the main factors that has influenced the rise of Adderall usage and other ADHD medications on college campuses is that many students are not adequately educated on the harm such substances can have on their physical

and psychological health. Students often are misinformed on the effects of illicit ADHD medication use, often considering it to be a safer drug than cocaine, marijuana, or even caffeine (Ricci et al., 2020). In order to help alleviate this problem, college administrators should be focused on educating students on the dangers of ADHD medication abuse, while also introducing safer, more effective alternatives. Education methods may include procuring funds to organize educational presentations, seminars, and awareness campaigns to better educate students on the prevalence of illicit ADHD medication use as well as healthier alternatives. Existing programs on college campuses addressing alcohol and marijuana use may also be expanded to cover illicit psychostimulant use and the comorbidity of such drugs, using existing data as evidence. Alternatives to illicit ADHD medication use should also be presented to students, which may include expanding mental health outreach programs and on-campus tutoring centers to better serve students struggling academically. Attention should also be brought to the development of healthier habits to minimize the risk of students turning to illicit psychostimulant use to increase academic performance. These practices may include exercising, staying hydrated, eating energy-sustaining foods, and getting 7-8 hours of sleep every night (Trockel et al., 2000; Reuter et al., 2020).

Such goals can be effectively achieved through disseminating information on this topic across college campuses using the standards proposed by Health Belief Model Theory. The Health Belief Model Theory details that messages relating to issues of health will see the best behavior change in the intended population if such messages successfully target perceived barriers, benefits, self-efficacy, and susceptibility (Jones et al., 2014). In order for college students to truly understand that ADHD medication abuse is dangerous and can pose serious harm to their well-being, education on this topic must be tailored to successfully dispel many of the preconceived notions students have of these drugs. As for the educational outreach approaches, survey participants stated that sharing real life stories (38.9%) and negative side effects (35.9%) would be likely to dissuade their personal unprescribed psychostimulant use (Ricci et al., 2020). This is the most effective way in which to curb illicit prescription stimulant use, as it directly contradicts many ideas college students previously held about such substances. By integrating these measures into future seminars and information sessions, colleges may begin to effectively curb rates of illicit prescription stimulant use across their undergraduate population.

Limitations and Future Research

The data presented showed the correlation between illicit ADHD medication use and the factors of mental health, physical health, and GPA. Though correlational relationships could be deduced from these findings, it should be emphasized that this data does not show that illicit ADHD medication use *causes* certain health effects or changes in GPA. For example, the statistically significant finding correlating depression and ADHD medication use does not mean that this drug use causes depression or depression causes drug use.

One limitation of this study was that it was not longitudinal. Changes in mental and physical effects or GPA were not reported over a certain time period of ADHD medication use. Instead, ADHD medication use was correlated with whether these specific hallmarks were observed at any point in time. So while the data showed that there was a statistically significant correlation between ADHD medication use and low GPA, data concerning a specific decrease in GPA while using Adderall was not collected. For future research, a longitudinal study could be conducted to specifically quantify any changes in GPA among different levels of ADHD medication misuse.

Other factors to consider that potentially could have confounding effects on the results are polydrug and alcohol use as well as comorbidity. Data from the survey showed statistically significant positive correlations between ADHD medication use and recreational use of marijuana, alcohol, cocaine, and prescription painkillers. Existing literature has shown that a dysfunctional prefrontal cortex, a referenced effect of illicit ADHD medication use, is related to impaired decision-making (Goldstein and Volkow, 2011). This impaired decision-making could thus result

in possible risky use of other substances illicitly, such as marijuana, alcohol, cocaine, and prescription painkillers. Another study found that consumption of alcohol more than twice a week and recreational painkiller use was positively correlated with non-prescription psychostimulant use, resulting in priming of the brain for continued substance use (Ricci et al., 2020). Thus, the confounding effects of such polydrug use must be considered when interpreting survey results. Previous studies have shown how alcohol abuse is often associated with an increased likelihood of having other addictive and psychiatric disorders (Regier et al., 1990; Kessler et al., 1997; Bucholz, 1999). Considering the effects of comorbidity, shown in Tables 5 and 6, it cannot be concluded that the correlation between ADHD medication use and low GPA is restricted to those two variables. Rather, the use of another drug, such as marijuana, could simultaneously factor into an individual's academic performance. Similarly, the effects of alcohol, cocaine, and prescription painkillers could possibly have an effect on mental health and GPA as well. For future research, the effects of comorbidity could be accounted for by conducting a longitudinal study where illicit use of other drugs, such as alcohol, marijuana, and cocaine, are controlled.

Lastly, because the data was collected through a survey form, it is important to consider the effect of self-report bias. Individual perspectives, backgrounds, experiences, and opinions can all affect the way a participant interprets and answers a question. Despite being confidential, social desirability and cultural norms may also have impacted participants' answers to survey questions.

Conclusions

This study examined the relationship between illicit ADHD medication use and academic performance of students enrolled in US colleges. Along with academic performance, which was measured by individuals' self-reported grade point average, physical and mental side effects were also measured by the distributed survey. The analyzed data revealed that ADHD medication use was significantly correlated with low GPA and increased mental health side effects, which included anxiety, depression, and panic attacks. Additionally, ADHD medication use was significantly correlated with physical side effects, including fatigue, headaches, and sleep disturbances. It was also found that a self-reported high GPA was negatively correlated with the belief in the efficacy of ADHD medications in aiding academic performance. Using data from this survey and existing literature, the existence of a cyclic relationship between ADHD medication use, academic performance, and negative side effects was proposed. This cyclic relationship proposed that the negative mental and physical effects of ADHD medication use and a decrease in academic performance sustains continued ADHD medication use.

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