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Childhood ADHD and Involvement in Early Pregnancy: Mechanisms of Risk

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Abstract

Objective—ADHD is associated with risky sexual behavior and early pregnancy, but few studies have examined mechanisms of risk linking childhood ADHD to early pregnancy. The present study utilized data from the Multimodal Treatment Study of ADHD to examine potential mechanisms that may account for the association between childhood ADHD and becoming pregnant or causing a pregnancy by age 18.

Method—Participants were 579 children with ADHD and 289 comparison peers followed over 16 years.

Results—Relative to the comparison group, those with childhood ADHD were at more than two times increased risk of early pregnancy. Univariately, persistence of ADHD symptoms, delinquency/substance use, and academic performance/achievement during adolescence each

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Declaration of Conflicting Interests

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mediated the association between childhood ADHD and early pregnancy. When considered together, only delinquency/substance use remained a significant mediator of this relationship.

Conclusion—Findings point toward specific targets of intervention for youth with ADHD to prevent early pregnancy.

Keywords

ADHD; pregnancy; delinquency; substance use

Individuals with ADHD are at increased risk for a host of negative outcomes including risky sexual behavior, early age of first sexual intercourse, infrequent use of condoms or other forms of birth control, high rates of sexually transmitted diseases, and a high number of sexual partners. This has been demonstrated across two longitudinal studies of ADHD cohorts and their peers without ADHD (Flory, Molina, Pelham, Gnagy, & Smith, 2006; Hechtman et al., 2016). However, the potential association between childhood ADHD and involvement in an *early* pregnancy, defined as pregnancy by age 18, has rarely been examined (see chapter by Barkley, Murphy, & Fischer, 2008, for an exception). Importantly, to date, no studies have examined potential mediators of the link between childhood ADHD and teen pregnancy. Early parenthood and pregnancy are of great significance, as they predict poorer physical and mental health outcomes for adolescents and their offspring, increased rates of child abuse and neglect, and lower educational attainment and income in adulthood (Elfenbein & Felice, 2003; Jaffee, 2002). Understanding risk processes contributing to early pregnancy can thus inform efforts to prevent these adverse outcomes.

Numerous factors have been shown in unselected samples to be associated with early unplanned pregnancy, including delinquency/substance use, academic underperformance, and parenting characterized by low warmth and/or poor monitoring/supervision (e.g., Scaramella, Conger, Simons, & Whitbeck, 1998). As noted, research has also indicated that although ADHD is associated with such risk factors for early pregnancy (e.g., Kent et al., 2011; Molina et al., 2012; Sibley et al., 2014; Sibley et al., 2011; Walther et al., 2012), these constructs have not been examined as mediators of the association between ADHD and early pregnancy.

Persistence of ADHD Symptoms

Although some symptoms of ADHD evident in childhood may remit by adolescence, longitudinal research has indicated that ADHD symptom persistence into adulthood occurs in approximately 60% of individuals with ADHD (Hechtman et al., 2016). Moreover, even those adolescents who no longer meet criteria for an ADHD diagnosis continue to display elevated ADHD symptoms and associated impairment than those without a past diagnosis. When considering the inhibitory control and planning ability necessary to refrain from engaging in unprotected sexual behavior—or to consistently use contraceptives—ADHD symptoms that persist into adolescence may also contribute to early pregnancy. In light of these findings, adolescent ADHD symptoms should be examined as a mediator in the relationship between childhood ADHD and early pregnancy.

Delinquency/Substance Use

Children with ADHD are more likely to experience comorbid mental health disorders. Specifically, conduct disorder has been reported in 27% of children with ADHD compared with 2% of their non-ADHD peers. Prospectively, a history of childhood ADHD has repeatedly predicted adolescent involvement in delinquent behaviors and substance use (e.g., Molina et al., 2007; Sibley et al., 2014; Sibley et al., 2011) although it may be the case that the early association of ADHD with externalizing behavior patterns is the culprit (Sibley et al., 2014). Developmentally, traits of behavioral undercontrol (i.e., impulsivity, difficulties with sitting still, impersistence), self-control, and behavioral inhibition in childhood are not only strongly correlated with symptoms of ADHD but have also prospectively predicted substance use in adolescence and adulthood (Molina & Pelham, 2014).

Research also indicates that early pregnancy may be associated with and preceded by recurrent patterns of deviant and risk-taking behaviors including delinquency and substance use (Scaramella et al., 1998). Adolescents who have been involved in a pregnancy are more likely than those without to have a history of delinquent behavior and substance use, as shown in both cross-sectional studies (e.g., Sarver, McCart, Sheidow, & Letourneau, 2014) and prospective longitudinal studies (Hockaday, Crase, & Stockdale, 2000; Woodward, Fergusson, & Horwood, 2001). This research suggests that sexual risk-taking and involvement in an early pregnancy may be a product of an underlying tendency toward deviancy (Scaramella et al., 1998). In addition, adolescent alcohol and substance use is a risk factor for risky sexual behavior during adolescence, such as inconsistent contraceptive use (Shrier, Emans, Woods, & DuRant, 1997; Tapert, Aarons, Sedlar, & Brown, 2001), further demonstrating potential associations between these activities and early pregnancy.

Integrating these areas of research, a recent cross-sectional study by Sarver and colleagues (2014) found that conduct problems and substance use mediated the association between ADHD and risky sexual behavior. However, the mediating effect for involvement in an early pregnancy was not examined. Addressing this limitation is critical given the significance of early pregnancy for long-term health, educational, and economic outcomes. Participation in delinquent activities and substance use may be one developmental pathway through which childhood ADHD can lead to early pregnancy and where preventative interventions might be directed. However, to date, research has yet to examine this mediation longitudinally.

Parenting Quality

Although the relationship between child ADHD and ineffective parenting is understood to be transactional (Johnston & Chronis-Tuscano, 2014), experimental research has convincingly shown that the behaviors of children with ADHD elicit less positive parenting including harsh and negative responses from parents (Pelham & Lang, 1999). More specifically, parents may also adopt more critical or strict parenting practices over time in response to the often difficult temperament and recurrent misbehavior of children with ADHD. This process has implications for the parent-child relationship as families of children with ADHD tend to report lower quality parent-child relationships, in addition to elevated conflict in family interactions (Edwards, Barkley, Laneri, Fletcher, & Metevia,

2001). ADHD symptoms in emerging adulthood have also been significantly and negatively associated with maternal and paternal support (i.e., latent variables consisting of involvement, warmth, and autonomy granting; Meinzer, Hill, Pettit, & Nichols-Lopez, 2015). Within the ADHD literature, parental monitoring and knowledge was protective against substance use and delinquency in adolescents with and without ADHD (Walther et al., 2012). Furthermore, ADHD significantly predicted alcohol use levels but only when parental knowledge was below the median level (Molina et al., 2012), further demonstrating the importance of parenting in preventing adverse developmental outcomes among youth with ADHD.

There is also substantial evidence that the quality of parenting may be particularly influential in the occurrence of early pregnancy for young people more broadly. Poor parental monitoring has been shown to predict early sexual activity, more partners, and less condom/contraceptive use in adolescents (Dittus, Michael, Becasen, Gloppen, & Guilamo-Ramos, 2013; Kincaid, Jones, Sterrett, & McKee, 2012; Wight, Williamson, & Henderson, 2006). Furthermore, parental warmth, involvement, and supportive parenting have also emerged as variables influential in the prediction of adolescent risky behavior and pregnancy (Kincaid et al., 2012; Scaramella et al., 1998; Simons, Sutton, Simons, Gibbons, & Murray, 2016). Thus, quality of parenting may be another key mechanism explaining the link between childhood ADHD and early pregnancy.

Academic Performance

Longitudinal studies have indicated that compared with those without ADHD, children with ADHD perform significantly worse in adolescence in terms of teacher ratings of academic performance and standardized achievement test scores (e.g., Molina et al., 2009). Many individuals with ADHD struggle academically and are greatly impaired in the school setting, particularly as organizational demands increase and academic tasks become more challenging during adolescence (e.g., Lee, Lahey, Owens, & Hinshaw, 2008; Raggi & Chronis, 2006). Even subthreshold levels of ADHD symptoms have been linked to poor adolescent academic performance (Bussing, Mason, Bell, Porter, & Garvan, 2010). Empirically, this has been demonstrated in a study by Langberg et al. (2011) in that teacher ratings of classroom performance mediated the relationship between symptoms of inattention in childhood and academic outcomes in adolescence. Academic failure among adolescents with ADHD has repeatedly been shown to be a critical stepping-stone to risky behavior (Molina et al., 2012; Sibley et al., 2014).

Academic underperformance has often been cited as a risk factor for early pregnancy (Kirby, 2002; Scaramella et al., 1998; Woodward et al., 2001). Those with greater academic ability may also have the cognitive foresight to anticipate the consequences of risky behavior (Gottfredson & Hirschi, 1990). Personal costs of involvement in an early pregnancy for these individuals may also be higher due to the academic and career prospects associated with stronger academic abilities, which serve as motivation to refrain from risky sexual activities (Kirby, 2002; Woodward et al., 2001). This mechanism is supported by longitudinal research demonstrating that lower academic expectations predicted adolescent pregnancy (e.g., Hockaday et al., 2000).

In sum, children with ADHD are at risk for unsafe sexual activity (Barkley et al., 2008; Flory et al., 2006; Hechtman et al., 2016). However, to date, no study has examined mechanisms linking childhood ADHD and involvement in a pregnancy before age 18.

Study Aims and Hypotheses

The aims of the current study are twofold. We sought to (a) prospectively examine the differential rates of involvement in an early pregnancy (defined as by age 18) in young adults with childhood combined-type ADHD and a local normative comparison group (LNCG), and (b) extend existing literature by examining potential mediating factors in adolescence linking childhood ADHD with early pregnancy. Consistent with prior research examining risky sexual behavior and ADHD (e.g., Flory et al., 2006; Hansen, Weiss, & Last, 1999), we hypothesized that (a) childhood ADHD would prospectively and significantly predict greater rates of involvement in an early pregnancy and (b) persistence of ADHD symptoms, delinquency/substance use, parenting quality, and academic performance/achievement would each mediate the association between childhood ADHD and pregnancy by age 18.

Method

Participants and Procedures

Male and female participants from the longitudinal follow-up of the Multimodal Treatment Study of ADHD (MTA) were included in the current study ($n = 868$). The original MTA sample ($n = 579$; 80.3% male) consisted of children with rigorously diagnosed combined-type ADHD across seven sites in the United States and Canada.¹ At each site, between 95 and 98 children aged 7.0 to 9.9 years ($M = 8.5$, $SD = .80$) were recruited through schools, primary care and mental health medical offices, parent self-help groups, word-of-mouth, and advertisements. Though the majority of participants were Caucasian (61%), 20%, 9%, and 11% identified as African American, Hispanic, or mixed race/other, respectively. For inclusion, children had to meet *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; *DSM-IV*; American Psychiatric Association, 1994) criteria for combined-type ADHD through a diagnostic battery consisting of a structured interview and parent and teacher reports (see MTA Cooperative Group, 1999). The initial purpose of the MTA was to compare the effectiveness of four treatment strategies (to which participants were randomly assigned): systematic medication management, multicomponent behavioral therapy, their combination, or referral to usual community care.

Upon completion of the 14-month treatment and initial 10-month follow-up period (2 years after the children with ADHD had been enrolled in the MTA), a comparison group of children (the LNCG; $n = 289$) was recruited from the same classrooms, in similar age and sex proportions as the original MTA children. The LNCG was intended for analyses regarding differential outcomes based on a history of childhood ADHD. The resulting

¹Sites were located at University of California, Berkeley (Berkeley, CA), Duke University (Durham, NC), University of California, Irvine (Irvine, CA), New York State Psychiatric Institute/Columbia University (New York, NY), New York University (New York, NY), University of Pittsburgh (Pittsburgh, PA), and McGill University (Montréal, Quebec).

comparison sample has been assessed in parallel with the ADHD sample, with the final assessment occurring at approximately age 25. Altogether, assessments for both groups occurred 2, 3, 6, 8, 10, 12, 14, and 16 years after the MTA baseline.

Assessments used multi-informant, multimethod data collection procedures. Measures varied across follow-up points, although many did not change between the baseline period and the 6-year follow-up (during which all participants were 16 years of age or younger). Beginning at the 8-, 10- and 12-year assessment points, when participants turned 18 years old, measures were modified or replaced with versions appropriate for the current age range. The outcome of interest for the current study (i.e., for females, pregnancy by age 18; for males, impregnating a partner by age 18) was assessed at the most recent time point for which the individual had participated in data collection (of the 12-, 14-, and 16-year follow-up periods). Of those with a pregnancy ($n = 50$), 3% indicated a pregnancy at the 12-year follow-up, 8% at the 14-year follow-up, and 89% at the 16-year follow-up.

A Certificate of Confidentiality from the National Institutes of Health, as well as standardized procedures for assuring privacy, encouraged disclosure on more sensitive measures (e.g., delinquency, substance use, sexual behavior). The 12-year assessment was the first period at which all participants were at least 18 years old (mean ages at 12-, 14-, and 16-year follow-up points were 20.9, 22.9, and 24.9 years, respectively). Mediators (delinquency/substance use, parenting, academic performance/achievement, ADHD symptom severity in adolescence) were assessed during adolescence (aged 13-17 years old) at the most recent assessment prior to pregnancy. This strategy ensured temporally precedent, yet proximal, prediction. Mediators were assessed at the 2-, 3-, 6-, 8-, and 10-year follow-ups for <1%, 2.5%, 37%, 53%, and 6% of the sample, respectively.

Measures

Pregnancy—Involvement in a pregnancy was assessed via participant self-report, as part of a health information questionnaire, on an item asking whether they had ever been pregnant or impregnated a partner. Participants were asked their age at the first pregnancy. Early pregnancy was defined in our models as involvement in any pregnancy at or before age 18.

ADHD symptom severity in adolescence—Severity of ADHD symptoms was measured by assessing symptom severity in adolescence using parent and adolescent report on the Swanson, Nolan and Pelham (SNAP-IV) Questionnaire (Swanson et al., 2001). The SNAP-IV is a 26-item rating scale which provides a dimensional representation of ADHD symptoms and oppositional defiant behavior based on *DSM-IV* criteria. Subscales of interest for the current study included the two *DSM-IV* ADHD symptom domains: inattention (nine items) and hyperactivity/impulsivity (nine items). Item responses were based on a 0 (*not at all*) to 3 (*very much*) scale. Responses were averaged across reporters and symptom domains to create a single composite of overall ADHD symptom severity during adolescence.

Delinquency/substance use—In line with procedures used both in prior MTA analyses (Molina et al., 2007; Molina et al., 2009) and elsewhere (e.g., Loeber, Stouthamer-Loeber, Van Kammen, & Farrington, 1991), adolescent involvement in delinquency was coded on an

ordinal scale of severity based on parent and youth report across several measures and then dichotomized to indicate involvement in serious delinquent behavior. The original scale ranged from 0 to 5: 0 = *no delinquency*; 1 = *minor delinquency limited to the home*, such as theft of less than US\$5; 2 = *minor delinquency outside of the home*, such as shoplifting items worth US\$5 or less; 3 = *moderately serious delinquency*, such as weapon carrying or theft of US\$5 or more; 4 = *serious delinquency*, such as breaking and entering, selling drugs, or attacking another individual; 5 = *reporting two or more instances of Level 4 delinquent behaviors*. As in other studies from the MTA group (Molina et al., 2007; Molina et al., 2009), delinquency was coded 1 if the adolescent scored 4 or 5 on the ordinal variable, indicating involvement in serious delinquent behavior. Within the ADHD group, 20.5% of participants were coded 1 on delinquency compared with 11.8% in the LNCG.

Substance use was determined through methods established in prior MTA work (Molina et al., 2007), using an adolescent self-report substance use questionnaire (Molina & Pelham, 2003) adapted for use in MTA assessments. Adolescents were asked to self-report, as part of the confidential measure, about their current and past use of alcohol (in amounts more substantial than a sip or taste), tobacco products, illicit drugs (including marijuana and street drugs), and inappropriate use of prescription medications. Substance use was coded 0 (no substance use or developmentally normative use) or 1 (substance use exceeding the developmental norm) using age-based criteria previously reported for this sample (Molina et al., 2007; Molina et al., 2009). Criteria were defined separately based on review of survey norms (e.g., National Survey on Drug Use and Health). For example, drinking alcohol at age 13 would be considered atypical whereas drinking alcohol at age 19 would be considered typical. Within the ADHD group, 29.8% were coded 1 on substance use compared with 24.4% in the LNCG.

The delinquency/substance use composite was created by summing each participant's delinquency and substance use scores,² with final scores ranging from 0 to 2.

Parenting—The Alabama Parenting Questionnaire (APQ; Shelton, Frick, & Wootton, 1996) was used to assess parenting practices and quality. The APQ is a widely used measure that provides a report of parenting practices in several domains. Given their hypothesized links to early pregnancy based on prior research, the Involvement, Positive Parenting, and Poor Monitoring/Supervision scales were utilized in the present study. Parent Involvement was measured with the mean of 10 items assessing how frequently parents and their children engage in conversations about daily activities, homework, and friends and how frequently parents get involved in children's daily activities and extracurricular activities. Positive Parenting was measured with the mean of six items assessing how frequently parents reward and praise their children for appropriate behavior. Poor Monitoring/Supervision was measured by 10 items asking the degree to which parents are unaware of their child's whereabouts and how often the child is unsupervised. For the *positive parenting* and *poor monitoring/supervision* sub-scales, we obtained mothers' reports of their own parenting and children's reports of their parents' overall parenting.

²The measure of delinquency did not include items related to risky sexual behavior.

We created a composite measure of parenting by first standardizing each APQ subscale for each informant and then calculating means for each APQ subscale across reporters (i.e., mother and adolescent report about their mother and father or their parents in general). The resulting means for each subscale were then averaged to create an overall parenting composite (poor monitoring was reverse coded), with higher numbers reflecting higher quality parenting.

Academic performance/achievement—The Academic Competence subscales of the Social Skills Rating System–Teacher Form (SSRS-T; Gresham & Elliott, 1989) were used as a measure of adolescent academic performance. The SSRS-T asks teachers to respond on a 5-point scale according to the participant’s performance relative to other students (1 = *lowest* 10%, 5 = *highest* 10%) in reading, math, motivation to succeed, parental encouragement to succeed, intellectual functioning, overall classroom behavior, and overall academic performance.

Adolescent academic achievement was also assessed via the Wechsler Individual Achievement Test (WIAT; Wechsler & Wechsler, 1992) standardized reading score. The WIAT is a widely used test of achievement in various academic domains and has well-established norms for grades Pre-K to 12/aged 4 to 50 years.

Combining these measures, each item was first standardized and the mean of the resulting set of variables was calculated to obtain an academic performance/achievement composite.

Data Analytic Plan

Missing data—To address missing data, analyses were performed using 100 imputed data sets generated in Mplus 7.1 (Muthén & Muthén, 1998-2012). All cases were included in our analyses, and the pattern of missing values for early pregnancy was assumed to be *missing at random* (MAR; see Schafer & Graham, 2002). Our model for generating imputed data sets adjusted for the influence of covariates and mediators in the model and auxiliary variables such as race/ethnicity and maternal education (the proxy for socioeconomic status) that we excluded from our primary analyses due to sample size considerations. After accounting for the influence of these variables, we assume that there is no residual pattern of missing values for early pregnancy.

Analytic approach—Differences in rates of early pregnancy between baseline diagnostic groups (ADHD vs. LNCG) were determined using logistic regression. In addition, ethnicity, maternal education status, childhood conduct disorder, and childhood oppositional defiant disorder were tested as univariate predictors of early pregnancy. Only gender emerged as a significant predictor. Logistic regression was also used to test for potential interactions between ADHD group and gender in predicting involvement in early pregnancy.

Delinquency/substance use, parenting, academic performance/achievement, and persistent ADHD symptoms in adolescence were first examined individually, in separate models, as potential mediators of the association between childhood ADHD and early pregnancy. Significance of the indirect effects was determined through use of the Sobel test (Baron & Kenny, 1986). Although the Sobel test is generally not recommended due to low power and

assumptions about the sampling distribution of the indirect effect (Hayes, 2013), a suitable alternative test is not available for analyses using multiple imputation. Although current best practice is to use bootstrapping to calculate unbiased standard errors of indirect effects (e.g., Preacher & Hayes, 2008), these methods have not yet been extended to analyses pooling results across multiple imputation data sets. Therefore, we used the Sobel test method.

In the full multivariate mediation model predicting early pregnancy, gender was included as a covariate. All other covariates (ethnicity, mother education status, childhood conduct disorder, and childhood oppositional defiant disorder) were eliminated as they did not show significant associations with pregnancy in any single mediator models.

Results

Differential Rates of Pregnancy

The risk of being involved in a pregnancy by age 18 was more than twice as high for the ADHD group compared with the LNCG group (9.3% for the ADHD group, $n = 39$ pregnancies vs. 4.6% for the LNCG group, $n = 12$ pregnancies; odds ratio [OR] = 2.08, 95% confidence interval [CI] = 1.04 to 4.16). However, there was no difference in the mean age of first pregnancy between the ADHD group and the LNCG group (17.36 years vs. 17.27 years, $t(48) = .25$, 95% CI = -0.62, 0.79).

Results also indicated that females (OR = 6.34, 95% CI = 1.826, 22.021) and, as reported above, ADHD group participants (OR = 3.37, 95% CI = 1.172, 9.689) were each independently more likely to report involvement in a pregnancy by age 18. However, the interaction between ADHD status and gender was not significant, demonstrating that the effect of ADHD group on early pregnancy was not significantly different for males and females (OR = 0.33, 95% CI = 0.08, 1.35).

Simple Mediation Models Predicting Early Pregnancy

Persistent ADHD symptoms during adolescence were associated with increased risk of early pregnancy (OR = 1.47, 95% CI = 1.02, 2.12), and adolescent ADHD symptoms were significantly predicted by childhood ADHD ($B = .91$, $SE = .06$, $p < .01$). The indirect effect of childhood ADHD on early pregnancy through adolescent ADHD symptoms was significant ($B = .35$, $SE = .17$, $p = .04$), and the direct effect of childhood ADHD was no longer significant when including this mediator in the model ($B = .36$, $SE = .43$, $p = .40$).

Higher scores on delinquency/substance use were associated with greater risk of early pregnancy (OR = 1.73, 95% CI = 1.14, 2.64), and adolescents with a history of childhood ADHD had higher scores on delinquency/substance use ($B = .15$, $SE = .04$, $p < .01$) than the LNCG. The indirect effect of childhood ADHD on early pregnancy through adolescent delinquency/substance use was significant ($B = .08$, $SE = .04$, $p = .04$), and the direct effect of childhood ADHD on early pregnancy was no longer significant when including this mediator in the model ($B = .64$, $SE = .36$, $p = .08$).

Parenting during adolescence did not predict early pregnancy (OR = 1.52, 95% CI = 0.96, 2.42), and the effect of ADHD group status on parenting approached significance ($B = -.12$,

$SE = .06, p = .05$). The indirect effect of ADHD on early pregnancy through parenting was not significant ($B = -.05, SE = .04, p = .21$). The direct effect of ADHD remained significant when parenting was included as a mediator in the model ($B = .78, SE = .36, p = .03$).

Greater academic performance/achievement was associated with reduced odds of early pregnancy (OR = .56, 95% CI = 0.36, 0.88), and adolescents with a history of childhood ADHD had significantly lower academic performance/achievement ($B = -.42, SE = .06, p < .01$). The indirect effect of ADHD on early pregnancy through academic performance/achievement was significant ($B = .25, SE = .10, p = .02$), and the direct effect of childhood ADHD was no longer significant when including this mediator in the model ($B = .49, SE = .37, p = .19$).

Multivariate Model Predicting Early Pregnancy

When all mediators were examined simultaneously in a multivariate model and allowed to covary, the indirect effect of ADHD on early pregnancy was significant through delinquency/substance use, but all other indirect effects (through parenting, academic performance/achievement, and persistent ADHD symptoms) were not significant (see Table 1 and Figure 1).

The direct effect of ADHD on early pregnancy was also not significant in this model. However, early pregnancy was significantly predicted by delinquency/substance use and parenting. In addition, delinquency/substance use, academic performance/achievement, and persistent ADHD symptoms during adolescence were all significantly predicted by ADHD group, whereas the effect of ADHD group on parenting only approached significance.

Discussion

This study extends prior literature by examining mediators during adolescence, through which ADHD may lead to early involvement in a pregnancy. Consistent with prior literature (Barkley et al., 2008), we found that the ADHD group was at more than two times increased risk of reporting a pregnancy by age 18 (9.3% vs. 4.6%). According to data published by the Centers for Disease Control, the rate of early pregnancy (i.e., pregnancies occurring before 18 years old) was 4.09% (Ventura, Curtin, Abrma, & Henshaw, 2012), demonstrating equivalent rates of early pregnancy in the LNGG and rates twice as high as this national report in the ADHD group.

In univariate models examining one potential mediator at a time, persistence of ADHD symptoms during adolescence, delinquency/substance, and academic performance/achievement each mediated the association between childhood ADHD and early pregnancy. In the multivariate model with all four potential mechanisms, adolescent delinquency/substance use was the only significant mediator of this relationship.

Consistent with these findings, prior research has linked delinquent behavior, substance use, and academic underachievement to early pregnancy (e.g., Hockaday et al., 2000; Scaramella et al., 1998; Woodward et al., 2001). In addition, persistence of ADHD symptoms is an

important factor to consider when examining longitudinal outcomes for individuals with ADHD (e.g., Molina et al., 2012) and early pregnancy appears to be another functional outcome for which persistence of ADHD symptoms may play an important role. However, when the four mediators were examined in the same model and allowed to covary, only delinquency/substance use remained a significant mediator of the association between ADHD and early pregnancy. This demonstrates that the association between ADHD and the components of delinquency/substance use could be examined in further detail for the purpose of predicting early pregnancy. Furthermore, it suggests that the common rationale given for the association between ADHD and pregnancy—that inattention and hyperactivity/impulsivity leading to a tendency toward risky sexual behavior and failure to plan ahead regarding contraception (Flory et al., 2006)—does not tell the whole story. An alternative explanation may be increases in unprotected sexual activity in delinquent adolescents and young adults following substance use (Kiene, Barta, Tennen, & Armeli, 2009).

However, it is important to note that even though other potential mediators (i.e., persistence of ADHD symptoms, parenting, and academic impairment) were no longer significant in the multivariate model, they should not be ignored. These variables are all significantly correlated which may have contributed to certain variables not “surviving” multivariate analyses. There is also likely to be underlying developmental unfolding of these correlated variables, such as earlier academic problems and persisting ADHD symptoms leading to increases in delinquency and substance use experimentation and ultimate escalation, an area to be studied in future research.

Consistent with prior literature, parenting practices, including involvement, positive parenting, and monitoring significantly predicted teen pregnancy in this study (Kincaid et al., 2012; Scaramella et al., 1998; Wight et al., 2006), but the direct link between childhood ADHD and parenting only approached significance. This was surprising given the wealth of research suggesting that difficulties in the interactions and relationships between individuals with ADHD and their parents extend into adolescence (Edwards et al., 2001; Johnston & Chronis-Tuscano, 2014). It is possible that combining across multiple informants and multiple diverse aspects of parenting complicated our ability to detect associations between childhood ADHD and parenting during adolescence, as well as the mediating effects of parenting quality.

Across the total sample, females were more likely than males to report involvement in a pregnancy prior to age 18. One possibility is that males may not always be aware when a pregnancy has occurred. It could also be that younger females were engaging in sexual activity with older male partners (VanOss Marin, Kirby, Hudes, Coyle, & Gomez, 2006).

There are several limitations of this study that must be considered. First, because of the small number of pregnancies in our sample overall, the ability to detect significant effects, particularly when considering multiple mediators, was reduced. This lack of power also prevented us from including certain relevant baseline characteristics as covariates in our models predicting a dichotomous outcome; future work in larger samples could profit from investigating effects of socioeconomic status, age of the mother at birth of proband, maternal education, age of menarche, IQ, presence or access to clinical care throughout childhood and

adolescence, and race/ethnicity (e.g., Woodward et al., 2001) in conjunction with the factors examined as mediators in the current study.

In addition, the method of creating composites (chosen because of the complex multiple mediator model) limited our ability to examine more refined mediator variables. For example, we did not investigate baseline and adolescent inattentive and hyperactive/impulsive symptom domains separately. In addition, we combined scores across adolescent delinquency and substance use. Similarly, we formed a composite score across positive parenting, parental involvement, and monitoring, each of which has been independently linked to early pregnancy. It is possible that this approach impacted our ability to detect mediating effects of specific aspects of parenting (Walther et al., 2012).

Finally, no data are available on the offspring born to teen parents in the MTA with and without ADHD. Prior research has demonstrated negative effects of teen pregnancy on offspring adjustment, including greater risk for child abuse and neglect as well as lower educational and career attainment (Elfenbein & Felice, 2003; Jaffee, 2002). Parent ADHD may further contribute to these risks. Future studies could examine downstream effects of early pregnancy among individuals with ADHD on parenting quality and offspring behavioral adjustment.

Despite these limitations, this longitudinal investigation points toward developmental pathways through which childhood ADHD may lead to early pregnancy. From these findings, it seems that an unfolding of risk over time from childhood ADHD to adolescent delinquency/substance use (and to a lesser extent poor academic performance/achievement and persistent ADHD symptoms) may increase risk for early pregnancy and could be further studied. Understanding developmental risk processes contributing to early pregnancy (particularly those that are modifiable) can inform efforts to prevent adverse outcomes. For example, interventions designed to reduce risk opportunities for adolescents may also prevent early pregnancy, as suggested by such studies showing positive outcomes on delinquency (Kimber, Sandell, & Bremberg, 2008).

In addition, these results suggest that reducing risk for delinquency while improving parenting warmth, involvement, and monitoring is important for teens in general, regardless of the presence of an ADHD diagnosis. Considering that parenting quality predicts the course of oppositional and conduct symptoms in youth with ADHD (Chronis et al., 2007; Harvey, Metcalfe, Herbert, & Fanton, 2011), behavioral parenting interventions aimed to improve positive parenting, involvement, and monitoring may be a particularly fruitful avenue for prevention/intervention. In addition, school-based delinquency prevention geared toward high risk youth, and their parents have demonstrated improvements in antisocial behavior, parent-child conflict, parenting practices, and less growth in deviant peer involvement (Dishion & Kavanagh, 2000). Given findings from the present study, it is quite possible that such interventions might also decrease risk for involvement in an early pregnancy.

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References

- American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 4th. Washington, DC: Author; 1994.
- Barkley, RA, Murphy, KR, Fischer, M. ADHD in adults: What the science says. New York, NY: Guilford Press; 2008.
- Baron RM, Kenny DA. 1986; The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*. 51:1173-1182. DOI: 10.1037/0022-3514.51.6.1173 [PubMed: 3806354]
- Bussing R, Mason DM, Bell L, Porter P, Garvan C. 2010; Adolescent outcomes of childhood attention-deficit/hyperactivity disorder in a diverse community sample. *Journal of the American Academy of Child & Adolescent Psychiatry*. 49:595-605. DOI: 10.1097/00004583-201006000-00008 [PubMed: 20494269]
- Chronis AM, Lahey BB, Pelham WE, Hall Williams S, Baumann BL, Jones HA, Rathouz PJ. 2007; Maternal depression and early positive parenting predict future conduct problems in young children with attention-deficit/hyperactivity disorder. *Developmental Psychology*. 43:70-82. DOI: 10.1037/0012-1649.43.1.70 [PubMed: 17201509]
- Dishion TJ, Kavanagh K. 2000; A multilevel approach to family-centered prevention in schools: Process and outcome. *Addictive Behaviors*. 25:899-911. [PubMed: 11125778]
- Dittus P, Michael S, Becasen J, Gloppen K, Guilamo-Ramos V. 2013; 4. Protective effects of parental monitoring knowledge and enforcement of rules on adolescent sexual behavior: A meta-analysis. *Journal of Adolescent Health*. 52(2):S14.
- Edwards G, Barkley RA, Laneri M, Fletcher K, Metevia L. 2001; Parent-adolescent conflict in teenagers with ADHD and ODD. *Journal of Abnormal Child Psychology*. 29:557-572. DOI: 10.1023/A:1012285326937 [PubMed: 11761288]
- Elfenbein DS, Felice ME. 2003; Adolescent pregnancy. *Pediatric Clinics of North America*. 50:781-800. [PubMed: 12964694]
- Flory K, Molina BSG, Pelham WE Jr, Gnagy E, Smith B. 2006; Childhood ADHD predicts risky sexual behavior in young adulthood. *Journal of Clinical Child and Adolescent Psychology*. 35:571-577. DOI: 10.1207/s15374424jccp3504_8 [PubMed: 17007602]
- Gottfredson, MR, Hirschi, T. A general theory of crime. Stanford, CA: Stanford University Press; 1990.
- Gresham, FM, Elliott, SN. Social skills rating system-parent, teacher, and child forms. Circle Pines, MN: American Guidance Systems; 1989.
- Hansen C, Weiss D, Last CG. 1999; ADHD boys in young adulthood: Psychosocial adjustment. *Journal of the American Academy of Child & Adolescent Psychiatry*. 38:165-171. DOI: 10.1097/00004583-199902000-00015 [PubMed: 9951215]

- Harvey EA, Metcalfe LA, Herbert SD, Fanton JH. 2011; The role of family experiences and ADHD in the early development of oppositional defiant disorder. *Journal of Consulting and Clinical Psychology*. 79:784–795. DOI: 10.1037/a0025672 [PubMed: 21942501]
- Hayes, AF. *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. New York, NY: Guilford Press; 2013.
- Hechtman L, Swanson JM, Sibley MH, Stehli A, Owens EB, Mitchell JT, MTA Cooperative Group. 2016; Functional adult outcomes 16 years after childhood diagnosis of attention-deficit/hyperactivity disorder: MTA results. *Journal of the American Academy of Child and Adolescent Psychology*. 55:945–952.
- Hockaday C, Crase SJCSM, Stockdale DF. 2000; A prospective study of adolescent pregnancy. *Journal of Adolescence*. 23:423–438. DOI: 10.1006/jado.2000.0329 [PubMed: 10936015]
- Jaffee SR. 2002; Pathways to adversity in young adulthood among early childbearers. *Journal of Family Psychology*. 16:38–49. [PubMed: 11915409]
- Johnston, C, Chronis-Tuscano, A. Families and ADHD. In: Barkley, RA, editor. *Attention-deficit/hyperactivity disorder: A handbook for diagnosis and treatment*. 4th. New York, NY: Guilford Press; 2014. 191–209.
- Kent KM, Pelham WE, Molina BSG, Sibley MH, Waschbusch DA, Yu J, Karch KM. 2011; The academic experience of male high school students with ADHD. *Journal of Abnormal Psychology*. 39:451–462. DOI: 10.1007/s10802-010-9472-4
- Kiene SM, Barta WD, Tennen H, Armeli S. 2009; Alcohol, helping young adults have unprotected sex with casual partners: Findings from a daily diary study of alcohol use and sexual behavior. *Journal of Adolescent Health*. 44:73–80. [PubMed: 19101461]
- Kimber B, Sandell R, Bremberg S. 2008; Social and emotional training in Swedish classrooms for the promotion of mental health: Results from an effectiveness study in Sweden. *Health Promotion International*. 23:134–143. [PubMed: 18211887]
- Kincaid C, Jones DJ, Sterrett E, McKee L. 2012; A review of parenting and adolescent sexual behavior: The moderating role of gender. *Clinical Psychology Review*. 32:177–188. [PubMed: 22366393]
- Kirby D. 2002; Antecedents of adolescent initiation of sex, contraceptive use and pregnancy. *American Journal of Health Behavior*. 26:473–485. [PubMed: 12437022]
- Langberg JM, Molina BSG, Arnold LE, Epstein JN, Altaye M, Hechtman L. 2011; Patterns and predictors of adolescent academic achievement and performance in a sample of children with attention-deficit/hyperactivity disorder (ADHD). *Journal of Clinical Child & Adolescent Psychology*. 40:519–531. [PubMed: 21722025]
- Lee SS, Lahey BB, Owens EB, Hinshaw SP. 2008; Few preschool boys and girls with ADHD are well-adjusted during adolescence. *Journal of Abnormal Child Psychology*. 36:373–383. DOI: 10.1007/s10802-007-9184-6 [PubMed: 17914666]
- Loeber R, Stouthamer-Loeber M, Van Kammen W, Farrington DP. 1991; Initiation, escalation and desistance in juvenile offending and their correlates. *Journal of Criminal Law and Criminology*. 82:1–48.
- Meinzer MC, Hill RM, Pettit JW, Nichols-Lopez KA. 2015; Parental support partially accounts for the covariation between ADHD and depressive symptoms in college students. *Journal of Psychopathology and Behavioral Assessment*. 37:247–255.
- Molina BSG, Flory K, Hinshaw SP, Greiner AR, Arnold LE, Swanson JM, Wigal T. 2007; Delinquent behavior and emerging substance use in the MTA at 36 months: Prevalence, course, and treatment effects. *Journal of the American Academy of Child & Adolescent Psychiatry*. 46:1028–1040. DOI: 10.1097/chi.0b013e3180686d96 [PubMed: 17667481]
- Molina BSG, Hinshaw SP, Swanson JM, Arnold LE, Vitiello B, Jensen PS, Houck PR. 2009; The MTA at 8 years: Prospective follow-up of children treated for combined-type ADHD in a multisite study. *Journal of the American Academy of Child & Adolescent Psychiatry*. 48:484–500. DOI: 10.1097/CHI.0b013e31819c23d0 [PubMed: 19318991]
- Molina BSG, Pelham WE Jr. 2003; Childhood predictors of adolescent substance use in a longitudinal study of children with ADHD. *Journal of Abnormal Psychology*. 112:497–507. [PubMed: 12943028]

- Molina BSG, Pelham WE Jr, Cheong J, Marshal MP, Gnagy EM, Curran PJ. 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. [PubMed: 22845650]
- Molina BSG, Pelham WE. 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.
- MTA Cooperative Group. 1999; A 14-month randomized clinical trial of treatment strategies for attention-deficit/hyperactivity disorder. *Archives of General Psychiatry*. 56:1073–1086. DOI: 10.1001/archpsyc.56.12.1073 [PubMed: 10591283]
- Muthén, LK, Muthén, BO. *Mplus user's guide*. 7th. Los Angeles, CA: Author; 1998–2012.
- Pelham WE, Lang AR Jr. 1999; Can your children drive you to drink? Stress and parenting in adults interacting with children with ADHD. *Alcohol Research & Health*. 23:292–298. [PubMed: 10890826]
- Preacher KJ, Hayes AF. 2008; Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods*. 40:879–891. [PubMed: 18697684]
- Raggi VL, Chronis AM. 2006; Interventions to address the academic impairment of children and adolescents with ADHD. *Clinical Child and Family Psychology Review*. 9:85–111. DOI: 10.1007/s10567-006-0006-0 [PubMed: 16972189]
- Sarver DE, McCart MR, Sheidow AJ, Letourneau EJ. 2014; ADHD and risky sexual behavior in adolescents: Conduct problems and substance use as mediators of risk. *Journal of Child Psychology and Psychiatry*. 55:1345–1353. [PubMed: 24813803]
- Scaramella LV, Conger RD, Simons RL, Whitbeck LB. 1998; Predicting risk for pregnancy by late adolescence: A social contextual perspective. *Developmental Psychology*. 34:1233–1245. [PubMed: 9823508]
- Schafer JL, Graham JW. 2002; Missing data: Our view of the state of the art. *Psychological Methods*. 7:147–177. [PubMed: 12090408]
- Shelton KK, Frick PJ, Wootton J. 1996; Assessment of parenting practices in families of elementary school-age children. *Journal of Clinical Child Psychology*. 25:317–329.
- Shrier LA, Emans SJ, Woods ER, DuRant RH. 1997; The association of sexual risk behaviors and problem drug behaviors in high school students. *Journal of Adolescent Health*. 20:377–383. [PubMed: 9168385]
- Sibley MH, Pelham WE Jr, Molina BSG, Coxe S, Kipp H, Gnagy EM, Lahey BB. 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. [PubMed: 24886010]
- Sibley MH, Pelham WE Jr, Molina BSG, Gnagy EM, Waschbusch DA, Biswas A, Karch KM. 2011; The delinquency outcomes of boys with ADHD with and without comorbidity. *Journal of Abnormal Child Psychology*. 39:21–32. [PubMed: 20697799]
- Simons LG, Sutton TE, Simons RL, Gibbons FX, Murray VM. 2016; Mechanisms that link parenting practices to adolescents' risky sexual behavior: A test of six competing theories. *Journal of Youth and Adolescence*. 45:255–270. [PubMed: 26718543]
- Swanson JM, Kraemer HC, Hinshaw SP, Arnold LE, Conners CK, Abikoff HB, Wu M. 2001; Clinical relevance of the primary findings of the MTA: Success rates based on severity of ADHD and ODD symptoms at the end of treatment. *Journal of the American Academy of Child & Adolescent Psychiatry*. 40:168–179. [PubMed: 11211365]
- Tapert SF, Aarons GA, Sedlar GR, Brown SA. 2001; Adolescent substance use and sexual risk-taking behavior. *Journal of Adolescent Health*. 28:181–189. [PubMed: 11226840]
- Van Oss Marin B, Kirby DB, Hudes ES, Coyle KK, Gomez CA. 2006; Boyfriends, girlfriends and teenagers risk of sexual involvement. *Perspectives on Sexual and Reproductive Health*. 38:76–83. DOI: 10.1363/3807606 [PubMed: 16772188]
- Ventura SJ, Curtin SC, Abma JC, Henshaw SK. 2012; Estimated pregnancy rates and rates of pregnancy outcomes for the United States, 1990–2008. *National Vital Statistics Reports*. 60(7):1–21.

- Walther CAP, Cheong J, Molina BSG, Pelham WE Jr, Wymbs BT, Belendiuk KA, Pedersen SL. 2012; Substance use and delinquency among adolescents with childhood ADHD: The protective role of parenting. *Psychology of Addictive Behaviors*. 26:585–598. [PubMed: 22329747]
- Wechsler, D, Wechsler, D. Wechsler Individual Achievement Test. San Antonio, TX: Psychological Corporation; 1992.
- Wight D, Williamson L, Henderson M. 2006; Parental influences on young people's sexual behaviour: A longitudinal analysis. *Journal of Adolescence*. 29:473–494. [PubMed: 16213580]
- Woodward L, Fergusson DM, Horwood LJ. 2001; Risk factors and life processes associated with teenage pregnancy: Results of a prospective study from birth to 20 years. *Journal of Marriage and Family*. 63:1170–1184.

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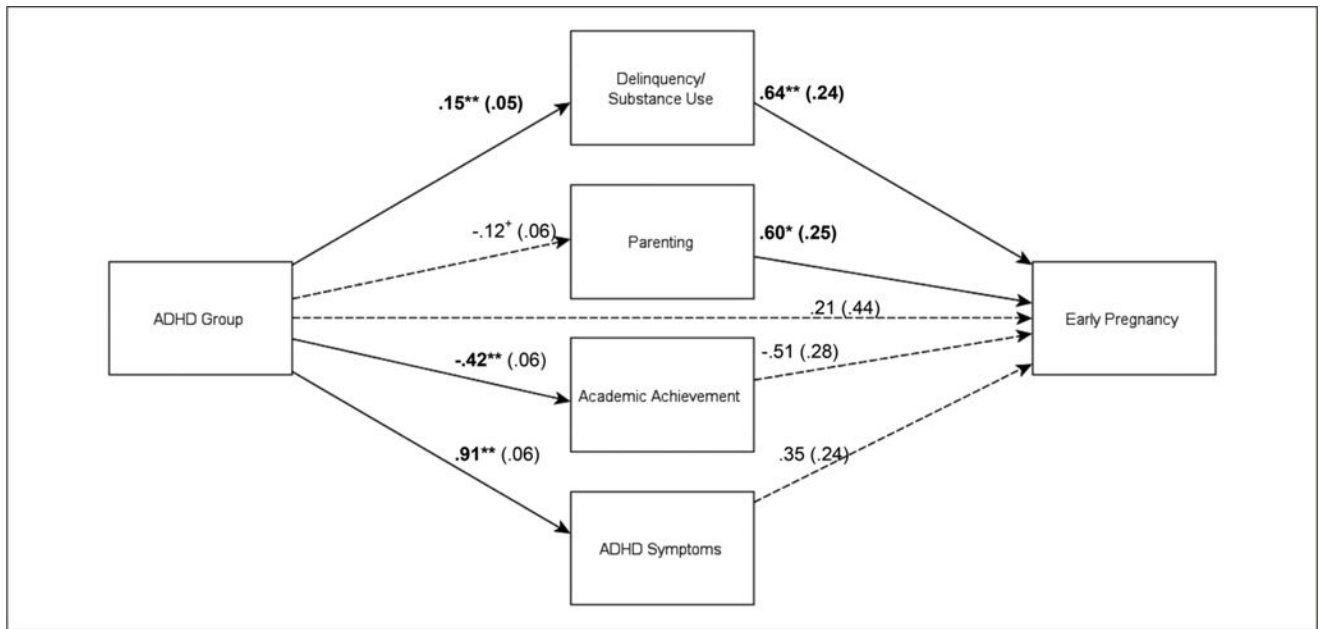


Figure 1. Full model predicting pregnancy before age 18 from ADHD group, mediated by delinquency/substance use, parenting, academics, and ADHD symptoms. *Note.* Paths show coefficients (standard errors). Mediating variables were permitted to covary in the model. †Approaching significance. * $p < .05$. ** $p < .01$.

Table 1

Indirect Effects of ADHD on Early Pregnancy Through Mediators in Multivariate Model

Mediator	Estimate	Sobel SE	<i>p</i>
Delinquency/substance use	.094	.046	.042*
Parenting	-.070	.047	.141
Academic performance	.216	.124	.083
ADHD symptoms	.317	.220	.149

*
p < .05.

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