The Changing Effects of an Early Childhood ADHD Diagnosis on Cognitive Development for Cohorts of Children Born across Three Decades

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Abstract

This study aims to determine if the effect of ADHD diagnosis on cognitive development has changed for children born in the early 2000s compared to those born in the early 1980s and whether the mechanisms linking diagnosis to cognition have changed for these birth cohorts. Using nationally-representative samples of youth surveyed in the National Longitudinal Study of Youth 1979-Children (NLSY-C), the Early Childhood Longitudinal Study-Kindergarten 1998 Study (ECLS-K 98), and the Early Childhood Longitudinal Study-Kindergarten 2011 (ECLS-K:2011), we employ OLS regression and matching techniques to test whether the effect of ADHD diagnosis in kindergarten or first grade on third grade cognition scores has changed across cohorts and whether the mechanisms linking ADHD diagnosis to cognition have shifted. Preliminary results indicate that the effect of ADHD diagnosis for subsequent cognition has declined across cohorts. Future analyses will explore whether and which mediating factors linking ADHD diagnosis to subsequent cognitive development have also shifted.

Introduction

Since 1980, the prevalance of diagnosed cases of attention deficit/hyperactivity disorder (ADHD) in childhood has risen by 200% (Olfson et al. 2003). Although diagnosed prevalence is lower in early-to-middle childhood compared to late childhood and adolescence, rates of ADHD diagnosis during the early schooling years have increased dramatically since 1980 (Boyle et al. 2011; Connor 2002; Hinshaw and Scheffler 2014). Children with ADHD symptoms often exhibit delayed literacy and numeracy skills and poorer performance later in school (Carroll et al. 2005; Spira and Fischel 2005; Steele et al. 2012). Although both diagnosed and undiagnosed children with ADHD symptoms may experience lower age- or grade-adjusted levels of literacy and numeracy than other children, children with an official ADHD *diagnosis* become eligible for special services in schools (e.g., special education, testing exemptions) and pharmacological prescriptions distinct from children with similar levels of ADHD symptoms who are not formally diagnosed with ADHD. While the negative consequences of ADHD *symptoms* have been documented in a number of populations, there has yet to be a systematic analysis of whether the effects of ADHD *diagnosis* in early childhood on later cognitive development has systematically changed across birth cohorts as diagnosed prevalence has skyrocketed since the 1980s. We also know little about whether the mechanisms linking ADHD diagnosis to later cognitive deficits have shifted alongside changes in diagnostic criteria and social expectations and treatment of behavior within families, schools, and the American medical system.

The question of cross-cohort changes since the 1980s in the effects of a childhood ADHD diagnosis on subsequent childhood cognitive development is of importance for health, education, and labor market researchers because appropriate early intervention through ADHD diagnosis, treatment, and social support may have tremendous corrective efficacy. Appropriate early identification and treatment within supportive family and school contexts may facilitate the development of higher cognitive and behavioral abilities and improved mental health for millions of children. Cognitive and behavioral skills and mental health are important for success in educational institutions and in the labor market (Cunha and Heckman 2007, 2010; Eisenberg et al. 2009; Fletcher 2014).

However, even with thorough evaluations, appropriate diagnoses, and comparable behavioral and/or pharmacological treatment, there is reason to suspect that diagnosed children may experience different treatment, school, and family contexts today compared to several decades ago. This may set them on different early post-diagnosis trajectories during a critical developmental period for determining child literacy and school readiness.

This study is, to the best of our knowledge, the first to investigate whether the effects of being diagnosed with ADHD for cognitive development have changed for cohorts of children born in the mid 1980s compared to those born in the mid 1990s and mid 2000s, and whether the role of two key mechanisms that may account for the lessening effect of an ADHD diagnosis on impaired cognitive development across birth cohorts since the 1980s. We investigate these questions using OLS regression and propensity score matching techniques. Matching techniques allow us to match children both within- and across-cohorts not only on a host of socioeconomic, health, and demographic characteristics, but also based on their manifestation of ADHD *symptoms* using behavioral measures collected *prior* to diagnosis that align closely with items used in the *Diagnostic and Statistical Manual of Mental Disorders*.[1] To gain some traction on the question of cross-cohort changes in the effects of an ADHD diagnosis, we leverage data from three longitudinal cohorts of children: the National Longitudinal Survey of Youth:1979 Children (NLSY-C), the Early Childhood Longitudinal Study-Kindergarten Cohort 1998 (ECLS-K), and the Early Childhood Longitudinal Study-Kindergarten Cohort 2011.

Research Questions and Hypotheses

Specifically, this paper seeks to answer two questions:

Question 1: Have the effects of an ADHD diagnosis in kindergarten or first grade on subsequent cognitive development changed for children born in the mid 1980s (between 1983 and 1986) compared to those born in the mid 1990s and the mid 2000s?

Hypothesis 1: With the expansion of ADHD diagnoses and the dissemination of efficacious treatments, we hypothesize that the negative effect of an ADHD diagnosis for subsequent cognitive development has declined across cohorts (i.e., an early-to-mid childhood ADHD diagnosis has become less debilitating for subsequent literacy and numeracy than in the 1980s).

Question 2: Have the mechanisms linking an ADHD diagnosis to impaired cognitive development changed between the 1980s, 2000s, and 2010s?

[1]See Currie and Stabile (2006) and Fletcher2014 for a discussion of this matching approach to generating more causal estimates of the effect of an ADHD diagnosis.

Hypothesis 2: Between the 1980s and 2010s, the rise of state high-stakes testing regimes and the expansion of pharmacological and behavioral treatments for ADHD help explain the less-negative effect of an ADHD diagnosis across cohorts of children born over the last three decades. Below we elaborate on each of these potential explanations in turn.

- **Expansion of State High-Stakes Testing Regimes:** Between cohorts born in the 1980s and the 2000s, there has been a rise in high stakes testing in schools (Hinshaw and Scheffler 2014). In the early 1980s very few states had any form of high stakes testing, and in those that did, testing took the form of high school graduation exams (Amrein and Berliner 2002). By 2002, 18 states had graduation exams, at least 48 states had implemented state-wide reading and mathematics assessments (tests were based at the local level for two states), eight states had promotion policies for students as young as elementary school, and 20 states had the power to sanction (close, reconstitute, or take over) low performing schools (Education Week 2002). By 2010, seven new states implemented graduation exams (for a total of 25 states with a graduation exam), 6 new states had introduced promotion exams (in comparison to just policies), and 12 new states implemented the power to sanction poor performing schools (for a total of 32 states) (Education Week 2010).

  This rise in high stakes testing has been associated with a rise in diagnosed ADHD prevalence (Hinshaw and Scheffler 2014).[2] For example, From 2003 to 2007, the rise in ADHD diagnoses was largest for children in states without prior accountability testing (Hinshaw and Scheffler 2014).

  In light of this rise in high-stakes testing and its association with ADHD diagnoses, we hypothesize that the increase in rates of childhood ADHD diagnosis have been characterized by an increase in diagnoses among children with both more- and less-extreme ADHD symptoms. With an increase in high-stakes testing, we expect that more children with high-levels of ADHD symptoms have become flagged for and diagnosed with ADHD because of their difficulties conforming to new pedagogical and testing regimes. In addition, we also hypothesize that more children with low levels of ADHD symptoms who under less-stringent testing regimes would not have otherwise been flagged for evaluation

[2] High-stakes tests are tests from which results are used to make significant educational decisions about schools, teachers, administrators, and students (Amrein and Berliner 2002).

and/or received an ADHD diagnosis are now diagnosed. As children with both more- and less-severe behavioral symptoms become diagnosed across cohorts, we anticipate that: 1) The variance in the range of symptoms of diagnosed children will increase and; 2) The rise in high-stakes testing helps account for the less-negative effect of an ADHD diagnosis on cognitive outcomes for cohorts born in the 1990s and 2000s compared to the 1980s.

- **Expansion of Pharmacological Treatments for ADHD:** Pharmacological treatments for ADHD have increased in both in number and in the rates with which they are consumed since the 1980s. Between the late 1980s and late 1990s, the use of stimulant medication in children grew 17%, and by 1996, 2.4% of all U.S. children were being treated with stimulant medication (Zuvekas and Vitiello 2012). At this time, Ritalin was prescribed to 90% of children medicated for ADHD (Wilens and Biederman 1992). Since 2000, there has been an increase in the numbers of medications available to treat ADHD, with approximately nine new drugs coming on the market (Zuvekas and Vitiello 2012). The numbers of children receiving stimulants reached approximately 3.5% by 2008 (Zuvekas and Vitiello 2012). We hypothesize that the increase in numbers of children receiving pharmacological treatments will help account for the less-negative effects of an ADHD diagnosis on cognitive outcomes for cohorts born in the 1990s and 2000s compared to the 1980s.

Data, Measures, and Methods

Data

To answer these questions, this study draws on three national samples of children followed from birth until at least age seven: the National Longitudinal Survey of Youth:1979 Children (NLSY-C), the Early Childhood Longitudinal Study-Kindergarten Cohort 1998 (ECLS-K), and the Early Childhood Longitudinal Study-Kindergarten Cohort 2011. Specifically, we use the restricted-use versions of each dataset (restricted-use license between Jenna Nobles (PI), University of Wisconsin-Madison and the Bureau of Labor Statistics (in the case of the NLSY-C) and the National Center for Education Statistics (for the ECLS-K:98 and ECLS-K:2011). [**Note to PAA session organizer: Please note that this extended abstract shows preliminary results from analysis conducted using the NLSY-C and the ECLS-K. However, we have gained access to the restricted-use ECLS-K:2011 dataset. By November 2014**

the second grade follow-up will be released to restricted-data users and we will be able to incorporate analysis from the K:2011 and present results from all three datasets in time for PAA 2015.]

The first data source is the National Longitudinal Survey of Youth (NLSY-C) 1979. We pool the subset of NLSY-C children born 1983-1986 for a sample of approximately 2,600 children, roughly 100 of whom are diagnosed with ADD/hyperactivity or ADHD (20 are diagnosed in Kindergarten or first grade). The 1993/94-born Early Childhood Longitudinal Study-1998 Kindergarten Cohort (ECLS-K:98) sample consists of approximately 9,800 children, roughly 525 of whom are diagnosed with ADHD (340 are diagnosed in Kindergarten or first grade). The 2005/06-born Early Childhood Longitudinal Study-2011 Kindergarten Cohort (ECLS-K:2011) sample consists of approximately 18,200 children, roughly 1,200 of whom are diagnosed with ADHD (roughly 500 are diagnosed in Kindergarten or first grade).

Measures

All three datasets have similar measures of the key outcomes – standardized literacy and numeracy test scores at ages 8-9 based on Item Response Theory. We also use as one of our dependent variables a combined "cognitive development" variable based on a summed index of both standardized literacy and numeracy test scores. All three datasets also contain the chief independent variable–ADD/hyperactivity or ADHD diagnosis by child age and grade based on maternal report of whether or not the child has been "diagnosed by a professional with this disorder" (a checklist of disorders/conditions is given) (see Morgan et al. (2013) for details on diagnosis items).

Another key variable in this study is ADHD symptoms. Following Currie and Stabile (2006), we use comparable items from the Behavior Problems Index in the NLSY-C and the Hyperactive/Impulsive and Approaches to Learning scales in the ECLS-K:98 and ECLS-K:2011 that align closely with diagnostic criteria in the DSM-IV to measure ADHD symptoms. ADHD symptoms are measured in quartiles based on within-cohort standardized average scores on questions asked about a child's impulsivity and approaches to learning in the ECLS-K and about a child's hyperactivity in the NLSY.[3] The symptoms measures are standardized within

[3] In sensitivity analyses, we will vary the measure of symptoms used to test the robustness of our conclusions to the choice of included items.

dataset in order to address issues of imperfect comparability across the measures. One of the key identification assumptions of our estimates of the effects of an ADHD diagnosis on cognitive development is that we match on/control for severity of ADHD symptoms measured prior to diagnosis.

Finally, all three datasets also contain important information on potential mediating factors: child state and school district in order to identify presence/type and year of implementation of state high-stakes testing regimes), subsequent school placement following ADHD diagnosis, home and care environment, and pharmacological and psychological treatment, and demographic and socioeconomic controls (child race, early health, and parental education and income). These include child's early health (child born above or at/below 5.5 lbs), family structure (living with biological father, other father or no father in household), child insurance status (child covered by insurance at kindergarten or first grade or not), maternal education (less than high school, high school graduate, some college, 4 year college grad), and income (above or at/below the federal poverty line. Controls are constructed to be identical or very comparable across studies. More information on these covariates is provided in Table 1.

Methods

Given that the specific factors (including the severity of ADHD symptoms) that select a child into an ADHD diagnosis may vary across children and across cohorts, we compare the effects of ADHD diagnosis for children born in the 1980s vs. the 1990s (and, in analyses forthcoming, the 1990s vs. 2000s) using two approaches: nearest neighbor propensity score matching and OLS regression. We match on/control for ADHD symptoms. We rely on propensity score matching to primarily answer our first two research questions, whether there are cohort differences in the effects of an ADHD diagnosis in Kindergarten or first grade on early literacy and numeracy, and whether these differences have been changing across cohorts.

To investigate our first question, we pool observations across samples. Our dependent variable is a measure for cognitive development. We first estimate a series of OLS regressions. In addition to estimating the main effects indicators for an ADHD diagnosis and for the 1993-94 (ECLS-K:98) birth cohorts, we also estimate an interaction term between the two (diagnosis*1993-94 birth cohorts) in order to investigate if there has been a change in the average effect of an ADHD diagnosis across the mid-1980s and mid-1990s birth cohorts. A significant interaction term would suggest that the effect of ADHD has changed over across cohorts. Our second through fourth OLS models incrementally add controls for demographic characteristics, then early life factors of the child, and finally controls for ADHD symptomology measured near the time a child was diagnosed with ADHD.

In order to approach a more causal estimate of the effect of an ADHD diagnosis within and then across cohorts, we supplement our OLS regression analysis with a matching exercise. Specifically, we use propensity score matching with nearest neighbor estimation to match diagnosed and undiagnosed cases within cohorts to obtain an effect of ADHD diagnosis on cognitive outcomes. Next, we match across cohorts again based on the propensity score to determine whether there is a difference in treatment across time for matched pairs.

With nearest neighbor propensity score matching, we control for (cohort differences in) selection into ADHD diagnosis by matching children on observed characteristics and then comparing children across diagnostic status and birth cohort. In doing so we are able to identify overlap in the distributions of observed factors between same-cohort children diagnosed with ADHD and those not diagnosed. Across-cohort matching allows us to identify whether the effect of diagnosis is changing across cohorts as overall ADHD prevalence has risen.

As a sensitivity check, we compare results from the propensity score matching to results from an ordinary least squares difference in difference regression model. If we reach significantly different conclusions across these two methods, this may suggest that unobserved selection affects our estimates.

To address our second research question, we again rely on regression analysis but this time we sequentially add into our controlled model a series of mediators related to prevalence of state high-stakes testing and children's use of pharmacological treatments (described above). We examine whether rising levels of these mediators help explain the differential effect of an ADHD diagnosis for the 1990s vs. 1980s birth cohorts (i.e., whether they diminish the magnitude of the interaction between an ADHD diagnosis and 1990s birth cohort).

Preliminary Results

Table 1 shows means and standard deviations on all variables in the current analyses by diagnosis status and birth cohorts. Table 1 and Figure 1 show that, among diagnosed children, descriptively we see that diagnosed children from the 1993-94 birth cohorts have a wider dispersion of ADHD symptoms than diagnosed children in the 1983-86 cohorts. That is, a larger proportion of diagnosed children fall in the bottom and top quartiles of the ADHD symptoms distribution in the 1993-94 cohorts compared to the 1983-86 cohorts (whereas the same is not true for *undiagnosed* children across cohorts). Roughly 5% of diagnosed children fall in the lowest quartile of symptoms scores in the 1993-94 cohorts, compared to no children from the 1983-86 cohorts. Figure 2 (and Table 1) shows the distribution of or our dependent variables - standardized third grade reading and math cognition test scores. We see that diagnosed children have lower test scores in both cohorts, but that scores appear, at least descriptively, lower for diagnosed children in the 1983-86 compared to the 1993-94 cohorts. A larger proportion of diagnosed children are born to college-educated mothers in the 1993-94 cohorts compared to the 1983-86 cohorts and are white. A larger share of diagnosed children in the 1983-86 cohorts are black than in the 1993-94 cohorts. The overwhelming majority of diagnosed children in both cohorts are male.

[TABLE 1 HERE]

[FIGURES 1 and 2 HERE]

Preliminary results shown in the uncontrolled model (1) of Table 2 suggest that an ADHD diagnosis is associated on average with a nearly one standard deviation decrease on cognitive development measured by averaged standardized third grade reading and math test scores. The interaction term suggests that the negative effect of an ADHD diagnosis on cognitive development has diminished significantly between cohorts born in the mid-1980s vs. the mid-1990s. For the mid-1990s cohorts, the average negative effect of an ADHD diagnosis is almost half as large (approximately one standard deviation). This effect remains robust to the addition of controls, except for family structure. Broadly, the comparison of effect sizes of an ADHD diagnosis between OLS and propensity score matching estimates shown in Table 3 show that the differential effect across cohorts remains when using propensity score matching.

[TABLE 3 HERE]

Subsequent analyses will introduce the ECLS-K:2011 sample to test for changes in the effects of an ADHD diagnosis across cohorts born in the 2000s in addition to the 1980s and 1990s. We will also examine the whether the mediating factors discussed in hypothesis two help account for changes across cohorts in the effects of an early childhood ADHD diagnosis on subsequent cognitive development.

Discussion

Amid a 200% increase in the prevalence of diagnosed ADHD in childhood, ADHD has become the most commonly-diagnosed childhood disorder. Scholars, policy makers and educators know surprisingly little about whether and how an early childhood ADHD diagnosis affects subsequent cognitive development during the critical years of foundational skill-building, whether this effect has changed across cohorts as diagnosed prevalence of ADHD has increased dramatically, and if so, why. This paper sets out to begin to investigate these questions using three national, longitudinal datasets of children. In doing so, this study aims to contribute empirical evidence at a time during which there is heightened social and policy awareness of the importance of early childhood behavioral and cognitive development for long-term educational and labor market outcomes. Policy makers have increased monetary investments in early childhood education in hopes that investing in children's development during the early years will offer lifecycle returns for decades to come (Angrist et al. 2010; Shonkoff and Phillips 2000). By extension, findings carry implications also for marriage markets, family stability, and intergenerational inequality (Alexander et al. 1997; Heckman et al. 2006).

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Table 1: Descriptive Statistics

	Diagnosed with ADHD				Undiagnosed with ADHD			
	83-86 Birth Cohorts (NLSY-C) (N=20)		93-94 Birth Cohorts (ECLS-K) (N=340)		83-86 Birth Cohorts (NLSY-C) (N=1840)		93-94 Birth Cohorts (ECLS-K) (N=12740)	
Variable	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Child ADHD/ADD Symptoms								
1 Quartile of Symptoms	0.000	0.000	0.049	0.217	0.232	0.422	0.255	0.436
2 Quartile of Symptoms	0.200	0.414	0.103	0.304	0.417	0.493	0.311	0.463
3 Quartile of Symptoms	0.267	0.458	0.107	0.310	0.174	0.379	0.202	0.401
4 Quartile of Symptoms	0.533	0.516	0.741	0.439	0.168	0.374	0.201	0.400
Child Test Scores								
Standardized Cognition Scores 3rd Grade	-0.669	1.156	-0.467	1.049	-0.057	0.963	0.083	0.978
Standardized Reading Scores 3rd Grade	-0.513	1.186	-0.451	1.057	-0.022	0.969	0.087	0.978
Standardized Math Scores 3rd Grade	-0.453	1.266	-0.395	1.057	-0.049	0.903	0.081	0.968
Maternal Characteristics								
Age at Child Birth	23.333	2.795	27.336	6.809	23.523	2.505	28.212	6.071
Less Than High School	0.133	0.352	0.103	0.304	0.092	0.289	0.114	0.317
HS Education	0.333	0.488	0.412	0.493	0.450	0.498	0.346	0.476
Completed Some College	0.467	0.516	0.284	0.452	0.307	0.461	0.278	0.448
Completed Four Year College Degree	0.067	0.258	0.202	0.402	0.152	0.359	0.262	0.440
White	0.667	0.488	0.798	0.402	0.473	0.500	0.679	0.467
Black	0.267	0.458	0.091	0.288	0.327	0.469	0.130	0.336
Hispanic	0.067	0.258	0.111	0.315	0.200	0.400	0.191	0.393
Other Child Characteristics								
Child Born Weighing Less than 5.5 lbs	0.000	0.000	0.123	0.330	0.071	0.257	0.099	0.299
Male	0.933	0.258	0.720	0.450	0.471	0.499	0.497	0.500
Early Care Environment								
Child Been in Childcare Outside Home	0.533	0.516	0.543	0.499	0.461	0.499	0.497	0.500

Table 2: OLS Estimates of the Effects of ADHD Diagnosis on Averaged Standardized Reading and Math Test Scores

	(1) No Controls	(2) Demographics	(3) Early Conditions	(4) ADHD Symptoms
ADHD Diagnosis	-0.970***	-1.039***	-0.992***	-0.853***
	(0.213)	(0.184)	(0.195)	(0.194)
93-94 Birth Cohort (K-98)	0.106***	-0.0792**	-0.123***	-0.0975***
	(0.0265)	(0.0243)	(0.0263)	(0.0264)
ADHD Diagnosis	0.434*	0.449*	0.443*	0.465*
*93-94 Birth Cohort (interaction)	(0.220)	(0.192)	(0.203)	(0.201)
Mother Completed HS		0.487***	0.374***	0.350***
(ref Less than HS)		(0.0269)	(0.0294)	(0.0292)
Mother Completed Some College		0.763***	0.605***	0.566***
(ref Less than HS)		(0.0282)	(0.0312)	(0.0311)
Mother Completed Four Year		1.118***	0.937***	0.883***
College Degree(ref Less than HS)		(0.0301)	(0.0334)	(0.0333)
Mother Age at Child Birth		0.00643***	0.00691***	0.00602***
		(0.00140)	(0.00148)	(0.00147)
Mother White		0.669***	0.560***	0.525***
		(0.0225)	(0.0246)	(0.0245)
Mother Hispanic		0.316***	0.278***	0.257***
		(0.0264)	(0.0282)	(0.0280)
Child Covered by			0.125***	0.142***
Insurance K-1st Grade			(0.0274)	(0.0272)
HH Income Below Federal			-0.298***	-0.283***
Poverty Line K-1st Grade			(0.0242)	(0.0240)
Birthweight Less than 5.5 lbs			-0.134***	-0.124***
			(0.0273)	(0.0270)
Male			-0.00220	0.0285
			(0.0160)	(0.0160)
Child Been in Childcare			-0.0676***	-0.0570***
Outside Home by K-1st Grade			(0.0165)	(0.0163)
Number of Other Children			-0.0553***	-0.0566***
in HH K-1st Grade			(0.00770)	(0.00763)
2 Quartile of Symptoms				-0.0673**
				(0.0217)
3 Quartile of Symptoms				-0.177***
				(0.0216)
4 Quartile of Symptoms				-0.342***
				(0.0240)
Constant	-0.0815**	-1.217***	-0.902***	-0.754***
	(0.0249)	(0.0456)	(0.0582)	(0.0592)
Observations	13810	12080	11150	11150

Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 3: Cross Cohort OLS and Propensity Score Matches Compared

	(1) Cog OLS–83-86 Birth Cohort	(2) Cog OLS–93-94 Birth Cohort	(3) Cog Psmatch–83-86 Birth Cohort	(4) Cog Psmatch–93-94 Birth Cohort
ADHD Diagnosis	-0.718***	-0.404***	-1.202***	-0.363***
	(0.194)	(0.0550)	(0.237)	(0.0893)
Observations	1390	9980	1390	9980

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4: Sensitivity Analysis OLS Symptoms Measured in Kindergarten, Diagnosis Occurred at First Grade 93-94 Birth Cohort

	(1) Cognition	(2) Reading	(3) Math
ADHD Diagnosis	-0.487***	-0.423***	-0.512***
	(0.0675)	(0.0684)	(0.0683)
Child Covered by Insurance K-1st Grade	0.112*** (0.0295)	0.122*** (0.0298)	0.0882** (0.0300)
Mother Completed HS (ref Less than HS)	0.325*** (0.0311)	0.334*** (0.0315)	0.265*** (0.0317)
Mother Completed Some College (ref Less than HS)	0.545*** (0.0333)	0.526*** (0.0337)	0.482*** (0.0340)
Mother Completed Four Year College Degree (ref Less than HS)	0.866*** (0.0354)	0.831*** (0.0359)	0.770*** (0.0362)
Mother Age at Child Birth	0.00575***	0.00604***	0.00468**
	(0.00149)	(0.00151)	(0.00152)
Birthweight Less than 5.5 lbs	-0.102*** (0.0282)	-0.0368 (0.0286)	-0.152*** (0.0288)
Male	0.0520**	-0.142***	0.230***
	(0.0170)	(0.0172)	(0.0174)
Number of Other Children in HH K-1st Grade	-0.0489*** (0.00806)	-0.0684*** (0.00817)	-0.0242** (0.00822)
Child Been in Childcare Outside Home by K-1st Grade	-0.0509** (0.0174)	-0.0488** (0.0176)	-0.0427* (0.0178)
HH Income Below Federal Poverty Line K-1st Grade	-0.294*** (0.0266)	-0.295*** (0.0270)	-0.256*** (0.0272)
2 Quartile of Symptoms	-0.132***	-0.105***	-0.142***
	(0.0218)	(0.0221)	(0.0224)
3 Quartile of Symptoms	-0.185***	-0.172***	-0.170***
	(0.0250)	(0.0253)	(0.0256)
4 Quartile of Symptoms	-0.386***	-0.357***	-0.364***
	(0.0252)	(0.0255)	(0.0257)
Mother Black	-0.553***	-0.464***	-0.561***
	(0.0273)	(0.0277)	(0.0278)
Mother Hispanic	-0.278***	-0.284***	-0.228***
	(0.0240)	(0.0243)	(0.0245)
Constant	-0.264***	-0.176**	-0.299***
	(0.0587)	(0.0595)	(0.0599)
Observations	9740	9750	9790

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Figure 1: ADHD Symptoms in Kindergarten or 1st Grade by ADHD Diagnosis

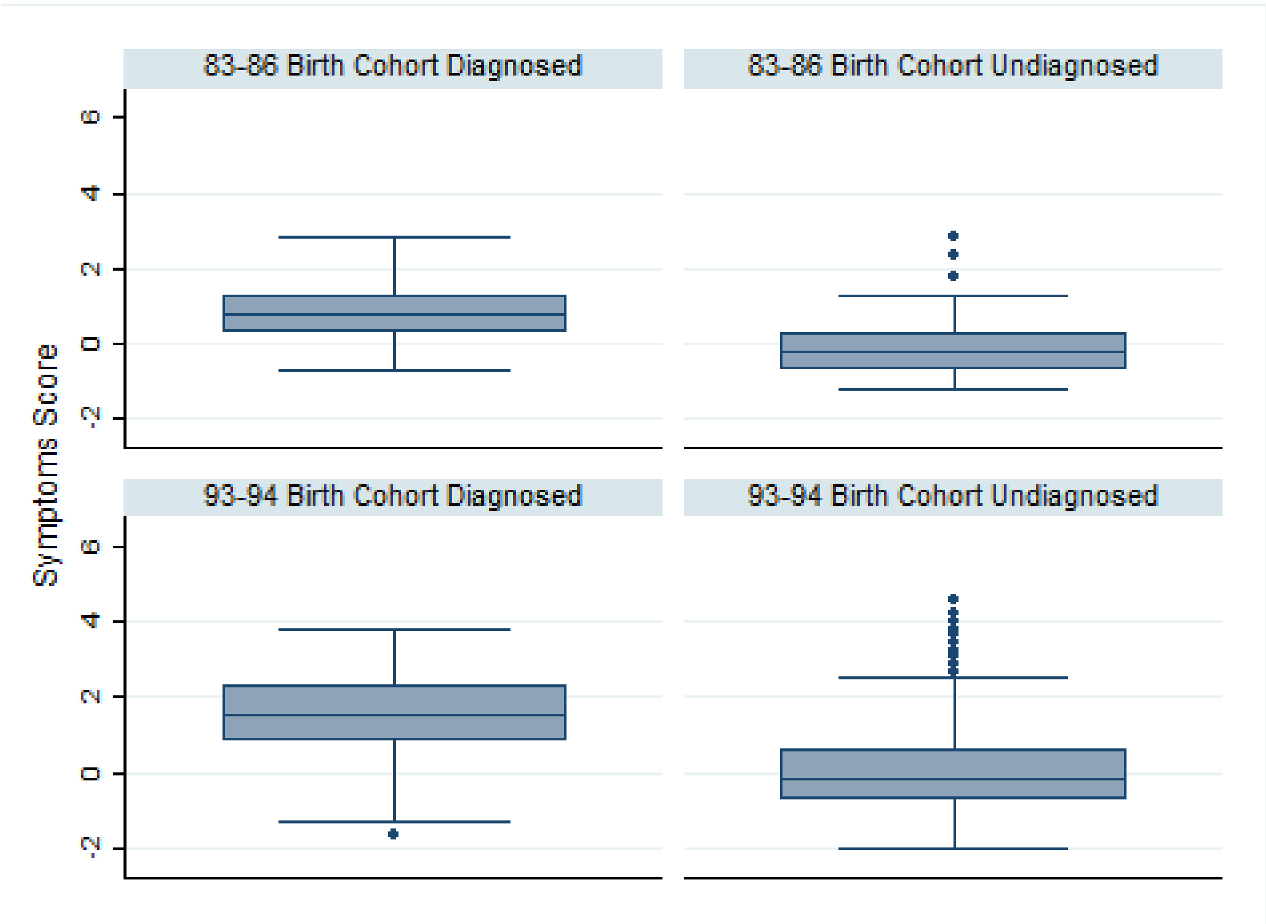

Figure 2: Cognition Scores in Third Grade by ADHD Diagnosis