

Adult Outcomes of Attention Deficit Hyperactivity Disorder and Conduct Disorder: Are the Risks Independent or Additive?

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Methods. Data were obtained from a longitudinal study sample of 754 adoptees and categorized based on review of the available adoption agency, medical, and psychiatric records of the biological parents. Categorical data were analyzed using χ^2 or Fisher's exact tests, as appropriate. Logistic regression analyses were used to assess the relative contribution of variables.

Results. There was not a statistically significant difference in the frequency or type of self-reported adult disruptive behavior, arrests, jail stays, felony arrests, or frequency of conduct disorder (CD) when inattentiveness, impulsivity, and hyperactivity were analyzed individually. The contributions of attention deficit hyperactivity disorder (ADHD) were independent and no additional increased risk for future illegal behavior was conferred by the combination of the disorders. While the effect of CD on illegal behavior was correlated with substance abuse and dependence, ADHD continued to be a significant contributor after controlling for substance abuse and dependence.

Conclusions. Data indicated that ADHD and CD are related but different disorders conferring risk for adult illegal behavior or arrest. In this sample, inattention was the most common domain impaired among those with ADHD, followed closely by hyperactivity, with impulsivity reported least often among those endorsing symptoms of ADHD.

Keywords Adoptees, ADHD, CD, Adult outcomes

INTRODUCTION

Although attention deficit-hyperactivity disorder (ADHD) was described over 100 years ago, an operational definition did not become commonly used until 1976 (1). Since that time the definition of ADHD has undergone revision with each

issue of the Diagnostic and Statistics Manual of Mental Disorders culminating in the recent edition which details that symptoms of inattentiveness, hyperactivity, and/or impulsivity must begin before age 7 and interfere with functioning across situations (2). DSM-IV then allows for the diagnosis of a number of subtypes of ADHD including inattentive type, hyperactive-impulsive type, combined type, and an NOS category for individuals with adult symptoms but unclear symptoms in childhood (3).

ADHD is a common mental illness affecting school age children and is a serious and costly public health problem for

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adults as well, affecting 2.7–6% of the adult population (4, 5). Several studies have demonstrated that substance abuse, mood disorders, anxiety disorders, and conduct disorder (CD) occur at higher rates in individuals with ADHD. Up to 32% of those adults seeking treatment for substance use disorders have ADHD (6). Though most people with ADHD never commit a crime and ADHD as a disorder does not cause criminal activity (7), several studies have described impaired social competence in those with ADHD (8). The presence of childhood ADHD appears to effect the course of development in a way that appears to confer risk for felony arrest by adulthood (7, 9–12). When looking at an offender sample, Soderstrom and colleagues found increased frequency of childhood-onset psychiatric disorders, including ADHD and CD, among perpetrators of crimes (10).

In this paper we examine a community sample of 754 adult adoptees, originally identified using agency records, with structured clinical interviews of adoptive parents and adoptees. This sample is comprised of individuals who were removed from their biological parents at birth by agencies in Iowa and placed with individuals who were not related to the newborn. These individuals were at least 18 years of age between 1975 and 1994. Approximately one half of the sample had biological parents with mental illness, chemical dependence, or behavioral problems. We seek to determine the frequency of childhood and adult disruptive behaviors and ADHD based on self-report and adoptive parent report. In addition we will discuss the interrelationships of these phenomena in this sample. After a review of the literature, our hypothesis was that disruptive behavior exceeding the threshold for conduct disorder would confer greater risk than ADHD for adult disruptive behavior, arrest, jail detention, and felony conviction. Further we hypothesized that the combination of CD and ADHD would be a more potent risk factor than either alone and that substance abuse would be the primary mediator.

METHODS

Data Set

Eligible participants for this study were adoptees who were at least 18 years of age between the years of 1975 and 1994. Adoptees were born in Iowa, removed from the biological parents at birth, and raised in adoptive homes. The current sample was originally comprised of five independent adoption studies and was categorized based on review of the available adoption agency, medical, and psychiatric records of the biological parents. The data analyzed come from the most recent follow-up interviews completed between 1999 and 2003 with adult adoptees currently aged 30–65. Consent was obtained for the follow-up interview. Subsequent use of the data for publication was granted by the interviewees. Appropriate oversight was given by the University of Iowa Institutional Review Board for human research.

Table 1 Questions Concerning Childhood Behaviors

Attention Deficit Hyperactivity Disorder: (ADHD)	
Criteria	
Trouble staying in seat	Blurts out answers
Does not complete tasks	
Threshold	
1 symptom frequent or very frequent: “possible” ADHD	
2 or more symptoms frequent or very frequent: “probable” ADHD or ADHD	
Conduct Disorder: (CD)	
Criteria	
Running away	Truancy
Stealing	Vandalism
Bullying	Fighting
Threshold	
1 symptom frequent or very frequent childhood disruptive behavior	
2 or more symptoms frequent or very frequent Conduct Disorder (CD)	

Follow-up interviews were conducted using the SSAGA-II (13, 14) by trained interviewers who were unaware of parental history or prior interview data. Adoptive parents were questioned about childhood behaviors exhibited by the adoptees. These questions are summarized in Table 1. With regard to ADHD, the adoptive parents were asked whether the subject had difficulty completing tasks, remaining in his or her seat, or blurting out answers. These three questions were culled from the data and selected as diagnostic because of their sensitivity for the detection of ADHD defined by much lengthier questionnaires available in two of the original adoption studies. A subject was classified as having “possible ADHD” if one of the above was endorsed as frequent or very frequent by the adoptive parent and “probable ADHD” or “ADHD” if two or more of the three symptoms were present. A subject was classified as having conduct disorder if the adoptive parent endorsed two or more of the following as occurring frequently or very frequently: running away, truancy, stealing, fighting, vandalism, or bullying. A subject was considered to have childhood disruptive behavior if one of the preceding problematic behaviors was endorsed as occurring frequently or very frequently during the childhood of the adoptee by the adoptive parent.

Statistical Analysis

Categorical data were analyzed using χ^2 or Fisher’s exact tests, as appropriate. Logistic regression analyses were used to assess the relative contribution of ADHD and CD in predicting arrests, jail sentences, felony convictions, and actions that would lead to criminal justice involvement. For all regression models, the interaction of any single symptom or combination of symptoms of ADHD and CD was initially included. However, these interaction effects were not significant for any of the outcomes of interest and were dropped from further consideration. The standard loglikelihood approach using Wald χ^2 tests was used. Additionally, because of the sometimes low incidence of the combined childhood diagnoses and dependent variables, exact probability methods were used. The exact and

Table 2 Correlation of ADHD and CD to Adult Outcomes: P-values and Exact Odds Ratios

Childhood Condition	Adult Outcome					
	Arrest		Jail		Felony	
ADHD	0.001	3.34	0.001	3.56	0.001	4.89
CD	0.001	4.06	0.002	3.14	0.003	3.95

large sample tests provided similar results, so only the more common Wald tests are presented. However, we did use the conditional exact method for calculating the odds-ratios and their confidence intervals (15, 16) as implemented in SAS® Version 9. Table 2 provides a summary of the p values and odds-ratios for ADHD and CD with regard to arrest, jail stay, and felony conviction.

Any level of missing data was infrequent, being noted in less than 5% of the adoptee sample. The specific missing data were not included in the applicable analysis, but the data that were present for each subject were analyzed.

RESULTS

The study group was composed of 754 subjects for all analyses not involving ADHD and CD and 727 subjects for all analyses involving ADHD and CD. See Table 3 for a summary of sample characteristics. The sample was 94% Caucasian and 47% male with ages ranging 30–65 years of age. Of those located for interview in this wave of follow-up, 41% ($n = 312$) had at least one biological parent with evidence of psychopathology, addiction, or behavioral disturbance. There was not a statistically significant difference in the incidence of ADHD among those who had behaviorally-disturbed biological parents ($n = 312$) as compared to those who did not ($n = 442$), but there was a significant correlation between those who had troubled biological parents and then developed conduct disorder ($p < 0.0001$).

Males were more likely than females to have ADHD ($\chi^2 = 39.8599$, $df = 1$, $p < 0.0001$), CD ($\chi^2 = 24.6472$, $df = 1$, $p < 0.0004$), self reported adult disruptive behaviors ($\chi^2 = 35.1932$, $p < 0.0001$), arrests ($\chi^2 = 43.7272$, $df = 1$, $p < 0.0001$), jail stays ($\chi^2 = 26.6991$, $df = 1$, $p < 0.0001$), and felony convictions ($\chi^2 = 14.0262$, $df = 1$, $p < 0.0002$).

Of those noting one or more symptoms of ADHD ($n = 239$), nearly two thirds had only one symptom ($n = 154$) while the remaining 85 had two or more symptoms. The most common symptom of ADHD in this sample was inattentiveness ($n = 170$), which occurred in approximately 22% of the sample and in 71% of those endorsing at least one symptom of ADHD. Hyperactivity ($n = 107$) and impulsivity ($n = 75$) each occurred at a lower frequency. There was not a statistically significant difference in substance of abuse among those with possible or

Table 3 Sample Descriptors

Age	
> 18 at time of identification	
30–65 at the time of interview	
Gender	
Male	47%
Female	53%
Race	
Caucasian	94%
Non-Caucasian	6%
Classification	
Proband	41%
Control	59%
Childhood ADHD	
0 symptom	67%
1 symptom	21%
2 or more symptoms	12%
Childhood CD	
0 symptom	70%
1 symptom	19%
2 or more symptoms	10%
Arrest	
Yes	83%
No	17%
Jail	
Yes	89%
No	11%
Felony	
Yes	96%
No	4%

probable ADHD as compared to those without ADHD (Wald $\chi^2 = 5.9$ and $p < 0.1$ for alcohol; Wald $\chi^2 = 7.0$ and $p < 0.07$ for marijuana; and Wald $\chi^2 = 4.3$ with $p < 0.23$ for amphetamines).

In assessing the sample for conduct disorder using DSM-IV symptoms of conduct disorder, almost one fifth of the sample (19% or $n = 141$) had one symptom of childhood disruptive behavior, 5% ($n = 39$) had evidence of two symptoms of disruptive behavior, and approximately 5% ($n = 42$) had evidence of three or more symptoms of disruptive behavior. The correlation of problematic alcohol or marijuana use was higher in those with any level of disruptive childhood behaviors (Wald $\chi^2 = 12.4$, $p < 0.05$ for alcohol and Wald $\chi^2 = 17.7$, $p < 0.01$).

While over half of the sample reported three or more adult behaviors that could be grounds for arrest including driving offenses ($n = 402$), only 17% ($n = 126$) noted a history of arrest, with 11% ($n = 81$) reporting a history of a prior jail stay, and 4% ($n = 27$) a history of a prior felony conviction.

Possible ADHD occurred at a higher rate in those reporting three or more adult behaviors, including driving offenses that could be grounds for arrest ($p < 0.0032$). When considering the variable of three or more reported adult behaviors for which the individual could have been arrested but was not, both ADHD (Wald $\chi^2 = 7.86$, $df = 1$, $p < 0.006$) and childhood disruptive behavior (Wald $\chi^2 = 6.55$, $df = 1$, $p < 0.011$) independently contributed to the logistic regression. However, the

odds-ratios did not suggest a very strong effect. Exact conditional odds-ratios were 1.61 (95% CI: 1.138–2.28) and 1.56 (95% CI: 1.09–2.23) for ADHD and childhood disruptive behavior, respectively. Using the more stringent criterion for CD, CD showed a larger odds ratio, 2.23 but a wider confidence interval (95% CI: 1.129–3.96). Both ADHD and CD fell from significance ($p < 0.21$ and $p < 0.26$ respectively) when controlled for substance use and dependence.

When evaluating the dependent variable of prior arrest both ADHD (Wald $\chi^2 = 29.79$, $df = 1$, $p < 0.001$) and childhood disruptive behavior (Wald $\chi^2 = 19.05$, $df = 1$, $p < 0.001$) independently contributed to predicting arrest. The exact odds ratio for ADHD was 3.34 (95% CI: 2.11–5.29), while the odds ratio for childhood disruptive behavior was 2.609 (95% CI: 1.65–4.12). The more stringent criterion for CD again increased the odds ratio to 4.06 (95% CI: 2.32–7.06) leaving the ratio for ADHD relatively unchanged. Both ADHD and CD retained significance ($p < 0.002$ and $p < 0.017$ respectively) for arrest when controlled for substance abuse and dependence.

With regard to jail stays, both ADHD (Wald $\chi^2 = 20.85$, $df = 1$, $p < 0.001$) and childhood disruptive behavior (Wald $\chi^2 = 10.54$, $df = 1$, $p < 0.002$) significantly contributed to predicting the subject reporting a jail stay. The conditional exact odds ratio for ADHD was 3.35 (95% CI: 1.93–5.87) and for CD the odds ratio was 2.33 (95% CI: 1.35–4.02). Using the more stringent criterion for conduct disorder, the conditional exact odds ratio for ADHD was 3.56 (95% CI: 2.07–6.18) and for CD the odds ratio was 3.14 (95% CI: 1.66–5.80). When controlling for substance abuse and dependence, ADHD retained significance ($p < 0.015$) while CD did not ($p < 0.120$).

Examining the dependent variable of felony conviction, only probable ADHD predicted a felony conviction (Wald $\chi^2 = 11.00$, $df = 1$, $p < 0.001$). Childhood disruptive behavior was non-significant (Wald $\chi^2 = 2.24$, $df = 1$, $p > 0.13$). When using the criterion for CD, it became significant (Wald $\chi^2 = 9.22$, $df = 1$, $p < 0.003$) and ADHD retained significance (Wald $\chi^2 = 10.22$, $df = 1$, $p < 0.001$). The odds ratios became 4.89 (95% CI: 1.84–12.94) and 3.95 (95% CI: 1.62–9.58) for ADHD and CD, respectively. ADHD also retained significance when controlling for substance abuse and dependence ($p < 0.015$) but CD did not ($p < 0.456$).

CONCLUSIONS

Review of this data obtained from a sample of 754 adoptees indicated that ADHD and CD are related but different disorders independently conferring risk for later illegal behavior, arrest, jail stay, or felony conviction. The children of troubled biological parents were significantly more likely to have CD, but not ADHD, when compared to those subjects whose biological parents were without significant psychopathology. The presence of CD, but not childhood disruptive behavior, significantly contributed to the prediction of felony conviction. ADHD was a stronger predictor of adult disruptive behavior

and adverse legal outcomes than childhood disruptive behavior and CD. ADHD retained significance in predicting adult disruptive behavior, arrest, jail stays, and felony conviction after controlling for other variables such as CD and substance abuse. Contrary to our initial hypothesis, the current analysis did not support the notion that the combination of CD and ADHD conferred additional risk. Further investigation is needed to better understand the genetic and environmental factors contributing to the phenomenology and outcomes of these complex disorders.

LIMITATIONS

Several important limitations should be noted. The sample is composed predominantly of Caucasian individuals from a rural state. The symptoms, behaviors, and legal involvements of the adoptees noted in this paper are based largely on self-report by the adoptees themselves. The childhood symptoms and behaviors described by the adoptive parents were after the adoptees became adults, consequently subtle or transient symptoms and behaviors may have been omitted. The symptoms were only counted toward the diagnosis of each condition if they were reported by the adoptive parents as occurring frequently to very frequently.

Across the various waves of interviews only selected symptoms of ADHD and CD were queried. The time parameters included in DSM-IV were not included in the SSAGA questions (e.g., onset of symptoms of ADHD before age 7, three or more childhood disruptive behaviors present in the same 12-month period) and this may have contributed to elevated frequencies of the disorders in this sample as compared to other community samples. Though the estimated frequencies of ADHD and CD were above general community estimates, the sample size became small when considering the subcategory of individuals with both more than one symptom of ADHD and more than one symptom of CD. This small sample size may have contributed to the failure to detect a significant interaction between CD and ADHD.

REFERENCES

1. Adler L, Chua H: Management of ADHD in adults. *J Clin Psychiatry* 2002; 63(Suppl.):29–35
2. Doyle R: The history of adult attention-deficit/hyperactivity disorder. *Psychiatr Clin North Am* 2004; 27:203–214
3. *Diagnostic and Statistical Manual of Mental Disorders* (ed. 4). Washington, DC, American Psychiatric Press, 1994
4. Weiss M, Murray C: Assessment and management of attention-deficit hyperactivity disorder in adults. *CMAJ* 2003; 168:715–722
5. Spencer TJ, Biederman J, Wilens TE, Faraone SV: Overview of neurobiology of attention-deficit/hyperactivity disorder. *J Clin Psychiatry* 2002; 63(Suppl.):3–9
6. Clure C, Brady K, Saladin M, Johnson D, Waid R, Rittenbury M: Attention-deficit/hyperactivity disorder and substance use:

- symptom, pattern, and drug choice. *Am J Drug Alcohol Abuse* 1999; 25:441
7. Goldstein S: Attention deficit/hyperactivity disorder implications for the criminal justice system. FBI Publications—Law Enforcement Bulletin 1997(June):online
 8. Thurber J, Heller T, Hinshaw S: The social behaviors and peer expectation of girls with attention deficit hyperactivity disorder and comparison girls. *Journal of Clinical Child & Adolescent Psychology* 2002; 31:443–452
 9. Mannuzza S, Klein R, Konig P, Giampino T: Hyperactive boys almost all grown up: IV criminality and its relationship to psychiatric status. *Arch Gen Psychiatry* 1989; 46:1073–1079
 10. Soderstrom H, Sjodin A, Carlstedt A, Forsman A: Adult psychopathic personality with childhood-onset hyperactivity and conduct disorder: a central problem constellation in forensic psychiatry. *Psychiatry Research* 2004; 121:271–280
 11. Burt S, Krueger R, McGue M, Iacono W: Parent-child conflict and the comorbidity among childhood externalizing disorders. *Arch Gen Psychiatry* 2003; 60:505–513
 12. Abikoff HB, Jensen PS, Arnold LL, Hoza B, Hechtman L, Pollack S, Martin D, Alvir J, March JS, Hinshaw S, Vitiello B, Newcorn J, Greiner A, Cantwell DP, Conners CK, Elliott G, Greenhill LL, Kraemer H, Pelham WE, Jr., Severe JB, Swanson JM, Wells K, Wigal T: Observed classroom behavior of children with ADHD: relationship to gender and comorbidity. *J Abnorm Child Psychol* 2002; 30:349–359
 13. Bucholz KK, Cadoret R, Cloninger CR, Dinwiddie SH, Hesselbrock VM, Nurnberger JI, Jr., Reich T, Schmidt I, Schuckit MA: A new, semi-structured psychiatric interview for use in genetic linkage studies: a report on the reliability of the SSAGA. *J Stud Alcohol* 1994; 55:149–158
 14. Hesselbrock M, Easton C, Bucholz KK, Schuckit M, Hesselbrock V: A validity study of the SSAGA--a comparison with the SCAN. *Addiction* 1999; 94:1361–1370
 15. Mehta C, Patel N: Exact logistic regression: Theory and examples. *Statistics in Medicine* 1995; 14:2143–2160
 16. Mehta C, Patel N, Senchaudhuri P: Efficient Monte Carlo Methods for Conditional Logistic Regression. *J Am Statistical Assoc* 2000; 95:99–108

