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The Academic Experience of Male High School Students with ADHD

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Abstract This study compared the high school academic experience of adolescents with and without childhood ADHD using data from the Pittsburgh ADHD Longitudinal Study (PALS). Participants were 326 males with childhood ADHD and 213 demographically similar males without ADHD who were recruited at the start of the follow-up study. Data were collected yearly from parents, teachers and schools. The current study used assessment points at which the participants were currently in or had recently completed grades 9, 10, 11, and 12. Results indicated that adolescents with ADHD experienced significant academic impairment in high school relative to comparison adolescents, including lower overall and main academic subject grade point averages (GPA), lower levels of class placement (e.g. remedial vs. honors), and higher rates of course failure. In addition, teacher reports indicated that adolescents with ADHD completed and turned in a significantly lower percentage of assignments and were significantly less likely to be working up to their potential. Adolescents with ADHD were also significantly more likely to be absent or tardy during the academic year, and they were over eight times more likely than adolescents without ADHD to drop out of high school. These findings demonstrate that children with ADHD continue to experience severe academic impairment into high school.

Keywords ADHD · Adolescence · Academic achievement · High school

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Attention-Deficit/Hyperactivity Disorder (ADHD) is a commonly diagnosed childhood disorder that is associated with serious impairments in school performance in childhood (Loe and Feldman 2007; Raggi and Chronis 2006). In recent years, ADHD has come to be viewed as a chronic disorder, with significant diagnostic continuity between ADHD in childhood, adolescence, and young adulthood (Barkley et al. 2002; Claude and Firestone 1995; Hart et al. 1995). It is well known that children diagnosed with ADHD have a variety of problems in adolescence, including greater likelihood of delinquency and substance use (Loeber et al. 1997; Molina and Pelham 2003; Sibley et al. 2010b). Relatively less information is available about academic functioning for adolescents compared to children with ADHD (Frazier et al. 2007). Considering the importance of secondary school functioning to long-term outcome, it is critical to understand how these students function academically during adolescence (Finn 2006).

Children with ADHD often exhibit specific deficits in the academic setting, including difficulty with organiza-

tional skills such as completing and returning assigned work. Clinic-referred children with ADHD have significantly poorer ratings on a parent-rated homework problem measure than other children, which includes items such as "fails to complete homework" and "forgets to turn homework in" (Power et al. 2006). School-based interventions for *middle school* students with ADHD have specifically targeted homework completion due to the difficulties young adolescents with ADHD have in this area (Evans et al. 2006). However, little is known about the academic behaviors of *high school* students with ADHD. Indices such as work completion and quality impact overall academic performance and thus the likelihood of retention and failure to graduate, so understanding how a high school student with ADHD performs on such variables is important (Evans et al. 2001).

Most studies of academic functioning in children focus on standardized achievement tests. Within the clinical literature, elementary school children with ADHD have significantly lower achievement scores in reading and math, and they obtain lower grades than non-ADHD children (Biederman et al. 1996; Frick et al. 1991; Loe and Feldman 2007). Several studies have shown that adolescents with ADHD also score lower on achievement tests than peers, though these studies typically report on younger adolescents rather than high-school-aged adolescents (Barbaresi et al. 2007). Fewer studies have examined naturally occurring measures of performance, such as grades, as a measure of academic outcome in adolescence. For high school students, GPA is arguably a more relevant measure of academic functioning than standardized test scores. GPA is typically computed across all academic subjects and reflects performance on a wide variety of tasks, such as homework, projects, and tests, and grades directly affect retention and graduation. Further, in a national survey of 1,644 colleges, GPA and class rank were reported as the most important factor in college admissions between 1979 and 2000 (Breland et al. 2002). The handful of studies that have examined GPA among adolescents with ADHD found lower GPAs compared to controls. The follow-up in the multisite Multimodal Treatment of ADHD study found that adolescents (14–18 years old) with childhood ADHD had an average GPA of 2.75, which was significantly lower than the 3.0 average GPA of adolescents without childhood ADHD (Molina et al. 2009). Barkley et al. (2006) reported a somewhat larger difference, 0.6 points. Although these studies report overall GPA for adolescents with ADHD–typically sampled over one grade or one report card—neither of these studies tested whether ADHD students' academic performance varied as a function of course difficulty. Some academic courses (i.e., math, history) may place appreciably higher demands on organizational and attentional capacities than others (i.e., art, drama, technology), and students with ADHD may perform relatively worse than other high school students in these core courses. Thus, there is value to examining overall GPA and academic GPA separately for all high school years, as well as separately for each core academic subject to search for differential deficits.

In addition to having lower academic achievement, studies have also shown that children with ADHD are more likely to repeat a grade than peers (Barkley et al. 2006, 2007; Barbaresi et al. 2007; Biederman et al. 1998; Faraone et al. 1993; Molina et al. 2009). Although grade retention is a valid measure of academic failure during elementary school, it is possible that it may not be a meaningful representation of academic outcome in high school. In high school, students may fail several academic courses in a year without having to repeat an entire grade. As a result, grade retention may not be sensitive to the typical instances of failure found in high school populations. Although one study found higher rates of course failure in high school students with ADHD (Claude and Firestone 1995), this outcome is sorely understudied. High rates of class failure are particularly concerning during high school as this indicator increases one's risk for school dropout (Janosz et al. 2000). Further examination of this outcome is needed in samples of older adolescents with ADHD.

Furthermore, students who have low GPAs and fail classes in middle or early high school years may be subsequently placed in remedial or basic level courses. One study reported that many adolescents with ADHD receive special education services in high school (Barkley et al. 2006), but no previous studies have otherwise examined course placement (i.e. honors, regular, or remedial) in high school for adolescents with ADHD. This variable is relevant both as a stand-alone outcome as well as an influence on other academic variables of interest. For example, students taking a less demanding course may have artificially inflated GPAs due to the reduced difficulty of the course. This suggests that in high school, consideration of course placement is critical both as a potential outcome of ADHD and when examining group differences in other variables such as GPA, academic course failure, and retention.

School attendance is another understudied variable that may be significantly worse for adolescents with ADHD (Barkley et al. 2007). Barbaresi and colleagues (2007) reported a 2.4 day/year difference in high school absences between a population-based ADHD and comparison sample. This finding is troubling as absences are an important predictor of school performance and educational attainment for children and adolescents (Lamdin 1996; Ou and Reynolds 2008). Given their difficulties with time management, it is also likely that adolescents with ADHD are more

frequently tardy than peers. Adults with ADHD are more frequently late to work than nonADHD adults (Barkley et al. 2007), but tardiness has not been evaluated in a high school sample. In a national survey, 21.7% of high school teachers, compared to 4.6% and 12.2% of elementary and middle school teachers, respectively, indicated that tardiness was a serious problem (US Department of Education 1995). Increases in absence and tardiness in adolescents with ADHD may also contribute to their academic problems and thus warrant further study.

Perhaps the most troubling academic outcome is high-school drop-out. Deficits in school performance and grade retention are significantly correlated with drop-out (Janosz et al. 2000). Since children with ADHD exhibit these deficits more often than peers, it seems likely that they will also experience higher drop-out rates. Indeed, these adolescents have been found to be up to three times more likely than their peers to drop-out of high school, with reported rates varying between 10% and 40% across the small number of follow up studies reported to date (Barbaresi et al. 2007; Barkley et al. 2007). These findings are particularly concerning, as high school dropout has been linked to a host of later negative life outcomes in domains pertinent to ADHD (National Center for Educational Statistics 2006; Office of Applied Studies 2003).

Given the serious nature of academic outcomes such as school drop-out, an important question is whether childhood risk factors can be identified for these adverse outcomes. In general populations, higher family socioeconomic status in childhood (SES) and higher child general intelligence (IQ) have been found to be predictive of better adult educational and occupational outcomes (Dubow et al. 2006; Feinstein and Bynner 2004). Furthermore, for children diagnosed with ADHD, disruptive behavior disorder symptom severity in childhood has been found to be a significant predictor of impairment into adolescence and adulthood (Lara et al. 2009; Sibley et al. 2010b). Although previous studies have examined childhood symptom severity of ODD and CD in relation to later behavioral outcomes and delinquency, fewer studies have examined the relation to later academic outcomes. Barkley and colleagues (2006) reported that childhood ADHD and lifetime CD severity predicted high school drop-out, but to our knowledge no other studies have conducted similar analyses. Thus, an important gap in the literature is whether childhood diagnostic variables such as ADHD, ODD, and CD severity predict high school academic outcomes, above and beyond the contribution of established risk factors such as SES and IQ.

The goal of the current study is to investigate the high school academic experience of adolescents with ADHD as compared to adolescents without ADHD. As noted, a handful of previous studies have examined outcomes in overall GPA, rates of course failure, school absences, retention, and rates of drop-out in ADHD adolescents. However, current literature on the high school ADHD population does not address variables such as GPA in specific academic courses, level of course placement, work completion and performance, and rates of tardiness to school; these variables may be important to providing a comprehensive picture of how adolescents with ADHD function in the high school setting. To replicate and further expand previous findings, we examined the following variables: 1) GPA for main academic courses (English, math, science and social studies) and overall GPA; 2) school attendance, including absences and tardies; 3) teacher-rated performance, specifically percentage of assignments completed and turned in and student potential; 4) course placement (remedial/basic vs. regular vs. accelerated/honors); 5) rates of failure in main academic courses; and 6) drop-out rates. We predicted that students with ADHD would perform worse on all measures relative to comparison teens. We also examined the relationship between attendance and academic GPA, expecting poorer attendance to be related to lower GPA. Lastly, we examined whether symptom severity of ADHD, ODD, and CD from baseline predicted poorer outcomes within the ADHD group above and beyond the contribution of IQ and parental education.

Method

Participants

Participants in the current study were part of the larger Pittsburgh ADHD Longitudinal Study (PALS). Probands for PALS were recruited from a pool of 516 children previously diagnosed with DSM-III-R or DSM-IV ADHD at the ADD Clinic at the Western Psychiatric Institute and Clinic (WPIC) in Pittsburgh, PA. Initial evaluations in childhood took place between 1987 and 1996, and participant ages ranged from 5.0 to 16.9 years, with 90% being between ages 5 and 12. Probands had participated in the Summer Treatment Program (STP) for children with ADHD, an intensive, evidence-based behavioral intervention for children with disruptive behavior disorders that includes behavior modification, parent training, and psychoactive medication trials when indicated (Pelham and Hoza 1996).

Probands were admitted to PALS on a rolling basis between the years of 1999 and 2003 and completed their first follow-up interview immediately upon enrollment. At the initial PALS follow-up interview, probands were between the ages of 11 and 28; an average of 8.3 years had passed since their initial childhood evaluation at referral to the STP (baseline). From the 516 potential

probands, data were collected from 364 (129 refused or failed to participate, 23 could not be located). Participants were compared with non-participants on 14 demographic and diagnostic variables, with only one significant comparison: conduct disorder (CD) symptom rating. Scores were slightly higher for nonparticipants (M = 0.53 on a 4-point scale) than for participants (M = 0.43).

At baseline, diagnostic information for the probands was collected from several sources including parent and teacher DBD ratings and a semi-structured diagnostic interview administered to parents by a Ph.D. level clinician. The interview assessed symptoms of the disruptive behavior disorders, along with probing situational and severity factors. At baseline, probands were excluded from participation in the STP based on the following criteria: full-scale IQ < 80, history of seizures or other neurological problems, and a history of pervasive developmental disorder, schizophrenia, or other psychotic or organic mental disorders.

A total of 240 non-ADHD participants (comparison group) were recruited on a rolling basis between 1999 and 2001. They were recruited from multiple sources to participate in a study of development in adolescents: several large pediatric practices (40.8%), local newspaper advertisements (27.5%), local universities and colleges (20.8%), and other methods, such as word-of-mouth and local public schools (10.9%). Comparison recruitment lagged 3 months behind proband enrollment in order to facilitate efforts to obtain demographic similarity. Comparison participants were selected based on four demographic characteristics: age, gender, race, and parent education level. A comparison participant was eligible if his or her enrollment increased the comparison group's demographic similarity to the probands. Information regarding comparison participants was gathered through a telephone interview administered to parents, including basic demographic characteristics, history of diagnosis and treatment for disruptive behavior problems, and an ADHD symptom checklist. Young adults (age 18+) also provided self-report. The same exclusionary criteria were applied to comparison participants as probands, with the addition of excluding those who met past or present criteria for a DSM-III-R diagnosis of ADHD. The comparison and proband groups did not differ significantly in age, gender, ethnicity, or highest parental education level. Families of probands had a significantly lower household income than comparison participants (ADHD, M = \$62,959, SD = \$47,971; comparison, M = \$76,091, SD = \$58,140). Due to the low number of female participants, only males were retained for the present analyses, leaving 539 (ADHD, n = 326; comparison, n = 213) participants. Outcomes for female participants are presented in a separate paper (Babinski et al. 2010). For demographics of participants in the current study, see Table 1.

Procedure

Starting with the first PALS follow-up interview, participants and their parents were interviewed yearly by postbaccalaureate research staff at WPIC. In cases where participants were unable to travel to WPIC, information was collected by telephone and mail. Informed consent was obtained and participants were assured of confidentiality except in cases of impending danger or harm to self or others. Self-report questionnaires were completed privately by either paper-and-pencil or through an internet portal. For the current study, data from when the participants were in

Table 1 Demographic characteristics

	ADHD[a]	Comparison[b]	p
IQ (M, SD)	101.8 (15.9)	111.4 (13.9)	<0.01
Age at 1st assessment (M, SD)	17.6 (3.3)	17.1 (3.2)	*ns*
Baseline diagnostic severity (M, SD)			
ADHD	2.28 (.43)	N/A	
ODD	1.87 (.66)	N/A	
CD	0.45 (.31)	N/A	
Total family income (M, SD)	61,6821 (47,261)	72,310 (48,809)	<0.05
Parent education			<0.01
High school grad/GED	13.0	8.6	
Partial college/specialized training(%)	43.0	30.0	
College or university degree (%)	22.3	27.1	
Graduate Professional degree (%)	21.7	34.3	
Ethnicity			*ns*
Caucasian (%)	80.4	85.4	
African–American (%)	12.3	8.0	
Other (%)	7.3	6.6	

ns not significant at $p \leq 0.05$; Baseline diagnostic severity score is the higher score reported by either parent or teacher on the DBD rating scale, calculated by taking the average symptom level on a scale from 0 "not at all present" to 3 "very much present".

[a] n ranges from 315 to 326, except for family income (n = 265).

[b] n ranges from 210 to 213, except for family income (n = 186).

grades 9, 10, 11, and 12 were used. A total of 163 out of the 539 participants completed grades 9th through 12th during the study; for these participants attempts were made to obtain current report card data and teacher ratings. This subset of 163 participants was demographically similar to the full sample. For all participants, an educational history questionnaire was completed by parents, which asked raters to report on their child's past education, from kindergarten through college (regardless of whether it had already transpired or was currently underway). In addition, the initial assessment point for PALS was used for all participants to obtain demographic information, including parental education level.

Measures

Educational History Questionnaire At each yearly follow-up visit, parents completed a questionnaire assessing participants' academic functioning in the past year. This measure inquired about current academic placement (remedial/basic, regular, or accelerated/honors) in each main course and the course outcome (pass/fail). The questionnaire also contained an item asking if the participant had left school and reason for leaving (graduated/dropped out). For participants not currently in school, parents were asked to retrospectively report their child's educational history. Thirty-nine percent of participants had solely retrospective report, 30% had solely prospective report, and 31% had a mixture of both (meaning the participant was in grade 10, 11 or 12 at initial study interview and thus had at least 1 year of prospective data while the earlier years in high school were retrospectively reported). Data for course placement were obtained for 485 participants (proband $n = 282$, comparison $n = 203$), while data for course failure were available for 478 participants (proband $n = 279$, comparison $n = 199$).

School Report Cards Schools were contacted to obtain the most recent school report card for participants enrolled in high school during the past year. Report cards were used to assess GPA in each main academic course, academic GPA, and overall GPA. Academic GPA is the four main academic courses combined (math, English, social studies, and science), while overall GPA is for all courses, both academic and elective (e.g., music, art, and gym). When only letter grades were given, school-reported grading conversions were used to obtain a number grade on a zero to 100 scale. If grading conversions were not reported by the school, a standard system was used ($A = 90$, $B = 80$, etc.). Report cards were used to obtain an official record of absences and tardies. For cases in which report card data were available for only a partial year, absences and tardies were pro-rated to reflect the entire school year. Out of the 163 participants (ADHD, $n = 95$; comparison, $n = 68$) who attended all 4 years of high school during the years of the follow-up study, report card data were available for between 148 and 152 participants, depending on the specific outcome variable (proband n ranges 86–88, comparison n ranges 62–64).

Classroom Performance Survey (CPS; Robin 1998) The CPS is a teacher rating scale that assesses a student's strengths and weaknesses in the classroom. It was given to teachers of participants who were enrolled in high school at each follow-up visit. High school students typically have multiple teachers, so participants identified the class in which they struggled most and the CPS was given to that teacher. If the nominated teacher was unable to provide ratings or if the participant had no particular difficulties, a randomly selected teacher completed the CPS. Items on the measure assessed work completion and work quality. Also reported was teacher perception of whether the student was "working up to his/her potential" (yes/no response). The CPS was only administered to the teachers of currently matriculated students; therefore, out of the 163 participants who attended all 4 years of high school during the years of the follow-up study, CPS data were available for 148 participants (proband $n = 83$, comparison $n = 65$).

Disruptive Behavior Disorder Rating Scale (DBD; Pelham et al. 1992) The DBD is a parent and teacher rating of DSM-III-R (updated to DSM-IV in 1995) symptoms of ADHD, ODD and CD. Raters evaluate the participant for each symptom on a four-point scale (0 = not at all, 1 = just a little, 2 = pretty much, or 3 = very much). To determine a severity score for each diagnosis, the symptom's highest rating from either parent or teacher was used; then the average rating for all symptoms was computed. Childhood severity scores from baseline were available for the participants with ADHD but not for comparison participants.

Cognitive Functioning All participants were tested at initial PALS follow-up visit using Vocabulary and Block Design subtests from either the Wechsler Intelligence Scale for Children-III (WISC-III; Wechsler 1991) or the Wechsler Adult Intelligence Scale-Revised (WAIS-R; Wechsler 1981). These subtests correlate highly with Verbal and Performance IQ scores, as indicated in the manuals. Estimated full-scale IQ scores were obtained from Table L-12 (WISC-III) and Table C-37 (WAIS-R) in Sattler (2001). Those who were tested using the WISC-III were tested again after turning 17 years of age using the WAIS-R. For the current study, WAIS-R scores were used; WISC-III scores were used if WAIS-R scores were unavailable.

Analyses

Analyses were conducted using the statistical program SPSS version 16. All academic performance outcome variables, with the exception of high school drop-out, were analyzed using repeated measures from each year of high school (9th through 12th grade) for each participant. To allow participants with missing data points to remain in the analyses, Linear Mixed Models (for continuous variables of GPA, absences, tardies, and percentage of assignments) and Generalized Estimating Equations (for categorical variables of course placement, course failure, and teacher-rated academic potential) were used to analyze the data. For high school drop-out, Cox Regression Survival Analysis was used. Analyses to examine baseline symptom severity of ADHD, ODD and CD as predictors of outcome were conducted separately because these data were available in the ADHD group only. In all analyses, except for those involving baseline symptom severity, parental education level and IQ were used as covariates because there were group differences on these factors (see Table 1). For parental education level, the highest level within the family, from either mother or father, was used. For Linear Mixed Models there is not yet a good estimate of effect size available in the SPSS program. Therefore, variance explained by the model was calculated using the formula $R^2 = 1 - e^{(-a+b)/n}$, where *a* and *b* are the −2 log likelihood of the intercept only and full models, respectively (Nagelkerke 1991).

Data on some dependent measures were gathered retrospectively and prospectively (e.g., the educational questionnaire), depending on the participants' age. Therefore, we conducted preliminary analyses to ensure that the nature of the data (prospective vs. retrospective) did not influence the outcomes of the main focus of the paper—differences between ADHD and comparison participants. Generalized estimating equation analyses with group and data type failed to show any evidence of an interaction between data type and group.

Results

GPA from Report Cards

For overall and academic GPA, the effects of group were significant at the $p < 0.01$ level indicating that after controlling for the covariates, adolescents with ADHD had significantly lower overall and academic GPAs over the course of high school than comparison adolescents (see Table 2). There was also a significant Group X Year interaction for both academic, $F(3, 114) = 3.18$, $p < 0.05$, and overall GPA, $F(3, 110) = 4.26$, $p < 0.01$. This interaction indicated that academic and overall GPA increased slightly over the high school years for adolescents with ADHD, but decreased slightly for comparison adolescents (Fig. 1). For all main academic courses, the effects of group were significant at the $p < 0.01$ level indicating that adolescents with ADHD had significantly lower GPAs in each main academic course across high school than comparison adolescents (see Table 2). For math GPA only there was a significant Group X Year interaction, $F(3,102) = 4.09$, $p < 0.01$; math GPA increased slightly across high school for

Table 2 Linear mixed model results for main effect of group on GPA

GPA	Mean (SD)[a]	df	*F*	*p*
Overall		(1,128)	24.2	<0.01
ADHD	75.6 (10.4)			
Comparison	81.4 (11.1)			
Academic		(1, 125)	22.9	<0.01
ADHD	74.1 (10.6)			
Comparison	79.8 (11.2)			
Math		(1, 119)	9.4	<0.01
ADHD	71.7 (13.2)			
Comparison	76.1 (13.3)			
English		(1, 121)	20.3	<0.01
ADHD	74.9 (11.2)			
Comparison	80.5 (11.6)			
Science		(1, 111)	17.0	<0.01
ADHD	73.0 (13.3)			
Comparison	79.1 (13.7)			
Social Studies		(1, 109)	17.9	<0.01
ADHD	74.0 (13.6)			
Comparison	80.5 (14.0)			

ADHD *n* ranges from 86 to 88; Comparison *n* ranges from 62 to 64.
[a] Indicates estimated marginal mean GPA on a 100 point grading scale

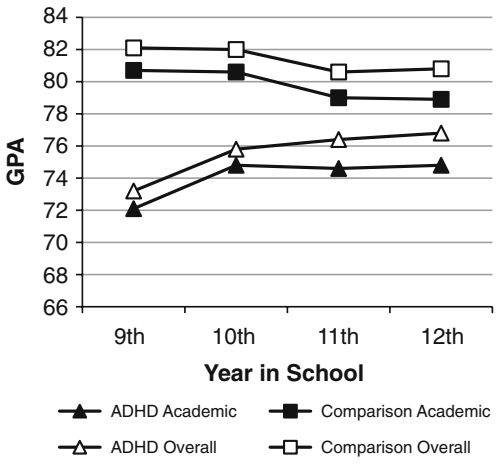

Fig. 1 Group X Year interaction for academic and overall GPA

adolescents with ADHD and decreased for comparison adolescents.

Attendance

Adolescents with ADHD were absent significantly more often each year in high school than comparison participants (ADHD M = 17.0, SD = 14.1, Control M = 10.1, SD = 14.6, $F(1, 106) = 19.3$, $p < 0.01$). There was a main effect of year on absences, with absences increasing each year for both groups, $F(3, 97) = 3.6$, $p < 0.05$. There was a main effect of group on tardies, with adolescents with ADHD (M = 8.0, SD = 11.3) tardy significantly more often than comparison participants (M = 4.2, SD = 11.9), $F(1, 122) = 8.8$, $p < 0.01$. A significant Group X Year interaction emerged for tardies only, indicating an increase for the comparison group during each year of high school, but a slight decrease for the ADHD group, $F(3, 104) = 2.77$, $p < 0.05$.

Attendance and Academic GPA

There was a significant main effect of absences on academic GPA [$F(1, 343) = 14.83$, $p < 0.01$], but no significant Group X Absence interaction. For tardies, there was no significant main effect on academic GPA, but there was a significant Group X Tardies interaction [$F(1, 309) = 4.67$, $p < 0.05$], indicating that increased tardies were significant for the comparison group in predicting lower GPA, but not for the adolescents with ADHD.

Teacher-rated Classroom Performance

The percentage of assignments completed and turned in on time within the last month was significantly lower for the adolescents with ADHD (64%) than for the comparison participants (83%), $F(1, 114) = 36.9$, $p < 0.01$. There was no significant main effect of year or Group X Year interaction. Teachers also were significantly less likely to rate adolescents with ADHD as working up to their potential than adolescents without ADHD ($b = -1.17$, $SE = 0.37$, $Wald = 18.9$, $OR = 0.31$, $p < 0.01$). There was no significant main effect of year in school for rating potential or Group X Year interaction. Across the high school years, 61% of comparison participants, but only 30% of adolescents with ADHD, were rated as working up to potential.

Course Placement

Course placement analyses used remedial/basic placement as the reference category. For all four academic subjects, adolescents with ADHD were significantly more likely to be placed in remedial/basic courses than those without ADHD (See Table 3). For math, there was a significant Group X Year interaction, $\chi^2(3, N = 485) = 9.53$, $p < 0.05$, which indicated that adolescents with ADHD were more likely to be placed in remedial/basic math early in high school, while comparison adolescents were more likely to be placed in a remedial/basic course later in high school. There was also a significant main effect of year, $\chi^2(3, N = 485) = 9.74$, $p < 0.05$, for history with both groups significantly more likely to be placed in a remedial/basic history course in grade 9 ($B = 0.38$, $SE = 0.17$, $Wald = 5.20$, $OR = 1.46$, $p < 0.05$) than in grade 12. No other main effects of year or Group X Year interactions were found for course placement.

Course Failure

For all four academic subjects, adolescents with ADHD were significantly more likely to fail throughout high school than adolescents without ADHD (See Table 3). There was also a significant main effect of year in rates of course failure in both math [$\chi^2(3, N = 478) = 9.61$, $p < 0.05$] and science [$\chi^2(3, N = 478) = 12.42$, $p < 0.01$]. For math, both groups were significantly more likely to fail in grades 9 ($b = 0.94$, $SE = 0.31$, $Wald = 9.38$, $OR = 2.56$, $p < 0.01$), 10 ($b = 0.72$, $SE = 0.30$, $Wald = 5.71$, $OR = 2.05$, $p < 0.05$) and 11 ($b = 0.64$, $SE = 0.28$, $Wald = 5.12$, $OR = 1.90$, $p < 0.05$) compared to grade 12. For science, both groups were significantly more likely to fail in grades 9 ($b = 0.64$,

Table 3 Academic course placement & failure: generalized estimating equation results for main effect of group

	b	SE	Wald	OR	Sig.
Math					
Placement	1.48	0.24	37.78	4.37	<0.01
Failure	1.25	0.41	9.60	3.50	<0.01
English					
Placement	1.52	0.24	41.54	4.57	<0.01
Failure	1.44	0.42	11.86	4.23	<0.01
Science					
Placement	1.35	0.24	30.86	3.85	<0.01
Failure	1.21	0.49	5.98	3.34	<0.05
Social Studies					
Placement	1.69	0.25	46.44	5.42	<0.01
Failure	1.57	0.51	9.35	4.78	<0.01

Placement, ADHD n = 282, comparison n = 203; Failure ADHD n = 279, comparison n = 199. Placement uses remedial/basic as the response category, thus representing the likelihood of probands being placed in lower level class over comparison participants. Failure uses fail as the reference category, thus representing the odds of probands failing when compared to the comparison group.

SE = 0.32, *Wald* = 4.10, *OR* = 1.90, $p < 0.05$) and 11 (b = 0.92, *SE* = 0.28, *Wald* = 10.66, *OR* = 2.51, $p < 0.01$) than in grade 12. No Group X Year interactions were found.

High School Drop-out

Adolescents with ADHD were significantly more likely to drop out of high school than adolescents without ADHD (b = 2.10, *SE* = 0.61, *Wald* = 11.96, *OR* = 8.14, $p <$ 0.01). By the end of 12th grade, 98.6% of the comparison participants reported being in high school, while only 85.9% of adolescents with ADHD reported remaining in high school.

Symptom Severity in Childhood as a Predictor of Proband Academic Performance

Baseline symptom severity of ADHD, ODD and CD for adolescents with ADHD were not significant predictors in analyses of GPA, attendance, drop-out, class placement, or failure in math, science and social studies. However, CD symptom severity at baseline, but not ADHD or ODD, was a significant predictor of English placement (b = 0.98, *SE* = 0.50, *Wald* = 3.99, *OR* = 2.71, $p < 0.05$) and failure (b = 1.45, *SE* = 0.47, *Wald* = 9.52, *OR* = 4.26, $p < 0.01$).

IQ and Parental Education Level

As noted above, IQ and parental education were included as covariates in the above analyses; however, they did not have significant effects in all models. Both covariates were significant for the variables Academic GPA, Overall GPA, absences, and history placement and failure. Parental education level was significant for math GPA, teacher-rated potential, and high school drop-out. IQ was significant for GPA in science, English and history; for placement and failure in math and science; and for English placement. Neither covariate was significant for tardies, percentage of assignments turned in, or English failure. As mentioned previously, Linear Mixed Models do not have a good estimate of effect size, so for variables in which this type of analysis was used (GPA, attendance, and percentage of assignments) and in which one or both covariates were also significant, single variable models were analyzed and R^2 was calculated to compare the relative importance of Group with that of the covariates, and should not be taken as an absolute measure of variance predicted by the variable in the model. R^2 for the full models was also calculated; the formula $R^2 = 1 - e^{(-a+b)/n}$ was used (Nagelkerke 1991). For Academic GPA, R^2 values were as follows: group only = 0.80, IQ only = 0.78, parent education only = 0.78, and full model = 0.88. Results followed a similar pattern for other dependent variables.

Discussion

The findings of this study indicate that children with ADHD grow up to have significant academic impairment in high school. Compared to adolescents without ADHD, high school students who were diagnosed with ADHD in childhood: 1) received lower grades; 2) took fewer advanced level courses; 3) failed significantly more academic courses; 4) were rated by teachers as performing more poorly; 5) had poorer school attendance; and 6) were more likely to drop-out before graduation. However, these poor academic outcomes in high school were not predicted by baseline symptom severity. These results both support and extend previous findings regarding the high school academic experience of adolescents with a childhood diagnosis of ADHD.

Grades, Course Placement, Course Failure, and Teacher Ratings of Academics

GPA showed a clear five to nine-point difference (on a 100-point scale) between the adolescents with childhood ADHD and the comparison participants, despite controlling for differences in IQ. Converted to letter grades, the means in Table 2 indicate that despite comparable aptitude, high school students with ADHD obtain C- grades on average, while the comparison participants without ADHD obtain B-/C+ grades. Our finding is consistent with that of Molina and colleagues (2009), who found a significant GPA difference in the MTA sample, with adolescents with childhood ADHD typically obtaining grades of B- and control adolescents typically obtaining B letter grades. However, our ADHD-comparison differences were larger, especially in 9th grade, where there was nearly a full letter grade difference (9 points) between groups. Similarly, Barkley et al. (2006) found that adolescents with ADHD had GPAs in the D letter range, while controls fell within the C range. Our sample and Barkley's were clinic-referred, while the MTA sample was study-referred. Given that our sample was referred in Pittsburgh to the same clinic and during the same time frame in which the MTA site sample was recruited, the differences suggest that clinic-referred ADHD samples have greater academic difficulty than study-referred samples. It is also noteworthy that Overall GPA was only slightly higher than academic GPA in our sample (Fig. 1). Including nonacademic subjects in GPA does not appear to substantively and artificially "raise" the GPAs of high school students with ADHD. Their problem in academic performance transcends course type. Thus, studies that employ overall GPAs are apparently understating academic GPA only a negligible amount.

Previous studies only examined GPA on the most recent report card at assessment, and adolescents had not all

recently completed the same year in high school. We examined both GPA and individual subject grades across all 4 years of high school, providing a more complete picture of high school GPA than previous studies. Our data suggested a slight upward and differential trend in GPA for adolescents with ADHD as they progressed through high school. This trend is previously unreported, as most data from high school combined report across years or only examined a single report card (Barkley et al. 2006; Molina et al. 2009) and is counterintuitive. There were also some significant Group X Year interactions in certain academic courses, indicating that by the time students with ADHD are in 12th grade, they have better GPA's overall, while comparison adolescents generally had decreasing GPA's over the school years.

There are several possible explanations for the differences in grade trends. First, drop-out rates in the ADHD sample increased annually (see discussion below). In the general education population (Hickman et al. 2008), students who drop out have significantly lower overall GPAs each semester throughout high school prior to dropping out. The increasing grade trend in the ADHD sample could be due to the lowest performers dropping out. Alternatively, schools do not require core subjects all 4 years of high school. For example, a typical requirement is 3 years of science and social studies and only two high-level math courses (Office of Support Service, Pittsburgh Board of Education, August 2006). Thus, it is possible that adolescents with ADHD take easier academic course loads after completing required courses, while those without ADHD continue to take harder courses throughout high school. Similarly, an adolescent who must re-take a failed course—more likely among the ADHD participants—is likely to perform better the second time. Therefore, what appears to be improvement in academic functioning over high school years in adolescents with ADHD may instead reflect decreases in course difficulty. On the other hand, transitions to new secondary school environments may be especially problematic for adolescents with ADHD (Evans et al. 2009). Thus, the grade trend reported herein may reflect a decrease in functioning from eighth grade to ninth grade that gradually climbs to stability once the adolescent adapts to the high school environment.

This is the first study of which we are aware that has examined course placement (other than rates of special education) in adolescents with ADHD. The current study found that adolescents with ADHD are four to five times more likely to have a lower class placement than their peers—that is, they are more likely to be in remedial level classes and less likely to be in advanced courses. Thus, adolescents with ADHD not only hold lower GPAs than comparison participants, but also take a less rigorous curriculum. Academic failure in ADHD adolescents may therefore stem from deficits that transcend class difficulty. For example, disorganization (e.g., missing assignments, forgetting tests) may lead to low grades even in cases where the material is easily understood. This has important implications for intervention with high-school-aged adolescents, which we discuss in more detail below.

Our study also found that in *all* main academic courses (math, English, science, and social studies), rates of failure were significantly higher for adolescents with ADHD, who were approximately three to five times more likely to fail than comparison adolescents. In absolute terms, adolescents with ADHD failed 7.5% of their main academic courses, while comparison participants failed 1.7%. This finding is consistent with previous course failure results in high school students with ADHD (Claude and Firestone 1995), and extend these results by examining failure in each main academic course. Surprisingly, these absolute rates are considerably lower than the rates of grade retention reported by Barkley et al. (2006), although the relative increases were comparable. These findings add to the existing literature by examining course failure rather than entire grade retention; examining only grade retention in at risk high school students may substantially underestimate the rate of failure for these adolescents.

Our results show that teachers rate high school students with ADHD as completing less work and not working up to potential compared to nonADHD students. Completing less work is a hallmark characteristic of children with ADHD in elementary settings (Loe and Feldman 2007). Late middle and early high school students with ADHD are also rated by teachers as academically impaired (Molina et al. 2009). Our findings show that these difficulties continue through high school, and no doubt lead to the low GPA and high failure rates discussed above.

School Attendance and Dropout

This study also found that adolescents with childhood ADHD had significantly poorer attendance in high school. Previous findings on absenteeism showed that adolescents with ADHD were absent 3.0% of the time, while comparison participants absence rate was 2.6% (Barbaresi et al. 2007)–about a 2.4-day difference per year. The current study found higher rates of absenteeism in both groups; adolescents with ADHD missed 9.7% of days and comparison participants missed 5.8%. This higher rate may reflect the fact that our sample was more demographically diverse than the Barbaresi and colleagues sample, which was a birth cohort in largely Caucasian, middle and upper middle class Rochester, MN. Our sample also reflects children whose symptoms were severe enough to warrant referral to a mental health clinic. The results on tardiness showed that ADHD children were significantly more tardy

than controls—a 3.8% difference. In our sample, adolescents with ADHD were absent or tardy 26 days per school year—nearly twice as often as the comparison participants, who were absent or tardy on 14 days.

Absenteeism was related to lower academic GPA in both adolescents with ADHD and comparison participants, which is consistent with previous literature in the general education population (Lamdin 1996; Ou and Reynolds 2008). However, tardies were related to lower academic GPA in comparison participants only. Because adolescents with ADHD had more absences (17 days) than the comparison group had for both absences and tardies combined, it is possible that there is no incremental effect of tardiness once a student has missed a certain amount of instructional time due to absences. In addition to its relationship to achievement, high school students who are absent without permission are significantly more likely to engage in risky health behaviors while not in school (Eaton et al. 2008). Thus, this finding that ADHD high school students are absent or tardy nearly 26 days per year is doubly concerning.

Adolescents with ADHD were 8.1 times more likely to drop out of high school than were comparison participants. Previous literature reported adolescents with ADHD as 2.7 times more likely to drop out; rates of drop-out ranged from 20 to 35% (Barbaresi et al. 2007; Barkley et al. 2006). Our higher differential drop-out may generalize more appropriately to the ADHD population because our sample is more demographically diverse and clinic-referred. From 1990 to 2001, around the same time period as when our subjects were evaluated, the national average for high school drop-out was relatively stable, ranging between 10.7% and 12.5% (Kaufman et al. 2004). Our results suggest that adolescents with ADHD may contribute to this alarmingly high rate. This finding is concerning given that adolescents who drop-out are at risk for serious negative outcomes such as criminal behavior, incarceration and substance abuse problems (Office of Applied Studies 2003; Thornberry et al. 1985).

Prediction from Baseline Characteristics

It is worth emphasizing that the current study controlled for group differences in IQ and parental education status, which are known predictors of academic outcomes (Dubow et al. 2006; Feinstein and Bynner 2004). In the current study, the relative importance of group (ADHD vs. comparison) as a predictor was as large as IQ and parental education in analyses in which all three were significant. Thus, the academic problems of high school students with childhood ADHD are substantial *beyond* somewhat lower IQ, as indicated in standardized measures of intelligence, *and* socio-economic status, as measured by parental education level. The present results suggest that ADHD should become a major factor that high school teachers and guidance counselors consider when examining reasons for poor functioning in students.

Baseline ADHD and ODD symptom severity did not significantly predict outcomes in this study. This may have been due to a restriction of range in the current sample; participants with ADHD were clinic referred and had to meet ADHD diagnostic criteria for study inclusion and many were also elevated on ODD symptoms. Barkley et al. (2006) reported that parent ratings of childhood activity level predicted drop-out, but their scale did not tap inattention or impulsivity symptoms. They also reported that lifetime CD predicted drop-out. In the present study childhood CD symptom severity only significantly predicted outcome for English course placement and failure. This is consistent with extant literature regarding associations between conduct problems and lower reading and verbal abilities (Bennett et al. 2003; Nigg et al. 1998). Since all probands had ADHD, this finding refers to a comorbid ADHD/CD condition. It is well established that comorbidity between ADHD and CD increases the risk for multiple negative outcomes (Sibley et al. 2010b); our results suggest that this is the case for at least one academic domain.

Limitations

One limitation of the current study is that all participants in the ADHD group attended an STP during childhood; therefore, we have no way to analyze the effect of this intervention on high school performance. However, it is unlikely that their participation impacted high school academic achievement given that an average of 8.3 years had passed since participation in the STP and the start of the current study. Another possible limitation of the current study is the use of GPA as an outcome measure. Although we believe GPA to be particularly ecologically valid in the high school setting, its use (e.g. versus standardized achievement tests) may be a limitation given that it is an imprecise metric that could vary across schools. A third limitation is lack of data on learning disabilities within the sample. Given the high comorbidity that has been found between learning disabilities and ADHD, future studies within this population should examine the relative impact of ADHD and concurrent learning problems on academic performance. Another conceivable limitation is the inconsistent sample sizes. Given the longitudinal nature of the study, not all participants provided data at each assessment point. Additionally, some measures, such as report cards, were only collected for those participants still in school. This meant that sample sizes varied for different outcome measures. However, given the consistency of findings across measures, this variability does not appear to have influenced the results.

Clinical Implications

These findings highlight the need for effective school-focused interventions with this population (Evans et al. 2009; Sibley et al. 2010a). It is well known that academics need to be targeted in school-based interventions for *children* with ADHD and these results demonstrate that this need continues through high school. For many years, stimulant medication, the most widely used treatment for childhood ADHD, has been relied upon to help with ADHD-related academic problems (Loe and Feldman 2007). However, it is clear that the vast majority of high school students with ADHD have discontinued pharmacotherapy (Molina et al. 2009), minimizing its potential utility in this age group (Evans et al. 2001). Thus, psychological and psychoeducational interventions need to be developed for this age range. In addition to school-based supports that may be presently offered (Evans et al. 2009), intensive interventions that target organization skills and effective techniques for studying (Sibley et al. 2010a) may be necessary to ameliorate the underperformance of high school students with ADHD. Furthermore, parents and teens should be trained to work with teachers to actively support the adolescents' academic progress through the high school years. Given the particularly poor academic functioning displayed by ninth grade students with ADHD, the transition to high school may be a critical period for these interventions. Future research should focus on the refinement and development of these approaches, as they are sorely needed and infrequently available (Smith et al. 2000). It is our hope that with such work, adolescents with ADHD will experience greater academic success during the high school years.

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