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Paths to Post-Secondary Education Enrollment among Adolescents with and without Childhood ADHD: A Longitudinal Analysis of Symptom and Academic Trajectories

Abstract

We examined developmental trajectories of ADHD symptoms, standardized achievement, and school performance for adolescents with and without ADHD who did and did not enroll in post-secondary education (PSE; *N* = 749; 79% boys; 63% White). Adolescents who eventually enrolled had less severe symptoms, but differences were modest and trajectories were similar over time. For all adolescents, standardized achievement trajectories declined up to two-thirds of a standard deviation from ages 9 to 17. By the end of high school, the average GPA of adolescents with ADHD was three-quarters of a point higher for those who eventually enrolled in PSE compared to those who did not. Overall, school performance mattered more than academic achievement for understanding eventual enrollment of adolescents with ADHD.

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Paths to Post-Secondary Education Enrollment among Adolescents with and without Childhood ADHD: A Longitudinal Analysis of Symptom and Academic Trajectories

Attention-deficit/hyperactivity disorder (ADHD) is increasingly recognized as a condition that typically begins in childhood and persists into adulthood for most people (Hechtman et al., 2016; Sibley, 2021). Long-term follow-up studies of children with ADHD have predominantly focused on the academic outcomes of young adults with ADHD histories compared to their non-ADHD peers, chief among them high school dropout, lower rates of post-secondary enrollment, and fewer eventual degrees completed (Barkley et al., 2008; Hechtman et al., 2016; Owens & Jackson, 2017). However, recent work drawing attention to the recurrent and fluctuating nature of ADHD symptoms and impairment across development (Caye et al., 2016; Sibley et al., 2021) serves as a potent reminder that snapshot histories of diagnostic status can occlude important developmental differences in children's patterns of progression over time. Academic difficulties, including problems with reading, writing, and/or mathematics (DuPaul et al., 2013; Frazier et al., 2007), are common among children with ADHD and often persist through adolescence, leaving those with ADHD at a distinct disadvantage in pursuing post-secondary education (PSE). Nevertheless, there is heterogeneity in these difficulties: Many adolescents with ADHD gain admission to college or university and 7.4% of first-year students in the U.S. self-report an ADHD diagnosis (Stolzenberg et al., 2019).

As they approach the end of high school and parent-supervised education, enrolling in post-secondary studies is the first hurdle that young people need to clear on their way to realizing the numerous advantages associated with a college degree. For those with childhood ADHD who eventually enroll in post-secondary studies, important differences in the timing and rate of improvement in symptoms and academic performance from childhood through adolescence may help to explain their success in reaching this educational milestone compared to their peers who do not eventually enroll. In this study, we draw on more than a decade of longitudinal data from the Multimodal Treatment Study of ADHD (MTA) to model trajectories of ADHD symptoms, academic achievement, and school performance in adolescents with and without ADHD who did and did not eventually enroll in post-secondary studies.

ADHD Symptoms and Academic Outcomes

Longitudinally, symptoms of ADHD tend to decrease in severity but persist for most, with just 25% of young adults with a history of ADHD functioning comparably to their non-ADHD peers (Loe & Feldman, 2007). In adolescence, symptom persistence is linked to poorer academic outcomes (Hechtman et al., 2016; Wu & Gau, 2013) and academic problems continue even with symptom remission (Owens & Jackson, 2017). Overall, students with persistent symptoms of ADHD are more likely to fail classes, have lower grades on their report cards in all school subjects, and have lower scores on standardized achievement tests. Long-term data from the sample we draw on for the present study confirm that adolescents who were classified as symptom-persistent in adulthood were less likely to attain a bachelor's degree than adolescents whose symptoms desisted by adulthood (8.0% vs. 17.8%; Hechtman et al., 2016). Symptom-related deficits in degree attainment should first be evident at the time of entry into post-secondary studies, yet differences in adolescent ADHD symptom trajectories leading up to post-secondary enrollment have not previously been tested. In this study, we consider that declining symptoms in adolescence might be important for later post-secondary enrollment. We tested whether adolescents with ADHD histories who eventually enrolled in PSE had less severe symptoms through adolescence that improved more quickly over time compared to adolescents with ADHD histories who did not eventually enroll in PSE. Results of these tests will speak to the importance of ongoing symptom monitoring through the high school years.

Measures of Academic Outcomes

The heterogeneity of educational outcomes in young people with ADHD histories emphasizes the importance of examining patterns of change in measures used to establish academic potential across development. Different measures of academic outcomes may well reveal different developmental patterns. For example, many children and adolescents with ADHD have lower standardized academic achievement scores and lower school grades than their typically developing peers (Barkley et al., 2006; Frazier et al., 2007; Kent et al., 2011), but the correlation between the two indices of academic success is low (Langberg et al., 2011).

Post-secondary education admission decisions are heavily based on a combination of standardized test scores and school grades, such that adolescents who eventually enroll in PSE necessarily show, on average, higher academic achievement and school performance. In much of the longitudinal work on ADHD, researchers report findings from academic achievement tests (Langberg et al., 2011) that are designed to measure acquired knowledge in specific academic areas such as reading, written expression, oral expression, and mathematics (e.g., Wechsler Individual Achievement Test; Psychological Corp, 1992). Scores on academic achievement tests are stable over time (Wright, 2010) and moderately to strongly correlated with IQ (Naglieri & Bornstein, 2003). Compared to typically developing peers, children, adolescents, and adults with ADHD score on average approximately 10 points lower on standardized achievement tests (Frazier et al., 2007; Owens & Jackson, 2017), and on full scale IQ assessments (Frazier et al., 2004). Thus, the learning difficulties characteristic of ADHD translate to lower levels of academic achievement that are evident across the lifespan and clearly correlated with measures of intelligence.

Academic outcomes are also measured as school performance: school grades, grade retention, and highest level of education completed (Langberg et al., 2011). At the 8-year follow-up, adolescents in the MTA with ADHD histories had lower teacher ratings of academic performance and lower overall grade point averages than their peers without ADHD histories (Molina et al., 2009). Moreover, academic performance indicators were approximately half a standard deviation higher for adolescents without ADHD histories than adolescents with ADHD histories.

Beyond academic information learned, school success requires many skills such as attending to classroom instruction, completing and turning in homework, and organizing tasks (Raggi & Chronis, 2006). In contrast to the stable pattern for standardized academic achievement, students generally show a slight increase in grade point average (GPA) from Grades 1 through 5 followed by a slight decrease from Grades 6 through 12 (Gutman et al., 2003). Students also show drops in GPA at transition periods, for example, as they move from elementary to middle or middle to high school (Alspaugh, 1998; Barber & Olsen, 2004). These changes in school grades during transition periods may be the result of different marking systems and criteria across educational levels. For children with ADHD, the transition to middle school is associated with an increase in ADHD symptoms (Langberg et al., 2008). Children who struggle with transitions earlier in development (i.e., middle school) may continue to struggle with later transitions (i.e., high school), and these persistent struggles may deter students from enrolling in college. Moreover, these difficulties may not be reflected well in ratings of ADHD symptoms.

Given that fewer children and adolescents with ADHD histories enroll in PSE compared to their non-ADHD peers, we might expect less successful academic achievement and school performance on average, with perhaps more prominent declines in grades through high school. Among adolescents with ADHD who do eventually enroll in PSE, patterns may deviate from their counterparts who do not enroll—for example, by exhibiting stable but higher achievement scores over time or improvements in grades through high school. Determining whether a hard-driving focus on school performance in high school, beyond symptom management, can offset childhood poor performance and lead to eventual enrollment in PSE has important clinical and academic implications. Thus, investigating potential differences in symptom severity and academic outcomes is a key goal of the present study.

The Present Study

Although post-secondary students with ADHD have more academic difficulties than their peers without ADHD (e.g., DuPaul et al., 2018, 2021; Frazier et al., 2007; Gormley et al., 2019), prior research has not tested whether patterns of change in ADHD symptoms and academics in childhood and adolescence can be tied to eventual enrollment—or not—in PSE. We therefore modeled trajectories of ADHD symptoms, academic achievement, and school performance to characterize patterns of change in four groups: (1) adolescents with childhood ADHD histories who eventually enrolled in PSE, (2) adolescents with childhood ADHD histories who did not enroll in PSE, (3) adolescents without ADHD histories who eventually enrolled in PSE, and (4) adolescents without ADHD histories who did not enroll in PSE.

As shown in other research with the MTA, adolescents with a history of ADHD in childhood in general tend to have higher levels of current ADHD symptoms compared to adolescents without ADHD histories (Hechtman et al., 2016; Howard et al., 2015; Molina et al., 2009; Roy et al., 2017). We hypothesized that symptoms would be more severe and remain elevated year over year for adolescents with ADHD histories who did not eventually enroll in PSE than for those who did.

Given evidence from prior research of the stability of standardized academic achievement (Wright, 2010), we also hypothesized that adolescents with ADHD histories would tend to have consistently lower scores compared to adolescents without ADHD histories, and that scores would be lowest among those who did not eventually enroll in PSE. For school grades, we similarly hypothesized that adolescents with ADHD histories would have lower grades than adolescents without ADHD histories. Because school grades reveal more variability across levels of schooling (Alspaugh, 1998; Barber & Olsen, 2004; Gutman et al., 2003), we further hypothesized that adolescents with ADHD histories who eventually enrolled in PSE would show stability or possibly improvement in school grades compared to their counterparts who did not enroll in PSE, particularly through the later teen years. In key symptom and academic domains that pose persistent challenges for children and adolescents with ADHD, this study seeks to clarify whether and when developmental variation contributes to PSE enrollment prospects for adolescents with versus without ADHD histories.

Method

Participants

ADHD participants were the 579 children diagnosed with *DSM–IV* ADHD Combined Type, initially recruited between the ages of 7 to 9.9 (M = 8.5, SD = 0.80) into the Multimodal Treatment Study of ADHD (MTA). Children at each of six sites (ns = 95-98) were randomly assigned to one of four treatment groups: multicomponent behavioral treatment, systematic medication management, the combination of the behavioral and medication treatments, or referral to usual community care. Children with common comorbid diagnoses participated, and exclusion criteria were limited to conditions requiring study-incompatible treatments (e.g., psychosis, neuroleptic medication), inability to participate (e.g., hospitalization, IQ below 80), cross-arm contamination (children in the same classroom or household), and family-related risks and threats to full participation (e.g., history of abuse, parent stimulant abuse, non-English-speaking primary caregiver). Recruitment strategy, detailed exclusion criteria, diagnostic procedures, treatment, and sample demographic characteristics can be found in other reports (Arnold et al., 1997; Hinshaw et al., 1997; MTA Cooperative Group, 1999). The MTA data are publicly available via data sharing agreement with the National Institute of Mental Health Data Archive (nda.nih.gov).

Baseline participant assessments took place prior to treatment randomization and again at 3 months, 9 months, and the conclusion of the 14-month treatment phase. After randomized treatment, follow-up assessments occurred at 2, 3, 6, 8, 10, 12, 14, and 16 years. These follow-up assessments approximately covered ages 9 through 25. At the 2-year assessment, a Local Normative Comparison Group (LNCG; $n = 289$) was recruited, randomly sampled from the same schools and grades as the ADHD group, and matched for age and sex. The entry and exclusion criteria for children in the LNCG were the same as for children in the ADHD group except they were not required to have ADHD. The LNCG was followed from the 2- through 16-year assessments. Of the 289 children in the LNCG, 31 were diagnosed with ADHD at study entry and thus were excluded from analyses. Attrition in the present study was modest, but participants in the LNCG provided more complete data than their counterparts in the ADHD group (study retention is documented in Swanson et al. (2017)).

For the present study, we drew on participant assessments from the 2- through 10-year follow-ups (i.e., ages 9-17) to model symptom and academic performance trajectories across adolescence. Of the 837 participants, 558 (*n* = 354 ADHD, 204 LNCG) had complete data across all five waves. Of the remaining 279 participants, 231 were missing data for one wave (*n* = 61 ADHD, 26 LNCG), two waves (*n* = 48 ADHD, 14 LNCG), three waves (*n* = 35 ADHD, 7 LNCG), or four waves (*n* = 33 ADHD, 7 LNCG). Finally, 48 participants in the ADHD group were missing data for all five waves. Analyses for the current study accommodated missing data using full information maximum likelihood (FIML) estimation. Under FIML, all participants who completed at least one wave of data are included in the model; missing values are not replaced but instead model parameters are estimated based on all available information. Under the missing at random assumption, this method is shown to produce unbiased parameter estimates even with a high level of missing data (Enders, 2010, p. 125) and is a gold-standard method for data analyses with missing data.

We performed a series of comparisons between cases with complete (*n* = 558) versus incomplete (*n* = 279) data. Comparisons were made separately for the ADHD group and the LNCG, and considered the following variables: age at baseline, grade at baseline, household income, birthweight (pounds), age of biological mother at child's birth, sex, race and ethnicity (coded non-Hispanic White, non-Hispanic Black, Hispanic, Other), parents' marital status (coded married/cohabitating vs. not), low-income status (coded annual household income < $10,000 vs. not), income from public assistance (e.g., welfare, social security income), mother education, father education, hospitalizations of the child, speech problems, number of school absences, school expulsions or suspensions, repeated school grade, parent mental health history, child's physical health (coded as good vs. not), and original treatment assignment (medication management, behavioral treatment, multimodal treatment, community treatment as usual). Overall, there were few significant differences between participants with complete versus incomplete data. For the ADHD group, participants with incomplete data more often had younger and less educated mothers, low-income status, and received income from social assistance. For the LNCG, participants with incomplete data more often had younger mothers and received income from social assistance. To increase confidence in the *missing at random* assumption for these data, variables that were found to significantly differ between groups were added as covariates to all analyses (Collins et al., 2001; Graham, 2003).

Post-Secondary Enrollment

The complete longitudinal data for all follow-up assessments (i.e., Years 2-16) were reviewed to establish whether each participant did or did not eventually enroll in PSE. Participants were coded as having enrolled in PSE if at any time they indicated current full- or part-time enrollment in a college, university, community college, or post-college graduate program; enrollment in college, university, or community college courses; or if they ever reported completing at least the first year of a post-secondary program. Using these criteria and excluding participants who were missing all data from years 2 to 10 (n = 48), 749 participants were positively identified as either having enrolled in PSE during their time in the MTA or not having enrolled; 40 participants with partial data from years 2 to 10 could not be classified because they had no attendance information beyond Year 10 (i.e., after mean age 18), and were also excluded. The 749 participants retained for analyses were classified as follows: ADHD Post-Secondary (n = 320), ADHD No Post-Secondary (n = 179), LNCG Post-Secondary (n = 205), and LNCG No Post-Secondary (n = 45).

An additional missing data analysis tested for differences between those who could be classified based on post-secondary status (*n* = 749) and those who could not be classified (*n* = 40). Within the ADHD histories group, participants who could not be classified were more often Hispanic and had mothers with less education. In the LNCG, participants who could not be classified were more often non-Hispanic Black, had younger and less educated mothers, and had less educated fathers.

Measures

ADHD Symptoms

ADHD symptoms were measured using the Swanson, Nolan and Pelham Questionnaire (SNAP-IV; Swanson et al., 2001). Nine symptoms of inattention and 9 of hyperactivity-impulsivity from DSM-IV are rated from 0 (not at all) to 3 (very much). The parent and teacher versions of the SNAP were completed at baseline, 14 months, and the 2, 3, 6, 8, and 10-year follow-up time points.

We calculated a composite score combining parent and teacher ratings of inattentive and hyperactive/impulsive ADHD symptoms, following procedures recommended by Kraemer, and documented in Howard et al. (2015) using the same data. Scores were first rescaled by standardizing baseline scores (*M* = 0, *SD* = 1) and centering parents' and teachers' scores at subsequent assessments around their respective raw baseline means and standard deviations. Rescaled parent and teacher scores at each wave were averaged to create composite parent-teacher ratings of both inattentive and hyperactive/impulsive symptoms at baseline through 10 years. Baseline means and standard deviations were added back to align with the original scales of the variables. Although this scoring method does not perfectly preserve the raw metric of the original SNAP scale, it draws on reports from both parents and teachers in a combined score. Much like the original metric, higher scores are indicative of more severe symptoms.

Academic Achievement

Standardized academic achievement was measured with the Wechsler Individual Achievement Test (WIAT; Psychological Corp, 1992). The WIAT consists of eight subtests, which are summarized to yield composite scores for reading, language, writing, and mathematics. The standardized mean score for the inventory and for each subtest is 100 with a standard deviation of 15. In the MTA, the basic reading, mathematical reasoning, and spelling subtests were administered at baseline, 14 months, and all follow-up time points. Notably, medium to strong correlations were found between IQ at baseline and the WIAT mathematics (r = .60 to .75), reading (r = .51 to .59), and spelling (r = .43 to .55) administered at the follow-up timepoints. These correlations underscore that achievement overlaps considerably with intelligence as a construct. Consequently, we elected not to include IQ as a covariate.

School Performance

Throughout the MTA study, parents provided MTA study personnel with copies of their children's report cards. Report card data, which are organized by grade rather than by study wave, were used to measure school performance outcomes in the present study. Specifically, overall GPA and core subject grades (mathematics and English) were used as measures of school performance from Grades 4 through 12. Mathematics and English grades were transformed to a five-point scale (Molina et al., 2009), with a grade of "A" being coded as "5" and a grade of "F" being coded as "1". Grade point average was on a conventional 0-to-4 scale. Small to medium correlations were found between IQ at baseline and mathematics (r = .24 to .55) and English (r = .24 to .41) school grades, and overall GPA (r = .31 to .47) across the follow-up timepoints.

Baseline Covariates

Consistent with previous studies using MTA data and based on the missing data analyses, all model analyses adjust for study site, sex, race/ethnicity, low-income status, age of biological mother, parent education, marital status, and externalizing disorders (i.e., a diagnosis of oppositional defiant disorder or conduct disorder at baseline). Additionally, for participants with ADHD histories, three contrast treatment codes (i.e., MTA medication algorithm effect, multimodal superiority effect, and behavioral substitution effect) were entered as covariates (see Jensen et al., 2007; Swanson et al., 2001) with all participants in the LNCG coded as 0. By including these covariates, we strengthen the study design and analyses because we can examine prediction above and beyond demographic and psychosocial variables known to be important for participation in post-secondary education.

Analytic Strategy

The analyses in this study are largely confirmatory. Data were obtained from a well-defined sample and directional hypotheses were informed by findings in the pre-existing literature. Latent curve modeling was conducted in Mplus Version 8.3 (Muthén & Muthén, 1998-2017). We originally anticipated conducting multi-group analysis, but the small size of the LNCG No Post-Secondary group (n = 45) posed convergence problems given the large number of free parameters estimated. Instead, we entered grouping factors into each model as predictors. This approach is equivalent to a constrained multi-group analysis where parameters such as residuals and covariate regression are held constant in all groups. Estimates of separate trajectories for each group are still obtained, and we report these as simple slopes with confidence bands.

Based on an initial visual inspection of the data, we used linear piecewise functions to separately model rates of change in ADHD symptoms (inattentive and hyperactive) through childhood (Piece 1; ages 9-13) and adolescence (Piece 2; ages 13-17). Likelihood ratio tests to identify the best functional form of change in symptoms supported a piecewise model over simple linear change for both inattention, $\chi^2(4) = 36.74$, $p < .001$, and hyperactivity-impulsivity, $\chi^2(4) = 32.00$, $p < .001$. In contrast, we modeled rates of change in standardized academic achievement (mathematics, reading, and spelling) through childhood and adolescence (ages 9-17) as a single linear trajectory because of the expected stability in standardized academic achievement over time and evidence favoring a simple linear functional form in preliminary tests.

We used linear piecewise functions again to separately model rates of change in school performance (math grades, English grades, overall GPA) through middle school (Piece 1; Grades 6-8), and high school (Piece 2; Grades 9-12). Likelihood ratio tests indicated that piecewise growth functions provided better fit to the data than linear, for mathematics school grades, $\chi^2(4) = 19.31$, $p < .001$, English school grades, $\chi^2(4) = 22.28$, $p < .001$, and GPA, $\chi^2(4) = 29.77$, $p < .001$. Moreover, a visual inspection of the observed data showed uniform declines in all groups between Grades 8 and 9, likely reflecting the transition from middle to high school. We included an indicator covariate coded 0 at Grades 8 and below and coded 1 at Grades 9 and above to explicitly incorporate this decline in each model. Too few datapoints were available for Grades 4 and 5, thus subsequent analyses include Grades 6-12.

Results

Table 1 shows the descriptive statistics for the time-invariant covariates for the four groups. The percentage of adolescents with at least one parent who graduated from college

Table 1

Descriptive Statistics for Time-Invariant Covariates for Adolescents with and without ADHD who do and do not go on to Post-Secondary Education

	ADHD		LNCG	
	PSE (n = 320)	No PSE (n = 179)	PSE (n = 205)	No PSE (n = 45)
Sex (% male)	75.6	86.0	79.5	80.0
Income Status (% low)	6.6	12.3	2.0	13.3
Age of Mother (years)	28.5	21.2	29.9	25.9
Parents Married/Cohabitating (%)	72.2	69.8	81.2	64.4
Parent Education[a] (% college graduate)	73.1	45.8	73.2	51.1
Externalizing Disorder[b] (%)	54.4	57.0	2.4	2.2
Study Site (% per site)				
• Site 1	14.4	17.3	16.6	17.8
• Site 2	15.3	16.2	17.1	8.9
• Site 3	12.8	19.6	13.7	31.1
• Site 4	22.8	11.7	19.0	15.6
• Site 5	21.3	13.4	17.1	8.9
• Site 6	13.4	21.8	16.6	6.7
Race and Ethnicity (%)				
• Non-Hispanic White	64.7	56.4	69.8	46.7
• Non-Hispanic Black	19.4	21.2	8.3	24.4
• Hispanic	5.3	12.8	11.2	22.2
• Other	10.6	9.5	10.7	6.7
Treatment Strategy Groups				
• Medication (%)	25.0	24.5	--	--
• Behavioral (%)	25.9	24.5	--	--
• Combined (%)	26.5	25.0	--	--
• Community (%)	22.6	26.1	--	--

Note. PSE indicates post-secondary enrollment during MTA follow up; [a]Mother or father graduated from college; [b]Conduct disorder or oppositional defiant disorder

differed across the four groups, χ^2 (3, N = 749) = 48.25, p < .001. Adolescents who eventually enrolled in PSE, regardless of ADHD histories, were more likely to have a mother or father who had graduated from college. The percentage of adolescents whose parents were married or cohabitating differed across the four groups, χ^2 (3, N = 749) = 10.13, p = .018. The highest proportion of married or cohabiting parents was observed in the LNCG Post-Secondary group. The number of adolescents with a comorbid diagnosis of an externalizing disorder (i.e., conduct disorder or oppositional defiant disorder) also differed across the four groups. As expected, adolescents with ADHD histories were more likely to have externalizing disorders than the LNCG, but there was no significant difference in prevalence of externalizing disorders for adolescents with ADHD who did versus did not eventually enroll in PSE. Race and ethnicity also differed across the four groups; there were fewer non-Hispanic Black adolescents in the LNCG Post-Secondary than the other three groups and there were fewer Hispanic students in the ADHD Post-Secondary group and the LNCG Post-Secondary than the other two groups.

Overview of Trajectory Results

For all analyses, ADHD status (ADHD vs. LNCG), post-secondary enrollment (post-secondary vs. no post-secondary), and the interaction between ADHD status and post-secondary enrollment were included in the models to permit estimates of distinct model-implied trajectories for each of these groups. Model fit statistics appear in Table 2 and detailed model results appear in Table 3. For each category of outcome variable (i.e., ADHD symptoms, academic achievement, school performance) *p*-values (excluding covariates) were corrected for multiple comparisons using the Benjamini-Hochberg false discovery rate procedure (Benjamini & Hochberg, 1995). To summarize, we observed significant ADHD status differences in overall *levels* of ADHD symptoms and academic achievement and significant post-secondary enrollment differences in inattentive symptoms, academic achievement, and school performance. At all ages, adolescents in the ADHD group tended to have worse symptoms and academic performance than their LNCG age mates. However, adolescents in the ADHD group who did and did not enroll in post-secondary studies did not differ from each other except in GPA (discussed below).

Table 2

Model Fit Indices for Final Latent Curve Models

	Chi-Square	SRMR	CFI	RMSEA
Inattentive Symptoms	$\chi^2(198) = 241.44$, $p = .019$	.044	.972	.017 [.008, .025]
Hyperactive Symptoms	$\chi^2(198) = 338.15$, $p < .001$	.052	.916	.031 [.025, .037]
WIAT Mathematics	$\chi^2(205) = 347.92$, $p < .001$	.061	.951	.031 [.025, .037]
WIAT Reading	$\chi^2(205) = 291.94$, $p < .001$	.047	.972	.024 [.018, .030]
WIAT Spelling	$\chi^2(205) = 317.07$, $p < .001$	.038	.967	.028 [.021, .033]
Math Grades	$\chi^2(138) = 157.41$, $p = .124$	.067	.979	.016 [.000, .028]
English Grades	$\chi^2(134) = 155.02$, $p = .103$	.046	.974	.017 [.000, .028]
GPA	$\chi^2(134) = 201.78$, $p < .001$	.041	.974	.028 [.020, .035]

Note. Standardized Root Mean Square Residual (SRMR); Comparative Fit Index (CFI); Root Mean Square Error of Approximation (RMSEA)

We observed few significant differences in *rates of change* in symptoms and academic performance by ADHD status and post-secondary enrollment. With respect to ADHD symptoms, from ages 13-17, hyperactivity-impulsivity symptoms declined more steeply for adolescents with ADHD histories than the LNCG. With respect to academic outcomes, for adolescents with ADHD histories, spelling achievement from ages 9-17 and English school grades from Grades 6-8 declined more steeply for those who did not eventually enroll in post-secondary education compared to those who did eventually enroll. Below, we estimated simple slopes to obtain separate rates of change for each of the four groups: ADHD Post-Secondary, ADHD No Post-Secondary, LNCG Post-Secondary, LNCG No Post-Secondary.

Trajectories of ADHD Symptoms

Previous studies reporting symptom trajectories for the MTA sample found that symptoms sharply decreased after treatment and that hyperactive symptoms were less prominent in adolescence than inattentive symptoms (Howard et al., 2015; Molina et al., 2009). Our findings paralleled these reports. Despite decreases in symptoms, adolescents with ADHD histories continued to experience more severe symptoms than the LNCG.

Table 3

Unstandardized Results for Latent Curve Models

	ADHD Symptoms		Academic Achievement			School Performance		
	Inattention	Hyperactivity-Impulsivity	Mathematics	Reading	Spelling	Mathematics	English	GPA
	B (SE)	B (SE)	B (SE)	B (SE)	B (SE)	B (SE)	B (SE)	B (SE)
Intercept (Age 13; Gr. 8)	0.11 (0.19)	-0.54‡ (0.16)	92.17‡ (2.63)	94.19‡ (2.37)	93.89‡ (2.70)	3.03‡ (0.20)	2.85‡ (0.23)	2.31‡ (0.15)
ADHD	1.13* (0.18)	0.93* (0.15)	-5.31* (2.18)	-6.47* (1.99)	-9.59* (2.24)	-0.35 (0.19)	-0.24 (0.22)	-0.25 (0.14)
Post-Secondary	-0.66* (0.18)	-0.21 (0.14)	10.38* (2.10)	4.84* (1.91)	5.07* (2.17)	0.59* (0.17)	0.54* (0.20)	0.60* (0.13)
ADHD*Post-Secondary	0.18 (0.20)	-0.15 (0.17)	-3.04 (2.38)	1.14 (2.17)	1.69 (2.45)	-0.23 (0.21)	-0.21 (0.24)	-0.30† (0.15)
Rate of Change[1]	0.20* (0.06)	0.09 (0.05)	-1.04* (0.28)	-0.94* (0.21)	-0.34 (0.23)	-0.04 (0.11)	0.11 (0.13)	-0.03 (0.07)
ADHD	-0.08 (0.07)	-0.08 (0.06)	-0.33 (0.31)	0.12 (0.24)	-0.77* (0.26)	-0.09 (0.14)	-0.23 (0.16)	-0.04 (0.08)
Post-Secondary	-0.10 (0.07)	-0.04 (0.06)	0.30 (0.31)	0.26 (0.23)	0.06 (0.25)	-0.06 (0.12)	-0.29† (0.14)	-0.02 (0.08)
ADHD*Post-Secondary	0.00 (0.07)	-0.05 (0.06)	0.02 (0.35)	0.12 (0.27)	0.70* (0.29)	0.26 (0.16)	0.42† (0.18)	0.07 (0.09)
Transition (Gr. 8-9)	--	--	--	--	--	0.22* (0.06)	-0.22* (0.07)	-0.19* (0.04)
Rate of Change[2]	-0.02 (0.05)	-0.06 (0.04)	--	--	--	0.01 (0.06)	-0.02 (0.07)	-0.03 (0.04)
ADHD	-0.07 (0.06)	-0.09† (0.05)	--	--	--	0.03 (0.07)	0.01 (0.09)	-0.03 (0.05)
Post-Secondary	0.04 (0.06)	0.02 (0.05)	--	--	--	-0.01 (0.06)	-0.04 (0.07)	0.01 (0.04)
ADHD*Post-Secondary	0.00 (0.07)	0.04 (0.05)	--	--	--	0.02 (0.08)	0.04 (0.09)	0.10 (0.05)
Covariates								
Sex (Male)	0.30‡ (0.07)	0.12 (0.06)	2.44‡ (1.15)	1.96 (1.03)	-0.41 (1.18)	-0.14 (0.08)	-0.09 (0.09)	-0.17‡ (0.06)
Treatment Site 2	0.06 (0.05)	0.00 (0.04)	-0.56 (0.85)	1.48‡ (0.75)	0.33 (0.86)	-0.14 (0.12)	-0.28‡ (0.13)	-0.11 (0.09)
Treatment Site 3	0.02 (0.04)	0.06‡ (0.03)	0.58 (0.63)	0.31 (0.56)	0.15 (0.64)	-0.12 (0.14)	-0.02 (0.14)	-0.43‡ (0.10)
Treatment Site 4	0.05 (0.02)	0.04 (0.02)	-0.69 (0.41)	-0.21 (0.36)	-1.00‡ (0.42)	0.04 (0.11)	0.05 (0.12)	-0.08 (0.08)
Treatment Site 5	0.00 (0.02)	0.02 (0.02)	0.63 (0.32)	0.12 (0.29)	0.11 (0.33)	0.09 (0.11)	0.10 (0.12)	-0.02 (0.08)
Treatment Site 6	0.00 (0.02)	-0.01 (0.01)	-0.33 (0.28)	0.22 (0.24)	-0.42 (0.28)	-0.59‡ (0.11)	-0.64‡ (0.12)	-0.60‡ (0.08)
Race & Ethnicity: Black	0.20‡ (0.09)	0.19‡ (0.07)	-9.96‡ (1.49)	-7.36‡ (1.33)	-3.20‡ (1.53)	-0.31‡ (0.11)	-0.32‡ (0.12)	-0.34‡ (0.08)
Race & Ethnicity:	0.01 (0.11)	0.05 (0.10)	-6.79‡ (1.92)	-2.83 (1.70)	-1.65 (1.95)	-0.11 (0.14)	-0.21 (0.14)	-0.05 (0.10)
Race & Ethnicity: Other	0.04 (0.10)	0.05 (0.08)	-4.36‡ (1.62)	-2.00 (1.44)	-0.99 (1.65)	-0.05 (0.13)	0.05 (0.13)	-0.03 (0.09)
Parent Education	0.00 (0.07)	0.05 (0.06)	5.51‡ (1.09)	3.07‡ (0.97)	3.66 (1.12)	0.29‡ (0.08)	0.39‡ (0.08)	0.30‡ (0.06)
Parent Marital Status	-0.12 (0.07)	-0.05 (0.06)	5.72‡ (1.21)	2.98‡ (1.08)	5.07‡ (1.23)	0.33‡ (0.09)	0.34‡ (0.09)	0.28‡ (0.06)
Low-Income Status	-0.08 (0.13)	-0.04 (0.11)	-1.26 (2.14)	-1.92 (1.91)	-1.94 (2.18)	0.14 (0.17)	-0.06 (0.17)	0.00 (0.11)
Externalizing Disorder	0.08 (0.07)	0.21‡ (0.06)	0.40 (1.13)	1.09 (1.00)	-0.95 (1.15)	0.07 (0.08)	0.06 (0.09)	-0.01 (0.06)
Age of Mom at Birth	0.01 (0.01)	0.00 (0.00)	0.23‡ (0.09)	0.18‡ (0.08)	0.19 (0.09)	0.01 (0.01)	0.01 (0.01)	0.01‡ (0.00)
Social Assistance Income	0.03 (0.09)	0.16‡ (0.08)	0.02 (1.54)	0.44 (1.37)	1.19 (1.58)	-0.05 (0.11)	0.02 (0.12)	-0.07 (0.08)
Medication Management	-0.02 (0.07)	-0.08 (0.06)	-0.38 (1.15)	-0.17 (1.03)	1.12 (1.17)	0.01 (0.09)	-0.02 (0.09)	-0.13‡ (0.06)
Multimodal Superiority	-0.03 (0.05)	-0.01 (0.04)	1.13 (0.80)	0.47 (0.71)	0.05 (0.82)	0.05 (0.06)	0.08 (0.06)	0.00 (0.04)
Behavioral Substitution	0.03 (0.05)	0.01 (0.04)	0.99 (0.81)	0.95 (0.72)	0.43 (0.83)	-0.05 (0.06)	0.02 (0.07)	-0.04 (0.04)

Note. *significant at the $p < .05$ level after Benjamini-Hochberg corrections for false detection rates; †$p < .05$ before Benjamini-Hochberg corrections for false detection rates; ‡$p < .05$ for covariate effects and intercept (no corrections applied). [1]Slope for ages 9-17 for academic achievement, ages 9-13 for ADHD symptoms, and Grades 6-8 for school performance; [2]Slope for ages 13-17 for ADHD symptoms and Grades 9-12 for school performance

Inattentive Symptoms

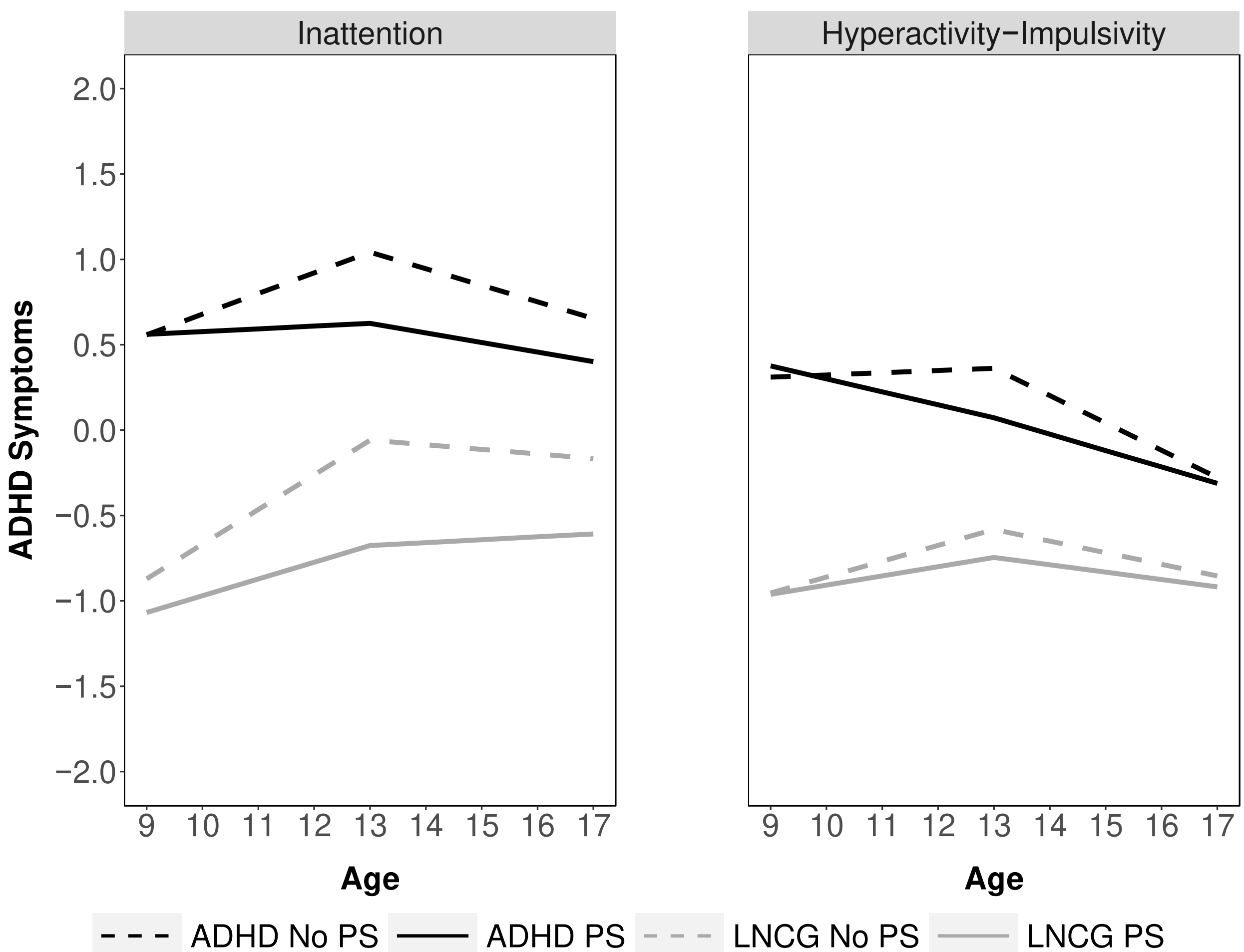
Figure 1 shows model-implied trajectories derived from results summarized in Table 3. Adolescents with ADHD histories had higher levels of inattentive symptoms than the LNCG. Within each group, adolescents who did not eventually enroll in PSE also had higher levels of inattentive symptoms than those who eventually enrolled in PSE. Tests of simple slopes showed that there was an increase in inattentive symptoms of nearly half a standard deviation from ages 9 to 13 for the ADHD No Post-Secondary group (B = 0.12, SE = 0.03, p = .001), 90% of a standard deviation in the LNCG No Post-Secondary (B = 0.20, SE = 0.06, p < .001), and 35% of a standard deviation in the LNCG Post-Secondary (B = 0.10, SE = 0.03, p = .001). Symptoms remained stable from ages 9 to 13 for the ADHD Post-Secondary group (B = 0.02, SE = 0.02, p = .54). From age 13 to 17 symptoms decreased by 24% of a standard deviation for the ADHD Post-Secondary group (B = -0.06, SE = 0.02, p = .01) and by 42% of a standard deviation for the ADHD No Post-Secondary group (B = -0.10, SE = 0.03, p = .001), whereas the already low symptoms for both the LNCG No Post-Secondary (B = -0.02, SE = 0.05, p = .65) and LNCG Post-Secondary (B = 0.02, SE = 0.02, p = .48) remained stable.

Hyperactivity-Impulsivity Symptoms

Figure 1 also shows that adolescents with ADHD histories had higher levels of hyperactive-impulsive symptoms than the LNCG. There was no significant effect of post-secondary enrollment. From age 9-13 hyperactive symptoms decreased by 36% of a standard deviation for the ADHD Post-Secondary group (B = -0.08, SE = 0.02, p < .001) and increased by 23% of a standard deviation for the LNCG Post-Secondary (B = 0.05, SE = 0.02, p = .03). Symptoms remained stable for the ADHD No Post-Secondary group (B = 0.01, SE = 0.03, p = .66) and the LNCG No Post-Secondary (B = 0.09, SE = 0.05, p = .07). From ages 13-17 symptoms decreased by 48%, 80%, and 39% of a standard deviation for the ADHD Post-Secondary group (*B* = -0.10, SE = 0.02, $p < .001$), the ADHD No Post-Secondary group (*B* = -0.16, SE = 0.02, $p < .001$), and the LNCG Post-Secondary (*B* = -0.04, *SE* = 0.02, *p* = .02), respectively. Symptoms remained stable for the LNCG No Post-Secondary (*B* = -0.06, *SE* = 0.04, *p* = .11).

Figure 1

Implied Trajectories for Inattention and Hyperactivity-impulsivity Symptoms by Age and Group with 90% Confidence Bands



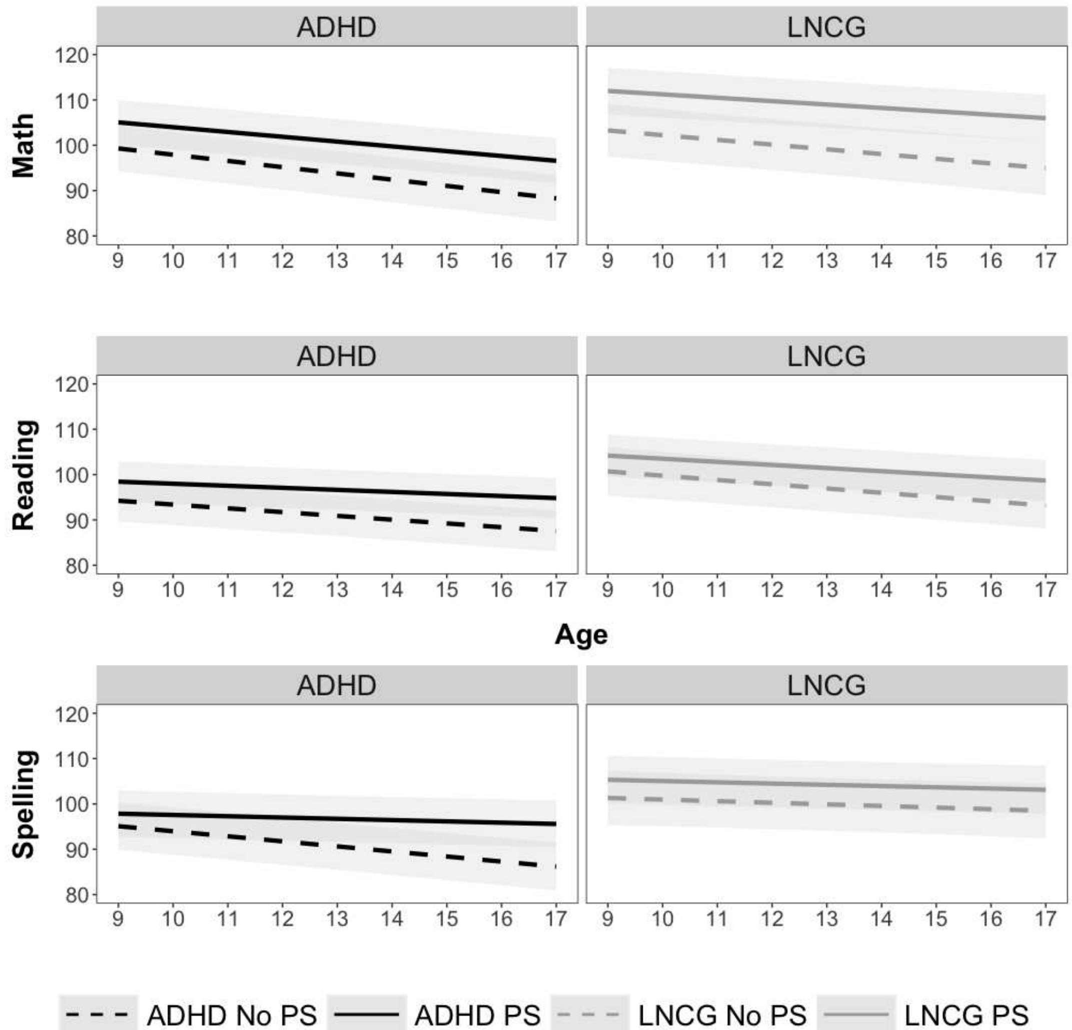
Trajectories for Academic Outcomes

Standardized Academic Achievement

Figure 2 shows that, at all ages, adolescents with ADHD histories had lower academic achievement scores than the LNCG. Similarly, adolescents who did not eventually attend PSE had lower academic achievement scores than those who did. The standardized mean score for the WIAT is 100 with a standard deviation of 15. For mathematics achievement, tests of simple slopes showed that scores slightly declined from ages 9-17 for all four groups: ADHD Post-Secondary (B = -1.06, SE = 0.11, p < .001; 57% of a standard deviation over 8 years), ADHD No Post-Secondary (B = -1.37, SE = 0.15, p < .001; 73% of a standard deviation), LNCG Post-Secondary (B = -0.75, SE = .13, p < .001; 40% of a standard deviation), and LNCG No Post-Secondary (B = -1.04, SE = 0.28, p < .001; 55% of a standard deviation). Similarly, for reading achievement, scores slightly declined over time for all four groups: ADHD Post-Secondary (B = -0.46, SE = 0.08, p < .001; 25% of a standard deviation), ADHD No Post-Secondary (B = -0.83, SE = 0.11, p < .001; 44% of a standard deviation), LNCG Post-Secondary (B = -0.69, SE = .10, p < .001; 37% of a standard deviation), and LNCG No Post-Secondary (B = -0.94, SE = 0.21, p < .001; 50% of a standard deviation). For spelling achievement, scores remained stable for the LNCG No Post-Secondary whereas they slightly declined over time for the ADHD Post-Secondary (B = -0.36, SE = 0.09, p < .001; 19% of a standard deviation), ADHD No Post-Secondary (B = -1.11, SE = 0.12, p < .001; 59% of a standard deviation), and LNCG Post-Secondary (B = -0.29, SE = .11, p = .007; 15% of a standard deviation). For spelling achievement, the rate of decline was steeper for the ADHD No Post-Secondary group than the ADHD Post-Secondary group.

Figure 2

Implied Trajectories for WIAT Mathematics, Reading, and Spelling Achievement by Age and Group with 90% Confidence Bands



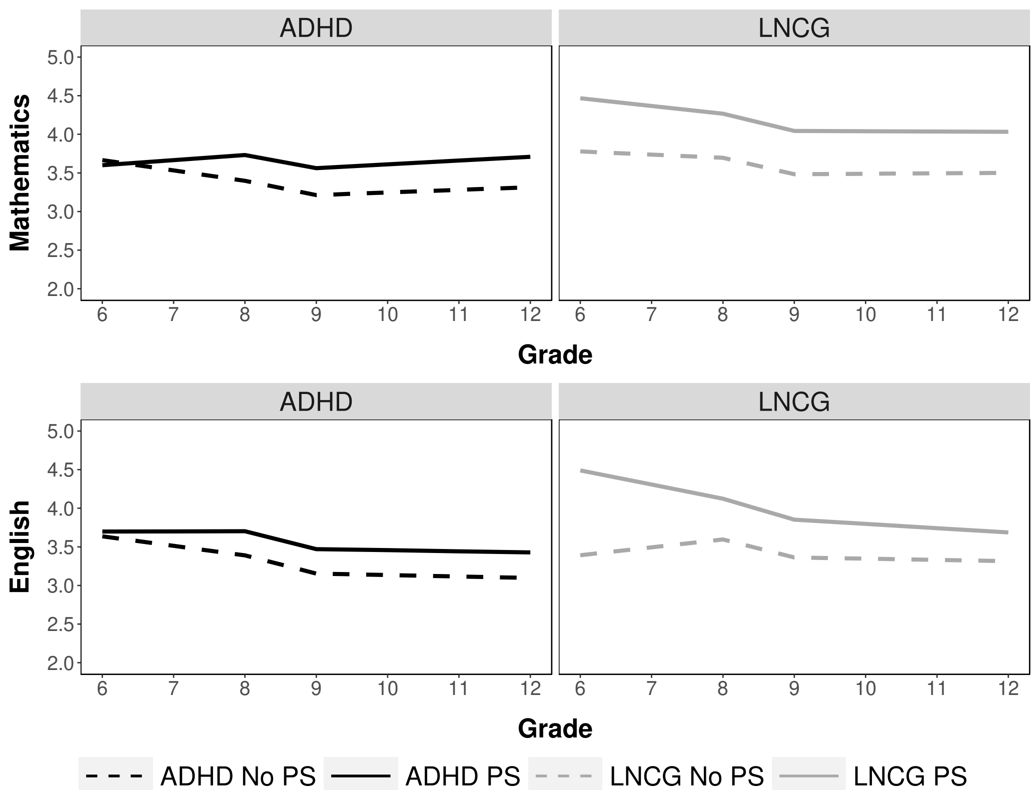
School Performance

School Grades by Subject. Figure 3 shows that adolescents who eventually enrolled in PSE tended to have higher grades in core subjects than those who did not eventually enroll. For mathematics and English grades in middle school, the LNCG Post-Secondary had significantly higher grades than the LNCG No Post-Secondary, whereas the ADHD Post-Secondary and

ADHD No Post-Secondary groups did not significantly differ. In high school, mathematics and English grades were higher for the LNCG Post-Secondary compared to the LNCG No Post-Secondary and for the ADHD Post-Secondary group compared to the ADHD No Post-Secondary group, however, these differences were not significant.

Figure 3

Implied Trajectories for Mathematics and English Grades by Grade and Group with 90% Confidence Bands



As shown in Figure 3, all groups experienced a decline in core subject grades during the transition from middle to high school (i.e., from Grade 8 to 9). Transition effects were significant for both mathematics and English school grades. The LNCG Post-Secondary experienced a decline in English grades (i.e., 36% of a letter grade) in middle school, B = -0.18, SE = .07, p =

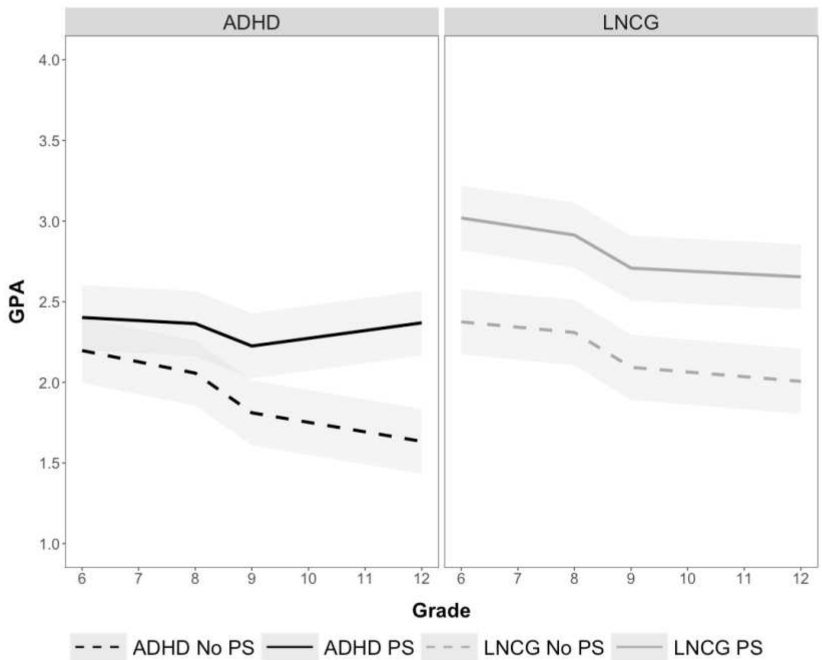
.006 (did not survive correction for multiple testing), however, they continued to achieve the highest grades in English during this time compared to the other three groups. English grades were stable for the other three groups in middle school and for all four groups in high school (simple slope *B*s ranged from -.13 to .11, all *p*s > .05). Mathematics grades were stable for all four groups in both middle school and high school (simple slope *B*s ranged from -.13 to .05, all *p*s > .05).

Overall Grade Point Average (GPA). At all time-points, the LNCG Post-Secondary had significantly higher GPAs than the LNCG No Post-Secondary. In contrast, the ADHD Post-Secondary group had significantly higher GPAs than the ADHD No Post-Secondary group in high school, but not middle school.

As shown in Figure 4, GPA was stable for all four groups through middle school (*B*s ranged from -.07 to -.02, all $p > .05$). Similarly, for both the LNCG No Post-Secondary ($B = -.03$, $SE = 0.04$, $p = .46$) and LNCG Post-Secondary ($B = -0.02$, $SE = 0.02$, $p = .32$) GPA remained stable in high school. In contrast, GPA declined on average by 18% of a point from Grades 9 to 12 for the ADHD No Post-Secondary group ($B = -0.06$, $SE = 0.03$, $p = .03$) whereas GPA improved by 15% of a point for the ADHD Post-Secondary group ($B = 0.05$, $SE = 0.02$, $p = .004$). We interpret high school rates of change with caution, however, as *p*-values did not survive correction for multiple testing. By Grade 12, the ADHD Post-Secondary group had GPAs that were, on average, 0.74 points higher than the ADHD No Post-Secondary group (Wald $\chi^2(1) = 18.62$, $p < .001$), similar in magnitude to the difference in GPA between the LNCG Post-Secondary and No Post-Secondary groups. Even as the gap between the ADHD and LNCG post-secondary groups narrowed, the latter still had GPAs that were, on average, 0.29 points higher in Grade 12 (Wald $\chi^2(1) = 21.48$, $p < .001$).

Figure 4

Implied Trajectories for Overall GPA by Grade and Group with 90% Confidence Bands



Discussion

In this study, we tested whether the symptom and academic trajectories of adolescents with or without ADHD who do and do not eventually enroll in PSE are distinct. Three key findings emerged from this study. First, ADHD symptoms were less severe in adolescents who eventually enrolled in PSE but differences were modest and trajectories were similar over time. Second, there were persistent gaps in academic achievement between adolescents with and without ADHD and between adolescents who did versus did not eventually enroll in post-secondary education, but trajectories were stable and thus did not provide informative developmental information. Third, divergent patterns of school performance among adolescents with ADHD histories were evident in high school. By Grade 12, adolescents who eventually enrolled in PSE had higher GPAs than those who did not. However, among those who eventually enrolled in PSE, adolescents with ADHD histories continued to have lower GPAs than those without ADHD histories.

ADHD Symptom Trajectories Leading to Post-Secondary Education

We examined differences in symptom trajectories with respect to post-secondary enrollment given well-known evidence that more severe symptomatology in childhood may lead to greater academic impairments (Barry et al., 2002) that in turn create barriers to post-secondary enrollment. In the present study, inattention symptom levels were higher on average and across development for adolescents who did not eventually enroll in PSE, regardless of their childhood ADHD status, consistent with evidence that more severe inattentive symptoms are linked to academic impairments in elementary, middle, and high school (Zoromski et al., 2015). Inspecting the simple slopes, there was some evidence that adolescents with ADHD histories who eventually enrolled in PSE had less difficulty up to age 13 (stable inattention symptoms and declining hyperactivity-impulsivity symptoms) than those who did not enroll. However, the symptom differences between the two groups of adolescents with ADHD were modest. Although more severe and persistent symptoms were negatively associated with the attainment of a bachelor’s degree (Hechtman et al., 2016), we find it encouraging that many adolescents with initially severe symptoms eventually enrolled in PSE, and suggest that symptom severity itself may play a less critical role in the pathway to post-secondary education enrollment than previously thought.

Other factors may play a mediating role between symptom severity and eventual post-secondary enrollment. For example, in elementary, middle, and high school, students are still in parent- and teacher-supervised educational environments. In supervised environments, parents and teachers can monitor students’ attendance and assignment completion, encourage perseverance, and implement interventions for students who may be struggling. With the additional support afforded to students in supervised environments, adolescents with relatively severe or persistent symptoms may still be likely to gain acceptance to post-secondary education. If symptoms are well-managed and students have access to accommodations and interventions, their role as a barrier to post-secondary enrollment may be minimized.

School Performance Predicts Later Enrollment in Post-Secondary Education

Consistent with other research, adolescents with ADHD histories had lower academic achievement and school performance than their typically developing peers (DuPaul et al., 2013; Frazier et al., 2007). Although adolescents with ADHD who went on to post-secondary education made some modest gains in GPA through high school, they still remained behind their non-ADHD peers on average. Differences in academic outcomes were also evident within groups of adolescents with ADHD histories. Adolescents with ADHD histories who eventually enrolled in PSE had higher academic achievement than their ADHD peers who did not eventually enroll. This difference in achievement appeared early and was persistent. Between ages 9 and 17, there was no critical time period in which adolescents with ADHD histories who eventually enrolled in PSE began to diverge from their counterparts who did not eventually enroll. This finding may be related, at least in part, to the strong link between standardized academic achievement and IQ. The achievement difference may therefore be well-established at a very young age, stable over time, and predictable from pre-existing factors. Having college-educated parents, for example, is associated with higher IQ, enrollment in PSE, and first-year cumulative GPA (Gormley et al., 2019; Vargas Lascano et al., 2015). Achievement scores thus have limited utility as a developmental measure. The stability of standardized academic achievement tests may preclude their use as a meaningful index of whether a child with ADHD is shifting on or off a path toward post-secondary enrollment.

In contrast, there were some notable deviations in school performance before and after middle school. There appeared to be a widening gap in school grades for core subjects between the two ADHD groups as adolescents progressed through middle school: Core subject performance declined by 26% (math) and 13% (English) of a letter grade for adolescents with ADHD histories who did not eventually enroll whereas they improved by 14% of a letter grade in math and remained stable in English for those who did eventually enroll. Notably, adolescents with ADHD histories had consistently lower grades in core subjects than their non-ADHD peers who eventually enrolled in PSE. These findings provide key evidence supporting a focus on subject mastery and study skills and work habits in middle school. Moreover, these findings are consistent with current conceptualizations of ADHD being a disorder of performance, rather than ability (Barkley, 2015).

For overall GPA we observed some changes over time, though effect sizes were modest and *p*-values did not survive correction for multiple testing. In high school, for adolescents with ADHD histories, overall GPAs declined by 18% of a point from Grades 9 to 12 for those who did not eventually enroll in PSE whereas they improved by 15% of a point for those who did eventually enroll. By Grade 12, the gap in GPA widened such that adolescents with ADHD histories who eventually enrolled in PSE had GPAs that were three-quarters of a point higher than their peers with ADHD who did not eventually enroll. Adolescents with ADHD who eventually enrolled in PSE caught up somewhat to their typically-developing counterparts, although the narrower gap between the two post-secondary groups still favored adolescents without ADHD histories, whose GPAs continued to exceed the GPAs of those with ADHD histories. These trends vary slightly from those found in the Pittsburgh ADHD Longitudinal Study, where GPA slightly improved in high school for students with ADHD histories, but slightly declined for their typically developing peers (Kent et al., 2011). Strategies that contribute to improved grades—choosing easier academic loads after completing required courses; retaking failed courses—may facilitate adaptation to the demands of high school and strengthen the chances of students with ADHD histories eventually enrolling in PSE. Unlike standardized achievement, school performance is affected by motivation and engagement in school, regular class attendance, note-taking habits, and homework completion (Raggi & Chronis, 2006). Involved and supportive parenting in adolescence may facilitate improved school performance (Hill & Wang, 2015). School performance may thus be a more informative marker in intervention efforts for identifying when adolescents with ADHD require support to strengthen long-term chances for school success. For children with ADHD histories, direct interventions, subject mastery support, and development of work and study skills in middle and high school may provide enduring benefits that set students on a path for academic success. Our findings, in particular, support a recommendation for such interventions during the transition from middle to high school.

Implications

Overall, to help students with ADHD succeed academically, further improvements to the classroom and school context are warranted. Many students with ADHD receive academic accommodations, such as extra time for tests, writing tests in a separate room, or having tests read aloud by a teacher (Lovett & Lewandowski, 2015), but these accommodations rarely improve students' performance and do not have benefits that are specific to students with ADHD (Lovett & Nelson, 2020). Instead, instructional design changes that support a more inclusive classroom and reduce the need for special accommodations, such as computer-aided instruction and choice-making strategies in which students are able to select work from a teacher-developed menu, may have academic benefits for all (Loe & Feldman, 2007; McGuire et al., 2003). Outside of the classroom, school-based interventions such as organizational skills training, instructional interventions (i.e., flash cards, writing strategy training), social skills training, and daily report cards are effective for students with ADHD (Bikic et al., 2017; Harrison et al., 2019; Moore et al., 2019). The Challenging Horizons Program, for example, is a multi-component intervention that has led to improvements in academic functioning and school performance for students in middle school (Evans et al., 2015) and high school (DuPaul, Evans, et al., 2021). Outside of school, interventions emphasizing parent-teen interactions and parent involvement in academics, such as the Supporting Teens' Academic Needs Daily program (STAND; Sibley et al., 2014) support adolescents' academic success. Using the MTA data, Howard et al. (2016) found that the lowest levels of impairment in adulthood were observed in adolescents who had involved parents and went on to PSE after high school, both for students with and without ADHD histories. However, results from the present study do not capture the potential contributions of ongoing medication treatment, behavioral and psychosocial therapies, nor patterns of cycling on and off treatments across development. Prior MTA work showed that cumulative stimulant exposure through adolescence was associated with greater services use in school (e.g., individualized education plans, special education classes; Murray et al., 2014). With adequate consideration for young people's unique and complex treatment exposures, interventions aimed at the individual, classroom, and family levels may help to prevent adolescents with ADHD from being diverted away from academic opportunities.

Limitations and Future Research

One limitation of the present study is that all adolescents with ADHD histories, regardless of comorbidity, were grouped together in the analyses. In the present sample adolescents with ADHD histories who eventually enrolled in PSE had rates of childhood externalizing comorbidity similar to those of their counterparts who did not eventually enroll in PSE. Moreover, when the analyses were repeated while also covarying symptoms of internalizing disorders, the results did not change. However, previous research has established that students with comorbid disorders tend to have lower academic performance and more problems with homework than their peers with ADHD only (Karustis et al., 2000; Mounteaux et al., 2007). Thus, additional comparisons highlighting comorbidity may have value in future work.

A second limitation is that our results are to some extent restricted by how we defined and coded post-secondary enrollment, owing in part to the level of precision in the MTA data. Participants were classified as enrolling in post-secondary education if they attended either community college or university, full-time or part-time. While we cannot decisively determine who went to community college versus university from the available demographic information, we estimate that by mean age 25, 80% of the LNCG Post-Secondary had enrolled in four-year university degree programs compared to just 55% of the ADHD Post-Secondary group. This is consistent with other research which has found that fewer adolescents with ADHD complete degree programs in comparison to their typically developing peers (Altszuler et al., 2016; Barkley et al., 2008). Admission to a four-year college or university is arguably more competitive and requires higher grades in high school than admission to community college. Moreover, the courses taken in high school often differ for students who plan to pursue university versus students who plan to pursue community college. Thus, in future work, separating community college and university enrollment may help further explain the improved GPA in high school of adolescents who eventually enrolled in post-secondary courses.

We also intentionally did not consider degree completion. From prior reports using the MTA data, we know that by the final wave of follow-up in this sample (mean age 25), 37.1% of the LNCG had obtained a bachelor's degree compared to only 12.9% of participants with ADHD (Hechtman et al., 2016). Thus, although this study provides information about developmental differences in symptoms and academic outcomes leading up to enrollment, the findings do not extend beyond that developmental window. In the present data, participants were followed to a mean age of 25 and thus were not followed long enough for us to definitively conclude who did and did not complete their degrees. Those with ADHD may take a "detour" through several jobs before settling down and completing a degree, potentially graduating later than those who go straight into college after high school.

Finally, in the present study we chose not to consider IQ as a covariate in the analyses given its high correlations with achievement. Although general intelligence is an important factor in eventual post-secondary enrollment, there are long-standing debates regarding whether IQ and standardized academic achievement are separate, distinct constructs (Flanagan et al., 1997; Lubinski & Dawis, 1992), and intelligence tests were first designed to measure students' ability for educational success. Given the strong relations between IQ and achievement we observed in this study (*r*s ranging from .43 to .75), the purpose of IQ assessments, and the apparent overlap in test coverage, we concluded that IQ as a covariate would compromise the interpretation of our modeled trajectories of achievement and school performance.

Conclusion

Overall, adolescents with ADHD histories who enrolled in PSE had less difficulty through age 13 with respect to symptom severity (i.e., stable inattention symptoms and declining hyperactivity-impulsivity symptoms) and were “high achieving” in the sense that their developmental profiles of academic achievement and school performance suggested fewer deficits compared to their ADHD peers who did not eventually enroll. Adolescents with ADHD who eventually enrolled in PSE had consistently higher standardized achievement compared to their peers who did not eventually enroll. Only school performance clearly showed points of developmental divergence in middle school and high school, with some improvements evident for adolescents with ADHD histories who went on to PSE. By the end of high school, however, these adolescents still achieved poorer average performance than their non-ADHD peers who went on to PSE. These results reinforce a well-established need for equity in education (Ainscow, 2020) to ensure that students who would otherwise excel academically, and want to pursue PSE, are not disadvantaged by their disability. Lower educational attainment may explain the relation between ADHD-related deficits and lifelong financial functioning (Pelham III et al., 2020), highlighting the vast consequences of inequitable school performance. Based on the findings in the present study, interventions throughout middle and high school, and during the transition between, that are specifically targeted toward improving school performance, sustaining performance, and ensuring access to desired career paths may be critical.

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