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ADHD and risky sexual behavior in adolescents: Conduct problems and substance use as mediators of risk

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Abstract

Background—Recent studies have linked attention-deficit/hyperactivity disorder (ADHD) to elevated rates of risky sexual behavior (RSB) in adult samples. The current study tested whether ADHD symptoms were associated with RSB among adolescents, and examined comorbid conduct problems and problematic substance use as joint mediators of this association.

Methods—ADHD symptoms, conduct problems (oppositional defiant disorder/conduct disorder symptoms), problematic alcohol use (alcohol use disorder symptoms, alcohol use frequency), problematic marijuana use (marijuana use disorder symptoms, marijuana use frequency), and RSB were assessed among an ethnically diverse cross-sectional sample of adolescents ($N=115$; mean age=14.9 years) involved in the juvenile justice system.

Results—Bootstrapped mediation models revealed an initial association between ADHD symptoms and RSB that was accounted for fully by the influence of problematic alcohol and marijuana use, but not conduct problems. A follow-up multiple groups mediation analysis demonstrated that the relationship between ADHD symptoms and RSB emerged only among youth with clinically elevated conduct problems, and that problematic marijuana use fully accounted for this relationship. Hyperactive/impulsive but not inattentive symptoms were related to RSB, although the pattern of indirect effects was consistent with the multiple groups analysis.

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Conclusions—The association between ADHD and adolescent RSB is restricted to youth with elevated comorbid conduct problems and reflects the contributions of comorbid marijuana use problems, and to a lesser extent alcohol use problems. Early identification and treatment of these comorbid conditions may be important for the prevention of negative sexual health outcomes among youth with ADHD.

Keywords

ADHD; Conduct Problems; Substance Use; Risky Sexual Behavior; Adolescents

Attention-deficit/hyperactivity disorder (ADHD) is a neurodevelopmental disorder characterized by developmentally inappropriate dimensions of inattention and hyperactivity/impulsivity. ADHD affects 5–7% of youth worldwide (Polanczyk et al., 2007) and produces a significant and costly societal burden (Pelham, Foster, & Robb, 2007). Psychosocial consequences associated with ADHD are well documented and include poor academic and social functioning (Boo & Prins, 2007; Sarver et al., 2012). The certainty of ADHD's unique impact on adverse health outcomes is less clear, but may include heightened risk for HIV and other sexually transmitted infections (STIs) secondary to elevated rates of risky sexual behavior (RSB; Nigg, 2013).

The first studies documenting a link between ADHD and RSB involved prospective evaluations of clinic-referred youth followed into early adulthood. Compared to community controls, Barkley and colleagues (2006) observed that hyperactive children followed until 19–25 years of age had an earlier age of first sexual intercourse, more lifetime sexual partners, higher rates of pregnancy/impregnation, and higher rates of lifetime STIs. Similarly, Flory and colleagues (2006) followed boys with and without ADHD through 18–26 years of age. ADHD probands experienced an earlier sexual debut, engaged in more casual sex, and had more lifetime partners and partner pregnancies compared to controls. In both studies, ADHD contributed independently to RSB, and comorbid conduct problems amplified rates of RSB among adult ADHD probands.

Comorbid conduct problems appear to be an important underlying mediator of the link between ADHD and RSB. Findings from a recent 33-year longitudinal study (Ramos et al., 2013) examined the effects of childhood ADHD on RSB in middle adulthood (mean age 41 years). A developmental sequence was found wherein the emergence of lifetime conduct disorder or antisocial personality disorder in adolescence or adulthood mediated the link between childhood ADHD and adult RSB. In contrast to earlier studies, children with ADHD who did not develop conduct disorder displayed similar rates of lifetime RSB as community controls.

The influence of alternative mediators underlying ADHD-related RSB remains unknown. However, substance use represents a relevant candidate, given strong evidence for the interrelations between ADHD, substance use, conduct problems, and RSB among adolescents. Indeed, meta-analytic findings of prospective studies confirm that ADHD predicts substance use problems in youth (Lee, Humphreys, Flory, Liu, & Glass, 2011). Comorbid conduct problems also exacerbate substance use risk (Biederman et al., 1997). Adolescent substance use also correlates with several sexual risk indicators including early

sexual debut, intercourse frequency, multiple sexual partners, and inconsistent condom use (Bryan & Stallings, 2002; Capaldi, Stoolmiller, Clark, & Owen, 2002). Given covariation between ADHD and the development of adolescent conduct problems and substance use, the issue of their relative contributions to RSB is important to clarify. For example, conduct disturbance predicts RSB in many (Capaldi et al., 2002; Donenberg et al., 2001; Ramos et al., 2013) but not all studies (Brown et al., 2010), and adolescent substance use appears to predict STIs more strongly than antisocial behavior (Capaldi et al., 2002). Therefore, increased RSB associated with ADHD may reflect indirectly the extent to which comorbid conduct problems, and particularly substance use problems, have developed. The current study is the first to test this prediction.

Developmental generalizability of previous findings also warrants investigation. No systematic study has assessed generalizability to adolescent samples. This is important because, relative to adults, adolescents are more likely to engage in sexual risk taking behavior (Fergus, Zimmerman, & Caldwell, 2007) and to have transient romantic relationships with high partner turnover (Carver, Joyner, & Udry, 2003). Interestingly, unique effects of ADHD on RSB were observed in prospective studies when RSB was measured during early (Barkley et al., 2006; Flory et al., 2006) but not middle (Ramos et al., 2013) adulthood, suggesting that ADHD may exert stronger contributions to RSB in adolescence than in adulthood.

The extant literature's reliance on restricted diagnostic groups also is a limitation given that taxonomic (Coghill & Sonuga-Barke, 2012) and genetic (Nikolas & Burt, 2010) investigations uniformly support a dimensional rather than categorical structure of ADHD. As an additional complicating factor, many of the past studies examining potential predictors of sexual risk have combined ADHD symptoms with other externalizing behaviors (Brown et al., 2010; Moffitt et al., 2011). This makes it difficult to discern the relative contributions of ADHD symptom dimensions to RSB. In particular, it seems reasonable to suspect that hyperactivity/impulsivity symptoms may be more strongly associated with RSB than inattentive symptoms, but this distinction has not previously been examined. However, one study did suggest that parent and teacher ratings of childhood hyperactivity do not predict adult RSB (Ramrakha et al., 2007). Collectively, firm conclusions regarding the contribution of ADHD symptom dimensions to RSB are limited as prior methods have either (a) examined ADHD diagnostic status only, (b) examined overall ADHD symptom severity, (c) used brief screening instruments to capture symptom constructs, or (d) used broad measures that combine ADHD symptoms with other externalizing behaviors.

The aims of the current study were to examine the association between ADHD symptoms and RSB in an adolescent sample and to test the extent to which conduct problems (oppositional defiant disorder [ODD]/conduct disorder [CD] symptoms) and problematic substance use (marijuana/alcohol use disorder symptoms and frequency of use) act as joint mediating pathways to RSB. We expected RSB to be predicted by ADHD and mediated more strongly by problematic substance use than conduct problems.

Given prior research (Ramos et al., 2013), follow-up analyses tested whether associations among ADHD symptoms, substance use, and RSB varied based on the presence/absence of elevated comorbid conduct problems. The study also examined ADHD symptom dimensions separately, and effects were expected to be driven more strongly by hyperactive/impulsive symptoms than by inattentive symptoms.

Methods

Design and Overview

Data for the current study come from an ongoing randomized clinical trial (RCT) evaluating the effectiveness of a substance use and sexual risk reduction intervention for youth involved in Juvenile Drug Court (JDC; ClinicalTrials.gov Identifier: NCT01511380; <http://www.clinicaltrials.gov/ct2/show/NCT01511380>). The study is being conducted in collaboration with two JDCs in the southeastern United States. All youth entering the JDCs as new referrals are screened by research staff for study eligibility. Following screening, research staff meet with youth and their caregivers to describe the study and to obtain informed consent/assent.

Participants in the RCT complete comprehensive interviews and clinical outcome measures at six time points (baseline, 3-, 6-, 9-, 12-, and 18-months post-baseline). The present study focuses exclusively on detailed informant interviews obtained at the baseline (pre-treatment) assessment only. Trained research assistants administered structured diagnostic interviews and clinical measures at times and places convenient to families, typically at the family's home. Families were compensated \$30 for completing each assessment. Institutional Review Board approval was obtained prior to data collection.

Participants

Youth enter JDC primarily through referral from juvenile justice authorities following arrest and adjudication for a substance-related offense. Inclusion criteria for the RCT are: (a) 12–17 years of age, (b) formal or informal probationary status, and (c) youth and parent/caregiver English fluency. Children with gross neurological problems, significant medical disorder, significant intellectual disabilities, or active psychosis were excluded. A JDC sample was chosen specifically for the current investigation to increase statistical power to test study hypotheses through achieving greater variability in RSB, as justice-involved youth exhibit more RSB than community or outpatient samples (Teplin, Mericle, McClelland, & Abram, 2003).

The sample for the current study includes 115 youth from the ongoing RCT who were recruited through October 2012. The sample's mean age was 14.9 years ($SD=1.4$). Gender composition was 84% male and 16% female. The racial composition of the sample was 55% Caucasian, 32% African American, 10% multiracial, 2% Hispanic and 1% Asian American. Approximately 27% of youth lived with both biological parents, 27% lived with a biological parent and another adult, 37% with a single biological parent, and 9% with other relatives. Most youth self-identified as heterosexual (91%), and 9% identified as bisexual. Overall, the sample of participating families was socioeconomically disadvantaged. Median annual

household income was in the \$20,000–\$30,000 range, and 41% of families were receiving some sort of financial assistance. Twenty-one youth (18%) had been prescribed psychiatric medication within the past year, primarily stimulants/atomoxetine (62%) or antidepressants (38%). Thirty-one youth (27%) had received outpatient mental health treatment in their lifetime (16 within past year). Ten youth (9%) had received outpatient substance abuse treatment in their lifetime (5 within past year).

Measures

ADHD, ODD/CD, and Marijuana/Alcohol Use Disorder Symptoms—ADHD, ODD/CD, and marijuana/alcohol use disorder symptoms were assessed using the Diagnostic Interview Schedule for Children-IV, 4.0 Present State version (DISC-IV; Shaffer, Fisher, Lucas, Dulcan, & Schwab-Stone, 2000). All DISC-IV Present State outcomes in the current investigation reflect past year symptoms only, with the exception of ADHD symptoms, which were assessed for the previous six months. Psychometric properties of the DISC-IV are well-established (Schwab-Stone et al., 1996; Shaffer et al., 2000). Research staff administered the DISC-IV to caregivers via computer, and adolescents self-administered the interview using a computer program that presented prerecorded questions via headphones.

The DISC-IV clinical symptom scoring algorithm was used to quantify symptoms from the ADHD, ODD, CD, marijuana use disorder, and alcohol use disorder modules, based on caregiver and youth report. The clinical symptom algorithm was chosen in lieu of determining diagnostic caseness due to its superior reliability when using combined caregiver-child symptom accounts of these behaviors (Schaffer et al., 2000)¹. This dimensional conceptualization takes advantage of the sample's full symptom range and retains continuous metrics of the disorders that align with extant research supporting the dimensional nature of ADHD symptoms, youth antisocial behavior, and substance use (Coghill & Sonuga-Barke, 2012). Caregiver and youth symptom endorsements were combined using the "OR rule" classification method wherein individual symptoms were counted as positive if endorsed by either the caregiver or youth.

ADHD Symptoms—ADHD was defined by the total number of combined DISC-IV clinical symptom endorsements across the inattention and hyperactivity/impulsivity items. Internal reliability (coefficient α) was .91 for combined ADHD symptoms, .91 for inattention symptoms, and .87 for hyperactivity/impulsivity symptoms.

Conduct Problems (ODD/CD Symptoms)—Conduct problems were defined by the total number of combined DISC-IV clinical symptom endorsements for ODD and CD. Internal reliability was .89 for combined ODD/CD symptoms, .86 for ODD symptoms and .79 for CD symptoms.

Marijuana/Alcohol Use Disorder Symptoms—Marijuana use disorder symptoms were defined as the number of DSM-IV symptoms endorsed for both marijuana abuse and marijuana dependence. An identical approach was used to define alcohol use disorder

¹Prevalence of diagnostic caseness for the disorders, however, is presented in Table 1 for interpretative purposes.

symptoms. Internal reliability was .86 for marijuana use disorder symptoms and .85 for alcohol use disorder symptoms.

Substance Use Frequency—Self-reported substance use frequency was assessed using a variation of the Form 90 (Miller, 1991), which is an interview based on the timeline follow-back (TLFB) methodology. The TLFB method quantifies the specific amounts of substances consumed by individuals during the previous 90 days. Only the number of reported days of marijuana and alcohol use were examined due to infrequent reports of use of other drugs in the sample (i.e., only 9 youth reported using a substance other than marijuana/alcohol in the past 90 days). Research with adolescents indicates that the TLFB method is reliable (Waldron, Slesnick, Brody, Turner, & Peterson, 2001) and yields data that correspond with biological markers and collateral reports of youth substance use (Donohue et al., 2004).

RSB—The Sexual Risk Behavior Scale (SRBS) assessed youths' self-reported involvement in risky sexual activities. The SRBS contains 21 questions related to youth's recent (past three months) and lifetime sexual relationships and behaviors. For the current study, seven indicators of risky sexual behavior were obtained from the SRBS. One additional item assessing youth's prior HIV testing history was obtained from an HIV Counseling and Testing Questionnaire (CTQ; Genberg et al., 2008). A composite variable representing total cumulative sexual risk was created to index RSB, given that unsafe sexual behaviors often cluster together (Capaldi et al., 2002) and the accumulation of multiple risk factors increases the likelihood of HIV and other STIs (Beadnell et al., 2005). The eight items extracted from the SRBS and CTQ were chosen based on a literature review of the behaviors reflecting risk for adverse sexual health. Items were dichotomized as present/absent. The first four items assessed lifetime history of: (a) vaginal sexual intercourse², (b) early sexual debut (defined as first intercourse at age 14), (c) multiple sexual partners (3 partners), and (d) HIV testing. The second four items assessed recent (past three months) history of: (e) engaging in sex with a casual partner (i.e., friend, non-romantic partner), (f) having a one-time sexual partner (i.e., stranger or acquaintance), (g) multiple sexual partners (2 partners), and (h) inconsistent condom use (defined as < 100% of sexual intercourse encounters). The internal consistency of the eight items was .77.

Covariates

Recruitment site, youth age, gender, race/ethnicity, and annual household income were considered as potential covariates in all models and retained if related significantly to RSB.

Data Analytic Approach

Prior to data analysis, two latent factor score variables were created reflecting problematic marijuana use and problematic alcohol use. This was accomplished using principal components factor analysis on the DISC-IV and TLFB measures for marijuana (74.65% variance accounted for; both factor loadings $r=.86$; eigenvalue=1.49) and alcohol (69.57% variance accounted for; both factor loadings $r=.83$; eigenvalue=1.39). This procedure had

²History of anal intercourse was not included because all youth endorsing anal sex histories also reported vaginal intercourse histories.

the advantage of forming variables that reflect reliable variance associated with problematic marijuana and alcohol use by removing method-specific and random error among the individual clinical symptom and use frequency measures.³

Mediation analyses were conducted utilizing bias-corrected, accelerated bootstrapped confidence interval (CI) procedures (Hayes & Scharkow, 2013; Shrout & Bolger, 2002). Bootstrapped CIs are preferred over traditional mediation methods, such as the Sobel method, due to the lack of restrictive assumptions regarding the sampling distribution of the indirect effect and increased reliability for detecting mediating effects. Bootstrapping was used to estimate and determine the statistical significance of all total, direct, and indirect effects. We selected 90% CIs over 95% CIs because the former favors detection of an additional independent contribution of ADHD to RSB (i.e., c' pathway) beyond the influence of the mediators included in the model.⁴

Effect ratios (indirect effect divided by total effect) were calculated to estimate the proportion of the relationship between ADHD and RSB that was attributable to each mediator instead of using traditional full versus partial mediation monikers. Effect ratios (ER) were not calculated for models with indirect effect CIs that included 0.0. AMOS version 18.0.2 was used for all analyses. Five thousand samples were derived from the original sample ($n=115$) by a process of resampling with replacement. All variables were standardized prior to entry into the models.

A two-tiered data analytic approach was used. Intercorrelations among the study variables were computed in Tier I. Tier II used bootstrapped mediation analyses to model whether the influence of ADHD on RSB is direct, indirect through its impact on the putative mediators (conduct problems, problematic marijuana use, problematic alcohol use), both direct and indirect, or better accounted for by the influence of conduct problems, problematic marijuana use, or problematic alcohol use as explanatory predictors but not mediators. Follow-up models examined the impact of elevated comorbid conduct problems (i.e., presence/absence of meeting diagnostic criteria for ODD/CD) on associations among ADHD symptoms, problematic substance use, and RSB. In addition, follow-up models examined each ADHD symptom dimension separately. Indirect effect magnitudes were contrasted when multiple significant pathways emerged. Residual variances among mediators were allowed to correlate in the models.

³A one-factor solution best described the constructs based on eigenvalues for a second factor falling below 1.0 for marijuana (0.51) and alcohol (0.61) use. An alternative unitary substance use factor and a two-factor solution representing separate substance use symptom severity and frequency variables were evaluated but both alternatives provided comparatively poorer solutions based on χ^2 contrasts (all model contrasts $p < .0005$).

⁴Briefly, the wider 95% CI increases the likelihood that the CI for c' will include 0.0, indicating that ADHD symptoms and RSB are no longer related significantly after accounting for the mediators (i.e., full mediation in Baron & Kenny, 1986, terminology). In contrast, the narrower 90% CI is less likely to include 0.0, and therefore is likely to result in a more conservative conclusion regarding the magnitude of the relation between ADHD and RSB after accounting for the mediators (i.e., partial mediation). For discussion and specific examples of this phenomenon, see Shrout and Bolger (2002).

Results

Preliminary Analyses

Table 1 presents descriptive statistics for the number of youth meeting diagnostic criteria for ADHD, ODD/CD, a marijuana use disorder, and an alcohol use disorder and for the number of youth endorsing each RSB item. Differences in the overall RSB rates were observed across the two recruitment sites, and the site variable was a significant covariate in all mediation models. In contrast, youth age, gender, race/ethnicity, and annual household income were not significant covariates in any model. Thus, all models are presented controlling for recruitment site only.

Tier I: Intercorrelations—Means, standard deviations, and correlations among the primary study variables are presented in Table S1 (see Appendix online). Multicollinearity tests were within acceptable ranges (e.g., Tolerance=.44–.84). All variables were significantly correlated with the exception of inattention symptoms and RSB. Inattention symptoms were retained in the Tier II mediation models, however, because indirect relationships between two variables may exist despite nonexistent direct relationships.

Tier II: Mediation Models

Total ADHD symptoms: The path analysis in Figure 1 depicts the direct effects and indirect pathways for the contribution of ADHD symptoms on RSB through its effect on problematic alcohol use, problematic marijuana use, and conduct problems. Together the model accounted for 38% of the variation in RSB ($p < .0001$). Examination of the total effect indicated that ADHD symptoms exerted a significant impact on RSB ($\beta = 0.17$, $SE = 0.08$, $p = .04$, $CI = 0.03–0.32$) prior to considering the mediators. ADHD symptoms were also associated with problematic alcohol use ($\beta = 0.33$, $SE = 0.09$, $p < .0005$, $CI = 0.19–0.42$), problematic marijuana use ($\beta = 0.32$, $SE = 0.09$, $p < .001$, $CI = 0.18–0.48$), and conduct problems ($\beta = 0.71$, $SE = 0.04$, $p < .0001$, $CI = 0.63–0.77$). In turn, problematic alcohol use ($\beta = 0.15$, $SE = 0.08$, $p = .07$, $CI = 0.03–0.29$) and problematic marijuana use ($\beta = 0.31$, $SE = 0.10$, $p = .0005$, $CI = 0.14–0.48$) predicted RSB after accounting for the influence of ADHD symptoms, whereas conduct problems ($\beta = 0.17$, $SE = 0.13$, $p = .20$, $CI = -0.04–0.39$) did not independently predict RSB after accounting for ADHD symptoms.

Interpretation of the full bootstrapped mediation model indicated that ADHD exerted significant indirect effects on RSB through joint independent contributions to problematic alcohol use ($\beta = 0.05$, $SE = .03$, $p = .04$, $CI = 0.02–0.12$; ER=29%) and problematic marijuana use ($\beta = 0.10$, $SE = .04$, $p = .01$, $CI = 0.04–0.19$; ER=59%). The indirect effect of ADHD on RSB through conduct problems was non-significant ($\beta = 0.12$, $SE = .09$, $p = .19$, $CI = -0.03–0.27$). Examination of the ER for the total of significant indirect effects revealed that the two pathways collectively accounted for 88% of ADHD's contribution to RSB. Pairwise contrasts indicated that the mediating pathways were not significantly different in magnitude (i.e., all 90% CIs for mediator contrasts contained 0.0). ADHD symptoms no longer predicted RSB after accounting for the indirect effects ($\beta = -0.09$, $SE = 0.13$, $p = .41$, $CI = -0.32–0.14$).

Impact of comorbid conduct problems: A follow-up multiple groups analysis revealed that the mediation models differed significantly according to the presence/absence of elevated comorbid conduct problems ($\chi^2(6)=16.68, p<.05$). For youth without a clinical diagnosis of ODD/CD, ADHD was not related to RSB either directly or indirectly (all 90% CIs contained 0.0; all p values $\geq .26$). In contrast, ADHD symptoms initially predicted RSB among youth with a diagnosis of ODD/CD ($\beta=0.26, SE=0.13, p=.04, CI=0.06-0.45$). This relationship was mediated entirely by problematic marijuana use ($\beta=0.30, SE=0.10, p=.002, CI=0.14-0.52; ER=100\%$) and not by problematic alcohol use ($\beta=0.04, SE=0.11, p=.72, CI=-0.03-0.14$), with the model collectively accounting for 61% of individual differences in RSB. Figure 2a–b depicts the mediation models separately for youth with and without elevated comorbid conduct problems.

ADHD domains: The pattern of results when modeling hyperactivity/impulsivity symptoms across the entire sample was highly consistent with the overall mediation model involving total ADHD symptoms. In contrast, inattention symptoms did not predict RSB, but contributed indirectly through their association with problematic alcohol and marijuana use (total indirect effect: $\beta=0.26, SE=0.08, p<.0001, CI=0.13-0.41$). Standardized β -weights, SE , effect ratios, and CIs are shown in Tables S2 and S3 for the inattention and hyperactivity/impulsivity models, respectively.

Repeating the models among youth with elevated conduct problems, the pattern and magnitude of effects from the symptom dimension analyses remained identical. For youth without elevated conduct problems, neither ADHD symptom dimension demonstrated direct or indirect relationships with RSB (all 90% CIs contained 0.0; all p values $> .32$).

Discussion

This was the first study to examine the association between ADHD symptoms and RSB in adolescents, and to test whether conduct problems and problematic substance use mediate the relationship. Data were obtained from a high-risk sample of youth involved in the juvenile justice system. Consequently, rates of clinical disorders and RSB were elevated relative to national estimates. For example, in the National Comorbidity Survey-Adolescent Supplement (Kessler, 2013), rates of ADHD, ODD/CD, and alcohol use disorders were 6.4%, 13.6%, and 4.6%, respectively, whereas the corresponding rates in the current sample were 15.7%, 42.6%, and 14.8%. Similarly, youth in the current study reported higher rates of lifetime vaginal intercourse (63.5% vs. 47.4%) and multiple sexual partners (34.8% vs. 15.3%) relative to youth participating in the national Youth Risk Behavior Survey (Centers for Disease Control and Prevention, 2012). Thus, participants were quite symptomatic and engaging in high rates of sexual risk behaviors.

Mediation models revealed an initial direct association between ADHD symptoms and self-reported RSB, replicating and extending prior research (Barkley et al., 2006; Flory et al., 2006). This effect, however, was accounted for by the independent pathways of problematic alcohol and marijuana use, but not conduct problems. ADHD's indirect relationship through these substance use pathways is also consistent with prior meta-analytic investigations demonstrating that childhood ADHD confers increased risk for later substance use problems

(Lee et al., 2011). Importantly, the interrelationships among ADHD, problematic substance use, and RSB differed according to the presence of youths' comorbid conduct problems. Specifically, the contribution of ADHD to RSB was restricted to a subset of youth exhibiting significant comorbid conduct problems and was mediated fully by problematic marijuana use, whereas ADHD was unrelated directly or indirectly to RSB among youth without elevated conduct problems. The results collectively indicate that the association between ADHD and RSB reflects the extent to which comorbid conduct problems—and particularly substance use problems—have developed.

The influence that conduct problems contributed to RSB underscores the importance of these behaviors as risk factors for adverse sexual health outcomes (Donenberg et al., 2001; Ramos et al., 2013). Indeed, the prediction of individual differences in RSB was substantially improved when examining only youth with ODD/CD (61%) relative to the overall sample (38%). These results also support prior findings (Ramos et al., 2013) demonstrating that the development of CD mediates the longitudinal association between childhood ADHD and sexual risk taking behavior later in life. The present investigation extends this explanation further by demonstrating that the presence of comorbid conduct problems moderates the indirect association of ADHD and RSB via stronger relationships with problematic substance use. Nonetheless, it is intriguing that conduct problems did not exert an independent mediating effect on RSB despite the high rates of early sexual debut among sexually active youth in the sample (74%). Indeed, conduct problems represent strong predictors of early sexual activity among youth (Ramrakha et al., 2007). The absence of an independent effect may reflect the moderate overlap with the substance use variables and/or the additional risk conveyed by problematic substance use for RSBs beyond early sexual debut.

A unique role emerged for problematic substance use, wherein engagement in alcohol and marijuana use mediated ADHD's contribution to RSB in the overall sample. Problematic alcohol and marijuana use each explained similar amounts of variance in the ADHD-to-RSB association that was independent of conduct problems. This finding broadly supports previous research regarding the prediction that substance use and conduct problems impact RSB differentially (Capaldi et al., 2002). Only problematic marijuana use, however, continued to mediate ADHD's relationship with RSB among youth with elevated comorbid conduct problems. There are several potential factors that may explain the unique influence of marijuana use problems on RSB in this subsample. For instance, this pattern corresponds to previous evidence from detained adolescent samples suggesting that marijuana but not alcohol use is linked to elevated rates of RSB, and that sexual activity occurs more frequently under the influence of marijuana relative to alcohol (Kingree & Betz, 2003). Additionally, the base rate for alcohol use in the sample was low relative to marijuana use, which may have limited detection of an effect within the smaller sample of youth with ODD/CD.

Limitations

The cross-sectional design constrains temporal conclusions regarding the role of the identified mediators. It is important to note that the study consisted of a relatively small

sample of primarily male substance using youth involved in the juvenile justice system. Thus, generalization to community samples, youth with less severe problems, and to populations with more girls is important to examine. Methodological limitations include reliance on self-report indicators of RSB, no teacher reported ADHD symptoms, and an absence of the examination of neurocognitive, social, and peer functioning indicators that are known to influence youth's RSB. Alternative contextual processes that are common to conduct problems and problematic substance use such as peer delinquency and sensation seeking need to be considered in future investigations.

Implications

Collectively, the association between ADHD symptoms and RSB among adolescents is restricted to youth with clinically elevated comorbid conduct problems, and is fully mediated by comorbid marijuana use problems. Such findings have several important clinical implications. First, it is important to note that while pharmacological interventions are used commonly to treat ADHD symptoms, it is unlikely that medication alone will prevent youth from engaging in RSB given limited evidence for positive, generalizable long-term effects of medication on other key psychosocial outcomes (Molina et al., 2009). Thus, regular screening for conduct problems, problematic substance use, and RSB seems warranted for youth receiving ADHD treatment. For younger ADHD-positive youth who have not yet developed conduct or substance use problems, the delivery of interventions aimed at preventing the emergence of these problems may reduce risk for later RSB. However, this hypothesis would need to be tested in a clinical sample. The recent development of early intervention efforts among pre-school aged children with ADHD (Halperin, Bédard, & Curchack-Lichtin, 2012), if successful, may hold particular promise for altering the risk for later conduct problems, substance use problems, and adverse sexual health outcomes. For older youth with ADHD who have already developed comorbid conduct problems and/or substance use problems, evidence-based behavioral treatments that directly target these conditions appear critical for reducing risk for engagement in RSB. Clinical providers who identify youth engaging in RSB also are encouraged to inform and refer youth for appropriate treatment to address RSB problems and mitigate adverse sexual health outcomes.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Key points

- Previous research has prospectively associated ADHD with heightened risky sexual behavior (RSB) in adulthood.
- The current study examined this association in a high-risk sample of adolescents, and tested whether comorbid conduct problems and problematic substance use jointly mediated the relation.
- The association between ADHD and RSB was restricted to youth with elevated comorbid conduct problems and was fully mediated by comorbid marijuana use problems.
- Early identification and treatment of these comorbid conditions is important for the prevention of negative sexual health outcomes among youth with ADHD.

Figure 1.

Final mediation path analysis predicting risky sexual behavior. Values reflect standardized β coefficients (90% CI in parentheses). Dashed line represents direct effect of attention deficit/hyperactivity disorder (ADHD) symptoms on risky sexual behavior. β coefficients below and above the dashed line indicate the direct effect of ADHD on risky sexual behavior before and after considering other mediators, respectively. The covariate of recruitment site is omitted from the model for visual clarity.

Figure 2a

ODD/CD Present

Figure 2b

ODD/CD Absent

Figure 2.

Final mediation path analyses predicting risky sexual behavior among youth with (Figure 2a) and without (Figure 2b) a clinical diagnosis of oppositional defiant disorder (ODD) or conduct disorder (CD). Values reflect standardized β coefficients (90% CI in parentheses). Dashed line represents direct effect of attention-deficit/hyperactivity disorder (ADHD) symptoms on risky sexual behavior after considering other mediators. The covariate of recruitment site is omitted from the model for visual clarity.

Table 1

Descriptive Statistics for Clinical Disorders and Risky Sexual Behaviors

Variable	<i>n</i> (%)	Symptom Count <i>M</i> (<i>SD</i>)
<i>Clinical Disorders</i>		
ADHD	18 (15.65)	10.29 (6.63)
ODD/CD	49 (42.60)	11.00 (5.90)
MUD	64 (55.65)	2.83 (3.15)
AUD	17 (14.8)	0.51 (1.48)
<i>Risky Sexual Behavior Indicators</i>		
Lifetime vaginal intercourse	73 (63.47)	
Lifetime early sexual debut ^a	54 (46.95)	
Lifetime multiple (≥ 3) sexual partners	40 (34.78)	
Lifetime HIV testing	18 (15.65)	
Past 3 month casual sexual partner ^b	11 (9.56)	
Past 3 month one-time sexual partner ^c	5 (4.34)	
Past 3 month multiple (≥ 2) sexual partners	5 (4.34)	
Past 3 month inconsistent condom use ^d	13 (11.30)	

Note: ADHD = attention-deficit/hyperactivity disorder; ODD = oppositional defiant disorder; CD = conduct disorder; MUD = marijuana use disorder; AUD = alcohol use disorder.

^aDefined as first sexual intercourse at age ≤ 14.

^bDefined as sexual intercourse with a non-romantic partner (e.g., a friend).

^cDefined as sexual intercourse with a stranger or acquaintance.

^dDefined as < 100% of sexual intercourse encounters.