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Contribution of ADHD Symptoms to Substance Problems and Delinquency in Conduct-Disordered Adolescents

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We examined adolescents with conduct disorder (CD) and substance problems to determine if those with attention deficit hyperactivity disorder (ADHD) symptomatology had more severe delinquency and substance involvement. ADHD symptomatology was assessed in two ways: (1) by self-reports using the Diagnostic Interview Schedule for Children (DISC) and (2) by use of DISC plus reports of others (parents, program staff, and program teacher). We divided boys into three ADHD groups based on DISC: those who met criteria, those who reported at least eight current symptoms, and those who reported fewer than eight symptoms. We also divided the same boys into two groups: those with reports of ADHD by two or more sources and those without this multisource ADHD. Examining these definitions of ADHD revealed that boys with either self- or multisource ADHD had more CD symptoms, earlier age of CD onset, more substance dependence diagnoses, and more comorbid depression and anxiety.

Adolescents who have both conduct disorder (CD) and attention deficit hyperactivity disorder (ADHD) may have particularly severe and persisting pathology (Loeber, 1991; Moffitt & Silva, 1988; Walker, Lahey, Hynd, & Frame, 1987). The relationship between CD and ADHD has been studied

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using a number of different methodologies, ranging from general population studies (e.g., New Zealand; Silva, 1990) to clinic samples of hyperactive children followed longitudinally (e.g., Gittelman, Mannuzza, Shenker, & Bonagura, 1985; Satterfield, Swanson, Schell, & Lee, 1994) and by using different definitions of the two disorders over time as the *Diagnostic and Statistical Manual of Mental Disorders* (DSM) has changed.

These and other studies have shown that ADHD and CD frequently co-occur (Loney & Milich, 1982; Reeves, Werry, Elkind, & Zametkin, 1987; Stewart, Cummings, Singer, & DeBlois, 1981). Studies of "hyperactive" children or adolescents that have looked at CD have found a much higher prevalence of CD compared to demographically similar subjects who are not hyperactive. Reported comorbidity varies, but usually ranges from 30 to 50% (Biederman, Newcorn, & Sprich, 1991). Studies of delinquent or CD youth report similar rates of comorbid ADHD, the exact rates depending on the ages of the individuals (Szatmari, Boyle, & Offord, 1989). Factor-analytic studies have demonstrated that inattention/hyperactivity and conduct problems/aggression are separable, but moderately to highly correlated, problem areas (Hinshaw, 1987).

It appears that those hyperactive children whose symptoms persist into adolescence are the ones at high risk for CD and substance abuse (Mendelson, Johnson, & Stewart, 1971). Gittelman et al. (1985) followed a group of boys who were initially diagnosed as hyperactive between the ages of 6 and 12. They attempted to find a group of "pure" hyperactives by excluding children with clear-cut conduct disorders at the beginning of the study. Even so, when they examined these boys at 16 years of age or older, they found that the hyperactive subjects whose symptoms persisted into middle adolescence were significantly more likely to develop an antisocial or substance use disorder (SUD) than those who did not have persisting ADHD symptoms. In fact, those in the original hyperactive group whose symptoms remitted by age 16 were no more likely to have an antisocial disorder or SUD than the control subjects. These studies generally show, then, that children with ADHD are at high risk for developing CD (particularly if their ADHD symptoms persist rather than remit) and that those subjects who do go on to develop CD then become more prone to antisocial personality disorder and drug abuse.

Other studies have approached the issue by comparing adolescents with both ADHD and CD to those with CD alone. Much like the results from the studies noted above comparing ADHD plus CD to ADHD alone, these investigators have found that youths with both disorders have greater pathology than youths with just CD (Gittelman et al., 1985; Moffitt, 1990; Walker et al., 1987). Moffitt (1990) found that at age 13 boys with ADHD plus "delinquency" had more family adversity, lower verbal intelligence, and

poorer reading skills than boys with either ADHD or delinquency but not both. Reeves et al. (1987) and Szatmari et al. (1989) concluded that children with ADHD and CD seem to represent a true "hybrid" disorder, manifesting all of the problems of both disorders rather than representing primarily one or the other. Several studies, however, have found evidence that the CD behaviors of those with both disorders are even more severe than those with CD alone. For example, Gittelman et al. found that ADHD plus CD was associated with more conflicts with teachers, greater frequency of fighting and stealing, and a higher frequency of illegal earnings and weapon use after the age of 18; they urged caution in interpreting their results, however, because the CD-only group was small. Walker et al. found that, among clinically referred children between the ages of 6 and 13, those with ADHD plus CD had more physical aggression and a greater variety and severity of antisocial behaviors than children with just CD, even though the children in the comorbid group were younger. Forehand, Wierson, Frame, Kempston, and Armistead (1991) found that among incarcerated male delinquents with an average age of 16, those who had CD and ADHD had lower verbal IQs, were arrested at an earlier age, and had more total arrests than those with just CD.

It is known that increased rates of SUD are associated with CD, but little is known about the rates of SUD in youths with ADHD plus CD, compared to youths with CD alone (Alterman & Tarter, 1986; Biederman et al., 1991) However, Tarter and his colleagues (Alterman, Tarter, Baughman, Bober, & Fabian, 1985; Tarter, Alterman, & Edwards, 1985) have done extensive research investigating antecedents to substance abuse, particularly alcoholism, which suggests that CD plus ADHD would predict more severe substance involvement. Tarter has suggested that important etiologic factors in substance abuse include significant deviations in temperamental traits, which may include hyperactivity, poor attention, and disturbances in emotional or activity regulation, characteristics associated with ADHD and conduct problems (Tarter et al., 1985). For example, Tarter and colleagues have found correlations between disturbances in behavioral activity regulation and substance abuse severity in adolescents (Tarter, Laird, Kabene, Bukstein, & Kaminer, 1990).

In terms of comorbid psychiatric disorders, it is known that individuals who have CD, ADHD, *or* SUD have higher than normal rates of anxiety and depressive disorders. Little is known, however, about the rates of anxiety, depression and other disorders in youths with CD/SUD plus ADHD (Kashani et al., 1987; McGee et al., 1990)

By their nature, only very large general population studies can examine many subjects with less-common disorders. Another approach is to examine an extreme group of delinquent and substance-abusing adolescents wherein

larger numbers of subjects are likely to have comorbid CD and ADHD (of varying severity levels). Schachar (1991) has suggested that such clinic samples may overrepresent those with mixed hyperactivity and conduct disturbance. While this methodology may have little applicability for most of the general population, it may help in understanding relationships among symptoms and behaviors at the extreme end of the externalizing disorder continuum.

The present study examined ADHD symptoms in a group of adolescents with conduct disorder and clinically significant substance involvement to determine whether ADHD contributed significantly to their substance involvement, aggression, and delinquency.

METHOD

Subjects

The sample for this study consisted of 171 adolescent boys ranging in age from 13 to 19 years who were admitted to an unlocked residential program for substance abusers with behavioral disorders. All boys admitted to this facility have serious behavior problems as well as substance involvement, but they cannot be homicidal, or suicidal, psychotic or have a recent history of fire-setting. This is a facility funded by state and federal funds. Referral sources include various social service agencies, the juvenile justice system, families, and private treatment providers. The majority of boys referred are involved with Social Services because of either family problems or their own substance involvement. Many of those referred are involved in the criminal justice system and are given the opportunity to participate in treatment in lieu of detention or incarceration. This sample includes the patients studied by Young et al. (1995) and Riggs, Baker, Mikulich, Young, & Crowley (1995).

A total of 246 boys were admitted, but 75 were excluded from this study because they eloped before completing the two major diagnostic instruments (DISC and CIDI-SAM, described below; $n = 68$), because they did not have a substance diagnosis ($n = 3$) or a lifetime CD diagnosis ($n = 1$), because of low IQ ($n = 1$) or not speaking English ($n = 1$), or because of errors in the data ($n = 1$).

Measures

A number of structured interviews and questionnaires were administered as a standard part of the clinical assessment of these boys. Whether

or not specific instruments were completed depended on how long adolescents remained in the program, whether their parents completed a questionnaire mailed to them, and when specific measures were added to the clinical protocol.

DISC. The structured Diagnostic Interview Schedule for Children, 2.1 (DISC; Fisher et al., 1993) was administered by trained interviewers. We relied on this child-DISC to make *Diagnostic and Statistical Manual of Mental Disorders* (3rd ed., revised) (DSM-III-R; American Psychiatric Association, 1987) diagnoses of CD, ADHD, mood disorders, and anxiety disorders as parents were frequently either unavailable or uncooperative in providing information in a structured interview format. In addition to relying on DISC for diagnosis, we used symptom counts to examine severity of disorders rather than solely relying on categorical data.

Soon after beginning to use the DISC, we discovered a problem in the information regarding CD behaviors. The DISC inquires about CD symptoms *in the last year.* A number of boys entering the treatment program came from detention centers or other locked facilities, thereby having reduced or no opportunity to engage in CD behaviors in the recent past. Therefore, we felt that, in some cases, asking only about the last year artificially reduced reports of CD behaviors. As a result, additional questions were added, asking subjects whether CD symptoms that had not occurred in the last year had *ever* occurred and ascertaining the age at which each CD symptom had first occurred. This provided two additional variables, lifetime diagnosis of CD (by three or more lifetime symptoms) and age of onset of earliest CD symptom. No other group, to our knowledge, has modified DISC CD diagnosis in this way.

Examination of the criteria for DISC diagnosis of ADHD revealed some inherent problems in relying on adolescent recall to diagnose a disorder that must begin before age 7 to meet DSM-III-R criteria. Many of the boys had trouble recalling when their ADHD behaviors began. Also DISC attempts to get at the notion of behaviors being "considerably more frequent than that of most people of the same mental age" (APA, 1987, p. 52) by asking the youth whether he perceives his symptoms as a "problem." It appeared that in our sample of boys who frequently had been involved in significant criminal behaviors, many reported symptoms but, in the context of their troubled lives, did not perceive them to be much of a problem. These factors led us to explore other ways of "diagnosing" or categorizing boys as having significant ADHD symptomatology. One simple way was to sum the number of current symptoms reported by the adolescent on the DISC, with a cut-off score of eight or more symptoms (the number used in DSM-III-R) as the criterion for a broader definition of ADHD.

CIDI-SAM. The Composite International Diagnostic Interview—Substance Abuse Module (CIDI-SAM; Cottler, Robins, & Helzer, 1989; Robins et al., 1988), a 30 to 60 min, structured interview was administered in order to diagnose DSM-III-R substance abuse and dependence for 10 drugs or drug classes.

CASI. The Comprehensive Addiction Severity Index—Adolescents (CASI; Meyers, 1991) is a semistructured interview that seeks information about onset age, frequency of use, and patterns of use for nine drugs or drug classes (Meyers, 1991). No data have been published about the psychometric properties of the CASI, so we analyzed individual item responses, including age of initial drug use, age of onset of regular drug use (defined as at least monthly), and number of drugs used regularly.

CBCL. The Child Behavior Checklist Behavior Problems scale (CBCL; Achenbach, 1991) consisting of 118 items that are endorsed as *not true, sometimes true,* or *very true,* was sent to parents for completion and return. A residence staff member who was familiar with the boy also completed the CBCL. We used the Attention Problems scale as a measure of ADHD and analyzed the Aggressive and Delinquent behavior scales as dependent measures.

CTRS. The Conners' Teacher Rating Scale (CTRS; Conners 1969, 1973) has 39 items that are rated on a 4-point scale from *not at all* to *very much.* We used the 10-item Hyperactivity Index as a measure of ADHD.

Peak Aggressive Incident. Lewis, Pincus, Shanok, and Glaser's (1982) Aggression Scale was modified (by T.J.C). After completing the CASI and DISC, the interviewer asked more about reported aggressive episodes. The peak incident was rated on a scale of 0 to 9:

0 to 1: fewer than three fights ever (pushing, wrestling, fists only)
2 to 3: three or more fights but no injuries requiring medical care, no weapon fights
4 to 5: fights with threats of violence, menacing with weapon, or one or two injury-free fire-setting episodes
6 to 7: fight-related injury to others requiring medical attention, rape, attempted murder, injury-arson, armed robbery, weapon fights
8 to 9: brutal attack with multiple assaults, brutal humiliating rape, torture

We used this rating as a dependent measure.

Social Class. We estimated Hollingshead-Redlich (1958) two-factor social class from boys' reports about the principal wage earner in the family of raising.

WAIS-R or WISC-R. The Wechsler Adult Intelligence Scale—Revised (WAIS-R; Wechsler, 1981) was administered to boys 16 and older, while

the Wechsler Intelligence Scale for Children—Revised (WISC-R; Wechsler, 1974) was administered to those under the age of 16 to yield IQ scores.

Procedure

Carefully trained interviewers (Bachelor's or Master's level) administered the DISC, CIDI-SAM, and CASI to boys, usually within the first week after admission. The peak aggressive incident rating was done subsequent to the structured interviews. Also, at that time the CBCL was mailed to parents for completion and return. After each adolescent had been in the residential program 1 month, a residence staff person completed the CBCL and the teacher at the program school completed the CTRS. Intelligence testing was administered by trained interviewers or graduate-level psychology students after subjects had been in the program for about 1 month.

Definition of ADHD

In order to evaluate ADHD symptomatology as comprehensively as possible in these subjects, we explored two different ways of defining ADHD. The first method employed only the DISC and yielded three groups: those with a formal DISC diagnosis of ADHD, those with a DISC current symptom count of eight or more but not meeting the criteria of age of onset and/or perceiving the symptoms as problems, and those without evidence of significant ADHD symptoms (current symptom count of less than eight). The second way we defined ADHD symptomatology used all four ADHD measures and required that the boy have elevated scores on two or more of the four measures. We used this second definition for two reasons: (1) It did not rely exclusively on adolescent self-reports, and (2) some have argued that, for ADHD to be diagnosed, there should be evidence of symptoms in more than one aspect of the individual's life; i.e., there should be evidence of "cross-situational" symptomatology. Operationally, we defined elevated scores as a report of eight or more symptoms on DISC, a *T*-score of 65 or higher on the Hyperactivity Index of the CTRS, and a *T*-score of 65 or higher on either the Staff or Parent CBCL Attention Problems Scale. For this method, subjects with fewer than two completed measures were excluded, leaving 143 subjects.

Analyses

Descriptive statistics on demographic and diagnostic variables were computed for the sample. Next, we computed Pearson correlations among

continuous ADHD measures. We set the alpha level at .01 to avoid Type I errors, but for the reader's information we list all p values less than .05 in the tables. Group comparisons were performed two ways. We performed one-way analyses of variance (ANOVAs) using the two levels of DISC criteria to define ADHD: (1) full ADHD diagnosis and (2) a report of eight or more symptoms without meeting other DISC criteria compared to (3) boys who reported fewer than eight ADHD symptoms; *post hoc* analyses were performed with conservative Scheffé contrasts using .05 as the criterion for significance. Next, we performed t-tests comparing boys who had elevated scores on two or more ADHD measures with those boys who had 0 or 1 elevated score; again, we used $p < .01$ as criterion for significance. The number of subjects for these analyses was 143 because 28 of the boys did not have two or more ADHD measures to inspect.

RESULTS

Sample Description

The mean age of the total sample of 171 boys was 16.05 years (SD = 1.31 years), and average grade level in school was 9.38 (SD = 1.16). Fifty percent of the boys were Anglo, 39% were Hispanic, 8% were African American, and 3% were American Indian. The average Hollingshead-Redlich socioeconomic status (SES) category was IV (lower middle class). Mean Wechsler full scale IQ was 98.05 (SD = 11.36). Mean length of stay in the treatment program was not quite 6 months.

The number of DSM-III-R CD symptoms necessary for diagnosis is three. All of the boys met criteria for CD using lifetime symptoms, and the average number of lifetime symptoms was 7.26 (SD = 2.11). Using the DISC criteria of examining symptoms only in the last year, 81% of the sample met criteria for CD. Using the DISC, 16% of the sample met full diagnostic criteria for ADHD (at least eight current symptoms, onset before age 7, and perceiving symptoms as problems). The average number of current ADHD symptoms for the sample was 7.67 (SD = 3.99).

Self-reports revealed substance dependence diagnoses on an average of 3.27 drugs (SD = 1.75). Average number of drugs used regularly (at least monthly) was 4.17 (SD = 1.60). Average age of initial substance use was 9.94 years (SD = 3.14 years), while average age of onset of regular substance use was 11.77 years (SD = 2.33 years).

Subjects had an average of 1.32 other psychiatric diagnoses (SD = 1.79). These excluded CD, oppositional defiant disorder, substance abuse, substance dependence, and ADHD. Seventy-nine (46.2%) of the boys met

Table I. Pearson Correlations Among ADHD Measures[a]

	DISC	CTRS	Staff CBCL	Parent CBCL
DISC	1.000	.149	.107	.105
CTRS		1.000	.015	.169
Staff CBCL			1.000	-.052
Parent CBCL				1.000

[a]ADHD = attention deficit hyperactivity disorder; DISC = Diagnostic Interview Schedule for Children; CTRS = Conners' Teaching Rating Scale; CBCL = Child Behavior Checklist.

diagnostic criteria for one or more anxiety disorders (other than simple phobia), while 37 boys (21.6%) met criteria for a depressive disorder. Twenty boys (11.7%) met DISC criteria for "mania" which does not correspond to a specific DSM-III-R diagnosis.

Relationships Among ADHD Measures

Intercorrelations of measures of ADHD symptomatology are presented in Table I. Pearson correlations among DISC ADHD symptom counts (reported by the adolescents), CBCL Attention Problems *T*-Score from the staff, CBCL Attention problems *T*-score from the parents, and Hyperactivity Index *T*-score from the CTRS were all nonsignificant.

Group Comparisons

As noted above, only 16% (n = 28) of the sample met DISC diagnostic criteria for ADHD, but an additional 38% (n = 65) of the sample reported eight or more current ADHD symptoms on DISC. Of the subgroup who had scores from at least two of the four ADHD measures (n = 143), 45% (n = 64) had two or more elevated scores, suggesting some degree of "pervasive" or "cross-situational" hyperactivity.

Using these two methods of defining ADHD symptoms, we assessed whether subjects with ADHD symptoms differed demographically from those who did not. Then we examined whether the ADHD groups had more severe CD, higher aggression scores, greater substance involvement, higher rates of comorbid psychiatric diagnoses, or lower IQ.

Demographic Variables. Table II provides a summary of demographic variables. The results from the ANOVAs looking at DISC and the *t*-tests looking at pervasive ADHD are consistent. Neither age nor education level differed between CD subjects with or without ADHD symptoms, regardless

Table II. Demographic Data[a]

	DISC ADHD						
		Symptom count			Number of elevated ADHD scores		
	Diagnosis *M* (*n*) (*SD*)	≥8 *M* (*n*) (*SD*)	<8 *M* (*n*) (*SD*)	ANOVA *p*-value	≥2 *M* (*n*) (*SD*)	<2 *M* (*n*) (*SD*)	*t*-test *p*-value
Age	16.14 (28) (1.15)	16.02 (65) (1.37)	16.04 (78) (1.32)	n.s.	16.20 (64) (1.34)	15.97 (79) (1.27)	n.s.
Education	9.32 (25) (0.85)	9.37 (63) (1.13)	9.45 (73) (1.28)	n.s.	9.33 (64) (1.09)	9.40 (78) (1.28)	n.s.
Days in treatment	135.38 (24) (138.56)	187.24 (59) (157.38)	180.48 (73) (158.66)	n.s.	197.24 (54) (149.77)	220.23 (74) (151.84)	n.s.

[a]DISC = Diagnostic Interview Schedule for Children; ADHD = attention deficit hyperactivity disorder; ANOVA = analysis of variance.

Table III. Delinquency and Aggression Measures[a]

	DISC ADHD						
		Symptom count			Number of elevated ADHD scores		
	Diagnosis *M* (*n*) (*SD*)	≥8 *M* (*n*) (*SD*)	<8 *M* (*n*) (*SD*)	ANOVA *p*-value	≥2 *M* (*n*) (*SD*)	<2 *M* (*n*) (*SD*)	*t*-test *p*-value
No. CD Symptoms	8.11 (27) (2.06)	8.20 (65) (1.96)	6.17 (77) (1.70)	.000	8.03 (63) (2.08)	6.56 (78) (1.98)	.000
Age — 1st CD Symptom	6.15 (27) (2.88)	8.02 (65) (3.16)	8.74 (77) (2.91)	.001	7.57 (63) (3.34)	8.74 (78) (2.87)	.027
Peak aggression	6.68 (25) (2.36)	7.28 (64) (1.63)	6.36 (76) (2.25)	.030	6.75 (63) (2.16)	6.51 (79) (2.16)	n.s.
CBCL *T*-score ratings							
Staff aggression	57.94 (16) (7.51)	55.12 (49) (8.00)	56.19 (57) (8.60)	n.s.	56.41 (51) (8.43)	55.69 (71) (8.10)	n.s.
Staff delinquency	66.56 (16) (10.46)	65.71 (49) (11.77)	67.14 (57) (10.67)	n.s.	66.73 (51) (12.32)	66.32 (71) (10.09)	n.s.
Parent aggression	70.50 (8) (7.82)	64.61 (28) (10.98)	61.00 (27) (8.14)	.045	65.35 (40) (9.81)	61.13 (23) (9.49)	n.s.
Parent delinquency	83.00 (8) (7.56)	74.04 (28) (10.91)	74.81 (27) (7.76)	n.s.	75.95 (40) (10.91)	74.74 (23) (6.88)	n.s.
Percentages of subjects meeting diagnostic criteria				Chi square			Chi square
DISC CD	96 (27)	91 (65)	67 (77)	.000	92 (63)	69 (78)	.001

[a]DISC = Diagnostic Interview Schedule for Children; ADHD = attention deficit hyperactivity disorder; ANOVA = analysis of variance; CD = conduct disorder; CBCL = Child Behavior Checklist.

of the definition. No difference in length of treatment was found for those with ADHD compared to subjects without.

Delinquency and Aggression Measures. Data in Table III show that, regardless of the definition of ADHD used, those subjects with evidence of significant ADHD symptoms self-reported more CD symptoms [$F(2, 166) = 24.23, p < .000$, and $t(139) = 4.27, p < .000$] and at least a trend toward an earlier age of onset of CD than those without ADHD [$F(2, 166) = 7.44, p < .001$ and $t(139) = 2.24, p < .027$]. Although all boys met criteria for CD using three symptoms across the lifespan, only 81% met strict DISC criteria. Table III shows that significantly more boys with ADHD symptomatology had DISC CD than boys without (both $ps < .001$). We did not find differences in our measures of aggression between boys with ADHD compared to those without, no matter how we defined aggression; specifically, no significant differences were found for the peak aggressive incident rating or for staff or parent reports of aggression or delinquency on the CBCL.

Substance Use Measures. To assess the severity of substance involvement, we analyzed number of dependence diagnoses, age at which first substance use began, age at which regular (monthly) substance use began, and drugs used regularly (Table IV). Results reveal that subjects with ADHD symptoms showed some signs of greater and earlier substance involvement. An ANOVA performed on the three ADHD DISC groups showed a significant difference in number of substance dependence diagnoses [$F(2, 168) = 5.23, p < .006$]; *post hoc* comparisons revealed that ADHD diagnosis boys had more dependence diagnoses than those with few or no ADHD symptoms ($p < .05$). Boys with ADHD symptoms across situations showed a trend toward more dependence diagnoses [$t(141) = -2.02, p < .046$]. Age of initial substance use did not differ between ADHD and non ADHD subjects, while age of regular substance use tended to be younger for ADHD subjects using the definition of two or more elevated scores [$t(140) = 2.45, p < .016$]. The ANOVA performed on DISC ADHD groups revealed a marginal difference in number of drugs used regularly [$F(2, 158) = 3.06, p < .05$), but the *post hoc* comparisons were all nonsignificant.

We then examined specific substance dependence among individuals with comorbid ADHD. Analyses on 10 classes of drugs revealed only a few "spotty" trends. Using DISC, chi-square analysis revealed significant group differences in percentages of subjects with dependence on hallucinogens [$\chi^2(2) = 9.36, p < .01$]. Chi-square comparisons of boys showing ADHD across situations to those without revealed two marginal differences. The trend was for more boys with cross-situational ADHD to be dependent on amphetamines ($p < .019$) and sedatives ($p < .024$). Percentages in Table IV reveal, however, that sedative dependence was quite rare in this sample.

Table IV. Substance Involvement Measures[a]

	DISC ADHD						
		Symptom count			Number of elevated ADHD scores		
	Diagnosis *M* (*n*) (*SD*)	≥8 *M* (*n*) (*SD*)	<8 *M* (*n*) (*SD*)	ANOVA *p*-value	≥2 *M* (*n*) (*SD*)	<2 *M* (*n*) (*SD*)	*t*-test *p*-value
No. dependency diagnoses	4.00 (28) (1.56)	3.46 (65) (1.86)	2.86 (78) (1.62)	.006	3.61 (64) (1.85)	3.01 (79) (1.68)	.046
Age—first use	9.48 (25) (2.95)	9.54 (63) (3.17)	10.34 (73) (3.16)	n.s.	9.34 (64) (3.15)	10.29 (78) (3.17)	n.s.
Age—regular use	11.40 (25) (2.36)	11.41 (63) (2.18)	12.15 (73) (2.38)	n.s.	11.23 (64) (2.38)	12.21 (78) (2.32)	.015
No. regular drugs	4.80 (25) (1.50)	4.29 (63) (1.84)	3.90 (73) (1.43)	.050	4.38 (64) (1.58)	4.01 (78) (1.52)	n.s.
	Percentages of subjects with dependence diagnoses						
	(*n* = 28)	(*n* = 65)	(*n* = 78)	Chi square	(*n* = 64)	(*n* = 79)	Chi square
Cocaine	29	23	18	n.s.	25	19	n.s.
Amphetamines	25	23	10	n.s.	27	11	.019
PCP	0	6	4	n.s.	5	4	n.s.
Cannabis	93	82	76	n.s.	86	82	n.s.
Alcohol	82	88	76	n.s.	83	77	n.s.
Sedatives	4	3	1	n.s.	6	0	.024
Hallucinogens	68	42	35	.01	48	41	n.s.
Inhalants	18	20	8	n.s.	17	11	n.s.
Opiates	7	6	3	n.s.	8	1	n.s.
Tobacco	75	54	56	n.s.	56	56	n.s.

[a]DISC = Diagnostic Interview Schedule for Children; ADHD = attention deficit hyperactivity disorder; ANOVA = analysis of variance.

Comorbid Psychiatric Diagnoses. Table V shows that, using DISC, boys with ADHD had more comorbid psychiatric diagnoses than boys without ADHD [$F(2, 168) = 20.98, p < .000$); subjects with either DISC diagnosis or symptoms had more comorbid diagnoses than subjects without ADHD symptoms ($p < .05$). Boys with reports of ADHD from two or more sources tended to have more comorbid diagnoses than those without [$t(141) = -2.43, p < .017$). Using DISC, chi-square analyses showed that more boys with ADHD had specific comorbid disorders involving depression, anxiety, and mania (all $ps < .001$). Boys with two or more elevated ADHD scores showed a only a trend toward more anxiety ($p < .04$). Follow-up analyses on individual anxiety disorders revealed that more boys with DISC diagnoses or high symptom counts had higher percentages of almost all individual diagnoses than boys with no evidence of ADHD (at least a trend for all but social phobia and avoidant disorder).

IQ. The analyses of IQ scores produced differences between groups according to formal diagnosis, but in the opposite direction than predicted. Table VI shows that boys with an ADHD diagnosis had significantly higher verbal IQ and full scale IQ values than subjects with either symptoms but no diagnosis and subjects without ADHD symptoms [$F(2, 115) = 7.39, p < .001$, and $F(2, 115) = 5.01, p < .008$, respectively]. These differences disappeared when comparing subjects with cross-situational ADHD versus those without.

DISCUSSION

We found in this sample of delinquent youths with substance involvement that the presence of ADHD symptoms was associated with more severe substance involvement, higher rates of anxiety and depression, more severe CD, and a tendency to start CD behaviors at an earlier age. It should be reiterated that we studied an extreme sample of youths who *all* had a CD diagnosis and substance involvement to the extent that they were in residential treatment for these problems. While our results are informative for this end of the continuum, they may not generalize to the general population where milder forms of these behaviors may exist.

More specifically, we found that the presence of ADHD symptoms, either by self-reports or from ratings by others, was associated with a greater likelihood of DISC diagnosis of CD and more lifetime CD symptoms. Formal DISC ADHD diagnosis was associated with reported earlier age of onset of the first CD symptom. These findings are similar to those of others (Moffitt, 1990; Offord, Sullivan, Allen, & Abrams, 1979; Szatmari et al., 1989; Walker et al., 1987), showing that adolescents with comorbid

Table V. Comorbid Disorders[a]

	DISC ADHD						
		Symptom count			Number of elevated ADHD scores		
	Diagnosis	≥8	<8	ANOVA *p*-value	≥2	<2	*t*-test *p*-value
No. other diagnoses Mean (*n*) (*SD*)	2.36 (28) (2.09)	1.89 (65) (2.06)	0.46 (78) (0.77)	.000	1.80 (64) (2.04)	1.03 (79) (1.76)	.017
	Percentages of subjects meeting diagnostic criteria						
	(*n* = 28)	(*n* = 65)	(*n* = 78)	Chi square	(*n* = 64)	(*n* = 79)	Chi square
Major depression	32	18	4	.001	16	9	n.s.
Mania	39	14	0	.000	13	9	n.s.
Anxiety disorders (Combined)	68	62	26	.000	53	35	.034
PTSD	29	22	9	.028	14	13	n.s.
Social phobia	21	17	6	n.s.	16	10	n.s.
Panic disorder	14	2	0	.001	3	1	n.s.
Agoraphobia	18	11	1	.008	9	4	n.s.
Separation anxiety	25	19	8	.045	14	11	n.s.
Avoidant disorder	7	6	1	n.s.	3	4	n.s.
Overanxious disorder	25	20	3	.001	17	10	n.s.
Generalized anxiety	11	15	1	.008	13	5	n.s.
Obsessive compulsive	29	31	3	.000	23	9	.016

[a]DISC = Diagnostic Interview Schedule for Children; ADHD = attention deficit hyperactivity disorder; ANOVA = analysis of variance; PTSD = posttraumatic stress disorder.

Table VI. Analysis of IQ Scores[a]

	DISC ADHD						
		Symptom count			Number of elevated ADHD scores		
	Diagnosis (n = 18) M (n) (SD)	≥8 (n = 48) M (n) (SD)	<8 (n = 52) M (n) (SD)	ANOVA p-value	≥2 (n = 53) M (n) (SD)	<2 (n = 63) M (n) (SD)	t-test p-value
Full-scale IQ	105.28 (11.68)	95.71 (10.94)	97.71 (10.80)	.008	96.72 (11.98)	99.10 (10.75)	n.s.
Verbal IQ	104.72 (11.66)	92.88 (11.63)	96.13 (10.51)	.001	94.92 (12.09)	97.13 (11.43)	n.s.
Performance IQ	105.72 (12.49)	99.81 (10.87)	100.73 (13.28)	n.s.	99.43 (12.75)	102.38 (11.83)	n.s.

[a]DISC = Diagnostic Interview Schedule for Children; ADHD = attention deficit hyperactivity disorder; ANOVA = analysis of variance.

ADHD and CD have worse psychopathology in terms of symptoms related to ADHD and CD.

We also extend those earlier findings, showing that boys with ADHD had more significant substance involvement in terms of more dependence and starting to use drugs regularly at an earlier age. This is consistent with the findings of Lahey et al. (1988) that substance abuse was more prevalent among fathers of children with ADHD plus CD than fathers of children with just CD. It is also consistent with the conclusions of Gittelman et al. (1985) and Klein and Mannuzza (1991) that, among children with ADHD, the greatest risk factor for the development of antisocial behavior and drug abuse is the maintenance of ADHD symptoms into adolescence. We did not find strong evidence that adolescents with ADHD chose specific drugs, except that youths with a ADHD diagnosis were more likely to be dependent on hallucinogens. We do not know why this would be the case.

Previous studies of children/adolescents with ADHD alone do not find increased rates of substance involvement in adolescence or early adulthood (Henker, Whalen, Bugental, & Barker, 1981; Kramer & Loney, 1982). Youths with CD alone have increased rates of drug abuse compared to normals, yet we found that those with CD and ADHD have even greater problems. What is it about the combination of these two externalizing disorders that produces more psychopathology and more substance involvement? Moffitt (1993) has argued that subtle neuropsychological dysfunction occurs frequently in children with both disorders. This dysfunction results in an individual less able to cope, one having fewer prosocial behaviors and therefore fewer options in life. Moffitt did not directly address substance abuse, but she argued that, when such an individual grows up in a family with significant adversity, that individual will have more delinquent and antisocial behaviors that persist across the lifespan. Tarter and others (Alterman & Tarter, 1983; Tarter et al., 1985; Vanyukov, Moss, & Tarter, 1994) have hypothesized a similar set of trait variables that interact with the environment in a diathesis–stress model as an important cause of substance abuse.

We also found more comorbid depression and anxiety in youths who have CD and ADHD. This is consistent with the findings of both studies of clinically referred subjects and epidemiological studies showing that ADHD in childhood is frequently comorbid with CD, major depression, and anxiety disorders (Anderson, Williams, McGee, & Silva, 1987; Biederman et al., 1991; Bird et al., 1988; Plizka, 1989). More recent studies have also demonstrated that this comorbidity persists (Biederman et al., 1991). For example, Biederman et al. (1993) found high rates of antisocial, major depressive, and anxiety disorders among adults with ADHD; they noted that the high rates of antisocial and substance use disorders in these adults

with ADHD were consistent with longitudinal studies of children with ADHD who are now grown (Gittelman et al., 1985; Weiss, Hechtman, Milroy, & Perlman, 1985). Other studies have shown that CD is associated with higher rates of depression and anxiety (Anderson et al., 1987; Bird et al., 1988; Zoccolillo, 1992), and Bukstein, Brent, and Kaminer (1989) in their review of comorbidity noted high rates of depression and anxiety disorders among substance abusers. Our findings of higher rates of anxiety and depression in these boys suggest there is a group of delinquent adolescents who have a wide range of symptoms and problems (both in the externalizing and internalizing realms) that may be associated with substance use. Moreover, there is a growing consensus that the antisocial behavior and substance use of children with comorbid CD and ADHD are more likely to persist or worsen compared to children with CD alone (Crowley & Riggs, 1995; Magnusson, Slottin, & Duner, 1983; Schachar, Rutter & Smith, 1981).

Given the very high rates of mania and anxiety disorder diagnoses in this sample, one might consider whether using the DISC results in some "overdiagnosis." The DISC does not attend to exclusionary criteria contained in DSM-III-R, which results in a greater likelihood that an individual will be given more than one anxiety disorder diagnosis. Also there is some overlap in the criteria for ADHD and some of these disorders such as restlessness, feeling "keyed up," and difficulty concentrating that may in some cases result in overdiagnosis. In addition, with regard to the mania diagnosis in particular, none of these youths presented as hypomanic clinically, so it appears especially likely that the DISC questions about mania are overinclusive. In future studies, it would be helpful to have clinical confirmation of diagnoses in order to avoid these methodological problems with DISC diagnosis.

From a methodological point of view, we have found ADHD to be a difficult condition to diagnose in this population. We did not have reliable records or other data with which to retrospectively diagnose ADHD, and parents were often not willing or able to provide helpful information. Reliance on the child-DISC which requires the adolescent to recall what he was like prior to the age of 7, seems unlikely to produce truly accurate data. Also, asking the adolescent whether the symptom is a problem is rather different from observing a child and noting whether the behavior is outside the range of normal behavior for the child's mental age. Barkley, Anastopoulos, Guevremont, and Fletcher (1991) found that the self-reports of adolescents about their ADHD symptoms frequently underestimated the actual levels of the symptoms or the degree of impairment as reported by parents and teachers. This suggests that our use of the child DISC, if anything, underestimated the degree of ADHD in this sample.

We attempted to address this by using another definition of ADHD that incorporated other measures including reports not only by the youth but also by staff, teachers, and parents. These data appear on the right sides of the tables in the Results section. There were two major difficulties with this procedure. The first was that we had considerable missing data. If subjects left the program before 4 to 5 weeks had elapsed, neither residence staff nor the teacher completed their respective questionnaires. Also, as noted above, we had a relatively low return rate on CBCLs mailed to parents; only 63 parent CBCLs were available for 171 subjects. The other problem was that the structure of the program may have affected the ratings completed while the boys were in treatment; in particular, there was little variability in the ratings done by residence staff. In retrospect, using multiple sources added little to our findings with DISC.

Another limitation of the present study is that we did not obtain data on subjects that would tell us whether there were adolescents who were diagnosed as having ADHD as children but who did not report or were not rated by others as having ADHD symptoms in adolescence. Whether or not there were many such individuals in this sample remains unknown.

Another complicating factor is the multidimensional character of ADHD (Hinshaw, 1987). The three main aspects are typically described as hyperactivity, inattention, and impulsivity. These are combined in the ADHD measures we used, but are differentially emphasized; i.e, by the Conner's Hyperactivity Index versus the CBCL Attention Problem Scale. Most of the current measures do not allow one to determine which dimension(s) may be abnormal in a given individual. If this were done, it would then be possible to know if one or more of the dimensions is especially important in understanding the contribution of "ADHD" to the problems of these adolescents. The change in ADHD diagnosis from DSM-III-R (APA, 1987) to DSM-IV (American Psychiatric Association, 1994) may be helpful in this regard. DSM-III-R lumped all of the symptoms together, while DSM-IV separates them into two subtypes, hyperactive/impulsive versus inattentive. In spite of all of the above difficulties, however, we conclude that using the DISC to obtain information about diagnosis *and* significant current symptoms was our single best way of exploring ADHD symptomatology in this population.

The most surprising finding (contrary to our prediction) was that boys with a formal ADHD diagnosis had higher verbal and full-scale IQs than boys without the diagnosis. To our knowledge, this has not been reported in other studies. Most studies have found no differences (August & Holmes, 1984; Koriath, Gualtieri, Van Bourgondien, Quade, & Werry, 1985; Loney & Milich, 1982; Stewart et al., 1981), but the majority of those so evaluated were younger children and the diagnosis was not based on self-

report. However, using methodology similar to ours with adolescents, Forehand et al. (1991) found significantly lower verbal IQs in their ADHD-plus-CD group compared to the CD-alone group.

In conclusion, these results point to a group of CD adolescents with significant ADHD symptoms as particularly troubled individuals. The boys showed earlier onset of problem behaviors, and, in middle adolescence, they showed very high levels of these behaviors, other diagnoses, and more substance involvement. It seems likely that they are at particularly high risk for continued serious antisocial behavior and substance abuse, with a high cost to themselves and to society. As such, they merit special study with regard to treatments that may prevent or at least ameliorate their destructive patterns of behavior. There is evidence that the ADHD symptoms of CD youths with SUD respond to stimulants as well as do the symptoms of those with ADHD but without CD and SUD (Barkley, McMurray, Edelbrock, & Robbins, 1989; Klorman et al., 1988). Pemoline, as opposed to methylphenidate or dextroamphetamine, may be a better choice for youths with SUD because of less potential for abuse. We are currently exploring this treatment with some of these adolescents.

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