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Attention Deficit Hyperactivity Disorder (ADHD) Subtypes, Co-occurring Psychiatric Symptoms and Sexual Risk Behaviors among Adolescents Receiving Substance Abuse Treatment

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Abstract

Background: Adolescents entering substance abuse treatment report clustered psychiatric symptoms and sexual risk behaviors representing differential levels of impairment and risk for maladaptive health outcomes.

Objectives: To examine the prevalence of Attention Deficit Hyperactivity Disorder (ADHD) subtypes among adolescents receiving outpatient substance abuse treatment; To document group differences in (a) past-year psychiatric symptom scores and (b) sexual risk behaviors by ADHD subtype and gender.

Methods: Self-report data were collected via structured interviews from 394 adolescents (280 males, $M = 16.33$ years, $SD = 1.15$ years), enrolled in an HIV/STI risk reduction intervention for adolescents receiving outpatient substance abuse treatment. ADHD diagnostic subtypes and other past-year psychiatric symptoms were assessed using the Brief Michigan Version of the Composite Internal Diagnostic Interview (UM-CIDI). Adolescents provided self-report data on sexual risk behaviors.

Results: Multivariate analyses of variance (MANOVAs) documented that Inattentive and Hyperactive-Impulsive ADHD subtypes were significantly associated with higher scores for all past-year psychiatric symptoms. The combined ADHD subtype was significantly associated with higher scores for all psychiatric symptoms except affective disorder. Girls reported significantly higher mean symptoms than boys for alcohol abuse and dependence, anxiety and affective disorder symptoms. Sexual risk behavior scores were not associated with ADHD status, but girls reported consistently higher scores for multiple risk behavior outcomes. Several psychiatric disorder symptoms were significant covariates of multiple sexual risk behaviors.

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Disclosure of Interest

The authors report no conflict of interest.

Conclusion/Importance: Brief screenings for ADHD, other psychiatric disorders and sexual risk behaviors can provide data for tailoring substance abuse services to improve adolescent health outcomes for high-risk subgroups.

Keywords

ADHD; Substance Abuse Treatment; Psychiatric Symptoms; Sexual Risk Behaviors; Adolescents; Gender

Attention-Deficit Hyperactivity Disorder (ADHD) is one of the most commonly diagnosed neurodevelopmental disorders among children, with 5% of the nation's children assigned a current diagnosis and more than 1 in 10 receiving a lifetime diagnosis (Sibley, Kuriyan, Evans, Waxmonsky, & Smith, 2014; Visser et al., 2014). ADHD is characterized by a persistent pattern of inattention and/or hyperactivity-impulsivity that interferes with functioning or development (American Psychiatric Association [APA], 2013). This symptom pattern is associated with negative developmental outcomes including comorbid psychological disorders (Larson, Russ, Kahn, & Halfon, 2011; Yoshimasu et al., 2012), and substance abuse and dependence during adolescence and adulthood (Breyer, Lee, Winters, August, & Realmuto, 2014; Gudjonsson, Sigurdsson, Sigfusdottir, & Young, 2012; Lee, Humphreys, Flory, Liu, & Glass, 2011). The widespread prevalence of ADHD diagnoses, the associated negative developmental outcomes, and long-term social and financial burdens to families and society define this disorder as a significant public health concern (Doshi et al., 2012; Polanczyk, Willcutt, Salum, Kielling, & Rohde, 2014).

ADHD and Co-Occurring Psychiatric Disorders

Children with ADHD diagnoses are significantly more likely to develop substance use disorders (SUDs) than children without ADHD diagnoses (Lee et al., 2011). Childhood ADHD has been found to predict greater initial exposure to substances at earlier ages and more rapid progression of substance use during adolescence (Molina et al., 2018). Chan, Dennis and Funk (2008) found that over 60% of adolescents receiving substance abuse treatment services met criteria for a current diagnosis of ADHD. Therefore, a lifetime diagnosis of ADHD is a significant risk factor for the development of substance abuse problems or substance dependence disorders.

In addition to SUDs, ADHD and associated symptoms are often comorbid with other psychiatric disorders. Most children with ADHD have at least one comorbid psychiatric disorder. In one large-scale study, parental reports about children diagnosed with ADHD indicated co-occurring diagnoses of learning disabilities (46%), conduct disorder (27%), anxiety (18%), and depression (14%), with economically disadvantaged children having a 3.8 times greater likelihood of having three or more comorbid diagnoses (Larson et al., 2011). In a community birth cohort study comparing incident cases of ADHD to population-based controls, diagnosis of ADHD was associated with significantly higher odds of manifesting diagnoses of adjustment disorders, oppositional defiant disorder, conduct disorder, mood disorders, anxiety disorders and SUDs (Yoshimasu et al., 2012).

Diagnostic Subtypes of ADHD

Assignment of a diagnosis of ADHD is defined in part by three separate subtypes which manifest unique symptom presentations: the predominantly inattentive, predominantly hyperactive/impulsive and combined subtypes (APA, 2013). Subtypes of ADHD appear to be associated with differential risk for specific co-occurring psychiatric disorders. First, evidence supports associations between ADHD subtype and specific substance use problems and SUDs. For example, the Inattentive subtype appears to share a robust relationship with nicotine dependence among adolescents and emerging adults (e.g., Pingault et al., 2013; Wilens et al., 2009), while the Hyperactive-Impulsive subtype predicts initiation of tobacco, alcohol, marijuana and illicit drug use and subsequent SUDs in population-based samples (Elkins, McGue, & Iacono, 2007; Liebreznz, Gamma, Ivanov, Buadze, & Eich, 2015). In contrast, other studies have noted that the Combined subtype of ADHD predicts more severe substance abuse outcomes, is associated with seeking substance abuse treatment (Kaye et al., 2016) and more extensive psychiatric comorbidity among treatment-seekers (Wilens et al., 2009), compared to the Inattentive and Hyperactive/Impulsive subtypes. However, other studies have reported no clear relation between ADHD subtypes and differential substance abuse outcomes. For example, a large population-based study indicated increased endorsement of ADHD symptoms alone was associated with higher odds of endorsing alcohol, tobacco and illicit SUDs, with no differences by subtype (Capusan, Bendtsen, Marteinsdottir, & Larsson, 2016). Thus, there is mixed evidence to support associations between ADHD subtypes and differential outcomes for substance use problems and SUDs.

Gender and ADHD Subtype

Although evidence documents that ADHD diagnoses co-occur with a range of psychiatric disorders, gender may influence the development of specific comorbid diagnoses. For example, boys are more likely than girls to be diagnosed with ADHD, with the gender ratio estimated at approximately 2.3:1 for community samples (Ramtekkar, Reiersen, Todorov, & Todd, 2010). Similarly, boys are more likely than girls to receive a lifetime SUD diagnosis, with an estimated gender ratio of approximately 2:1 (APA, 2013). However, researchers have argued that girls diagnosed with ADHD and SUD may have more severe presentations than boys. Girls with ADHD are more likely to experience severe internalizing problems, including anxiety disorders and non-suicidal self-injury (Eme, 2017). In addition, girls with SUDs are more likely to experience elevated depression symptoms (e.g., Poulin, Hand, Boudreau, & Santor, 2005).

Gender may interact with ADHD subtype and influence co-occurring psychopathology and degree of impairment in treatment samples. Hurmic, Debrabant, Kervran, Auriacombe and Fatseas (2015) examined adult outpatient clients receiving substance abuse treatment services and reported that the Hyperactive-Impulsive subtype was more prevalent among women, while the Combined subtype was associated with higher likelihood of polysubstance use and legal problems. However, a study of adults seeking treatment for ADHD found no differences in types of comorbid disorders across ADHD subtypes, although gender differences were documented. Men with ADHD were more likely to endorse SUDs, in particular marijuana and polysubstance dependence, while women with ADHD were more likely to endorse personality pathology, in particular borderline types (Soendergaard et al.,

2016). Therefore, it may be important to include gender and ADHD subtype in study design and treatment planning efforts, as these factors may be related to systematic differences in both degree of psychiatric impairment at treatment entry, as well as treatment engagement and treatment outcomes.

ADHD and Sexual Risk Behaviors

In addition to co-occurring psychiatric disorders, adolescents receiving substance abuse treatment may report extensive co-occurring sexual risk behaviors. A recent meta-analysis documented a significant positive relation between substance use and sexual risk behavior among adolescents in clinical settings ($r = .418$; Ritchwood, Ford, DeCoster, Sutton, & Lockman, 2015). Youth presenting for substance abuse treatment report earlier onset of sexual activity, more lifetime sexual partners, less condom use, and more exposure to sexually-transmitted infections (STIs) than community-based samples of youth (Tapert, Aarons, Sedlar, & Brown, 2001). In addition to substance abuse, lifetime diagnosis of comorbid psychiatric disorders is associated with significant increases in adolescents' sexual risk-taking (Brown et al., 2010). With regard to ADHD, among young women, Inattentive subtype symptoms were uniquely associated with using alcohol before sex, while hyperactive/impulsive subtype symptoms were uniquely associated with greater odds of having three or more sexual partners in the prior year, and greater odds of a lifetime risky male sexual partner (Hosain, Berenson, Tennen, Bauer, & Wu, 2012). Therefore, some evidence suggests that specific sexual risk behaviors are associated with ADHD subtype, gender, and co-occurring psychiatric disorders.

Adolescents receiving substance use treatment services typically report clustered psychiatric symptoms and sexual risk behaviors, reflecting differential impairment and risk for maladaptive health outcomes (Oshri, Tubman, Wagner, Leon-Morris, & Snyders, 2008). The presence of ADHD and co-occurring diagnoses can pose a substantial challenge to treatment engagement and positive treatment outcomes (Schoenfelder & Kollins, 2014; Tamm et al., 2013). Similarly, ADHD and co-occurring psychiatric disorders are associated with specific forms of sexual risk behavior in clinic samples of adolescents, indicating great likelihood of negative short- and long-term negative health outcomes (e.g., Brown et al., 2010). Therefore, screening adolescents for ADHD and co-occurring psychiatric symptoms at treatment entry may provide treatment service providers important information about specific psychiatric impairments and broader patterns of health risk behaviors that can be addressed during substance abuse treatment planning and implementation. Adolescents with SUDs, ADHD and co-occurring disorders may benefit from integrated interventions that incorporate modalities that can address addictive disease processes, co-occurring psychiatric disorders and associated health-risk behaviors (Wilens & Morisson, 2012).

The Present Study

The present study was based on baseline data from part of a larger study (R01 AA 014322), evaluating a brief motivational intervention (BMI) for HIV/STI risk reduction among adolescents receiving outpatient treatment services. We examined heterogeneity among ADHD subtypes to determine if overall patterns of comorbid psychiatric symptoms and co-

occurring sexual risk behaviors varied systematically by ADHD subtype, as has been documented in previous examinations of substance abuse treatment response and outcomes (Tamm, Adinoff, Nakonezny, Winhusen, & Riggs, 2012). Additionally, we examined heterogeneity of comorbid psychiatric symptoms and co-occurring sexual risk behaviors to identify systematic variation by gender, given the lack of consistent findings in broader substance abuse literatures (e.g., Lee et al., 2011).

The study evaluated two hypotheses. First, we expected that the more complex, severe form of ADHD (i.e., combined type) would be associated with more extensive patterns of comorbid psychiatric symptoms and sexual risk behaviors. Second, we did not expect that overall patterns of comorbid psychiatric symptoms and co-occurring sexual risk behaviors to vary systematically by gender due to the high levels of both reported in this treatment sample of adolescents in previous analyses (e.g., Tubman, Oshri, Taylor, & Morris, 2011). Evaluation of these hypotheses in a diverse, multi-ethnic sample of adolescents receiving outpatient substance abuse treatment services provides important information to treatment providers regarding multivariate relations between a common risk factor for SUDs (i.e., ADHD) and (a) co-occurring patterns of psychopathology and (b) preventable sources of morbidity among vulnerable youth.

Materials and Methods

Participants

The sample consisted of 394 adolescents, including 280 males (71.1%) and 114 females (28.9%), receiving substance use treatment services at two outpatient facilities in South Florida. Inclusion criteria for the study were: 1) parental consent, 2) adolescent assent and 3) sexual activity during the prior six months, based on the parent study's HIV/STI risk reduction aims. Adolescents who, by case manager report, were actively suicidal or exhibited significant cognitive deficits or developmental delays were not eligible to participate due to ethical concerns about client safety and the cognitive capacities required for the psychotherapeutic intervention delivered in the treatment arm of the larger study.

Participants' ages ranged from 12 to 18 years old ($M = 16.33$ years; $SD = 1.15$ years). The sample was ethnically diverse and included adolescent who identified as non-Hispanic White (25.4%), Hispanic (44.9%), non-Hispanic Black (20.6%), or from other (9.1%) racial/ethnic groups. The majority of the participants (83.2%) were born in the United States, and 44.9% and 55.1% of their fathers and mothers, respectively, were also born in the United States. Most of the sample ($n = 295$, 74.8%) reported their father, mother, or both as their primary caregiver(s). Over half of the participants ($n = 208$, 52.7%) reported repeating one or more school grades.

Participants' prevalence rates for past-year diagnoses of ADHD varied by subtype: Inattentive subtype (37.3%), Hyperactive-Impulsive subtype (28.9%) and Combined subtype (21.5%). Participants reported a mean of 10.74 lifetime sex partners and 4.89 past-year sex partners. At the time of last intercourse, 37.1% reported not using a condom. Boys ($M = 11.79$) reported higher average numbers of lifetime sex partners than girls ($M = 8.13$), $F(1, 376) = 5.59$, $p < .05$, but there was no significant difference in their numbers of past-year

sex partners between boys ($M = 5.17$) and girls ($M = 4.19$). Girls (58.2%) were more likely than boys (28.6%) to report not using a condom at last intercourse, $\chi^2(1, n=383) = 28.879, p < .001$. Girls also reported lower mean ratings than boys for how often they used condoms during sex [3.99 vs. 3.25, $F(1, 381) = 28.675, p < .001$], as well as how likely they were to use a condom every time they have sex in the future [2.20 vs. 2.70, $F(1, 381) = 6.618, p < .01$]. The majority of participants reported lifetime substance use of marijuana (93.6%), opioids (32.0%), hallucinogens (29.0%), amphetamines (19.0%), and heroin (3.1%). In addition, 75% of the sample reported alcohol use during the prior 180 days. During the prior 12 months 89.1% of the sample met diagnostic criteria for one or more DSM-IV diagnoses, including: Drug Abuse (76.1%), Drug Dependence (45.4%), Alcohol Abuse (41.3%), Alcohol Dependence (15.0%), and Conduct Disorder (48.9%).

DSM-IV Psychiatric Diagnoses.

Past year DSM-IV psychiatric symptoms were assessed via adolescents' self-report using the Brief Michigan Version of the Composite International Diagnostic Interview (UM-CIDI; Kessler, Wittchen, Abelson, McGonagle, Schwarz, Kendler et al., 1998), a comprehensive, structured diagnostic interview developed by the World Health Organization (WHO). The UM-CIDI is administered by trained lay interviewers as a means to assess disorders defined by the Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 2013). The administration of the UM-CIDI included skip patterns and probe questions. This instrument was developed to standardize the assessment of psychiatric disorders in community settings and samples (Kessler, Wittchen, Abelson, & Zhao, 2000). The UM-CIDI has excellent interrater reliability and good test-retest reliability, as well as sufficient validity based on concordance with clinical judgments and structured clinical interviews (Haro, Arbabzadeh-Bouchez, Brugha, de Girolamo, Guyer, Jin et al., 2006; Kessler, Abelson, Demler, Escobar, Gibbon, Guyer et al., 2004). Among adolescents in the National Comorbidity Survey-Adolescent Supplement (NCS-A), UM-CIDI-generated diagnoses demonstrated good aggregate concordance with blinded clinical diagnostic ratings generated using the K-SADS (Kessler, Avenevoli, Green, Gruber, Guyer, He, ... et al., 2009). The UM-CIDI yields categorical diagnoses for three subtypes of ADHD including: the Inattentive Subtype, the Hyperactive-Impulsive Subtype, and the Combined Subtype. Analyses for the present study also included six aggregated symptom score categories derived from the UM-CIDI. These included: (a) ADHD, (b) Conduct Disorder (CD)/Oppositional Defiant Disorder (ODD), (c) Affective Disorders (Major Depressive Disorder, Dysthymia), (d) Anxiety Disorders [Generalized Anxiety Disorder (GAD), Specific Phobia, Social Phobia, Panic Disorder], (e) Alcohol Abuse and Dependence Disorders and (f) Drug Abuse and Dependence Disorders.

Sexual Risk Behaviors.

Adolescents provided self-report data for several sexual risk behavior variables that index behavioral risk for HIV/STI exposure (Coates, Richter, & Caceres, 2008), including unprotected intercourse, numbers of sex partners, co-occurring substance use and sexual behavior, in addition to expectancies about sexual risk behaviors co-occurring with alcohol or drug use. Adolescents reported for the previous six months how often they or a partner (a) drank alcohol or (b) used drugs to get high before or during sex. These two items were

scored on a Likert scale, from 1 (*never*) to 5 (*always*). Adolescents also provided a global rating of unprotected intercourse by responding to the statement, “When you have sex, how often do you use a condom”? using a Likert scale from 1 (*never*) to 5 (*every time*). Adolescents reported their numbers of (a) past year and (b) lifetime sex partners.

Adolescents also responded to the four items from the Risky Sex Scale (O’Hare, 2001) assessing alcohol-sexual behavior outcome expectancies. The items assessed greater likelihood after using alcohol or drugs of: having sex with a new date; having sex with a familiar friend; having unprotected sex; or having unplanned sex). Each item used the five-point response format, from 1 (*strongly disagree*) to 5 (*strongly agree*). In this sample, the estimated Cronbach alpha was .78 for this subscale. Subscale scores were predictive of independent measures of sex under the influence of drugs, count measures of unprotected sex, and condom use at last intercourse (Tubman, Des Rosiers, Schwartz, & O’Hare, 2012).

Procedure

Adolescents were approached in groups during their first week of enrollment in outpatient substance abuse treatment and invited to participate in a brief motivational HIV/STI risk reduction intervention. They were read the eligibility criteria and were invited to meet with a project staff member to confirm their eligibility and begin the informed consent process. Adolescents who met inclusion criteria were assessed for DSM-IV psychiatric symptoms and were administered a battery of questionnaires before being enrolled in the HIV/STI risk reduction intervention. In the broader NIAAA-funded study, participants completed a 60- to 90-minute assessment of substance use, sexual risk behaviors, demographics, as well as putative mediators and moderators of intervention impact. Trained graduate students collected data using a structured interview protocol on laptop computers at each client’s substance abuse treatment facility. The clinical interview was completed with the participant only. Active consent was obtained from both adolescents and a primary caregiver via procedures approved by the Institutional Review Board (IRB) at the sponsoring university. Participants were compensated \$25 for completing the baseline assessment.

Analytic Plan

Multiple analysis of variance (MANOVA) was used to document significant differences in the aggregate levels of self-reported psychiatric symptoms (anxiety disorders, affective disorders, CD/ODD, alcohol abuse and dependence, and drug abuse and dependence) by ADHD diagnostic status and gender. Patterns of significant differences in psychiatric symptoms by ADHD diagnostic status and gender were examined across ADHD subtypes to identify inconsistencies in patterning of group differences. Group differences in sexual risk behaviors were also investigated in a series of three MANCOVAs that used ADHD subtype and gender as fixed factors, five UM-CIDI-generated symptom counts as covariates and six measures of sexual risk behaviors as dependent variables outcomes.

Results

Table 1 summarizes the means, standard deviations, ranges and intercorrelations among total scores for six self-reported psychiatric symptom scores from the CIDI. Self-reported scores

are highest for total ADHD symptoms, total anxiety symptoms and total conduct disorder symptoms and lowest for alcohol abuse and dependence symptoms. Each of the six symptoms has a wide range of reported scores. Correlations among psychiatric symptom scores ranged from 0.22 to 0.49, with the highest correlations between forms of internalizing disorders (i.e., anxiety and affective disorder symptoms) and forms of externalizing disorders (i.e., ADHD, CD, and SUD symptoms). The lowest correlations were between anxiety disorder symptoms and SUD symptoms. Correlations between psychiatric disorder symptoms and sexual risk behavior scores were less consistently statistically significant. For example, psychiatric symptom scores were significantly related to measures of substance use before or during sex but generally not significantly correlated with measures of cumulative sex partners.

Group Differences in Past Year Psychiatric Symptoms by Clinical Status for ADHD and Gender

Table 2 summarizes mean psychiatric symptom scores for anxiety, affective, conduct and substance use disorders by clinical status for ADHD Inattentive Subtype and gender. There was a significant multivariate pattern of differences in mean psychiatric symptoms scores by ADHD-Inattentive Subtype clinical status [Pillai's Trace = .11, $F(5, 373) = 9.24$, $p < .001$] and gender [Pillai's Trace = .16, $F(5, 373) = 14.44$, $p < .001$]. Compared to adolescents without the diagnosis, adolescents assigned diagnoses of ADHD-Inattentive Subtype reported significantly higher average symptom scores for: anxiety disorders, $F(1,377) = 10.05$, $p < .01$; affective disorders, $F(1,377) = 13.46$, $p < .001$; conduct disorder, $F(1,377) = 22.09$, $p < .001$; alcohol abuse and dependence, $F(1,377) = 21.09$, $p < .001$ and drug abuse and dependence, $F(1,377) = 26.32$, $p < .001$. In addition, compared to boys in this sample, girls reported significantly higher average symptom scores for: anxiety disorders, $F(1,377) = 18.10$, $p < .001$; affective disorders, $F(1,377) = 57.31$, $p < .001$, as well as alcohol abuse and dependence, $F(1,377) = 15.81$, $p < .001$. All statistical interactions between clinical status for ADHD-Inattentive Subtype and gender on mean psychiatric symptom scores were non-significant.

Table 3 summarizes mean psychiatric symptom scores for anxiety, affective, conduct and substance use disorders by clinical status for ADHD Hyperactive-Impulsive Subtype and gender. There was a significant multivariate pattern of differences in mean psychiatric symptoms scores by ADHD Hyperactive-Impulsive Subtype clinical status [Pillai's Trace = .13, $F(5, 373) = 11.16$, $p < .001$] and gender [Pillai's Trace = .14, $F(5, 373) = 12.30$, $p < .001$]. Compared to adolescents without the diagnosis, adolescents assigned diagnoses of ADHD Hyperactive-Impulsive Subtype reported significantly higher average symptom scores for: anxiety disorders, $F(1,377) = 14.31$, $p < .001$; affective disorders, $F(1,377) = 7.01$, $p < .01$; conduct disorder, $F(1,377) = 34.17$, $p < .001$; alcohol abuse and dependence, $F(1,377) = 23.02$, $p < .001$ and drug abuse and dependence, $F(1,377) = 20.62$, $p < .001$. In addition, compared to boys in this sample, girls reported significantly higher average symptom scores for: anxiety disorders, $F(1,377) = 17.14$, $p < .001$; affective disorders, $F(1,377) = 48.09$, $p < .001$, as well as alcohol abuse and dependence, $F(1,377) = 15.28$, $p < .001$. All statistical interactions between clinical status for ADHD Hyperactive-Impulsive Subtype and gender on mean psychiatric symptom scores were non-significant.

Table 4 summarizes mean psychiatric symptom scores for anxiety, affective, conduct and substance use disorders by clinical status for ADHD Combined Subtype and gender. There was a significant multivariate pattern of differences in mean psychiatric symptoms scores by ADHD Combined Subtype clinical status [Pillai's Trace = .10, $F(5, 373) = 8.16$, $p < .001$] and gender [Pillai's Trace = .12, $F(5, 373) = 10.18$, $p < .001$]. Compared to adolescents without the diagnosis, adolescents assigned diagnoses of ADHD Combined Subtype reported significantly higher average symptom scores for: anxiety disorders, $F(1, 377) = 7.93$, $p < .01$; conduct disorder, $F(1, 377) = 25.81$, $p < .001$; alcohol abuse and dependence, $F(1, 377) = 16.10$, $p < .001$ and drug abuse and dependence, $F(1, 377) = 18.20$, $p < .001$. In addition, compared to boys in this sample, girls reported significantly higher average symptom scores for: anxiety disorders, $F(1, 377) = 10.75$, $p < .001$; affective disorders, $F(1, 377) = 38.83$, $p < .001$, as well as alcohol abuse and dependence, $F(1, 377) = 12.07$, $p < .001$. All statistical interactions between clinical status for ADHD Combined Subtype and gender on mean psychiatric symptom scores were non-significant.

Three sets of supplementary cross-tabulation analyses were conducted to help interpret group differences in substance abuse and dependence symptoms, i.e., one for each ADHD subtype by lifetime use of specific substances or prior experience with substance abuse treatment. Across the three sets of analyses, robust patterns of findings emerged suggesting that, compared to adolescents without any subtype diagnosis of ADHD, adolescents assigned a diagnosis of any subtype of ADHD were more likely to report lifetime patterns of polysubstance use, including higher rates of: regular cigarette use, as well as use of sedatives/barbiturates, pain killers/analgesics, tranquilizers, inhalants, powder cocaine and hallucinogens. In addition, adolescents assigned a diagnosis of any subtype of ADHD were more likely to report lifetime experience of inpatient, residential or day treatment for substance use problems. Across the entire sample, 80.2% of the participants endorsed marijuana as their drug of choice.

Group Differences in Sexual Risk Behaviors by Clinical Status for ADHD and Gender

Group differences in sexual risk behaviors were investigated in a series of three MANCOVAs that used ADHD subtype and gender as fixed factors, five UM-CIDI-generated symptom counts as covariates and six measures of sexual risk behaviors as dependent variables. Covariates included total psychiatric symptoms scores for anxiety disorders, affective disorders, conduct disorder, alcohol abuse and dependence and drug abuse and dependence. Across these three MANCOVAs, there were no significant multivariate patterns of differences in mean sexual risk behavior variables by ADHD Inattentive Subtype clinical status [Pillai's Trace = .015, $F(6, 354) = .874$, NS], ADHD Hyperactive-Impulsive Subtype clinical status [Pillai's Trace = .014, $F(6, 354) = 0.817$, NS], or ADHD Combined Subtype clinical status [Pillai's Trace = .016, $F(6, 354) = 0.969$, NS]. Across these three MANCOVAs, there were no significant statistical interactions between gender and ADHD Subtype.

In the MANCOVA including ADHD Inattentive Subtype, gender was associated with significant group differences in sexual risk behavior [Pillai's Trace = .173, $F(6, 354) = 12.333$, $p < .001$]. Compared to boys in this sample, girls reported significantly lower condom

use scores, $F(1,359) = 23.357, p < .001, (M_{\text{boys}} = 3.98, M_{\text{girls}} = 3.27)$; lower numbers of lifetime sex partners, $F(1,359) = 6.323, p < .05 (M_{\text{boys}} = 11.80, M_{\text{girls}} = 8.09)$; lower numbers of past-year sex partners, $F(1,359) = 4.39, p < .05 (M_{\text{boys}} = 5.20, M_{\text{girls}} = 4.15)$; less frequent use of alcohol before sex, $F(1,359) = 4.714, p < .05 (M_{\text{boys}} = 2.19, M_{\text{girls}} = 2.06)$ and greater likelihood of engaging in sexual risk behaviors when using alcohol or other drugs, $F(1,359) = 24.854, p < .001 (M_{\text{boys}} = 2.97, M_{\text{girls}} = 3.50)$. Significant covariates included conduct disorder symptoms [Pillai's Trace = .050, $F(6, 354) = 3.120, p < .01$], alcohol abuse and dependence symptoms [Pillai's Trace = .070, $F(6, 354) = 4.439, p < .001$] and drug abuse and dependence symptoms [Pillai's Trace = .166, $F(6, 354) = 11.760, p < .001$]. Conduct disorder symptoms covaried significantly with lifetime sex partners ($p < .05$) and alcohol-sexual risk behavior expectancies ($p < .01$); alcohol abuse and dependence symptoms covaried significantly with frequency of alcohol use before sex ($p < .001$); drug abuse and dependence symptoms covaried significantly with frequency of alcohol use before sex ($p < .05$), frequency of drug use before sex ($p < .001$) and alcohol-sexual risk behavior expectancies ($p < .001$).

In the MANCOVA including ADHD Hyperactive-Impulsive Subtype, gender was associated with significant group differences in sexual risk behavior [Pillai's Trace = .151, $F(6, 354) = 10.478, p < .001$]. Compared to boys in this sample, girls reported significantly lower condom use scores, $F(1,359) = 21.443, p < .001 (M_{\text{boys}} = 3.98, M_{\text{girls}} = 3.27)$; less frequent use of alcohol before sex, $F(1,359) = 4.945, p < .05 (M_{\text{boys}} = 2.19, M_{\text{girls}} = 2.06)$ and greater likelihood of engaging in sexual risk behaviors when using alcohol or other drugs, $F(1,359) = 21.701, p < .001 (M_{\text{boys}} = 2.97, M_{\text{girls}} = 3.50)$. Significant covariates included conduct disorder symptoms [Pillai's Trace = .053, $F(6, 354) = 3.270, p < .01$], alcohol abuse and dependence symptoms [Pillai's Trace = .073, $F(6, 354) = 4.651, p < .001$] and drug abuse and dependence symptoms [Pillai's Trace = .157, $F(6, 354) = 10.977, p < .001$]. Conduct disorder symptoms covaried significantly with lifetime sex partners ($p < .05$), alcohol-sexual risk behavior expectancies ($p < .01$) and condom use frequency ($p < .05$); alcohol abuse and dependence symptoms covaried significantly with frequency of alcohol use before sex ($p < .001$); drug abuse and dependence symptoms covaried significantly with frequency of alcohol use before sex ($p < .05$), frequency of drug use before sex ($p < .001$), condom use frequency ($p < .05$) and alcohol-sexual risk behavior expectancies ($p < .001$).

In the MANCOVA including ADHD Combined Subtype, gender was associated with significant group differences in sexual risk behavior [Pillai's Trace = .131, $F(6, 354) = 8.917, p < .001$]. Compared to boys in this sample, girls reported significantly lower condom use scores, $F(1,359) = 19.201, p < .001 (M_{\text{boys}} = 3.98, M_{\text{girls}} = 3.27)$ and greater likelihood of engaging in sexual risk behaviors when using alcohol or other drugs, $F(1,359) = 15.981, p < .001 (M_{\text{boys}} = 2.97, M_{\text{girls}} = 3.50)$. Significant covariates included conduct disorder symptoms [Pillai's Trace = .054, $F(6, 354) = 3.372, p < .01$], alcohol abuse and dependence symptoms [Pillai's Trace = .071, $F(6, 354) = 4.533, p < .001$] and drug abuse and dependence symptoms [Pillai's Trace = .166, $F(6, 354) = 11.703, p < .001$]. Conduct disorder symptoms covaried significantly with lifetime sex partners ($p < .05$) and alcohol-sexual risk behavior expectancies ($p < .01$); alcohol abuse and dependence symptoms covaried significantly with frequency of alcohol use before sex ($p < .001$); drug abuse and dependence symptoms covaried significantly with frequency of alcohol use before sex ($p < .01$), frequency of drug

use before sex ($p<.001$), condom use frequency ($p<.05$) and alcohol-sexual risk behavior expectancies ($p<.001$).

Discussion

The findings of the present study did not support the hypotheses evaluated by the analyses. However, the findings revealed important information that can assist in treatment planning and tailoring intervention content to reduce risk for maladaptive health outcomes among adolescents receiving outpatient substance abuse treatment services. With regard to our first hypothesis, positive status for the Combined Subtype of ADHD was not associated with more severe patterning of psychiatric symptoms and sexual risk behaviors. Adolescents reported comparable levels for most co-occurring psychiatric symptoms across the Inattentive, Hyperactive-Impulsive, and Combined subtypes and each ADHD subtype demonstrated a similar pattern of significant differences in reported psychiatric symptoms compared to adolescents not assigned an ADHD diagnosis. In contrast, ADHD subtype status was not significantly associated with higher multivariate patterns of sexual risk behavior.

Our findings contradict some research suggesting that endorsement of both the inattentive and hyperactive/impulsive symptoms of ADHD is associated with overall greater clinical severity, compared to one set of symptoms alone (e.g., Kaye et al., 2016; Wilens et al., 2009). Methodological issues may in part explain the different findings of our study, including the use of the briefer UM-CIDI by research interviewers rather than longer structured interviews by experienced clinicians, and the inclusion of a diverse, multicultural sample of adolescents recruited from outpatient treatment facilities serving the general public. The lack of significant gender by ADHD subtype interactions is congruent with earlier studies that document lack of gender differences in subtype comorbidities, as well as a lack of differences in patterns of comorbidities across ADHD subtypes. However, this finding does not match other research findings that suggest comorbidity profiles may differ by ADHD subtype status and gender (e.g., Levy, Hay, Bennett, & McStephen, 2005; Soendergaard et al., 2016). More research is needed to determine if and how gender may influence subtype presentations of ADHD and the patterning of co-occurring psychiatric symptoms. Our data, drawn from a diverse sample of adolescents receiving outpatient treatment services, suggest that specific ADHD subtypes alone do not confer differential vulnerability for co-occurring psychopathology or sexual risk behaviors.

In support of our second hypothesis, significant gender differences were documented in multivariate patterns of co-occurring psychiatric symptoms and sexual risk behaviors. Girls in our sample reported higher average scores than boys for anxiety, affective, alcohol abuse and dependence disorder symptoms, as well as for sexual risk behaviors under the influence of alcohol or other drugs and frequency of condom use. These results are congruent with earlier research studies that documented adolescent girls may be at unique risk for internalizing disorders (Jensen & Steinhausen, 2015) and alcohol, marijuana, and illicit drug abuse and dependence when compared to boys (Elkins et al., 2018a; Elkins et al., 2018b; Sihvola et al., 2011). Our study's data also provide some initial support to the idea that girls may be at greater risk for alcohol abuse and/or sexual risk behaviors as a means to cope with

internalizing distress. While our study was cross-sectional and used self-report data, these results warrant further investigation in order to confirm possible gender differences.

The results of our study extend findings in the existing research literature documenting substantial co-occurrence between ADHD and substance abuse problems. In our sample, overall prevalence rates of past-year ADHD diagnoses were 29.2% across the subtypes, similar to previous studies of adolescents in substance abuse treatment (Chan et al., 2008; van Emmerik-van Oortmerssen et al., 2012). Our data indicate that adolescents with any ADHD diagnosis in our sample were more likely to endorse both cigarette and illicit drug use, and report more extensive histories of treatment for substance abuse. These findings lend support to the notion that subtypes of ADHD do not confer differential risk for substance abuse outcomes (Capusan, Bendtsen, Marteinsdottir, & Larsson, 2016). Rather, adolescents with any ADHD diagnosis may be at risk for early onset of problematic substance use (Dunne, Hearn, Rose, & Latimer, 2014; Biederman et al., 2006).

Substance abuse risk from ADHD may be conferred, in part, by psychiatric symptoms co-occurring with ADHD. Our findings indicate that ADHD symptoms are significantly correlated with anxiety, affective, conduct, and SUD disorder symptoms, consistent with previous research documenting significant associations between ADHD, SUDs, and other co-occurring diagnoses among adolescents (Larson et al., 2011; Lee et al., 2011; Storr, Pacek, & Martins, 2012; Yoshimasu et al., 2012). Psychiatric diagnoses, including ADHD, often predate SUDs and become exacerbated as substance use accelerates, promoting negative developmental outcomes as reciprocal influences persist (Deas & Brown, 2006; Wilens & Biederman, 2006). The overrepresentation of ADHD and other co-occurring internalizing and externalizing psychiatric symptoms in substance abuse treatment samples is explained in part by underlying deficits in emotion regulation (e.g., Shadur & Lujuez, 2015) and impulsivity (e.g., Wilens & Zulauf, 2015), in addition to other individual-level characteristics. Future research may determine specific mechanisms of risk for development of SUDs, including externalizing pathways, internalizing pathways or combinations of both (e.g., Cicchetti & Handley, 2019; Farmer et al., 2016).

The lack of significant relations between ADHD diagnostic status and indicators of sexual risk behavior may be explained in several ways. First, earlier analyses of this sample documented significant between-group differences in some forms of sexual risk behavior, between a cluster of adolescents with very low levels of current psychopathology and four other clusters of adolescents with higher levels of psychopathology (Oshri et al., 2008). In the present analysis, both adolescents with and without a current ADHD diagnosis reported high levels of co-occurring psychiatric symptoms and comparable high levels of sexual risk behaviors. Second, a study by Sarver, McCart, Sheidow and Letourneau (2014) found that the relation between impulsivity and sexual risk behavior was almost entirely mediated by conduct and substance use problems. In our sample, clients both with and without a current ADHD diagnosis reported high levels of co-occurring conduct disorder and SUD symptoms. Therefore, patterning of sexual risk behavior may be better explained by a general propensity towards externalizing behaviors, rather than influences specific to ADHD. Third, an earlier study documenting that childhood ADHD prospectively predicted risky sexual behaviors in early adulthood was restricted to an entirely male and largely Caucasian sample

of community individuals (Flory, Molina, Pelham, Gnagy, & Smith, 2006). Therefore, the ADHD-sexual risk behavior relation may not generalize to other groups. The sample used in the present study was younger, more diverse in terms of gender and race/ethnicity, and recruited from outpatient substance abuse treatment centers.

Implications for Substance Abuse Treatment

Most adolescents receiving treatment for substance abuse problems experience co-occurring psychiatric symptoms. Adolescents assigned ADHD diagnoses, in addition to ongoing substance use problems, are likely to benefit from integrated approaches to the treatment of these co-occurring conditions. Personalized feedback can be provided on how substance abuse may worsen comorbid psychiatric conditions (Esposito-Smythers, Rallis, Machell, Williams, & Fischer, 2018). The combination of stimulant medication and cognitive behavioral therapy (CBT) has shown effectiveness for decreasing substance use among adolescents with comorbid ADHD and SUD (Tamm et al., 2013), in particular, extended release stimulants that display low potential for abuse (Zaso, Park, & Antshel, 2015). Other interventions that may aid in addressing comorbid conditions involve envisioning the pros and cons of a future without substance use, setting practical goals for both SUDs and comorbid conditions, and developing strategies to overcome SUD treatment barriers (Esposito-Smythers et al., 2018). Discussion of both SUDs and co-occurring mental health issues may emphasize how decreasing substance use can have positive effects on mental health more broadly. Additional assessments for adolescents manifesting severe psychiatric symptoms can determine if an adolescent needs adjunctive interventions for co-occurring psychiatric conditions.

Adolescents accessing substance abuse treatment services should be screened routinely for ADHD symptoms, in addition to substance use severity, and impairment related to co-occurring psychiatric disorders (e.g., Matthys et al., 2014). Attending to core developmental needs of adolescents, such as the need to demonstrate autonomy and competence, is critical to engage youth in substance abuse treatment, enhance motivation to change maladaptive behaviors and facilitate positive treatment outcomes for co-occurring mental and behavioral health issues (Brauers, Kroneman, Otten, Lindauer, & Popma, 2016). While adolescents' mental health needs can act as significant barriers to their engagement with substance abuse treatment, frameworks that address both psychopathology and substance abuse have the capacity, not only to enhance adolescents' willingness to engage in substance abuse treatment, but also to transform the systems that deliver treatment services for SUDs (Ford & Blaustein, 2013).

Our findings also have significant implications for HIV/STI risk reduction efforts in the context of adolescent substance abuse treatment programs. Boys and girls in treatment for substance abuse may endorse substantially different patterns of sexual risk behaviors. Thus, HIV/STI prevention materials implemented in treatment settings should be tailored to provide gender-appropriate behavioral risk reduction strategies. Several randomized controlled trials aimed at empowering women who use alcohol and other drugs to negotiate condom use with potential sexual partners, as well as biomedical prevention strategies to reduce HIV risk when women are unable to negotiate condom use, have shown initial

efficacy (e.g., Wechsberg et al., 2015). As substance use is more strongly related to sexual risk behavior among women (Ritchwood et al., 2015), addressing the role of alcohol and drug use in enacting sexual risk behavior is particularly important for risk reduction among adolescent girls. Adolescents receiving substance abuse treatment services can benefit from routine screening for sexual risk behaviors, in addition to ADHD symptoms and co-occurring psychiatric impairment, as adolescents in our study reported substantial heterogeneity in these behavioral health concerns.

Limitations

The results of the present study should be interpreted in the context of several important limitations. First, the data analyzed were collected from a single source, which can result in inflated associations among variables. More stable estimates of psychiatric symptoms may have been obtained using multiple informants and assessment techniques. These self-report data were also subject to biases, including distorted recall and social desirability. Second, the cross-sectional analyses presented do not allow causal statements to be drawn from the findings. Third, the analyses presented are based on a sample of adolescents receiving outpatient substance abuse treatment services. These findings may not generalize to samples of adolescents undergoing inpatient treatment or to adolescents with substance use problems in community settings. Last, it is possible that the ADHD symptoms assessed in our study are the result of prolonged substance abuse.

Despite these limitations, this study documented multivariate patterns of psychiatric symptoms associated with ADHD diagnostic status, regardless of ADHD subtype, that did not generalize to co-occurring sexual risk behaviors. The screening of adolescent clients entering treatment for substance use problems is warranted to facilitate treatment planning and to better understand barriers to treatment engagement, as well as the unique needs of boys and girls receiving these services. Future research is needed to understand more fully the influence of combinations of ADHD subtypes, co-occurring psychiatric symptom profiles, and sexual risk behaviors on the health and well-being of adolescents receiving substance abuse treatment services.

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Table 1

Means, Standard Deviations, Ranges, and Intercorrelations among Psychiatric Symptom Scores and Sexual Risk Behaviors in a Sample of Adolescents Receiving Outpatient Treatment Services

	1	2	3	4	5	6	7	8	9	10	11	12
<i>Psychiatric Symptom Scores</i>												
1 ADHD	--	.34*	.30*	.43*	.30*	.36*	.17*	.11*	-.06	-.21*	-.02	.03
2 Anxiety		--	.49*	.28*	.22*	.25*	.11*	.15*	-.07	-.06	-.04	.06
3 Affective			--	.24*	.39*	.36*	.16*	.24*	-.16*	-.05	.05	.11*
4 Conduct Disorder				--	.32*	.43*	.20*	.21*	-.15*	-.29*	.14*	.06
5 Alcohol Abuse/Dependence					--	.45*	.35*	.23*	-.15*	-.20*	.04	.05
6 Drug Abuse/Dependence						--	.29*	.41*	-.17*	-.40*	.11*	.12*
<i>Sexual Risk Behaviors</i>												
7 Alcohol Use Before Sex							--	.41	-.15*	-.31*	.17*	.16*
8 Drug Use Before Sex								--	-.17*	-.30*	.16*	.14*
9 Condom Use During Sex									--	.17*	.05	.04
10 Alcohol-Sexual Outcome Expectancies										--	-.06	-.09
11 Lifetime Sex Partners											--	.61*
12 Past-Year Sex Partners												--
Mean	8.70	8.00	3.02	8.20	1.57	4.51	2.13	2.62	3.77	3.13	10.74	4.90
SD	5.45	5.41	4.06	3.18	2.23	3.50	1.11	1.35	1.27	1.02	13.68	7.73
Range	18	32	18	17	10	11	4	4	4	4	149	90

Note:

* = $p < .05$. $N = 394$

Table 2

Mean Psychiatric Symptoms Score by ADHD-Inattentive Type Status and Gender

	Clinical Diagnosis				No Diagnosis			
	Boys (<i>n</i> = 101)		Girls (<i>n</i> = 41)		Boys (<i>n</i> = 170)		Girls (<i>n</i> = 69)	
	M	SD	M	SD	M	SD	M	SD
Psychiatric Symptom Score								
Anxiety Disorders ^{a, c}	8.87	5.65	11.17	7.05	6.75	3.26	9.50	6.43
Affective Disorders ^{b, c}	2.90	3.43	6.76	4.49	1.79	3.16	4.62	5.01
Conduct Disorder ^b	9.43	2.90	9.37	2.93	8.11	2.63	7.71	2.41
Alcohol Abuse/Dependence ^{b, c}	1.85	2.16	3.24	2.95	1.08	1.84	1.70	2.37
Drug Abuse/Dependence ^b	5.90	3.06	6.10	3.58	3.81	3.22	4.20	3.76

Note. Pillai's Trace_{ADHD} = .11, $F(5, 373) = 9.24$, $p < .001$. Pillai's Trace_{gender} = .16, $F(5, 373) = 14.44$, $p < .001$.

^a $p_{ADHD} < .01$

^b $p_{ADHD} < .001$

^c $p_{gender} < .001$.

Table 3

Mean Psychiatric Symptoms Score by ADHD-Hyperactive-Impulsive Type Status and Gender

	Clinical Diagnosis				No Diagnosis			
	Boys (<i>n</i> = 76)		Girls (<i>n</i> = 34)		Boys (<i>n</i> = 195)		Girls (<i>n</i> = 76)	
	M	SD	M	SD	M	SD	M	SD
<u>Psychiatric Symptom Score</u>								
Anxiety Disorders ^{a, c}	9.12	5.91	11.88	7.67	6.92	3.51	9.34	6.09
Affective Disorders ^{b, c}	2.96	3.50	6.41	4.34	1.91	3.18	4.97	5.11
Conduct Disorder ^b	9.66	2.67	9.97	2.96	8.19	2.75	7.59	2.27
Alcohol Abuse/Dependence ^{b, c}	1.99	2.39	3.44	2.95	1.12	1.77	1.75	2.42
Drug Abuse/Dependence ^b	5.83	3.34	6.32	3.68	4.11	3.18	4.28	3.68

Note. Pillai's Trace_{ADHD} = .13, $F(5, 373) = 11.16$, $p < .001$. Pillai's Trace_{gender} = .14, $F(5, 373) = 12.30$, $p < .001$.

^a $p_{ADHD} < .01$

^b $p_{ADHD} < .001$

^c $p_{gender} < .001$.

Table 4

Mean Psychiatric Symptoms Score by ADHD-Combined Type Status and Gender

	Clinical Diagnosis				No Diagnosis			
	Boys (<i>n</i> = 55)		Girls (<i>n</i> = 27)		Boys (<i>n</i> = 216)		Girls (<i>n</i> = 83)	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
<u>Psychiatric Symptom Score</u>								
Anxiety Disorders ^{a, c}	9.45	6.17	11.22	7.44	7.05	3.71	9.77	6.43
Affective Disorders ^c	2.91	3.64	6.15	3.60	2.03	3.19	5.18	5.26
Conduct Disorder ^b	9.80	2.76	9.96	3.08	8.30	2.74	7.80	2.38
Alcohol Abuse/Dependence ^{b, c}	2.07	2.28	3.37	2.83	1.19	1.88	1.92	2.57
Drug Abuse/Dependence ^b	6.31	3.27	6.19	3.61	4.15	3.19	4.49	3.77

Note. Pillai's Trace_{ADHD} = .10, $F(5, 373) = 8.16$, $p < .001$. Pillai's Trace_{gender} = .12, $F(5, 373) = 10.18$, $p < .001$.

^a $p_{ADHD} < .01$

^b $p_{ADHD} < .001$

^c $p_{gender} < .001$.