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Drug Use and Psychosocial Functioning of a Community Derived Sample of Adolescents with Childhood ADHD

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Abstract

We describe the late adolescent psychosocial outcomes from a relatively large, community-identified sample of children with ADHD who have been assessed longitudinally from childhood through late adolescence. A range of outcomes were compared between ADHD ($n=119$) and normal control ($n=93$) groups, as well as ADHD subgroups that varied as a function of the course of externalizing, predominantly ODD, problems (persisters, desisters, escalators, and resisters). ADHD youth that did not show externalizing problems during childhood (ADHD-resisters) were associated with drug use outcomes generally comparable to the normal non-affected controls. All other ADHD groups with externalizing problems (ADHD-persisters, ADHD-escalators, and ADHD-desisters) consistently revealed worse drug use outcomes compared to controls/ADHD-resisters. However, ADHD youth with or without externalizing problems showed worse outcomes compared to the control group on the non-drug, psychosocial functioning variables. The study highlights that ADHD with co-existing disruptiveness, whether the disruptiveness persists or remits before adolescence, is associated with an increased risk for drug involvement and that ADHD, regardless of the comorbid pattern, confers a poorer level of psychosocial functioning.

Keywords

ADHD; psychosocial functioning; adolescence

Introduction

There are several well described outcomes documented for those diagnosed with ADHD in childhood (August et al., 2006; Barkley, 1998; Molina, Smith, & Pelham, 1999; Milberger, Biederman, Faraone, Chen, & Jones, 1997). About a third to a half will no longer meet diagnostic criteria for ADHD in young adulthood and often have a benign outcome (Barkley, Fischer, Smallish, & Fletcher, 2004). There are children with ADHD that continue to display ADHD symptoms but have developed a number of compensatory skills that allow them to minimize the social and behavioral effects of the disorder (Shaw, Lacourse & Nagin, 2005). Then there are those children that continue to have symptoms and by adolescence have collected a number of co-existing problems, including substance use and abuse and internalizing and externalizing behavioral disorders (Weinberg, Rahdert, Colliver, & Glantz, 1998).

This comorbid group can show compromised life functioning in multiple domains including employment, educational attainment, and social relations (Clark, Prior & Kinsella, 2002;

Demaray & Elliot, 2001; Fischer, Barkley, Smallish, & Fletcher, 2005; Marshal, Molina & Pelham, 2003; Molina, Marshall, Pelham, & Wirth, 2005). Research has demonstrated that adolescents or young adults with ADHD have lower peer status and feel less confident (Stormont, 2001), and experience more life stress (Tillman et al., 2003). ADHD youth who experience persistence of their symptoms are at greater risk for unsatisfying employment, divorce and alienation from family, staggering debts, contact with the criminal justice system, and drug abuse (August, Realmuto, MacDonald, Nugent, & Crosby, 1996; Barkley et al., 2004; Biederman, 2004; Mannuzza, Klein, Bessler, Malloy, LaPadula, 1998; Shaw et al., 2005; Young, Toone & Tyson, 2003). Not only is the individual and family affected but health systems deliver an inordinate amount of services to them to deal with their myriad of problems (Biederman, 2004).

While the course for this troubled group is well documented, what contributes to these outcomes is less clear. The adverse psychosocial consequences may stem from persistent ADHD symptoms or from the co-existing symptoms that have their own risk for disability. A candidate for a contributing co-existing problem that has been linked to adverse ADHD outcomes in cross-sectional and prospective studies is the group of disruptive or externalizing problems, such as conduct disorder (CD) or oppositional defiant disorder (ODD) (August et al., 2006; Gittelman, Manuzza, Shenker, Bonagura, 1985; Crowley & Riggs, 1995). An inventory and tracking of the magnitude and persistence of the earliest of the comorbid problems may be useful in linking distal dysfunctional outcomes to initial presentation. For example, early onset disruptive behaviors, such as CD or ODD, may importantly contribute to the risk for these later adverse outcomes (Loeber, Burke, Lahey, Winters, & Zera, 2000; for review see Barkley, 1998).

This study follows to late adolescence a community cohort of children initially identified by a screening measure for ADHD who were subsequently diagnostically evaluated. Symptoms of ADHD and externalizing problems were measured at multiple time points. The current evaluation measures adolescent life outcomes. Because both ADHD symptoms as well as other disruptive symptoms were tracked, the differential contribution of each of these entities to these adverse outcomes could be discerned. Our previous report on these data (August et al., 2006) described alcohol and other drug use outcomes among ADHD youth with and without categorical comorbid externalizing disorders (primarily ODD). The present paper extends these findings by incorporating the temporal pattern (onset and offset) of dimensional measures of disruptive problems across several years of childhood in order to more specifically examine the varying course of disruptiveness on later psychosocial functioning and drug use outcomes.

Method

Participants

These analyses are part of an ongoing longitudinal study of ADHD that began in 1991 as part of the Minnesota Competence Enhancement Project (MNCEP). A multi-gate screening procedure was employed to identify disruptive children. (see August, Realmuto, Crosby, & MacDonald, 1995). To accomplish this, a total of 7,231 students in grades 1 through 4 (and ranging in age from 7 to 11 years) were screened. Of these, 318 (ages 7 to 9) were identified as having cross-setting disruptive behavior based on scores from the teacher and parent Conners' Hyperactivity Index (HI-T, HI-P; Goyette, Conners, & Ulrich, 1978) that exceeded 1.75 SD units above the normative mean. The ratio of boys to girls was 4.1:1. In addition, stratified random sampling was used to obtain a control sample of 144 children (HI-T score below 1.1 SD above the normal mean) proportionately equivalent by demographic characteristics (school, age, and gender) to the 318 children identified as disruptive. Mean raw scores (range for each 0–30) for the two groups on the HI-T and HI-P were as follows: disruptive, 22 and 21; controls, 2 and 5, respectively. All participants at baseline (T1) had an

IQ score of ≥ 80 (Kaufman Brief Intelligence Test; K-BIT; Kaufman & Kaufman, 1990), did not have a pervasive developmental disorder, were from predominantly middle socioeconomic status families (Hollingshead, 1975) and were predominantly Caucasian. All children participated in a two-year psychoeducational intervention during the initial two years of the project. The results of the intervention were insubstantial and deemed to be insignificant to long-term outcomes (Braswell et al., 1997).

To further assess diagnostic status, the parents of the 318 children who screened positive for cross-setting disruptiveness were interviewed with the Revised Parent Version of the Diagnostic Interview for Children and Adolescents (DICA-R; Reich, Shayla, & Taibelson, 1992) by trained assessment technicians. The interview was modified to include all symptoms related to the Diagnostic and Statistical Manual of Mental Disorders (3rd ed., rev.) (DSM-III-R; American Psychiatric Association, 1987) diagnoses of ADHD, ODD, CD, separation anxiety disorder, avoidant anxiety disorder, overanxious disorder, major depressive disorder (MDD), and dysthymia. In accord with the hierarchical rule provided in DSM-III-R, ODD was not diagnosed in the presence of CD. As stipulated in DSM-III-R, the diagnosis of ADHD required endorsement of any 8 of 14 symptoms with an age of onset prior to age 7 for a majority of symptoms. Of the initial 318 children identified with cross-setting disruptive behavior at T1, 205 (64%) met ADHD criteria (for a breakdown of the frequencies of ADHD and comorbid disorders see August et al., 1996).

The project re-assessed these children in 1995 (T2) at which time all were between 11–15 years, and again in 1996 (T3) when children ranged in age from 12–16 years (see August, Braswell, & Thuras, 1998). Subjects not assessed at both T2 and T3 were not contacted and were excluded from further analysis. These families (representing 37 ADHD and 28 control youth) did not fit the inclusion criteria for our grant which required multiple data points. In addition, because of our interest in the role of disruptive behaviors associated with ADHD compared to diagnosis free controls, we did not consider for this analysis the 30 ADHD cases that had an internalizing (depression or anxiety) comorbid disorder, and the 17 control children that met at least one DSM-III-R diagnosis at either the T2 or T3 assessment. These sample inclusion and exclusion criteria produced the following sample sizes *eligible* for the T4 assessment: ADHD ($n = 138$) and controls ($n = 99$). ADHD status required that the youth meet an ADHD diagnosis at T1 and at either or both T2 and T3. Eligible controls were absent any DSM-III-R diagnosis at all three time points.

Assessments at T4 were timed to coincide with participants' status as either a senior in high school or one-year post-graduate, thus the age range at T4 is narrower than the age range at T1. After attrition at T4 (discussed below) the final sample sizes were as follows: ADHD ($n = 119$), and controls ($n = 93$), yielding an overall follow-up rate of 89% (86% for ADHD, 94% for controls). We further subdivided the ADHD group according to their T1 and T2 score on the teacher report of BASC Externalizing Problem composite scale (defined below). Five groups were identified based on the presence of ADHD and the course of externalizing problems: persisters ($n = 27$); desisters ($n = 15$); escalaters ($n = 9$); resisters ($n = 42$); and others ($n = 26$) (groups defined below).¹ The sample demographics of the subject groups for the present study are provided in Table 1.

Measures

Background and Grouping Variables—The Four Factor Index of Social Status (Hollingshead, 1975) was administered to parents at T1. A score of 8 (low SES) to 66 (high

¹When we applied the same cutoffs to the control group, there were 3 desisters, 2 escalaters and 77 resisters. All cases in the control group were included in the present study.

SES) was derived based on parent occupation and education that correlate with five levels of SES (unskilled to major business/professionals).

The Kaufman Brief Intelligence Test (K-BIT; Kaufman & Kaufman, 1990) was individually administered to child participants at T1 to assess expressive and receptive vocabulary and nonverbal problem solving (matrices). Age-based standard scores with a mean of 100 and a standard deviation of 15 were derived.

The Diagnostic Interview for Children and Adolescents – Revised (DICA; Reich et al., 1992) was used to assess childhood psychiatric disorders and administered to one parent (usually mother) over-the-phone at three assessment points (T1 [excluding controls], T2, and T3). Structured diagnostic interviews administered to parents over the telephone have been shown to be valid (Holmes et al., 2004; Todd, Joyner, Heath, Neuman, & Reich, 2003). The DICA-R generates standardized diagnoses as reflected by the DSM-III-R. Each item was scored *yes* if the behavior was definitely endorsed or *no* if the respondent indicated “sometimes”, “rarely”, or “never”. Specific diagnostic parameters, including age of onset, duration of symptoms, and frequency were recorded. Diagnostic scoring algorithms were adopted from the DICA-R.. Twenty percent (every fifth interview completed) of the interviews were independently rated by an assessment technician via an extension phone, in order to obtain interrater reliability on item scoring and to prevent interviewer drift. Kappas for symptoms were derived for each disorder; average symptom kappas ranged from 0.88 for conduct disorder at T1 to 1.00 for ADHD at T2 (see August et al., 1998).

To assess externalizing problems, we administered the Externalizing Problems Composite Scale of the Behavior Assessment System for Children – Teacher Rating Scale (BASC-TRS; Reynolds & Kamphaus, 1992). Teacher reports of behavioral rating scales were administered at T1 and T2 to measure our disruptive construct. This construct consists of the Hyperactivity, Aggression, and Conduct Problems scales. Scale items were rated on 4-point Likert scale ranging from 0 = never to 4 = almost always. The composite scale is reported as *T*-scores. The measure has been normed and validated on both clinical and normative populations and has favorable psychometric properties. The composite scale scores from the two assessments was used to categorize study participants with childhood ADHD into four subgroups based on the course of externalizing problems: ADHD-persisters, ADHD-desisters, ADHD-escalaters, and ADHD-resisters. A cutoff of *T* score ≥ 60 (1 SD above the normative mean) was used to indicate clinical level of externalizing problem and a cutoff of *T* score ≤ 55 was used to designate normative behavior. Within the ADHD participants, those who had *T* scores ≥ 60 on the externalizing composite at both time points were categorized as ADHD-persisters; those who had *T* scores ≤ 55 at both time points were grouped as ADHD-resisters; those who had *T* scores ≥ 60 at T1 and ≤ 55 at T2 were categorized as ADHD-desisters; and those who had *T* scores ≤ 55 at T1 and > 60 at T2 were designated as ADHD-escalaters.

Comorbid symptoms were assessed utilizing an 18-item youth report ($\alpha = .86$) from the screen section of the structured Adolescent Diagnostic Interview (ADI; Winters & Henly, 1993). These items were administered at T4 to measure current (prior year) anxiety and mood problems that reflect DSM-IV anxiety and depressive disorders. This variable was scored as the number of symptom endorsements (range 0 – 18).

Utilization of community mental health services was measured via the parent version of the ADI (Winters & Henly, 1993). These three items, also measured at T4, inquire whether mental health services were used within the community or school during the prior year (range 0–3).

Outcome measures—Our outcome variables, measured at T4, include continuous and categorical variables and reports from youth and parent. Parent reports on continuous variables

were obtained from the parent version of the BASC (BASC-PRS; Reynolds & Kamphaus, 1992); parent report of service utilization was obtained from the parent version of the ADI. Youth outcome variables were mainly based on the youth version of the ADI.

Youth report of drug use was assessed in two ways. For continuous variables, we measured lifetime and prior year drug use frequency (DUF) across 12 drug categories using items from the Monitoring the Future Survey (Johnston, O'Malley, & Bachman, 2001). Item responses are based on 7 points (1=never; 7= 40+ times). Our analysis focused on lifetime and prior year alcohol and marijuana use (the two drugs that were reported the most frequently) and lifetime and prior year aggregate drug use (sum across all 12 drug categories; range 12 – 84). Categorical outcomes were DSM-IV SUDs (lifetime) as measured with the Substance Use Disorders module of the ADI (Winters & Henly, 1993). The ADI has established reliability and validity in adolescent clinical and non-clinical populations (Winters & Henly, 1993). With respect to SUDs for adolescents, there is a controversy as to the whether the distinction between abuse and dependence is valid for adolescents (Martin & Winters, 1998). Thus we chose to analyze the general SUD category and not make a distinction between abuse and dependence. For the data analysis, a SUD refers to the presence of either an abuse or dependence diagnosis. Base rate considerations limited our analysis to alcohol, marijuana and a category for any other SUD. For the latter, this meant the presence of an abuse or dependence diagnosis for at least one of these drugs: amphetamines, cocaine, hallucinogens, barbiturates, heroin, inhalants or club drugs. We also created a “two or more SUDs” variable given that this poly-SUD variable has been linked to a higher likelihood of continued drug use problems compared to adolescents with a single SUD (Winters & Lee, in press). Finally, we included tobacco use in the outcome analysis. The Tobacco Use Questionnaire used items from the Cigarette Use Questionnaire (CUQ; Winters, 2006), to assess the adolescent's lifetime and recent (prior 12 months) use of tobacco. A wide range of reliability (internal consistency) and validity evidence (concurrent and criterion) has been reported on the CUQ (Winters, 2006), including the items we used in our tobacco questionnaire. Regular tobacco use was defined as weekly or daily use of any tobacco product including smokeless tobacco during the prior 12 months. Tobacco use is very common among ADHD youth (Milberger et al., 1997).

Questions regarding conduct problems and antisocial behaviors that comprise the DSM-IV criteria for a conduct disorder (e.g., ran away from home overnight; deliberately destroyed other's property) were used to assess self-report of delinquency ($\alpha = .82$). This 18-item variable was scored as the count of the number of symptom endorsements (range 0 – 18).

Prior year physical health problems were measured via self-report with an 11-item scale (e.g., weight gain or loss, 10+ pounds; was hospitalized; engaged in unhealthy sex). The score was based on an unweighted sum of the number of symptoms endorsed (range 0 – 11; $\alpha = .87$).

Two scales from the BASC-PRS, Leadership and Social Skills, was utilized to measure interpersonal problems (parent report; $\alpha = .93$). This 24-item variable is based on the unweighted average of the two scales. Given that these two scales are highly correlated (0.74), we combined them into one construct. Our combined variable measures sociability (e.g., joins clubs or social organizations/groups; begins conversations appropriately), assertiveness (e.g., has lots of ideas; will speak up if the situation calls for it), and interpersonal skills (e.g., has good eye contact; encourages others to do their best). Scores were reversed so that high scores indicated interpersonal problems. This variable is reported in the form of T scores.

Procedures

Participants were treated in accordance with the guidelines published by the American Psychological Association (American Psychological Association [APA] 2001) and in compliance with the committee on the protection of human subjects at the University of

Minnesota. No adverse events occurred during the course of this study. Adolescent participants and their parents completed an assessment battery that focused on the youth's drug use behaviors, and also included measures of psychopathology and psychosocial adjustment. The majority of the participants were interviewed in person during a one-time session by two highly trained research technicians. Technicians were not blind to ADHD vs. control status but were not knowledgeable about an ADHD person's comorbidity status. Due to distant relocation, some of the participants were interviewed over-the-telephone. Adolescents were paid a stipend of \$75.00 for their participation.

Data Analysis

Several analytical strategies were used in this study. First, an attrition analysis was performed to test whether there were significant differences in characteristic variables between those who were included in the present study and those who attrited. One-way ANOVAs and chi-square tests were conducted to compare the two groups on characteristic variables separately for the disruptive and control groups. Second, group differences in outcomes were analyzed in three sets of analyses. In the first round of group difference tests, we compared the aggregate ADHD group versus the control group to examine whether young adults who had a childhood diagnosis of ADHD showed different outcomes compared to the controls. In the second round of analyses, we compared the ADHD-Externalizer categories (ADHD-persisters, desisters and escalaters combined) with the ADHD-resisters. This set of analyses was conducted to examine whether having clinical levels of externalizing problems at any one or both time points (T3 or T4) in addition to having an ADHD diagnosis had an impact on outcomes compared to those who had ADHD diagnosis but never showed clinical levels of externalizing problems. In the final round of analyses, we explored whether timing/pattern of externalizing problems within the ADHD externalizing groups were related to different outcomes by comparing ADHD-persisters vs. ADHD-desisters vs. ADHD-resisters. ADHD-escalaters were excluded from this analysis due to small sample size. For the group tests, we used ANCOVA for continuous outcomes, logistic regression for binary outcomes (i.e. diagnosis), and negative binomial regression for count data. Negative binomial regression is regarded as a generalization of the Poisson regression. Both Poisson and negative binomial regression models are designed for analysis of count data. Negative binomial regression generalizes the Poisson by relaxing the assumption of Poisson distribution on equality of mean and variance, which is commonly required for highly skewed data (Cameron & Trivedi, 1998). In all outcome analyses, effects of age, gender, and SES were controlled for by including the variables in the models. Significant group main effects ($p < .05$) were followed by post hoc tests with Bonferroni corrections for multiple comparisons.

Results

Attrition Analysis

To test for attrition related effects, two sets of analysis were conducted. First, we compared T1 ADHD and control cases whom were "ineligible" for a T4 assessment because of early attrition and had no T2 and T3 data (ADHD $n = 37$; control $n = 28$) versus cases that were "eligible" for a T4 assessment, i.e., cases for whom T2 and T3 data were available and other inclusion criteria were met (ADHD $n = 138$; control $n = 99$). Separate one-way ANOVAs (attrition status) for continuous variables, and a separate chi-square analysis for categorical data, were conducted within the disruptive and control groups across several demographic (age, gender, ethnicity, IQ, SES, and % single parent status) and T1 measures (HI-T, HI-P, and # of ADHD symptoms). For the ADHD group, we found only one significant group difference: the ineligible ADHD group had a lower SES compared to the eligible ADHD group ($p < .05$). For the control group, we found no significant group differences in the variables between the eligible and ineligible groups.

Next we examined the T4 eligible sample to examine differences between the consenters and non-consenters. We again compared T1 data between these two respective samples within the ADHD and control groups separately. For the ADHD group, only one variable showed a group difference. The non-consenting ADHD group ($n = 19$) had a significantly lower SES ($p < .05$) compared to the consenting ADHD group ($n = 119$). For the control group, there were no significant differences between the non-consenting control ($n = 6$) and consenting control ($n = 93$) groups on any of the T1 variables. Both attrition analyses suggest that our data were not affected by a systematic loss of subjects for analysis. In general, disruptive and control subjects who were not eligible for the present study because of an assessment point at only T1 were quite similar to those who were eligible. Also, eligible ADHD and control cases who could not be located or who refused to participate at T4 were similar on nearly all variables compared to eligible cases that received a T4 assessment.

Outcomes as a Function of Diagnostic Groups

Means and standard deviations (or percentages) on substance use and other functional outcomes for the control group, all inclusive ADHD group (ADHD total), and ADHD by course of externalizing problem subgroups are presented in Table 2. To test whether ADHD participants had different outcomes compared to those in the control group, hierarchical logistic regressions were conducted on drug use outcomes, with age, gender, and SES entered in Step 1 and group status in Step 2.

ADHD vs. Controls—Summary of the results of the ADHD total group vs. the control group are presented in Table 3 (categorical substance use outcomes) and Table 4 (continuous psychosocial outcomes). There was a main effect of ADHD group on alcohol use disorder, marijuana use disorder, and regular tobacco use after controlling for demographic variables. Significant odds ratios indicated that the odds for having alcohol use disorder, marijuana use disorder or regular tobacco use were 2.4, 2.7 and 2.2 times higher, respectively, in the total ADHD group compared to the control group. Summary of ANCOVAs and negative binomial regression results for the continuous psychosocial outcomes are presented in Table 4. ANCOVAs conducted separately on interpersonal problem and on driving safely showed that there was a significant ADHD group main effect on interpersonal problems after controlling for demographic variables. These results indicated that youths in the ADHD group had more severe interpersonal problems than those in the control group. Negative binomial regression conducted each on delinquency and physical problems showed that there was a significant ADHD group main effect on both variables. The results indicated that, compared to the control group, the ADHD group had significantly higher number of events endorsed on the delinquency items and the physical health problem items.

ADHD-externalizers versus ADHD-resisters—We further examined subgroups among the ADHD total group. This set of analyses compared youth that revealed a clinical level of externalizing problems (CD or ODD) at either T1 or T2 versus those ADHD youth that were absent of such externalizing status at both T1 and T2. Thus, ADHD-persisters, ADHD-desisters, and ADHD-escalaters were combined into an “ADHD-externalizer” group, and then compared to the ADHD-resisters. Table 5 presents a summary of hierarchical logistic regression results conducted on drug use outcomes, with age, gender, and SES entered in Step 1 and the ADHD-externalizer group entered in Step 2. Significant main effect of the ADHD-externalizer group was detected on alcohol use disorder, marijuana use disorder, and regular tobacco use after controlling for demographic variables. Significant odds ratios showed that alcohol use disorder, marijuana use disorder or regular tobacco use were 3.2, 4.1, and 2.6 times higher, respectively, in the ADHD externalizer group compared to the ADHD-resisters. A summary of the results on the psychosocial outcomes (ANCOVA and negative binomial regression) are presented in Table 6. There was a significant ADHD-externalizer group effect

on delinquency. Examination of the means (Table 2) revealed that ADHD-externalizer group had significantly higher number of events endorsed on the delinquency items than did their counterpart. No significant ADHD-externalizer group effect was detected on interpersonal problem, driving safely, or physical problems.

ADHD-persisters versus -desisters versus -resisters—The final set of analyses explored whether timing and pattern of externalizing problems within the ADHD groups were related to outcomes. ADHD escalators were removed from the analysis because of small sample size. Table 7 presents summary of hierarchical logistic regression results conducted on drug use outcomes, with age, gender and SES entered in Step 1 and two dummy variables (ADHD-persisters, ADHD-desisters) in Step 2. Significant odds ratio showed that ADHD-resisters had the lower odds across outcomes. Significance was observed for alcohol use disorder (ADHD-desisters had 5.5 times higher odds), marijuana use disorder (ADHD-persisters had 6.3 higher odds), and regular tobacco use (ADHD-persisters had 4.1 higher odds). Posthoc comparisons revealed that there was no significant difference between the ADHD-persisters and ADHD-desisters on the outcomes. ANCOVA and negative binomial regression analyses on the psychosocial outcomes revealed that there was a significant main effect of group only on the delinquency outcome (Table 8). Significant regression coefficient estimates indicated that ADHD-persisters and ADHD-desisters had more problems than resisters for delinquency. Post-hoc analysis on delinquency did not detect group difference between ADHD-persisters and ADHD-desisters.

Discussion

The study revealed two major findings. The first was that ADHD youth with a history of externalizing problems (as indicated by elevated scores on a continuous measure) experienced worse outcomes pertaining to drug use compared to both normal controls, as well as ADHD youth absent of assignment to an externalizing group. ADHD youth that did not show externalizing problems at both T1 and T2 (ADHD-resisters) presented with drug use outcomes generally comparable to the normal controls. All other ADHD groups (ADHD-persisters, ADHD-escalators, and ADHD-desisters) consistently revealed worse drug use outcomes compared to normals/ADHD-resisters. This finding is consistent with a small body of literature that shows that a diagnosis of ADHD during childhood does not reliably confer a higher risk for later substance use disorders, particularly if ADHD is absent of a conduct or oppositional defiant disorder (August et al., 2006). It is also noteworthy that within the ADHD externalizing group, those children who maintained their disruptive behavior over time, compared to those whose symptoms subsided to a non-clinical level, had similar rates of substance use disorders at outcome. This suggests that externalizing problems once infecting the developmental trajectory of children may have lasting effects. Although further study within longitudinal samples is needed, these results would appear to necessitate a very concerted effort at monitoring and applying prevention interventions for children with comorbid externalizing problems including those who appear to have matured out of developmental difficulties.

The second major finding provides a slightly different picture of the putative effects of ADHD on late adolescent outcomes. We found that among the non-drug related, psychosocial functioning variables, ADHD youth showed worse outcomes compared to the normal group and there was no difference among the ADHD groups for these outcomes except for delinquency. The difference between the ADHD resistor group on delinquency and the others was expected in that the persister, desister and escalator groups are defined by the presence of externalizing problems. Specifically, ADHD children as a group had more physical health incidents, psychosocial problems and delinquency than controls. The deficits we report in social functioning may have its roots in faulty information processing and executive management inherent in ADHD. These processes are important for producing and modulating

adaptive cognitive-emotional responses and reactions (Herpertz et al., 2005). Faulty skills in these areas may be part of poorer adaptive communication skills, inappropriate social behavior, social knowledge deficits and biases, and chronically negative interactions with peers and teachers (Demaray & Elliot, 2001; Clark, Prior, & Kinsella, 2002). Furthermore, social deficits as a mediator may encourage greater affiliation with deviant peers, which may contribute to other problem behaviors, such as drug use (Marshall, Molina, & Pelham, 2003). The scope and long term effects of externalizing problems for ADHD children namely substance use is further emphasized by the similar outcomes in this domain for the children whose externalizing problems remitted (desisters) to persisters. Further study of the onset/offset and pattern of externalizing problems among children with ADHD appears warranted.

In summary, our study indicates that youth with a childhood history of ADHD are at risk for continuing social and physical health problems. However, ADHD youth who do not experience externalizing problems may be not be at the same elevated risk for substance use disorders as those who do. This study also demonstrates the significance of co-occurring externalizing disorders as important distinguishing clinical features of ADHD. Children with ADHD and externalizing disorder may have a more deleterious developmental trajectory compared to children with only ADHD. Early identification, prevention, early intervention, and continuous monitoring may be a necessary part of their mental and physical health care.

Limitations

There are several limitations of the study. First, there was some sample attrition. Although the two attrition analyses (ineligible cases and non-ascertained cases at T4) indicated that these groups were similar on nearly all baseline variables compared to the non-attrition cases, there was a difference in baseline family SES between the retained and attrited ADHD groups. The attriters had a lower SES. Because SES may be associated with risk for substance use, our ability to find differences among ADHD subgroups and differences between the ADHD-resistor and control groups may have been hampered. Second, the results of the study should not be generalized to all at-risk ADHD samples. Not only was our sample identified from the community (in contrast to many ADHD studies that recruit youth from clinical settings), but our sample is a relatively affluent one (e.g., on average, 13% of students at the research schools were receiving free or reduced priced lunches). Our ADHD group, particularly the ADHD-resisters, may represent a milder version of the disorder compared to ADHD groups in other studies; a less pernicious expression of ADHD may confer a lower risk to drug abuse. Also, our screening tool, the Connors Hyperactivity Index, a 10-item measure that provides a general screen for disruptiveness (CRPS-R: Goyette et al., 1978), has only 2 items that measure inattention. This measure was a logical choice at the time the study was initiated in 1990 as a way to quickly and cost-effectively screen 7,400 children. Our screening method may have identified primarily children with ADHD-combined type using DSM-IV criteria and excluded children with only attention problems (ADHD-predominately Inattentive Type). The rate of substance use disorders among ADHD Inattentive type may be different compared to ADHD-Combined Type

There are other limitations of our study. The relatively small sample restricts some of the additional analyses that would have extended our findings. For this reason we did not include youth with ADHD and a co-existing internalizing disorder (e.g., depression, anxiety, PTSD). Also, the sample of girls is relatively small and thus one should cautiously interpret a lack of gender effects on outcome. A further limitation is the methodology of data collection. Substance use disorder outcomes were based on self-report. Self report that is not corroborated by objective data may underestimate the rate of disorders. There are several studies supporting the validity of adolescent drug abuse self-report (Maisto, Connors, & Allen, 1995; Winters, 2003), but one cannot rule out that our self-report data may be a reflection of respondent

distrustfulness or inaccuracy. However, we did obtain a relatively high rate of admittance to illicit drugs and to substance use disorders. An additional check on measurement validity was that the control group reported rates of drug use that was comparable to rates observed in national surveys (e.g., Substance Abuse and Mental Health Services, 2004). Finally a comparison of drug use self-report data and results from urine drug screen testing as part of the T4 assessment did not produce a discordant drug urine test in conjunction with self reported use.

The clinical implications of this study include close monitoring of children with ADHD for externalizing problems. A standard of care might include a selective prevention intervention approach targeted towards externalizing problems. Also, children who have externalizing problems in the context of ADHD may need focused drug prevention strategies that have been shown to mitigate these risks. Further research examining subtypes of ADHD and the development of externalizing disorder and substance use disorders is warranted.

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Table 1

Demographic Characteristics of the Control and the ADHD Groups

Variable	Controls <i>n</i> =93	ADHD-Persisters <i>n</i> =27	ADHD-Desisters <i>n</i> =15	ADHD-Escalators <i>n</i> =9	ADHD-Resisters <i>n</i> =42	ADHD Group <i>n</i> =26	<i>p</i>
Male (%)	69	59	87	89	86	92	=.05
White (%)	98	85	100	89	93	96	ns
Mean age	18.2 (1.2)	18.0 (0.8)	18.7 (1.3)	18.4 (1.0)	18.4 (1.0)	18.2 (1.2)	ns
Mean IQ (baseline)	109.7 (12.0)	102.3 (7.8)	106.2 (15.3)	97.1 (6.9)	106.9 (11.1)	105.3 (13.9)	<.01 ^a
Mean SES (baseline) ^b	50.3 (10.5)	48.5 (9.0)	46.6 (13.9)	43.7 (11.3)	45.0 (11.1)	47.9 (9.5)	ns
Single parent family (%)	7	15	20	22	23	23	ns
BASC-T Externalizing Composite at T1	46.4 (7.4)	70.8 (12.5)	69.7 (12.3)	53.7 (7.0)	48.7 (6.1)	60.9 (8.8)	<.001
BASC-T Externalizing Composite at T2	46.7 (6.6)	67.4(7.4)	51.8 (5.1)	65.2 (4.1)	48.6 (5.3)	57.2 (8.2)	<.001
Comorbid Symptom at T4	2.9 (3.2)	4.4 (4.0)	4.8 (4.2)	4.2 (4.4)	4.0 (4.2)	3.6 (3.8)	ns
Mental Health Service Utilization at T4	0.4 (0.6)	1.3 (0.5)	1.0 (0.7)	1.4 (0.9)	0.7 (0.7)	1.0 (0.7)	<.001

^a Within the ADHD groups, differences in IQ were non-significant.

^b Hollingshead, 1975; range 17–66

Table 2

Percentages or Raw Means and SDs of Psychosocial Functioning Outcomes for the Control and the ADHD Groups

Variable	Controls n=93	ADHD Total n=93	ADHD- Persisters n=27	ADHD- Desisters n=15	ADHD- Escalators n=9	ADHD- Resisters n=42	ADHD Group n=26
DSM-IV Alcohol Use Disorder (%)	26	47	48	73	67	33	27
DSM-IV Marijuana Use Disorder (%)	25	50	67	53	56	36	39
DSM-IV Other Drug Use Disorder (%)	5	11	15	13	11	7	8
Regular Use of Tobacco (%)	42	63	78	60	78	52	54
Interpersonal Problems (BASC-P)	45.6 (11.8)	56.8 (8.6)	56.6 (9.6)	58.1 (9.7)	56.1 (6.9)	56.5 (8.2)	55.6 (7.6)
Delinquency	1.5 (2.4)	4.1 (3.4)	5.1 (3.7)	4.9 (3.3)	5.6 (3.7)	2.8 (2.7)	3.7 (3.8)
Driving safely	2.2 (0.8)	2.0 (0.8)	1.9 (1.0)	2.3 (0.8)	2.2 (0.8)	2.0 (0.8)	2.4 (0.7)
Physical Health Problems	2.2 (1.7)	3.1 (2.2)	3.0 (2.0)	4.0 (2.6)	2.9 (2.2)	3.0 (2.1)	2.4 (1.6)

Table 3

Summary of Logistic Regressions on Drug Use Outcomes comparing ADHD total vs. Control

Variable	Alcohol Use Disorder		Marijuana Use Disorder		Other Drug Use Disorder		Regular Tobacco Use	
	B	OR (95% CI)	B	OR (95% CI)	B	OR (95% CI)	B	OR (95% CI)
Age	0.26	1.29 (1.28-1.30)	0.08	1.08 (1.07-1.09)	-0.26	0.77 (0.75-0.78)	0.13	1.14 (1.13-1.15)
Gender	0.25	1.28 (1.25-1.31)	0.59	1.81 (1.77-1.85)	-0.13	0.88 (0.84-0.91)	0.10	1.10 (1.08-1.13)
SES	-0.04	0.96* (0.96-0.96)	-0.01	0.99 (0.99-0.99)	-0.01	0.99 (0.99-0.99)	-0.02	0.99 (0.98-0.99)
ADHD group	-0.89	2.44** (2.39-2.49)	1.00	2.73** (2.67-2.79)	1.00	2.73 (2.62-2.84)	0.79	2.21* (2.17-2.25)

Note. Gender 1 = male, 0= female (reference group).

* p < .05.

** p < .01

Table 4

Summary of ANCOVA and Poisson Regressions on Functioning Outcomes Comparing ADHD Total vs. Control

Variable	Summary of Results		
ANCOVA	<i>F</i>	<i>df</i>	<i>p</i>
Interpersonal Problem			
Age	0.46	1,172	ns
Gender	0.85	1,172	ns
SES	2.42	1,172	ns
ADHD group	44.72	1,172	<.001
Driving Safely			
Age	0.04	1,154	ns
Gender	0.66	1,154	ns
SES	0.03	1,154	ns
ADHD group	0.52	1,154	ns
Negative Binomial Regression	<i>B</i>	χ^2	<i>p</i>
Delinquency			
Age	-0.07	0.66	ns
Gender	0.52	5.75	<.05
SES	-0.004	0.18	ns
ADHD group	0.96	26.94	<.001
Physical Problems			
Age	0.05	1.06	ns
Gender	-0.15	1.40	ns
SES	-0.01	1.06	ns
ADHD group	0.36	9.64	<.01

Summary of Logistic Regressions on Drug Use Outcomes comparing ADHD-Externalizers (P, D and E) vs. ADHD-Resisters

Table 5

Variable	Alcohol Use Disorder		Marijuana Use Disorder		Other Drug Use Disorder		Regular Tobacco Use	
	B	OR (95% CI)	B	OR (95% CI)	B	OR (95% CI)	B	OR (95% CI)
Age	0.43	1.53 (1.51-1.56)	0.34	1.40 (1.38-1.42)	-0.63	0.53 (0.52-0.55)	0.17	1.18 (1.17-1.20)
Gender	0.01	1.00 (0.97-1.04)	0.19	1.21 (1.17-1.25)	-0.26	0.77 (0.73-0.81)	0.02	1.02 (0.99-1.06)
SES	-0.04	0.96 (0.96-0.96)	-0.02	0.98 (0.97-0.98)	-0.01	0.99 (0.99-1.00)	0.001	1.00 (1.00-1.00)
ADHD group	1.15	3.16* (3.07-3.26)	1.41	4.08** (3.96-4.21)	0.64	1.90 (1.81-2.00)	0.95	2.57* (2.50-2.65)

Note. Gender 1 = male, 0 = female (reference group).

* p < .05.

** p < .01

Table 6

Summary of ANCOVA and Poisson Regressions on Functioning Outcomes comparing ADHD-Externalizers (P, D and E) vs. ADHD-Resisters

Variable	Summary of Results		
ANCOVA	<i>F</i>	<i>df</i>	<i>p</i>
Interpersonal Problem			
Age	3.34	1,80	ns
Gender	0.56	1,80	ns
SES	0.18	1,80	ns
ADHD group	0.15	1,80	ns
Driving Safely			
Age	0.64	1,67	ns
Gender	0.18	1,67	ns
SES	0.31	1,67	ns
ADHD group	0.02	1,67	ns
Negative Binomial Regression	<i>B</i>	χ^2	<i>p</i>
Delinquency			
Age	-0.03	0.11	ns
Gender	0.42	3.14	ns
SES	-0.0003	0.00	ns
ADHD group	0.68	11.72	<.001
Physical Problems			
Age	0.18	6.76	ns
Gender	-0.33	3.77	<.05
SES	0.0001	0.00	ns
ADHD group	0.05	0.10	ns

Summary of Logistic Regressions on Drug Use Outcomes for ADHD-Persisters vs. ADHD-Desisters vs. ADHD-Resisters²

Table 7

Variable	Alcohol Use Disorder		Marijuana Use Disorder		Other Drug Use Disorder		Regular Tobacco Use	
	B	OR (95% CI)	B	OR (95% CI)	B	OR (95% CI)	B	OR (95% CI)
Age	0.38	1.46 (1.44–1.48)	0.40	1.50 (1.47–1.52)	-0.64	0.53 (0.51–0.54)	0.23	1.25 (1.23–1.27)
Gender	-0.15	0.86 (0.83–0.89)	0.37	1.45 (1.40–1.51)	-0.30	0.74 (0.71–0.78)	0.19	1.21 (1.17–1.26)
SES	-0.40	0.96 (0.96–0.96)	-0.03	0.97 (0.97–0.98)	-0.01	0.99 (0.99–1.00)	-0.002	1.00 (0.99–1.00)
ADHD group		$p < .05$, D > R		$p < .01$, P > R		ns		$p = .067$, P > R
ADHD-persisters	0.82	2.27 ^{**} (2.19–2.36)	1.84	6.27 ^{**} (6.03–6.51)	0.57	1.76 (1.67–1.86)	1.40	4.06 ^{**} (3.91–4.21)
ADHD-desisters	1.71	5.50 ^{**} (5.27–5.75)	0.85	2.34 (2.24–2.43)	0.78	2.18 (2.05–2.33)	0.35	1.43 (1.37–1.48)

Note. Gender 1 = male, 0 = female (reference group). P = ADHD-persister, D = ADHD-desister, R = ADHD-resister.

$p < .05$.

^{**} $p < .01$

² Including a fourth group, ADHD-escalators, in the analyses (logistic regression, ANCOVA, and negative binomial regression) yielded similar results, but with less power to detect significance in some outcomes (e.g., regular tobacco use). Escalators did not significantly differ from any of the other groups.

Table 8

Summary of ANCOVA and Poisson Regressions on Functioning Outcomes for ADHD-Persisters vs. ADHD-Desisters vs. ADHD-Resisters

Variable	Summary of Results		
ANCOVA			
	<i>F</i>	<i>df</i>	<i>p</i>
Interpersonal Problem			
Age	2.82	1,70	ns
Gender	0.68	1,70	ns
SES	0.26	1,70	ns
ADHD group	0.16	2,70	ns
Driving Safely			
Age	0.64	1,60	ns
Gender	0.81	1,60	ns
SES	0.001	1,60	ns
ADHD group	1.16	2,60	ns
<hr/>			
Negative Binomial Regression			
	<i>B</i>	χ^2	<i>p</i>
Delinquency			
Age	0.02	0.04	ns
Gender	0.48	3.53	=.06
SES	-0.001	0.01	ns
ADHD group		11.41	<.01; P, D >
ADHD-persisters	0.78	10.92	=.001
ADHD-desisters	0.55	4.51	< .05
Physical Problems			
Age	0.19	6.09	< .05
Gender	-0.33	3.05	ns
SES	-0.003	0.19	ns
ADHD group		1.68	ns
ADHD-persisters	-0.03	0.02	ns
ADHD-desisters	0.23	1.44	ns

Note. P = ADHD-persister, D= ADHD-desister, R = ADHD-resister.