First- Year College Students with ADHD: Risk for and Correlates of Alcohol and Substance Use

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Abstract

College students with attention-deficit/hyperactivity disorder (ADHD) are at higher than average risk for alcohol and substance use; however, it is unclear whether having ADHD, either alone or in combination with other factors, increases this risk. Further, no prior studies have systematically examined factors that correlate with alcohol and substance use among college students with ADHD. A sample of first year college students with (n = 228; 52.2% female; 76.8% Caucasian) and without (n = 228; 51.3% female; 51.3% Caucasian) ADHD from 10 eastern US universities participated in a longitudinal study examining the long-term outcomes of college students with ADHD. Participants completed a battery of measures including self-report ratings of alcohol and substance use; ADHD, externalizing disorder, anxiety disorder, and depression symptoms; executive functioning; and learning and study strategies. First-year college students with ADHD were significantly more likely to use tobacco, cannabis, and illicit drugs (Cohen's d range = 0.30 to 0.33), but not alcohol (Cohen's d = 0.18). Separate multiple regression models indicated that each of the four substance use outcomes was best explained by a unique combination of predictive factors with anxiety symptoms and executive functioning deficits correlated with increased use of at least two of the substances. Additional longitudinal research is necessary to identify variables associated with ongoing substance use in college students with ADHD so as to inform screening, prevention, and intervention efforts.

Keywords: attention-deficit/hyperactivity disorder, college students, alcohol use, drug use, tobacco use

It is currently estimated that between 2% and 8% of college students have ADHD, and an increasing number of young adults with ADHD continue to pursue postsecondary education opportunities (DuPaul, Weyandt, O'Dell, & Varejao, 2009; Green & Rabiner, 2012; Murphy & Barkley, 1996). With limited availability of diagnostic assessment and treatment services (DuPaul & Weyandt, 2009), college students with ADHD are at significantly elevated risk for a host of adverse outcomes (e.g., school dropout, depression). One risk that represents a major public health concern is a pattern of substance use and abuse, which among students with ADHD has been documented to begin as early as adolescence (Molina, et al., 2013; Sibley, et al., 2014). Recent research has identified a bidirectional relationship between substance use disorders and ADHD among both adolescents and adults (Wilens & Kaminski, 2018). Additionally, a meta-analysis of longitudinal studies following children with ADHD into adolescence and adulthood indicated that children with ADHD were at significantly higher risk of developing substance abuse disorders, and that this finding was consistent across studies (Lee, Humphreys, Flory, Liu, & Glass, 2011). Among the general college population, students without ADHD are overall more likely to engage in risky substance use behaviors including illicit drug use, binge drinking, and misuse of prescription medications (Pedrelli, Nyer, Yeung, Zulauf, & Wilens, 2015). There is an even greater prevalence of substance use among

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individuals with ADHD compared to typical peers, particularly in young adulthood (Miranda, Colomer, Berenguer, Roselló, & Roselló, 2016). It is important to examine risk factors and predictors of substance use among college students because heavy drinking and substance use may interfere with academic success, including decreased likelihood of graduating (Arria et al., 2013; Martinez, Sher, & Wood, 2009), and most college counseling and health centers are ill-equipped to adequately address these risks (Perron et al., 2011).

Consistent with findings for the adult ADHD population, college students with ADHD report greater substance use than their typical peers (Green & Rabiner, 2012). Alternatively, the research is mixed regarding alcohol use. Some studies have documented more frequent drinking and greater alcohol consumption among college students with ADHD (Blase et al., 2009), but other studies have found no differences in alcohol use between college students with ADHD and their peers (Molina et al., 2007; Rabiner, Anastopoulos, Costello, Hoyle, & Swartzwelder, 2008). However, research suggests that college students with ADHD are more likely to report experiencing negative consequences of problems related to their alcohol use. For example, Baker, Prevatt, and Proctor (2012) found that college students with ADHD were significantly more likely than typical peers to feel they could not control their drinking, and they were more likely to experience serious adverse effects associated with binge drinking (e.g., blacking out, going to the hospital); they are also more likely to endorse items indicative of alcohol dependence (Rooney, Chronis-Tuscano, & Yoon 2012).

For tobacco use, college students with ADHD have been found to be between 2.5 and 3.5 times more likely to have smoked cigarettes than their non-ADHD peers (Rabiner et al., 2008), which is consistent with additional research finding higher rates of smoking (Lambert & Hartsough, 1998; Pingault et al., 2013) and higher likelihood of beginning to use tobacco products (Blase et al., 2009). Prior studies have identified that college students with ADHD are at heightened risk of using cannabis and illicit drugs. Specifically, it has been estimated that this population of students is more than 2.5 times as likely to have used cannabis and more than 6 times as likely to have used other drugs in the past year (Green & Rabiner, 2012; Upadhyaya et al., 2005). Another study suggested that students with ADHD were three times as likely as their typical peers to have used cannabis and tobacco products and four times more likely to have used illicit drugs (Rooney et al., 2012).

It remains unclear whether having ADHD, either alone or in combination with other factors, increases the risk of alcohol and substance use. Prior research in the general population has sought to identify other variables beyond ADHD status that may predict risk for substance abuse problems.

Primary ADHD Symptoms

There are numerous factors that may contribute to the relationship between ADHD and substance use. Preliminary research has found more severe ADHD symptoms to be predictive of drug-related behaviors (Barkley, Fischer, Smallish, & Fletcher, 2004; Molina & Pelham, 2003). Upadhyaa and Carpenter (2008) found that frequency of tobacco, cannabis, and alcohol use in the past month increased proportionally along with the number of ADHD symptoms an individual endorses. In particular, inattention symptoms have been tied to substance use outcomes (Miranda et al., 2016; Molina & Pelham, 2003). Current inattention symptoms in college students with ADHD have been linked to higher levels of cannabis use and problems (Bidwell, Henry, Willcutt, Kinnear, & Ito, 2014), as well as tobacco use (Glass & Flory, 2012). Although inattention symptoms have not been found to be predictive of alcohol use in college students with ADHD, there is an association between inattention and problems relating to alcohol use (Glass & Flory, 2012; Mesman, 2015). Additionally, childhood history of hyperactivity-impulsivity predicts earlier onset of use of alcohol, cannabis, and tobacco (Bidwell et al., 2014; Chang, Lichtenstein, & Larsson, 2012). Beyond core ADHD symptoms, another common feature of ADHD – impaired executive functioning – has been linked to higher levels of substance use, earlier onset of use, and greater substance-related problems (Munro, Weyandt, Marraccini, & Oster, 2017; Nigg et al., 2006). The relationship between executive functioning and risk for substance abuse is generally thought to be bidirectional, such that college students who engage in binge drinking behaviors have been shown to perform worse on tasks of executive control (Parada et al., 2011).

Comorbid Conditions and Symptoms

It may be important to consider the comorbid conditions that frequently co-occur with ADHD and have the potential to impact substance use outcomes and related functional impairment (Biederman et al., 1996). High rates of comorbidity have been identified between substance use and mental health problems, particularly among young adults ages 18-25 (Chan, Dennis, & Funk, 2008). A substantial body of research has identified a strong link between conduct disorder and externalizing symptoms and substance use in young adults and adolescents with

ADHD (Miranda et al., 2016; Molina & Pelham, 2003; Molina et al., 2012). However, Rooney et al., (2012) examined alcohol and illicit drug use among college students with and without ADHD and found that, even when controlling for Conduct Disorder (CD) symptoms, students with ADHD still obtained significantly higher scores for self-reported alcohol use. Substance abuse risk is also higher among adults with internalizing disorders (Grant et al., 2004). One study found that college students with poor mental health or depression were more likely to report drinking, engaging in frequent and heavy drinking, and experiencing alcohol-related problems (Weitzman, 2004), although the relationship between depression and alcohol use appears to be bi-directional (Pedrelli, Shapero, Archibald, & Dale, 2016). Anxiety, in particular, is thought to contribute to alcohol use as a result of individuals using alcohol to reduce their perceived anxiety symptoms in the short-term, which in the long-term may actually increase anxiety (Kushner, Abrams, & Borchardt, 2000).

Demographic Characteristics

Numerous demographic variables have been found to predict substance use outcomes among college students, including college students with ADHD. Several studies have concluded that males are at higher risk of engaging in substance use and abuse than females (Chen & Jacobson, 2012; McCabe et al., 2007). In a review of the literature, Borsari, Murphy, and Barnett (2007) observed that men tend to engage in greater alcohol use than women, but both genders experience similar levels of alcohol-related problems. Race and ethnic differences have also been observed, such that Caucasian college students, particularly Caucasian males with ADHD, have been identified as an especially high-risk population for substance use and abuse (Baker et al., 2012; Borsari et al., 2007; McCabe et al., 2007). In contrast, several studies have established that young African American adults tend to be at lower risk for substance abuse and dependence (e.g., Malone, Northrup, Masyn, Lamis, & Lamont, 2011; Turner & Gill, 2002). Hispanic youth are thought to occupy an intermediate level of risk such that they report less substance use than Caucasian students, but have relatively higher risk of substance use compared to other racial/ethnic minorities (Malone et al., 2011). The relationship between socioeconomic status and substance abuse is more nuanced. One review of the literature found that extreme poverty, in combination with childhood behavior problems, was predictive of worse long-term substance abuse outcomes; however, some studies have linked higher parental education and occupational prestige to increased use of alcohol and cannabis, at least among adolescents in the general population (Hawkins, Catalono, & Miller, 1992). At present, it is unknown whether socioeconomic status is related to substance abuse risk among college students with ADHD.

Other Predictors of Substance Abuse

To date, it is unknown whether ADHD-related functional impairment in academic or social domains directly predicts substance abuse risk. Previous studies have linked substance use to reduced academic functioning (e.g., lower educational attainment, poor achievement, lower GPAs) among college students and young adults (Macleod et al., 2004; Singleton & Wolfson, 2009). As a result, it may be the case that poor academic functioning could be predictive of substance abuse risk. In addition, social impairment in high school students with ADHD has been found to be associated with alcohol use through the impact on delinquency (Molina et al., 2012).

More recent research has further focused on examining whether psychopharmacological treatment of ADHD impacts future substance use behaviors. Several studies have observed that treating ADHD with medication does not increase risk of later substance use behaviors (Humphreys, Eng, & Lee, 2013; Molina et al., 2013; Molina & Pelham, 2014). However, evidence has been mixed regarding whether treating ADHD with medication directly protects against developing later substance use disorders, with some studies finding that it does (Uchida, Spencer, Faraone, & Biederman, 2015) and others that it does not (Molina, et al., 2013). Interestingly, Muld, Jokinen, Bölte, and Hirvikoski (2015) found that individuals with ADHD and substance abuse problems who were treated with medication were less likely to relapse and were more likely to voluntarily seek treatment for substance abuse. It remains unknown whether receiving other types of services, including psychosocial treatment, may moderate the association between ADHD and substance use and abuse. Given the evidence base for psychotropic medication and psychosocial interventions to reduce ADHD symptoms (e.g., MTA Cooperative Group, 1999a, 1999b), it is possible that accessing these types of services will influence later substance use patterns by limiting the impact of the number of symptoms or symptom severity.

Objectives of the Proposed Study

Given the significant prevalence of ADHD in the college student population (e.g., DuPaul et al., 2009), there is a growing need for research regarding substance abuse outcomes among this at-risk population. In addition to ADHD status, there is evidence to sug-

gest that primary ADHD symptoms (e.g., Barkley et al., 2004; Miranda et al., 2016), co-morbid externalizing conditions (e.g., Molina et al., 2012) and being male or Caucasian (e.g., Baker et al., 2012), may heighten the risk of substance abuse among college students with ADHD. Among the general college population, internalizing disorders and poor academic functioning have also been linked to greater substance use (Singleton & Wolfson, 2009). At present, it is unknown whether treatment participation may be associated with substance abuse risk, or lack thereof, among college students with ADHD. It will be important to gain a better understanding of how these variables influence the risk of substance abuse among students with ADHD. The transition to college marks a particularly key period for intervention because many first-year college students develop a pattern of risky substance use that puts them on a trajectory towards negative outcomes throughout the college years and beyond (Borsari et al., 2007).

The purpose of this study was two-fold. The first aim was to examine whether first-year college students with ADHD differ from their peers without ADHD in their self-reported risk of substance abuse related to alcohol, cannabis, tobacco, and other illicit drugs. It was hypothesized that college students with ADHD would display significantly higher risk of abuse of all four substances compared to their typical peers. The second aim was to examine whether demographic characteristics, severity and type of ADHD symptoms, executive functioning deficits, comorbid symptoms, functional impairment, and receipt of treatment services were predictive of substance use behaviors and associated problems. It was hypothesized that Caucasian males with severe inattention symptoms would demonstrate the highest levels of risk for abuse of all four substances. The presence of comorbid mental health conditions and problems, including both internalizing and externalizing symptoms, were expected to predict substance abuse risk. Although prior research has not addressed the effects of academic/social impairment and treatment participation on substance use outcomes among the college ADHD population or has led to inconclusive results, it was hypothesized that greater impairment would be predictive of increased risk of substance abuse given previous research indicating that greater impairment leads to poorer outcomes overall. Additionally, it was hypothesized that participating in treatment for ADHD symptoms would be predictive of decreased risk for substance abuse given the evidence base for psychotropic medication and psychosocial interventions to reduce ADHD symptoms in childhood (e.g., MTA Cooperative Group, 1999a, 1999b), which may in turn effect substance abuse behaviors.

Method

Participants and Setting

Participants were part of the Trajectories Related to ADHD in College (TRAC) Project, a longitudinal study comparing two cohorts of college students with and without ADHD (for details regarding participants and procedures, see Anastopoulos et al., 2018). Participants were recruited during their first year of college across nine different universities in the Eastern United States and needed to meet criteria for ADHD in either all or no measures for inclusion in the ADHD or comparison groups. Students who did not meet criteria for ADHD on all measures were excluded from the study.

In the current study, participants were students in their first year of four-year college from across multiple universities within three states on the east coast. The total sample of participants (N=456, 52.2% female), which included an equal number of students (n = 228) with and without ADHD, was used to address the study's first aim related to group differences. The two groups did not differ significantly with respect to gender, age, and ethnicity (see Table 1). To address the study's second aim examining predictors of substance use, only participants from the ADHD group who had completed all stages of first year data collection (N=207) were included in the analyses.

Procedures

All procedures were reviewed and approved by the Institutional Review Boards at each campus site. Students were screened for participation using a semi-structured clinical interview. Self- and parent-report of current and childhood ADHD symptoms were used to determine whether students would be included in the study using the ADHD Rating Scales (parent version, childhood version, past six months; DuPaul, Power, Anastopolous, & Reid, 1998). Students were included in the ADHD group if they met DSM-5 criteria for ADHD on all measures; if they did not meet criteria for ADHD on any measure, they were included in the Comparison group. Students then met with graduate research assistants to complete subsequent measures. For participant assessment procedures and detailed screening measures, see Anastopolous et al. (2016).

Dependent Measures

World Health Organization – Alcohol Smoking and Substance Involvement Screening Test V3.0 (WHO ASSIST; WHO ASSIST Working Group, 2002). Substance use (tobacco, alcohol, and illicit drug use) was operationalized using the, WHO AS-

SIST, a validated screening instrument for determining an individual's substance use patterns (Humeniuk et al., 2008). The WHO ASSIST is an eight-question interview that covers 10 substances: tobacco, alcohol, cannabis, cocaine, amphetamine-type stimulants, inhalants, sedatives, hallucinogens, opioid, and "other drugs." The questions assess lifetime and current use of substances, and individuals respond using Likert scale options assessing quantity and frequency of use, as well as degree to which use is problematic. The WHO ASSIST has sensitivity ranging from 54-94% and specificity ranging from 50-96%. The assessment also has a good to excellent test-retest reliability ranging from 0.58 to 0.90 depending on the item, and it has construct validity ranging from 0.77 to 0.94 (WHO ASSIST Working Group, 2002).

Use of tobacco, alcohol, and cannabis were analyzed separately. Due to the low incidence of use of the other substances in this sample, all the other substances were analyzed as one "other" category. The raw scores for each substance are combined to give one final total score per substance at the end of the measure. For the purpose of this study, total scores for tobacco, alcohol, cannabis, and a combined score for all other drugs were calculated and included in the analyses.

CAARS-Self Report. ADHD symptom severity was measured using the Conners' Adult ADHD Rating Scale – Self-Report Long Form (CAARS – S:L), a self-report scale that has demonstrated reliability and validity as a measure of the presence and severity of ADHD symptoms (Conners, Erhardt, & Sparrow, 1999; Erhardt, Epstein, Conners, Parker, & Sitarenios, 1999). The CAARS – S:L is a 66-item self-report questionnaire in which respondents rate items pertaining to their behavior experiences using a four-point Likert scale for each item. The responses range from 0 (*not at all, never*) to 3 (*very much, very frequently*). The CAARS – S:L has a diagnostic sensitivity of 82%, specificity of 87%, and an overall diagnostic efficiency rate of 85%. For the purpose of this study, self-reported symptoms from all three domains of the measure (inattention/memory problems, hyperactivity/restlessness, and impulsivity/emotional lability) were included in data analyses.

Behavior Rating Inventory of Executive Function- Adult Version (BRIEF-A). The BRIEF-A (Roth, Isquith, & Gioia, 2005) is a standardized self-report measure that measures adults' views of their self-regulation and executive in their everyday environment over the past month in which they complete the measure. Appropriate internal consistency, test-retest reliability, convergent and discriminant validity have been demonstrated as well. The measure is comprised of 75 self-report items over nine scales that measure different aspects of executive functioning. The scales are Inhibit, Shift, Emotional Control, Self-Monitor, Initiate, Working Memory, Plan/Organize, Task Monitor, and Organization of Materials. Scores from each of these scales are combined to yield a Global Executive Composite (GEC), which represents the individual's overall executive functioning skills; elevated scores indicate increased executive functioning deficits. In the current study, GEC was used in the analyses.

Beck Depression Inventory- Second Edition (BDI-II; Beck, Steer, & Brown, 1996). The BDI-II measures depression symptom severity among adults, where adults report symptom severity over the past two weeks. The scale includes 21 items, and it has been shown to include high levels of reliability and validity in adults as well as in college students (Sprinkle et al., 2002). In the current study, total score on this measure was used in the analyses.

Beck Anxiety Inventory (BAI; Beck & Steer, 1993). The BAI measures severity of anxiety symptoms, where participants self-report symptom severity over the past week. The scale includes 21 items related to anxiety. The BAI has been shown to have moderate reliability and validity in measuring anxiety symptoms and severity. In the current study, total score on this measure was used in the analyses.

Externalizing Behavior Rating Scale (EBRS). The EBRS was developed for this project to measure self-reported symptoms and severity of externalizing disorders like Oppositional-Defiant Disorder (ODD) and Conduct Disorder (CD). Participants were instructed to complete items to best describe their behavior over the past six months. The 20-item scale rated on a four-point scale (0 = *not at all*, 3 = *very much*) includes eight items based on the DSM-IV-TR criteria for ODD (e.g., "losing your temper," "arguing with others") and 12 developmentally appropriate items based on criteria for CD (e.g., "starting physical fights," "deliberate fire setting"; American Psychiatric Association, 2013). Total scores measure symptom count and severity of ODD and CD, with higher scores indicating higher symptom severity. Severity scores for both ODD and CD were used for analyses in the current study. The EBRS has demonstrated adequate internal consistency for all items (α=.85) as well as for ODD (α=.85) and CD (α=.66) subscales (Anastopoulos et al., 2016). Significant correlations between the subscales and the CAARS ADHD Index also support the validity of this measure.

Learning and Study Strategy Inventory-Second Edition (LASSI). The LASSI measures student's self-reported awareness and use of various study skills (Weinstein & Palmer, 2002). Subscales

are measured within the 80-item self-report measure including Anxiety (α=.87), Attitude (α= .77), Concentration (α=.86), Information Processing (α=.84), Motivation (α=.84), Selecting Main Ideas (α=.89), Self-Testing (α=.84), Study Aids (α=.73), Test Strategies (α=.80), and Time Management (α=.85) (Weinstein & Palmer, 2002). Items are reported on a 5-item Likert scale (a= *not at all typical of me*, e= *very much typical of me*). Adequate internal consistency and reliability have been demonstrated for this measure (Cano, 2006; Weinstein & Palmer, 2002). The preliminary test-retest reliability correlation was reported as 0.88 (Weinstein & Palmer, 2002). For the present study, the motivation and concentration subscales were included in the analyses because conceptually these are the most likely subscales to contribute to or be affected by alcohol and substance use.

ADHD Impact Module for Adults. The ADHD Impact Module for Adults (AIM-A; Landgraf, 2007) is a self-report measure designed to evaluate six domains related to the quality of life for adults with ADHD. Aside from the Living with ADHD subscale (α = .68), all domains on the AIM-A demonstrated adequate levels of internal consistency (α = 0.83 to 0.91). The entire measure has also demonstrated adequate discriminant validity. For the purposes of the current study, the Relationships/Communication and Performance and Daily Functioning subscales were used as possible predictors given their conceptual relationship with alcohol and substance use.

Services for College Students Interview. Information on history of receiving psychological treatment was collected from the Services for College Students Interview (SCSI), a modified version of the validated Services for Children and Adolescents – Parent Interview (SCAPI) (Jensen et al., 2004). Although the SCSI has not been validated as yet, the SCAPI has been found to be a reliable instrument with a test-retest reliability of 0.97 overall (Hoagwood et al., 2004). The SCSI is a 12-item semi-structured interview that asks about assistance that the individual received anytime in their first year of college. For the purpose of this study, only responses related to use of individual and group counseling (Question 12) and medication use (Question 7) were included in the analyses. Question 7 asked if students had taken medication for ADHD-related difficulties since the start of the fall semester. Question 12 asked if students had participated in or received group or individual counseling/therapy at any time since classes began in the fall. Responses on these two questions were either "yes" or "no," and these binary data were included in the current study.

Data Analysis

To address the first aim, a multivariate analysis of variance (MANOVA) was conducted to determine whether there was a difference between the ADHD and Comparison groups regarding substance use using total scores for the four substances on the WHO ASSIST and for which substances the differences occur. Additionally, Cohen's d effect sizes were calculated to determine the magnitude of obtained differences between groups.

To address the study's second aim, a separate hierarchical regression analysis was conducted for each substance use outcome, with the base model including demographic characteristics that have been typically associated with alcohol and drug use in previous research (e.g., gender, race/ethnicity, parental education level). Subsequent models included correlates related to primary ADHD symptoms and executive functioning; comorbid conduct, anxiety, and depressive disorder symptoms; impairment in social, daily, and study skills functioning; and treatment service utilization (i.e., medication and psychosocial treatment for ADHD symptoms). Stepwise regression procedures were used within each model to identify statistically significant predictors.

Results

Substance Use Patterns in ADHD and Comparison Groups

An initial analysis was conducted to examine the first aim as to whether first-year college students with ADHD were more likely to engage in substance use relative to the Comparison group. An initial multivariate analysis of variance (MANOVA) examined group differences between the ADHD and Comparison groups in their patterns of substance use. Prior to completing the data analyses, multivariate data normality was assessed. Skewness and kurtosis were analyzed, and initially the total scores for tobacco, other drugs, and externalizing behavior scales did not meet criteria for data normality based on Curran, West, and Finch's (1996) recommendations for skewness values to fall between -2 and 2 and kurtosis values to fall between -7 and 7. The data for these variables were transformed utilizing a square root transformation due to the high number of scores of 0. Following the transformation, all variables met criteria for data normality with the exception of the "other drugs" variable and the conduct disorder severity variable, which fell slightly outside the range for normal data. The skewness and kurtosis values as well as means and standard deviations are presented in Table 2.

There was a statistically significant group effect, Wilks' Λ = .963, F (4, 416) = 4.019, p = .003, and the group factor accounted for 3.7% of variance in substance use, which was a small effect. Separate univariate analyses of variance (see Table 3) determined that there were no statistically significant group differences in alcohol use (F (1,419) = 9.96, p = .062; Cohen's d = 0.18). Alternatively, participants in the ADHD group were significantly more likely to engage in tobacco use (F (1,419) = 9.96, p = .002; Cohen's d = 0.30), cannabis use (F (1,419) = 11.51, p = .001; Cohen's d = 0.30), and illicit drug use (F (1,419) = 12.19, p = .001; Cohen's d = 0.33).

Predicting Substance Use in College Students with ADHD

Only the initial regression model, which included demographic variables, accounted for 7.0% of the variance in risk of alcohol use; F (1, 112) = 9.52, p = .003. Contrary to hypotheses, ADHD symptoms, comorbid symptoms, impairment, and treatment participation did not significantly increase the amount of variance explained regarding risk of alcohol use (see Table 4). Standardized regression weights indicate that male gender was a significant predictor of higher levels of risk of alcohol use.

The results of a hierarchical regression analysis indicated that demographic variables, executive functioning deficits and primary ADHD symptoms as well as comorbid symptoms (i.e., model 3), accounted for 12.4% of the variance in risk of tobacco use (F [3, 110] = 6.32, p = .001). Consistent with study hypotheses, male gender, greater executive functioning deficits, and higher anxiety symptom self-ratings predicted greater frequency of tobacco use (see Table 5). Contrary to hypotheses, the final two models (i.e., self-reported functioning and ADHD treatment receipt) did not significantly increase the amount of variance explained for tobacco use.

The regression model that included ADHD symptoms executive functioning deficits accounted for significant variance (4.9%) in cannabis use (F [1, 112] = 6.79, p = .01). Specifically, higher BRIEF global executive composite score indicating greater executive functioning deficits predicted higher cannabis use after controlling for demographic variables and ADHD symptoms (see Table 6).

For other drugs, the regression model that included demographic variables, executive functioning deficits and primary ADHD symptoms, comorbid symptoms, and impairment accounted for 15.9% of the variance (F [3, 110] = 8.13, p < .001) in risk for abuse. For the final model, higher comorbid anxiety disorder symptoms and lower levels of motivation predicted higher levels of other drug abuse after accounting for demographic variables, ADHD symptoms, executive functioning deficits, and comorbid symptoms of CD and depression (see Table 7)

Discussion

As hypothesized, first-year college students with ADHD reported statistically significant greater use of tobacco, cannabis, and other substances (e.g., cocaine, inhalants, sedatives, hallucinogens), relative to their non-ADHD comparison peers. This result is generally consistent with previously reported findings regarding these substances (Blase et al., 2009; Pingault et al., 2013; Rabiner et al., 2008; Rooney et al., 2012; Upadhyaya et al., 2005). Contrary to study expectations, the two groups did not differ with respect to their frequency of consuming alcohol. The current findings therefore add to an increasing body of literature suggesting that college students with ADHD may not differ from their non-ADHD peers in terms of their self-reported frequency of alcohol use (Molina et al., 2007; Rabiner et al., 2008).

For the group differences that were detected, it is important to bear in mind that ADHD diagnostic status only accounted for 3.7% of variance in substance use differences between the two groups. Thus, many factors (e.g., peer relationships and influences, social expectations in college environment) other than ADHD itself need to be identified to create a more complete picture of why it is that college students with ADHD report higher rates of substance use than do their non-ADHD college peers.

Emerging from the hierarchical regression analyses are findings indicating that each of the four substance use outcomes under consideration is best explained by a unique combination of predictive factors. For example, being male and having high levels of anxiety and executive functioning deficits accounted for 12.4% of the variance in tobacco use among students with ADHD. Cannabis use within this same group was predicted by only one factor - namely, high levels of executive functioning deficits - accounting for 4.9% of the variance. High levels of anxiety and executive functioning deficits, along with low levels of academic motivation, emerged as significant predictors accounting for 15.9% of the variance in other substance use (e.g., cocaine, inhalants, sedatives, hallucinogens). Male gender alone predicted a total of 7.0% of the variance in alcohol use.

The obtained findings are consistent with previously reported results addressing the contributions of gender (Bosari et al., 2007), executive functioning (Nigg et al. 2006), and anxiety (Kushner et al., 200)

to substance use within an ADHD population. In contrast with prior research (Bidwell et al., 2014; Glass & Flory, 2012), severity of ADHD symptoms failed to emerge as a significant predictor for any substance use outcome. More than likely, this discrepancy is a function of the restricted range of ADHD symptom severity within the ADHD-only sample. For reasons that are not entirely clear, co-occurring depression symptoms, externalizing behaviors, and receipt of treatment services did not enhance prediction of any substance use outcome, contrary to what has been reported in other studies (Molina et al., 2012; Pedrelli et al., 2016; Uchida et al., 2015).

Taken together, results from this study replicate and extend findings from prior research addressing substance use within an ADHD college population. In contrast with the college samples used in previous investigations, the current study found higher rates of substance use in a sample that was limited to first-year college students with and without ADHD. That such differences would appear during the first year of college has important clinical and research implications. Although it would need to be substantiated by longitudinal research, the fact that first-year college students with ADHD display higher rates of substance use may place them at increased risk for negative outcomes throughout the college years and beyond (Borsari et al., 2007). Also requiring clarification is whether these patterns of atypical substance use began prior to or following initial enrollment in college. In either case, development of both prevention and intervention programs targeting substance use issues within an at-risk ADHD population would seem to be in order.

Limitations

Although promising, it is important to consider the current findings in the context of study limitations. For example, the correlational nature of the design precludes drawing inferences about what may actually cause substance use within an ADHD college population. Also limiting the findings is that the primary outcome measure, the ASSIST, relies on self-report rather than objective assessment of substance use, thereby potentially introducing possible reporter biases into analyses. Not having information about the participants' use of substances prior to enrolling in college (i.e., pre-college baseline data) eliminates any possibility of determining the timing of when substance use patterns began. Although this is the largest study of alcohol and substance use among college students with ADHD to date, data were collected at three sites in the eastern US thus potentially limiting generality of findings to colleges from other regions of the US. Also there was limited information pertaining to use of disability services and other treatment among the study sample, particularly services and treatment addressing ADHD, such as executive functioning coaching, counseling, and prescription medication use. Although data on use of these services and treatments were collected, the data were quantitative (i.e., no qualitative data were collected), and numbers relating to utilization were too small to meaningfully analyze. Future research should include a primary focus on college disability service use and pharmacotherapy and how well these interventions impact substance use among college students with ADHD. Finally, this study focused on first year college students, thus longitudinal studies are necessary to document changes in alcohol and substance use across the college years as well as to examine whether ADHD vs. non-ADHD group differences are evident beyond the first year.

Clinical Implications

Despite these limitations, the results of this study have several important implications for clinicians and higher education support personnel working with college students. First, it is clear that students with ADHD, particularly males, may be at higher risk for use of substances (i.e., tobacco, cannabis, and illicit drugs) that may negatively impact physical and mental health functioning. Thus, ongoing surveillance of substance use should be conducted routinely in the context of physical examinations, counseling sessions, and academic support for students with ADHD. To the extent that use becomes chronic and impairing, then referral for appropriate treatment services will become necessary. Prevention efforts could also be undertaken to reduce or eliminate tobacco consumption in light of long-term physical risks. Second, comorbidity of ADHD and anxiety disorder symptoms may represent higher level of risk, thus necessitating regular assessment of internalizing symptoms among students with ADHD. Given the relatively high rate of anxiety disorder among college students with ADHD (Anastopoulos et al., 2018), this risk factor is particularly salient. Third, the fact that executive functioning deficits are associated with greater use of tobacco and cannabis highlights the importance of addressing these deficits through academic support services. Efforts to improve planning, time management, and organizational skills of students with ADHD may not only enhance executive functioning but could also indirectly impact substance use; however, this contention requires controlled investigation. Finally, counseling and academic support should emphasize strategies to improve student motivation to complete

assigned responsibilities as a focus on motivation may indirectly address student use of illicit substances.

The results of this study have particular relevance to disability services providers in college and university settings. As more research establishing the relationship between ADHD and substance use in college students is emerging, disability service providers at universities may serve in a unique position to initiate conversations with administrators, parents, and students sharing these findings and emphasizing the importance of addressing risky substance use behaviors as part of disability service provision. Additionally, given the finding that ADHD diagnosis only accounted for 3.7% of variance between groups, it is important to focus on other factors (e.g., peer influences, social norms in college) that may be contributing to group differences and how those factors may uniquely influence college students with ADHD in terms of proclivity towards substance use.

Overall, there are few studies that have focused on the efficacy of psychosocial interventions among college students with ADHD (DuPaul & Weyandt, 2009; Green & Rabiner, 2012). Recent studies have demonstrated the effectiveness of combined intervention efforts involving long-term (i.e., semester- and year-long), individual mentoring focusing on study skills (e.g., organization strategies and time management), elements of cognitive behavioral therapy (e.g., psychoeducation and coping skills for managing impairment in executive functioning), and a supportive mentor-student relationship (Allsop, Minskoff, & Bolt, 2005; Anastopoulos & King, 2015). However, none of these strategies have been investigated in terms of their impact on outcomes related to substance use. Future research should examine how specific interventions provided through disability service offices at colleges and universities may impact substance use behaviors, particularly in students with ADHD.

Conclusions

This is the largest study conducted to examine alcohol and substance use among college students with ADHD. Consistent with prior adult ADHD studies, first year college students with ADHD were more likely to use tobacco, cannabis, and illicit drugs than were their non-ADHD peers. Although this group difference was in the small to medium range, this finding has clear clinical implications given the physical and mental health risks associated with substance use. Groups did not differ regarding alcohol use, presumably due in large part to the fact that alcohol use is highly prevalent in the general college population (Molina et al., 2007). It is important to note that ADHD diagnostic status alone only accounted for about 4% of the differences between groups, thus we also examined other variables that may impact substance use in this population. A variety of factors were correlated with substance use, chiefly executive functioning deficits, anxiety disorder symptoms, and lower academic motivation. Additional longitudinal research is necessary to identify variables associated with ongoing substance use in college students with ADHD so as to inform screening, prevention, and intervention efforts.

References

Allsop, D. H., Minskoff, E. H. & Bolt, L. (2005). Individualized course-specific strategy instruction for college students with learning disabilities and ADHD: Lessons learned from a model demonstration project. *Learning Disabilities Research and Practice, 20*, 103–118.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). American Psychiatric Publishing.

Anastopoulos, A. D., DuPaul, G. J., & Weyandt, L. L., Morrissey-Kane, E., Sommer, J. L., Rhoads, L. H.,…Gudmundsdottir B. G. (2018). Rates and patterns of comorbidity among first-year college students with ADHD. *Journal of Clinical Child & Adolescent Psychology, 47,* 236-247.

Anastopoulos, A. D. & King, K. A. (2015). A cognitive-behavior therapy and mentoring program for college students with ADHD. *Cognitive and Behavioral Practice, 22*, 141-151.

Arria, A. M., Garnier-Dykstra, L. M., Caldeira, K. M., Vincent, K. B., Winick, E. R., & O'Grady, K. E. (2013). Drug use patterns and continuous enrollment in college: Results from a longitudinal study. *Journal of Studies on Alcohol and Drugs, 74*, 71-83.

Baker, L., Prevatt, F., & Proctor, B. (2012). Drug and alcohol use in college students with and without ADHD. *Journal of Attention Disorders, 16*, 255-263.

Barkley, R.A., Fischer, M., Smallish, L., & Fletcher, K. (2004). Young adult follow-up of hyperactive children: Antisocial activities and drug use. *Journal of Child Psychology and Psychiatry, 45*, 195-211.

Beck, A. T., & Steer, R. A. (1993). *Beck Anxiety Inventory manual.* Psychological Corporation.

Beck, A. T., Steer, R. A., & Brown, G. K. (1996). *Manual for the Beck Depression Inventory–II.* Psychological Corporation.

Bidwell, L. C., Henry, E. A., Willcutt, E. G., Kinnear, M. K., & Ito, T. A. (2014). Childhood and current ADHD symptom dimensions are associated with more severe cannabis outcomes in college students. *Drug and Alcohol Dependence, 135*, 88-94.

Biederman, J., Faraone, S., Milberger, S., Guite, J., Mick, E., Chen, L.,…& Spencer, T. (1996). A prospective 4-year follow-up study of attention-deficit hyperactivity and related disorders. A*rchives of General Psychiatry, 53*, 437-446.

Blase, S. L., Gilbert, A. N., Anastopoulos, A. D., Costello, E. J., Hoyle, R. H., Swartzwelder, H. S., & Rabiner, D. L. (2009). Self-reported ADHD and adjustment in college: Cross-sectional and longitudinal findings. *Journal of Attention Disorders, 13*, 297-309.

Borsari, B., Murphy, J. G., & Barnett, N. P. (2007). Predictors of alcohol use during the first year of college: Implications for prevention. *Addictive Behaviors, 32*, 2062-2086.

Cano, F. (2006). An in-depth analysis of the Learning and Study Strategies Inventory (LASSI). *Educational and Psychological Measurement, 66,* 1023-1038.

Chan, Y., Dennis, M. L., & Funk, R. R. (2008). Prevalence and comorbidity of major internalizing and externalizing problems among adolescents and adults presenting to substance abuse treatment. *Journal of Substance Abuse Treatment, 34*, 14-24.

Chang, Z., Lichtenstein, P., & Larsson, H. (2012). The effects of childhood ADHD symptoms on early-onset substance use: A Swedish twin study. *Journal of Abnormal Child Psychology, 40*, 425-435.

Chen, P., & Jacobson, K. C. (2012). Developmental trajectories of substance use from early adolescence to young adulthood: Gender and racial/ethnic differences. *Journal of Adolescent Health, 50*, 154-163.

Conners, C. K., Erhardt, D., & Sparrow, E.P. (1999). *Conners' ADULT ADHD Rating Scales (CAARS)*. Multi-Health Systems.

Curran, P. J., West, S. G., & Finch, J. F. (1996). The robustness of test statistics to nonnormality and specification error in confirmatory factor analysis. *Psychological Methods, 1*, 16-29.

DuPaul, G. J., Power, T. J., Anastopoulos, A. D., & Reid, R. (1998). *ADHD rating scale-IV: Checklists, norms, and clinical interpretation.* Guilford Press.

DuPaul, G. J., & Weyandt, L. L. (2009). Introduction to special series on college students with ADHD. *Journal of Attention Disorders, 13*, 232-233.

DuPaul, G. J., Weyandt, L. L., O'Dell, S. M., & Varejao, M. (2009). College students with ADHD: Current status and future directions. *Journal of Attention Disorders, 13*, 234- 250.

Erhardt, J. N., Epstein, D., Conners, C. K., Parker, J. D. A., & Sitarenios, G. (1999). Self-ratings of ADHD symptoms in adults II: Reliability, validity, and diagnostic sensitivity. *Journal of Attention Disorders, 3*, 153-158.

Glass, K., & Flory, K. (2012). Are symptoms of ADHD related to substance use among college students? *Psychology of Addictive Behaviors, 26*, 124-132.

Grant, B. F., Stinson, F. S., Dawson, D. A., Chou, P., Dufour, M. C., Compton, W., &…Kaplan, K. (2004). Prevalence and co-occurrence of substance use disorders and independent mood and anxiety disorders: Results from the National Epidemiologic Survey on Alcohol and Related Conditions. *Archives of General Psychiatry, 61*, 807-816.

Green, A. L., & Rabiner, D. L. (2012). What do we really know about ADHD in college students? *Neurotherapeutics, 9*, 559-568.

Hawkins, J. D., Catalano, R. F., & Miller, J. Y. (1992). Risk and protective factors for alcohol and other drug problems in adolescence and early adulthood: Implications for substance abuse prevention. *Psychological Bulletin, 112*, 64-105.

Hoagwood, K. E., Jensen, P. S., Arnold, L. E., Roper, M., Severe, J, Odbert, C,…MTA Cooperative Group. (2004). Reliability of the Services for Children and Adolescents - Parent Interview. *Journal of the American Academy of Child and Adolescent Psychiatry, 43*, 1345-1354.

Humeniuk, R., Ali, R., Babor, T. E., Farrell, M., Formigoni, M. L., Jittiwutikarn, J.,…Simon, S. (2008). Validation of the alcohol, smoking and substance involvement screening test (ASSIST). *Addiction, 103*, 1039-1047.

Humphreys, K. L., Eng, T., & Lee, S. S. (2013). Stimulant medication and substance use outcomes. *JAMA Psychiatry, 70,* 740.

Jensen, P. S., Eaton Hoagwood, K., Roper, M., Arnold, L. E., Odbert, C., Crowe, M.,…Wells, K. (2004). The services for children and adolescents-parent interview: Development and performance characteristics. *Journal of the American Academy of Child and Adolescent Psychiatry, 43*, 1334-1344.

Kushner, M. G., Abrams, K., & Borchardt, C. (2000). The relationship between anxiety disorders and alcohol use disorders: a review of major perspectives and findings. *Clinical Psychology Review, 20*, 149-171.

Lambert, N. M., & Hartsough, C. S. (1998). Prospective study of tobacco smoking and substance dependencies among samples of ADHD and non-ADHD participants. *Journal of Learning Disabilities, 31*, 533-544.

Landgraf, J. M. (2007). Monitoring quality of life in adults with ADHD: Reliability and validity of a new measure. *Journal of Attention Disorders, 11*, 351-362.

Lee, S. S., Humphreys, K. L., Flory, K., Liu, R., & Glass, K. (2011). Prospective association of childhood attention-deficit/hyperactivity disorder (ADHD) and substance use and abuse/dependence: A meta-analytic review. *Clinical Psychology Review, 3*1, 328-341.

Macleod, J., Oakes, R., Copello, A., Crome, I., Egger, M., Hickman, M., ... & Smith, G. D. (2004). Psychological and social sequelae of cannabis and other illicit drug use by young people: A systematic review of longitudinal, general population studies. *The Lancet, 363*, 1579-1588.

Malone, P. S., Northrup, T. F., Masyn, K. E., Lamis, D. A., & Lamont, A. E. (2011). Initiation and persistence of alcohol use in United States Black, Hispanic, and White male and female youth. *Addictive Behaviors, 37*, 299-305.

Martinez, J. A., Sher, K. J., & Wood, P. K. (2008). Is heavy drinking really associated with attrition from college? The alcohol-attrition paradox. *Psychology of Addictive Behaviors: Journal of the Society of Psychologists in Addictive Behaviors, 22*, 450-456.

McCabe, S. E., Morales, M., Cranford, J. A., Delva, J., McPherson, M. D., & Boyd, C. J. (2007). Race/ethnicity and gender differences in drug use and abuse among college students. *Journal of Ethnicity in Substance Abuse, 6*, 75-95.

Mesman, G. R. (2015). The relation between ADHD symptoms and alcohol use in college students. *Journal of Attention Disorders, 19*, 694-702.

Miranda, A., Colomer, C., Berenguer, C., Roselló, R., & Roselló, B. (2016). Substance use in young adults with ADHD: Comorbidity and symptoms of inattention and hyperactivity/impulsivity. *International Journal of Clinical and Health Psychology, 16*, 157-165.

Molina, B. S., Hinshaw, S. P., Arnold, L. E., Swanson, J. M., Pelham, W. E., Hechtman, L.,…Marcus, S. (2013). Adolescent substance use in the Multimodal Treatment Study of Attention-Deficit/Hyperactivity Disorder (ADHD) (MTA) as a function of childhood ADHD, random assignment to childhood treatments, and subsequent medication. *Journal of the American Academy of Child & Adolescent Psychiatry, 52*, 250-263.

Molina, B. S., & Pelham, W. E., Jr. (2003). Childhood predictors of adolescent substance use in a longitudinal study of children with ADHD. *Journal of Abnormal Psychology, 112*, 497-507.

Molina, B. S., & Pelham, W. E. (2014). Attention-deficit/hyperactivity disorder and risk of substance use disorder: Developmental considerations, potential pathways, and opportunities for research. *Annual Review of Clinical Psychology, 10*, 607-639.

Molina, B. S., Pelham Jr, W. E., Cheong, J., Marshal, M. P., Gnagy, E. M., & Curran, P. J. (2012). Childhood attention-deficit/hyperactivity disorder (ADHD) and growth in adolescent alcohol use: The roles of functional impairments, ADHD symptom persistence, and parental knowledge. *Journal of Abnormal Psychology, 121*, 922-935.

Molina, B. S., Pelham, W. E., Gnagy, E. M., Thompson, A. L., & Marshal, M. P. (2007). Attention-deficit/hyperactivity disorder risk for heavy drinking and alcohol use disorder is age specific. *Alcoholism: Clinical and Experimental Research, 13*, 643-654.

MTA Cooperative Group. (1999a). A 14-month randomized clinical trial of treatment strategies for attention-deficit/hyperactivity disorder. The MTA Cooperative Group. Multimodal Treatment Study of Children with ADHD. *Archives of General Psychiatry, 56*, 1073-1086.

MTA Cooperative Group. (1999b). Moderators and mediators of treatment response for children with attention-deficit/hyperactivity disorder: The Multimodal Treatment Study of children with attention-deficit/hyperactivity disorder. *Archives of General Psychiatry, 56*, 1088-1096.

Muld, B. B., Jokinen, J., Bölte, S., & Hirvikoski, T. (2015). Long-term outcomes of pharmacologically treated versus non-treated adults with ADHD and substance use disorder: A naturalistic study. *Journal of Substance Abuse Treatment,51*, 82-90.

Munro, B.A., Weyandt, L.L., Marraccini, M.E., & Oster, D.R. (2017). The relationship between nonmedical use of prescription stimulants, executive functioning and academic outcomes. *Addictive Behaviors, 65*, 250-257.

Murphy, K, & Barkley, R.A. (1996). Prevalence of DSM-IV symptoms of ADHD in adult licensed drivers: Implications for clinical diagnosis. *Journal of Attention Disorders, 1*, 147-161.

Nigg, J. T., Wong, M. M., Martel, M. M., Jester, J. M., Puttler, L. I., Glass, J. M., & ... Zucker, R.A. (2006). Poor response inhibition as a predictor of problem drinking and illicit drug use in adolescents at risk for alcoholism and other substance use disorders. *Journal of the American Academy of Child & Adolescent Psychiatry, 45*, 468-475.

Parada, M., Corral, M., Mota, N., Crego, A., Rodríguez Holguín, S., & Cadaveira, F. (2012). Executive functioning and alcohol binge drinking in university students. *Addictive Behaviors, 37,* 167-172.

Pedrelli, P., Nyer, M., Yeung, A., Zulauf, C., & Wilens, T. (2015). College students: Mental health problems and treatment considerations. *Academic Psychiatry: The Journal of the American Association of Directors of Psychiatric Residency Training and the Association for Academic Psychiatry, 39*, 503-11.

Pedrelli, P., Shapero, B., Archibald, A., & Dale, C. (2016). Alcohol use and depression during adolescence and young adulthood: A summary and interpretation of mixed findings. *Current Addiction Reports, 3*, 91-97.

Perron, B. E., Grahovac, I. D., Uppal, J. S., Granillo, M. T., Shutter, J., & Porter, C. A. (2011). Supporting students in recovery on college campuses: Opportunities for student affairs professionals. *Journal of Student Affairs Research and Practice, 48*, 47-64.

Pingault, J. B., Cote, S. M., Galera, C., Genolini, C., Falissard, B., Vitaro, F., & Tremblay, R. E. (2013). Childhood trajectories of inattention, hyperactivity and oppositional behaviors and prediction of substance abuse/dependence: A 15-year longitudinal population-based study. *Molecular Psychiatry, 18,* 806-812.

Rabiner, D. L., Anastopoulos, A. D., Costello, J., Hoyle, R. H., & Swartzwelder, H. S. (2008). Adjustment to college in students with ADHD. *Journal of Attention Disorders, 11*, 689-699.

Rooney, M., Chronis-Tuscano, A., & Yoon, Y. (2012). Substance use in college students with ADHD. *Journal of Attention Disorders, 16*, 221-234.

Roth, R. M., Isquith, P. K., & Gioia, G. A. (2005). *Behavior Rating Inventory of Executive Function - Adult Version* (BRIEF-A). Psychological Assessment Resources.

Sibley, M. H., Pelham, W. E., Molina, B. S., Coxe, S., Kipp, H., Gnagy, E. M.,…Lahey, B. B. (2014). The role of early childhood ADHD and subsequent CD in the initiation and escalation of adolescent cigarette, alcohol, and marijuana use. *Journal of Abnormal Psychology, 123*, 362-374.

Singleton, R. J., & Wolfson, A. R. (2009). Alcohol consumption, sleep, and academic performance among college students. *Journal of Studies on Alcohol and Drugs, 70*, 355-363.

Sprinkle, S. D., Lurie, D., Insko, S. L., Atkinson, G., Jones, G. L., Logan, A. R., & Bissada, N. N. (2002). Criterion validity, severity cut scores, and test-retest reliability of the Beck Depression Inventory-II in a university counseling center sample. *Journal of Counseling Psychology, 49,* 381-385.

Turner, R.J., & Gil, A.G. (2002). Psychiatric and substance use disorders in south Florida: Racial/ethnic and gender contrasts in a young adult cohort. *Archives of General Psychiatry, 59*, 43-50.

Uchida, M., Spencer, T. J., Faraone, S. V., & Biederman, J. (2015). Adult outcome of ADHD: An overview of results from the MGH longitudinal family studies of pediatrically and psychiatrically referred youth with and without ADHD of both sexes. *Journal of Attention Disorders*, 1-12.

Upadhyaya, H. P., Rose, K., Wang, W., O'Rourke, K., Sullivan, B., Deas, D., & Brady, K. T. (2005). Attention-deficit/hyperactivity disorder, medication treatment, and substance use patterns among adolescents and young adults. *Journal of Child and Adolescent Psychopharmacology, 15,* 799-809.

Upadhyaya, H. P., & Carpenter, M. J. (2008). Is attention deficit hyperactivity disorder (ADHD) symptom severity associated with tobacco use? *The American Journal on Addictions, 17*, 195-198.

Weinstein, C. E. & Palmer, D. R. (2002). *Learning and Study Strategies Inventory* – (2nd ed.) *User's manual*. H&H Publishing Company, Inc.

Weitzman, E. R. (2004). Poor mental health, depression, and associations with alcohol consumption, harm, and abuse in a national sample of young adults in college. *Journal of Nervous and Mental Disease, 192,* 269-277.

Wilens, T. E., & Kaminski, T. A. (2018). The co-occurrence of ADHD and ADHD and substance use disorders. *Psychiatric Annals, 48*, 328-332.

WHO ASSIST Working Group. (2002). The Alcohol, Smoking and Substance Involvement Screening Test (ASSIST): Development, reliability and feasibility. *Addiction, 97*, 1183-1194.

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Table 1

Participant Demographic Data

	ADHD	*Comparison*
Original Sample	%	%
Gender (% female)	52.2	51.3
Ethnicity		
Hispanic	10.5	10.1
Race		
Caucasian	76.8	66.7
African American	11.0	13.6
Asian	2.6	8.3
Multiracial	4.4	3.5
Other	5.3	7.9
	M (SD)	*M (SD)*
Age (years)	18.27 (.58)	18.19 (.46)
ADHD Analytic Sample (n=207)	%	
Gender (% female)	53.6	
Ethnicity		
Hispanic	10.6	
Race		
Caucasian	76.3	
African American	12.1	
Asian	2.9	
Multiracial	3.4	
Other	5.3	
	M (SD)	
Age (years)	18.25 (.54)	

Note. Attention-deficit/hyperactivity disorder (ADHD) group $n = 228$, Comparison group $n = 228$.

Table 2

ADHD Sample Means and Standard Deviations

	M	*SD*	Skewness	Kurtosis
CAARS DSM-IV IN	77.93	12.10	.04	-.34
CAARS DSM-IV HI	62.95	13.39	-.33	1.64
BRIEF Global Executive	65.32	10.09	.05	-.46
Total CD Severity	.18	.43	2.25	4.19
BDI Total	15.40	9.39	.83	.12
BAI Total	14.23	11.05	1.27	1.50
LASSI				
Concentration	18.76	6.18	.57	-.13
Motivation	28.79	6.09	-.45	-.09
AIM				
Performance and Daily Functioning	50.29	19.12	.10	-.40
Relationships/Communication	70.30	19.46	-.82	.39
Total ADHD Knowledge				
Correct Score	23.98	6.28	.27	.19
Overall Score	61.45	10.69	-.06	.01
Total Tobacco Use	.99	1.41	1.22	.34
Total Alcohol Use	6.46	6.63	1.35	1.28
Total Cannabis Use	4.60	7.10	2.02	4.21
Total Other Drug Use	.43	1.11	2.67	6.68

Note. IN = inattention; HI = hyperactivity-impulsivity

Table 3

ADHD and Control Group Differences

	df	*F*	*p* value	Cohen's *d*	ηp^2
Alcohol	1	3.512	.062	0.18	.008
Tobacco	1	9.963	.002	0.30	.023
Cannabis	1	11.505	.001	0.30	.027
Other Drugs	1	12.187	.001	0.33	.028

Table 4

Final Regression Model for Alcohol Use

	β	*R*	R^2	Adjusted R^2	*F*
		.28	.08	.07	9.52**
Gender	.28**				
Race	-.04				
Ethnicity	-.09				
Parent Highest Education Level	.16				

Note. $^{**}p < .01$

Table 5

Final Regression Model for Tobacco Use

	β	*R*	*R2*	Adjusted R^2	*F*
		.38	.15	.12	6.32***
Gender	.22*				
Race	-.04				
Ethnicity	.04				
Parent Highest Education Level	-.01				
CAARS IN	-.01				
CAARS Hyperactive-Impulsive	.04				
BRIEF Global	.23*				
Conduct Disorder Symptoms	.11				
BAI Total Score	.20*				
BDI Total Score	.11				

Note. CAARS = Conners Adult ADHD Rating Scale. BRIEF = Behavior Rating Inventory of Executive Functioning. BAI = Beck Anxiety Inventory. BDI = Beck Depression Inventory *** $p < .001$ *$p < .05$

Table 6

Final Regression Model for Cannabis Use

	β	*R*	R^2	Adjusted R^2	*F*
		.24	.06	.05	6.79*
Gender	.18				
Race	-.02				
Ethnicity	-.01				
Parent Highest Education Level	.05				
CAARS Inattention	.03				
CAARS Hyperactive-Impulsive	.04				
BRIEF Global	.24*				

Note. CAARS = Conners Adult ADHD Rating Scale. BRIEF = Behavior Rating Inventory of Executive Functioning. *$p < .05$

Table 7

Final Regression Model for Other Drug Use

	β	*R*	R^2	Adjusted R^2	*F*
		.43	.18	.16	8.13***
Gender	.09				
Race	.03				
Ethnicity	-.11				
Parent Highest Education Level	.03				
CAARS IN	-.04				
CAARS Hyperactive-Impulsive	.12				
BRIEF Global	.17				
Conduct Disorder Symptoms	-.02				
BAI Total Score	.21*				
BDI Total Score	-.07				
AIM Daily Functioning	.12				
AIM Relationships	-.11				
LASSI Concentration	.07				
LASSI Motivation	-.22*				

Note. CAARS = Conners Adult ADHD Rating Scale. BRIEF = Behavior Rating Inventory of Executive Functioning. BAI = Beck Anxiety Inventory. BDI = Beck Depression Inventory. AIM = . LASSI = Learning and Study Strategy Inventory. ***$p < .001$ *$p < .05$