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Examining the Validity of ADHD as a Diagnosis for Adolescents with Intellectual Disabilities: Clinical Presentation

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Abstract Children with intellectual and developmental disabilities are at heightened risk for mental disorders. Using current diagnostic criteria, disruptive behavior disorders, specifically Attention-Deficit/Hyperactivity Disorder (ADHD), appear to be the most prevalent co-occurring disorders. However, the validity of ADHD as a diagnosis for children and adolescents with intellectual disabilities remains unclear. The present study examined the clinical presentation of ADHD (prevalence, sex differences, and comorbidity) among adolescents with and without intellectual disability (ID) as well as investigated the validity of ADHD for adolescents with ID by examining similarities in terms of symptom presentation, developmental course, and associated functional impairment. The sample included 142 adolescents and their families, about a third of whom were classified in the ID group and the remaining were in the typically developing (TD) group. Findings indicated that adolescents with ID continue to be at elevated risk for ADHD (risk ratio: 3.38:1) compared to their typically developing peers. Additionally, the presentation of ADHD appeared similar among adolescents with and without ID, supporting the validity of an ADHD diagnosis for this population of adolescents. Implications for public policy and intervention are discussed.

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Introduction

Children and adolescents with intellectual disabilities (ID, i.e., mental retardation) are at heightened risk for psychopathology. Research shows that children with ID are at least three times as likely to have a mental disorder than typically developing children, and the most common mental disorder appears to be Attention-Deficit/Hyperactivity Disorder (ADHD) (Baker et al. 2010; Dekker et al. 2002; deRuiter et al. 2008; Emerson and Hatton 2007; Neece et al. 2011). However, debate ensues as to the validity of a mental disorder diagnosis among people with ID. The primary goal of the current study was to examine whether ADHD is a valid diagnosis for adolescents with moderate to borderline ID.

ADHD and Intellectual Disability

Among children and adolescents, epidemiological studies have reported clinically significant emotional and behavior problems and/or diagnosable mental disorders in a third to a half of cases (Dekker and Koot 2003; Emerson and Einfeld 2010). When investigators have included a comparison group with typical cognitive development (TD), about two and a half to over four times as many children with ID had serious behavior/emotional problems as those with typical cognitive development (Dekker, et al. 2002; deRuiter et al. 2008; Emerson et al. 2010). Studies that examine specific diagnoses in youth with ID generally find that disruptive behavior disorders are the most common comorbid diagnoses (Dekker and Koot 2003; Emerson and Hatton 2007).

Analyses with a sample of 5-year-old children showed that every disorder assessed was more prevalent in the developmental delayed group than the TD group and that the percent of children meeting criteria for ADHD most highly differentiated the two groups (risk ratio 3.21 to 1; Baker et al. 2010). A follow-up study extended these findings across development and found that children with ID continued to be at significantly higher risk for meeting ADHD diagnostic criteria at ages 6, 7, and 8 as well (Risk ratios ranged from 3.10:1 to 4.07:1; Neece, et al. 2011).

The heightened prevalence estimates of mental disorder in youth with ID may actually be an underestimate of the true prevalence. The diagnosis of ID may sometimes obscure mental health problems that would be diagnosed in a TD individual. This "diagnostic overshadowing" occurs when problematic behaviors are attributed to limited cognitive functioning without further assessment, diagnosis, or treatment of other comorbid diagnoses (Jopp and Keys 2001; Reiss and Szyszko 1983).

Although there is evidence that the prevalence of ADHD is elevated in children and adolescents with ID, questions remain about the validity of an ADHD diagnosis for this population. A meta-analysis by Frazier et al. (2004) of TD samples found that children with ADHD generally had an IQ nine points lower than children without ADHD. However, while ADHD can lower IQ test performance, it is not presumed to be the cause of intellectual disabilities. The reverse is less clear because many ADHD symptoms (e.g., inattentiveness, overactive/impulsive behavior) are characteristic of individuals with low cognitive functioning, and, therefore, some have argued that a diagnosis of ADHD in children and adolescents with ID is simply a misclassification of symptoms of the intellectual deficit rather than a distinct and separate co-occurring disorder (Gjaerum and Bjornerem 2003; Reiss and Valenti-Hein 1994; Tonge et al. 1996). One critical problem in this area of research is that the base rate of inattention and hyperactive-impulsive symptoms among children and adolescents with ID has not been established and, therefore, the extent to which the symptoms of ADHD are intrinsic to ID is not clear. Thus, we do not know whether ADHD symptoms among adolescents with ID are solely an expression of impairments in intellectual functioning or whether ADHD is a separate construct that accounts for variability in outcomes above and beyond the youth's cognitive abilities.

The Validation Study

A groundbreaking paper by Robins and Guze (1970) described a method for achieving diagnostic validity in psychiatric illnesses consisting of five phases: clinical descriptions, laboratory findings, exclusion of other disorders, follow-up study, and family study. Over the years researchers have expanded Robins and Guze's ideas and suggested that a psychiatric disorder is considered valid when a consistent pattern of data emerges in several domains; including clinical correlates (e.g., behavioral phenotypes), family history, developmental course, and treatment response (Antshel et al. 2006). Thus, consistent with the methodology outlined in Robins and Guze (1970) and more recent papers, we looked at the patterns of data across multiple domains associated with ADHD, focusing on the similarities and differences among adolescents with and without ID. In an attempt to understand the validity of ADHD among adolescents with ID, it is important to examine whether the core symptoms present in similar ways among youth with and without ID. Toward this aim, this paper examined the descriptive characteristics of ADHD among adolescents with and without ID. More specifically, we investigated (1) whether the prevalence of psychopathology, and ADHD specifically, differs in adolescents with ID vs. TD, including differences in sex and comorbidity; and (2) whether ADHD is the same disorder among adolescents with ID and typically developing youth.

Prevalence

As noted, the prevalence of ADHD in youth with ID is 2.5 to 4 times higher than in youth with TD. Dekker and Koot (2003), for example, found the prevalence of ADHD among youth with ID to be about 14 %, which is about three times the prevalence of ADHD in typically developing youth (3–5 %; American Psychiatric Association 2000). They were one of the few research teams to differentiate the prevalence of ADHD by subtype. In their sample of 474 6–18 year old children with ID, the inattentive subtype was most prevalent, followed by the combined type, and finally the hyperactive-impulsive subtype. Similar findings were reported at ages 5 through 8 years in a separate sample of children with mild to moderate ID (Baker et al. 2010; Neece et al. 2011). The current study builds upon this research by examining the prevalence of ADHD and its subtypes in a sample of same-age adolescents with ID, as well as a comparison group of adolescents without ID.

Sex Differences

Among typically developing populations, ADHD is diagnosed more often in males than females. According to the DSM-IV, the male-to-female ratios range from 4:1 (general population) to 9:1 (clinic settings) (American Psychiatric Association 2000). However other studies have found smaller ratios and the sex differences appear to decrease over time (Kessler et al. 2006). Some researchers have attributed the difference in odds ratios to the later onset of ADHD in girls, the stronger presence of the Inattentive

subtype in females, and to the fact that the criteria for ADHD were developed largely on samples of boys.

Studies of youth with intellectual disabilities have been inconsistent as to whether sex differences in the prevalence of ADHD are found (Einfeld et al. 2010; Hastings et al. 2005). Hastings and his colleagues found that boys were rated as having more symptoms on one measure of hyperactivity, but no sex differences were found on a measure of attention or a second hyperactivity measure. Likewise, no sex differences were found in the prevalence of ADHD in the sample of five to eight-year-olds studied by Baker et al. (2010) and Neece et al. (2011). This variability suggests that sex differences may prove to be one way that ADHD in ID differs from ADHD in typically developing youth.

Comorbidity

Youth with ADHD often have more than one psychiatric disorder. Among those in the large scale Multimodal Treatment Study of Children with ADHD (MTA) only 31.8 % had ADHD alone; the majority of children meeting diagnostic criteria for ADHD also met criteria for at least one other disorder, most often Oppositional Defiant Disorder (ODD: 39.9 %) (Jensen et al. 2001). However, other diagnoses were also comorbid with ADHD including anxiety (38.7 %), conduct disorder (14.3 %), and affective disorder (3.8 %).

Comorbidity among children with ADHD and ID has rarely been examined. Simonoff et al. (2006) found that children with ADHD/ID tended to have higher emotional symptom scores compared to those with ADHD but no ID, but the groups did not differ on conduct problems or social communication problems. Baker et al. (2010) and Neece et al. (2011) reported that children with ID experienced significantly elevated rates of comorbid disorders in middle childhood compared to TD children, with ADHD and ODD being the two most common co-occurring disorders. In the present study we examined co-occurring DSM-IV disorders among adolescents with ADHD and ID vs. ADHD alone.

Symptom Picture

ADHD is a heterogeneous condition. Individuals can obtain the same ADHD symptom count with very different symptom patterns, all of which result in the same diagnosis. Studies generally find two factors for ADHD symptoms, designated as the inattentive-disorganized factor and the hyperactive-impulsive factor (Lubke et al. 2007). However, virtually no study has investigated of the patterns of ADHD symptoms in youth with ID. Simonoff et al. (2006) found that the relative endorsement of inattention, over activity, and impulsivity on a questionnaire did not differ for adolescents with or without mild ID. Baker et al. (2010) and Neece et al. (2011) reported similar findings in their longitudinal study of children across ages 5–8 years. The present study examined the patterns of DSM-IV ADHD symptoms among adolescents with and without ID, and also investigated whether the two-factor measurement model of ADHD symptoms that has been supported in typically developing samples (Lubke et al. 2007) would replicate in a sample of adolescents with ID.

Developmental Course

The developmental course of ADHD appears to vary by subtype. Hyperactivity/impulsivity is generally more pronounced in preschool and tends to decline with time. In contrast, problems with inattention tend to emerge later in development (typically between ages 8 and 12 years) and become more pronounced with age as peers undergo rapid maturation of the prefrontal cortical structures and accompanying cognitive abilities at the same time that school demands intensify (Applegate et al. 1997; Willoughby 2003). Although there are symptom changes across development, many children with ADHD have some form of impairment persisting into adulthood (Faraone et al. 2006).

Very few studies have examined the developmental course of ADHD in children with ID. However, limited evidence suggests that the symptoms of ADHD may persist longer in this population (Xenitidis et al. 2010). Peterson et al. (2001) found that adolescent IQ significantly predicted the presence of ADHD in adulthood. This suggests that continuity of symptoms over time may be related to intellectual functioning, placing children and adolescents with ID at risk for more persistent symptoms across development. Trajectories of ADHD inattentive and hyperactive/impulsive symptoms across middle childhood (ages 5 to 8 years) have been found to be similar in children with and without ID (Neece et al. 2011). The current study extends the analysis of developmental course of ADHD symptoms from childhood into early adolescence (ages 5 to 13 years).

Impairment

To meet DSM-IV criteria for ADHD, Criterion D states that the child or adolescent must have some evidence of clinically significant impairment in social, academic, or occupational functioning (APA 2000). Thus, it is not enough for the child to have clinical levels of inattention and/or hyperactive/impulsive symptoms, as these symptoms also must interfere with the child's daily life and overall functioning. Children with ADHD have been found to have more impairment across a variety of domains including behavioral functioning (Harvey et al. 2009), social functioning (Gresham et al. 1998), academic functioning (Barkley et al. 1990), family functioning (Johnston and Mash 2001), and health outcomes (Biederman et al. 1994; Szatmari et al. 1989).

Little is known about functional impairment experienced by children and adolescents with ADHD and ID. Stein et al. (1995) compared children with ADHD (mean IQ=101) to children with mild ID on measures of adaptive behavior. They found that the ADHD group had a mean Vineland Adaptive Behavior Scale (Sparrow et al. 2005) composite score of 73, which was well below what would be expected given their level of intellectual functioning. Additionally, the ADHD and mild ID groups were not significantly different from each other in terms of adaptive behavior (communication, daily living, and socialization domains). Many studies have found that co-occurring ADHD increases the impairment of children with other psychiatric disorders including obsessive-compulsive disorder (Geller et al. 2003), depression (Birmaher et al. 1996), and Tourette's syndrome (Carter et al. 2000). However, no study to the authors' knowledge has examined whether comorbid ADHD and ID results in greater functional impairment than either diagnosis alone, a finding that will advance the validation of ADHD as a diagnosis for children and adolescents with ID. If ADHD in the presence of ID is simply an expression of the ID then one would not expect ADHD diagnosis to explain variance in the youth's impairment over and above his/her intellectual functioning. Conversely, if ADHD is a valid comorbid condition among children with ID, one would expect ADHD diagnosis to account for variance in the level of impairment independent of cognitive functioning.

The Current Study

The aims of the present study were (1) to characterize the clinical presentation of ADHD in adolescents with and without ID and (2) to further understand the validity of ADHD as a diagnosis for adolescents with ID. Toward the first aim, the following hypotheses were investigated: (1) The *prevalence* of all mental disorders assessed will be higher in the ID group compared to the TD group, and ADHD will be the disorder that most differentiates the two groups; (2) there will not be *sex differences* in ADHD rates in the ID group; (3) rates of *comorbidity*, especially with ODD, among adolescents with ADHD and ID will be higher compared to adolescents with ADHD and no ID. Toward the second aim we hypothesized that (4) the *symptom picture* will be similar among adolescents with comorbid ADHD and ID and adolescents with ADHD alone, and the factor structure of ADHD symptoms will be similar among adolescents with and without ID; (5) the *developmental course* will show that adolescents with ID and ADHD have higher levels of ADHD symptoms across time, but the trajectory of ADHD symptoms will be similar for adolescents with ID and typically developing adolescents; and (6) ADHD symptoms and diagnosis will predict parent reports of adolescent *functional impairment*, independent of the child's intellectual functioning.

Method

Participants

Participants were 142 families of youth aged 13 years. They were participating in a longitudinal study of young children, with samples drawn from Southern California (87.3 %) and Central Pennsylvania (12.7 %). Most families (75.3 %, n=107) had been recruited 10 years earlier, with the intake assessment conducted near the child's 3rd birthday. Another 7 families of children with ID entered the study at child age 5 years. Additionally, 19 families of TD adolescents and nine families of adolescents with ID entered the study at child age 13 years. There were no significant differences in demographic characteristics based on geographic region or cohort.

Youth in the ID group were recruited through agencies that provide services for people with developmental disabilities and, more recently, through schools. In California, practically all families with children with intellectual and developmental disabilities register for services with one of a network of Regional Centers. Youth in the TD group were initially recruited though pre-schools and day-care programs and later through middle schools. For all recruitment, school and agency personnel mailed brochures describing the study to families who met selection criteria. Interested parents phoned the research center to obtain information about the study and, if interested, to set up an initial home visit.

Based on a prorated (three subscales) WISC-IV Full Scale IQ Score (Wechsler 2003) at age 13 years, adolescents were classified as intellectual disability (ID, IQ 70 or lower, n=30), or borderline intellectual functioning (BIF, IQ 7184, n=12) if their scores on the Vineland Adaptive Behavior Scales were also below 85 (VABS, Sparrow et al. 2005). Children were classified as typically developing (TD) if their IQ was 85 or higher (n=100). There were no significant differences in demographic characteristics between the ID and Borderline groups. Additionally, there were no differences in the rates of psychopathology between the ID and Borderline groups for any of the diagnoses assessed. Thus, because the ID and Borderline groups did not differ on any demographic variable or on prevalence of the mental disorders assessed, these two groups were combined in subsequent analyses in order to increase statistical power. For the remainder of the paper, the "ID" group (n=42) includes the children who met criteria for intellectual disability as well as borderline intellectual functioning.

Additionally, exclusion criteria for all sub-samples included adolescents who were non-ambulatory, had severe neuro-impairment, had a diagnosis of Fragile X or autism, or had another disability that would affect their ability to fully participate in the procedures described below. The inclusion criterion for the ADHD group was that adolescent met diagnostic criteria for one or more subtypes of ADHD on the

Diagnostic Interview Schedule for Children. Adolescents who did not meet this criterion were included in the non-ADHD group. Within the ID group, 43.3 % (n=13) met criteria for ADHD while 56.7 % (n=17) did not meet criteria.

Table 1 shows demographic characteristics at child age 13 years, by intellectual group status (ID, Borderline, and TD). In the combined sample there were slightly more boys than girls (52.8 % boys) and 54.2 % of the youth were white non-Hispanic, with others divided among Hispanic (16.9 %), African American (9.9 %), Asian American (2.1 %) and other or mixed (16.9 %). Recruitment had initially focused on intact families, so 71.4 % of participants were married. Sixty-nine percent of families had an annual income above $50,000 in 2009–2010, and the average years of schooling was 3 years of college for mothers and fathers. The status groups did not differ on child gender, mother marital status, and family income. However, in the TD sample mothers and fathers completed significantly more years of education and mothers were more likely to be white non-Hispanic compared to mothers of children with ID. These variables were included as covariates when indicated (see Data Analytic Plan).

Procedures

The present study primarily used data collected when the adolescents were 13 years old. The Institutional Review Boards of the participating universities approved all study methods. Parents typically completed a battery of questionnaires independently prior to the laboratory visit; however, if parents had not completed their packet of questionnaires particular key measures were completed at the center visit. During a center assessment session, measures were taken of family demographics (interview with mother), adolescent intelligence (WISC-IV), adolescent adaptive behavior (Vineland), and adolescent mental health (DISC interview with mother). The mental health measure had also been administered previously for children in the continuing sample, at ages 5, 6, 7, 8, and 9 years. Prior to the assessment, mothers were asked to take their children off psychostimulant medication if they were comfortable with doing so. Two youth remained on stimulant medication during the center assessment session.

Measures

Wechsler Intelligence Scale for Children – Fourth Edition (WISC–IV; Wechsler 2003) Full Scale IQ (FSIQ) was estimated using three subtests of the WISC-IV (Vocabulary, Matrix Reasoning, and Arithmetic). This score has a mean of 100 and a standard deviation of 15. Sattler and Durmont (2004) reported that this prorated IQ correlated highly (r=.91) with the FSIQ from the full WISC-IV administration. While they did not specify whether this correlation was consistent across all levels of cognitive functioning, their normative sample included a substantial number of children with mild and moderate ID, learning disabilities, ADHD, and other childhood disorders.

Vineland Scales of Adaptive Behavior-II (VABS; Sparrow, et al. 2005) The Vineland is a commonly-used semi-structured interview that asks caregivers to report on adaptive behaviors that their children usually do. The Adaptive Behavior Composite score, comprised of three subscales: *communication*, *daily living skills*, and *socialization*, was used, which, like the FSIQ, has a mean of 100 and a standard deviation of 15. The VABS has good reliability (alphas in the low 80s for most subscales) and validity (Sparrow et al. 2005).

Diagnostic Interview Schedule for Children (DISC; Costello et al. 1985) The DISC was administered to mothers to determine the presence of mental disorders in the youth.

Table 1 Demographics characteristics at child age 13 years

	ID n=42	TD n=100	χ^2or t	Effect size (Cohen's d or odds ratio)
Children				
Gender (% boys)	55.0	52.0	χ^2=0.02	OR=1.13
Race (% Caucasian)	42.5	59.2	χ^2=2.55	OR=0.51
WISC IQ (SD)	62.8 (12.1)	109.0 (11.7)	t=21.07***	d=3.88
VABS adaptive behavior (SD)	73.5 (11.8)	95.8 (10.1)	t=11.67***	d=2.03
Parent and family				
Marital status (% married)	62.5	75.5	χ^2=1.77	OR=0.54
Mother's race (% Caucasian)	45.5	65.3	χ^2=4.05*	OR=0.44
Mother's education (M. grade)	14.7 (2.5)	16.0 (2.4)	t=2.87**	d=0.53
Family income (%>$50 K)	57.5	76.5	χ^2=4.12*	OR=0.42
Father's education (M. grade)	14.0 (3.1)	15.8 (2.8)	t=3.06**	d=0.61

†p<.10. *p<.05. **p<.01. ***p<.001

The DISC is a highly structured diagnostic interview covering current DSM-IV criteria for child psychiatric disorders. Respondents are asked about the presence of symptoms that fall under the major diagnostic categories including ADHD. The DISC has undergone extensive testing, refinement and revision (Shaffer et al. 1993) and has achieved acceptable levels of reliability (Edelbrock and Costello 1988). The DISC had been administered to mothers of continuing participants at child ages 5 through 9 years, and those ADHD symptom counts were used in the Developmental Course analyses to examine symptom trajectories.

An alternative way of administering the DISC was used (Edelbrock et al. 1999). Eleven modules that were appropriate for adolescents were selected: ADHD, ODD, Conduct Disorder, Specific Phobia, Social Phobia, Separation Anxiety Disorder, Generalized Anxiety Disorder, Obsessive Compulsive Disorder, Major Depressive Disorder, Dysthymic Disorder, and Eating Problems. Standard administration was followed for the ADHD and ODD sections of the DISC in order to obtain a symptom count and make a diagnostic decision for each participant. For other sections of the DISC, the interviewer began by reading a brief summary of the diagnostic criteria for each diagnosis. After the overview, the interviewer asked the mother to select the diagnostic areas that were relevant to her child and only these selected modules were administered, in the standard way. This administration procedure has been found to increase reliability, decrease attenuation (reporting fewer symptoms for disorders assessed later), take less time, facilitate more meaningful communication between parent and interviewer, and be more interesting for parents than the standard procedure of administering all areas in a fixed order (Baker et al. 2010; Edelbrock et al. 1999; Jensen et al. 1999; Neece et al. 2011).

Child Behavior Checklist Ages 6–18 and Teacher Report Form (CBCL and TRF; Achenbach and Rescorla 2001) The CBCL, a widely used parent-report measure of child and adolescent socioemotional and behavioral functioning, has sound reliability and validity. Parents rate 113 behaviors on a 3-point scale from 0 (*not true*) to 2 (*very true or often true*) for their child. The CBCL yields a total problem score, broad-band externalizing and internalizing scores, seven narrow-band scales, of which Attention Problems was used in the current study, and 6 DSM-oriented scales, of which the ADHD subscale was used in the present analyses. The CBCL yields T scores for all subscales; for total and broad-band scales, the mean is set at 50 with a standard deviation of 10. Scores above 70 are considered to be in the clinical range. The CBCL was used to corroborate ADHD diagnoses in this sample. The TRF, very similar to the CBCL, was completed by the adolescent's selected teacher. This measure was used to examine ADHD symptoms in a different setting (school) and to substantiate ADHD diagnostic classifications.

Conners' Parent Rating Scale-Revised S and Conners' Teacher Rating Scale-Revised S (CPRS and TRS; Conners 2000) The CPRS, a measure of ADHD symptoms, was included to corroborate ADHD classifications further, as well as to examine the factor structure of ADHD symptoms in the ID and TD groups. It has 27-items on a 4-point Likert scale and yields three subscales—oppositional, cognitive problems/inattention, and hyperactivity—as well as an overall ADHD Index score. The CPRS has been shown to have good predictive power for ADHD (Pillow et al. 1998) and has been found to distinguish children with comorbid ID and ADHD from children with ID alone (Deb et al. 2008). Additionally, the youth selected the teacher that he/she had the closest relationship with to complete the CTRS. This measure is very similar to the CPRS, with 28 items and the same item responses and subscales.

Impairment Rating Scale (IRS; Fabiano et al. 2006) The IRS is a 7-item questionnaire that asks parents to rate both their child's impairment and need for services in seven domains (e.g. How your child's problems affect his or her relationship with playmates; How your child's problems affect his or her academic progress at school); these sum to an overall Functional Impairment Severity Index. The IRS has been tested in ADHD samples and found to have good psychometric properties, be highly effective in discriminating between children with and without ADHD, and account for unique variance in ADHD diagnosis beyond ratings of ADHD symptoms (for detailed review see Fabiano et al. 2006).

Data Analytic Plan

Chi-square statistics were used to examine prevalence of ADHD between the ID and TD groups, and to test the relationships between ADHD classification based on the DISC and other questionnaire measures of ADHD symptoms. Chi-square statistics also were used to compare rates of mental disorders by child gender within the ID and TD subsamples, and to examine comorbidity of mental disorders between the two groups.

Independent sample t-tests were used to examine ADHD alone vs. ID/ADHD group differences in mother and father reports on relevant subscales of the CBCL and CPRS. For teacher reports on the TRF and CTRS, only effect sizes were calculated because cell sizes were too small to conduct parametric statistics. Analyses of symptom presentation utilized independent-sample t-tests to test for differences in the

total number of ADHD symptoms as well as number of inattentive and hyperactive-impulsive symptoms endorsed for youth in the ADHD alone vs. ID/ADHD groups. A Spearman's rank correlation was conducted to examine the relative frequency of ADHD symptom endorsement in the two groups.

To investigate the ADHD symptom picture further among children with or without ID, Principle Components Analyses with CPRS scores were conducted in the ID and TD subsamples. Multiple previous studies have confirmed the factor structure of this instrument (for a review see Conners et al. 1998). The results presented report promax rotated, principle-axis, standardized regression coefficients of the pattern matrix for the 27 CPRS items.

Hierarchical linear modeling (HLM; Raudenbush and Bryk 2002) was used in addressing developmental course of ADHD, to assess the trajectories of ADHD symptoms (total, inattentive, and hyperactive/impulsive) from ages 5 to 13. First, to examine significant change over time unconditional growth models were conducted including only an intercept (representing the dependent variable at Time 1) and slope (representing the linear rate of change of the dependent variable across ages 5–13). Other growth functions (i.e., quadratic and cubic functions) were also examined to determine whether they improved the fit of the model. An additional growth function was included in the model if it significantly improved the model fit and reduced the deviance statistic as indicated by the chi-square model comparison test. Second, to examine whether the trajectories differed among adolescents with ID and TD, conditional growth models were run which included intellectual status (TD vs. ID) as a predictor of the dependent variable intercept and slope(s).

A univariate analysis of variance was used to analyze mother-reports of functional impairment. This analysis examined the impact of (1) intellectual status, (2) ADHD diagnosis, and (3) the interaction between status and diagnosis in predicting impairment. If the main effect of ADHD was significant after controlling for intellectual functioning, this would mean that ADHD diagnosis independently predicted child functional impairment over and above intellectual disability status. This finding would indicate that child impairment was not only a function of differences in intellectual functioning but also of differences in ADHD functioning, supporting the notion that ADHD may be a distinct entity and a valid diagnosis for adolescents with ID.

For all analyses, variables that had a significant relationship ($p<.05$) with the independent variable(s) *and* the dependent variable(s) were tested as covariates. Covariates were retained in the final model if they predicted the dependent variable at $p<.10$. Additionally, in order to reduce the influence of extreme data points, all data points that were more than three standard deviations above or below the mean of a variable were set equal to plus or minus 3 standard deviations from the mean.

Results

Prevalence Table 2 shows that 52.4 % of children in the ID sample met DISC criteria for at least one of the Axis I disorders that were assessed. The most prevalent disorders in the ID sample were the disruptive behavior disorders: Attention Deficit Hyperactivity Disorder (ADHD: 40.5 %) and Oppositional Defiant Disorder (ODD: 23.8 %). Specific phobia was the next most prevalent (19.0 %). For the remaining 9 disorders assessed by the DISC few or no youth met diagnostic criteria.

The prevalence of meeting criteria for any disorder was significantly higher among adolescents with ID compared to those with TD. Table 2 shows these differences as odds and risk ratios. The highest risk ratio was for ADHD, which was 3.38 times as prevalent in the ID sample as in the TD sample. The inattention subtype differentiated the samples most highly, with a risk ratio of 4.37. Additionally, there were significant correlations between IQ scores and inattentive ($r=-.29$, $p<.001$), hyperactive/impulsive ($r=-.30$, $p<.001$), and total ($r=-.33$, $p<.001$) ADHD symptoms.

Continuity of ADHD Symptoms Across Measures and Reporters In order to substantiate the DISC diagnosis of ADHD, other measures of ADHD symptomotology were used to compare adolescents who were classified as "ADHD" to adolescents who were classified as "No-ADHD". Table 3 shows the group differences contrasting mother and father reported CBCL t-scores and CPRS ADHD Index scores for youth with or without ADHD diagnosis at age 13 years within each status group. Within the ID and TD groups, these indices significantly differentiated the ADHD and no-ADHD groups in 17 of 20 analyses, with an additional analysis showing a trend.

A valid diagnosis of ADHD ideally should be based on the child meeting diagnostic criteria in two more contexts (APA 2000). While we could not administer the DISC to teachers, we obtained the Teacher Report Form (TRF) of adolescent behavior problems as well as Conners' Teacher Rating Scale (CTRS). Means and effect sizes for the TRF sub-scales and CTRS ADHD Index within each status group (ID, TD) were examined to assess whether teachers reported more ADHD-like behaviors in adolescents classified as ADHD according to the DISC. TRF mean scores for the ADHD and ID group ranged from 57.8 to 70.0 compared to the ID only group which ranged from 52.1 to 57.3. Differences in TRF scores between adolescents with and without ADHD had fairly large effects in the ID group

Table 2 Diagnostic status of sample at age 13 years

Variable	ID (n=42)	TD (n=100)	X^2	Relative risk (ID: TD)	Odds ratio	CI for odds ratio
Any mental disorder	52.4	30.0	X^2=5.46*	1.74:1	2.57	1.22–5.39
ADHD (Any subtype)	40.5	12.0	X^2=13.06***	3.38:1	4.99	2.11–11.81
ADHD-inattention subtype	26.2	6.0	X^2=9.61**	4.37:1	5.56	1.90–16.28
ADHD-hyperactive/impulsive subtype	4.8	3.0	X^2=0.00	1.60:1	1.62	0.28–10.05
ADHD combined subtype	9.5	3.0	X^2=1.74	3.17:1	3.40	0.72–15.93
Oppositional defiant disorder	23.8	13.0	X^2=1.81	1.83:1	2.09	0.84–5.24
Conduct disorder	2.4	0.0	–	–	–	–
Separation anx dis	7.1	1.0	X^2=2.14	7.10:1	7.62	0.77–75.45
Social phobia	0.0	2.0	–	–	–	–
Specific phobia	19.0	4.0	X^2=6.82**	4.75:1	5.65	1.60–19.96
Generalized anxiety disorder	0.0	1.0	–	–	–	–

†p<.10. *p<.05. **p<.01. ***p<.001

The following diagnoses had 0 % for both ID and TD: Obsessive-Compulsive Disorder, Anorexia Nervosa; Bulimia Nervosa; Major Depressive Disorder; Dysthymic Disorder

(Cohen's d ranged from 0.60 to 1.82). In the TD group, among adolescents with ADHD TRF scores ranged from 49.0 to 56.3 and among TD adolescents without ADHD scores ranged from 50.4 to 54.1. Differences in the TD group provided fairly small to medium effects size estimates (d ranged from 0.18 to 0.42). When comparing adolescents with and without ADHD on the CTRS t-scores, again results suggested large effects in the ID group (d=1.31) and smaller but still moderate effects in the TD group (d=0.43). Across reporters and measurement methods adolescents classified as ADHD were reported to exhibit elevated levels of attention problems, overall behavior problems, and ADHD symptoms regardless of whether they had ID.

Sex Differences In both the ID and TD group, ADHD was more prevalent among boys than girls; however, these differences were not statistically significant. ADHD criteria were met in the ID sample by 40.9 % of boys and 33.3 % of girls, X^2 (1, N=40)=0.03, ns, OR=1.39, 95 % CI [0.38, 5.07], and in the TD sample by 13.7 % of boys and 6.4 % of girls, X^2 (1, N=98)=0.75, ns, OR=2.33, 95 % CI [0.57, 9.61]. No sex difference within ADHD subtypes approached statistical significance.

Sex differences in the number of ADHD symptoms were also examined. In the TD sample boys were reported to have significantly more total ADHD symptoms (t(96)=2.90, p<.01) and inattentive ADHD symptoms (t(96)=3.11, p<.01), and there was a trend for hyperactive/impulsive ADHD symptoms (t(96)=1.81, p=.07). By contrast, in the ID group no sex differences in total, inattentive, or hyperactive/impulsive ADHD symptoms approached significance.

Table 3 Association between DISC classification and parent-report measures

	ID			TD		
	No ADHD	ADHD	t-value	No ADHD	ADHD	t-value
Mother report						
CBCL total BP	54.7	61.6	2.45*	46.9	54.1	2.21*
CBCL ext. BP	49.5	58.2	3.17**	46.7	51.3	1.57
CBCL attention problems	58.6	68.7	3.96***	53.2	59.6	4.17***
CBCL ADHD scale	56.0	65.6	4.72***	53.0	61.5	5.28***
CPRS ADHD index	55.2	74.0	4.13***	50.7	60.5	3.64***
Father report						
CBCL total BP	54.3	59.4	1.38	45.5	53.8	2.01*
CBCL ext. BP	51.2	56.8	1.92†	44.8	52.6	2.06*
CBCL attention problems	56.4	65.8	2.58*	53.2	57.1	2.18*
CBCL ADHD scale	54.2	63.5	2.90*	52.7	60.3	4.46***
CPRS ADHD index	53.3	65.9	2.72*	50.2	61.3	3.78***

†p<.10. *p<.05. **p<.01. ***p<.001

Comorbidity The co-morbidity of mental disorders in this sample was high. Of the adolescents who met criteria for one disorder, 27.8% met criteria for more than one disorder. More of the adolescents in the ID sample (54.5 %) had one or more additional disorders than in the TD sample (10.0 %), X^2 (1, N=52)=10.20, p<.001, OR=10.80, 95 % CI [2.51,46.43]. The two disorders that were most highly co-morbid were ADHD and ODD. Among adolescents in the ID sample who met criteria for either of these disorders, 58.5 % met criteria for both disorders; in the TD sample only 8.7 % met criteria for both disorders, X^2 (1, N=40)=9.43, p<.01, OR=15.00, 95 % CI [21.62, 85.68].

In the combined sample, adolescents who met criteria for ADHD exhibited higher rates of ODD compared to adolescents who did not meet criteria for ADHD, X^2 (1, N=142)=14.20, p<.001, OR=6.18, 95 % CI [2.39, 15.97]. Adolescents with ADHD did not exhibit significantly higher rates of any other disorder. Within the status groups, adolescents who met criteria for ID and ADHD had a higher prevalence of ODD compared to adolescents with ID alone, X^2 (1, N=42)=16.20, p<.001, OR=2.43, 95 % CI [1.38, 4.29]. In the TD group, however, there was no difference in ODD prevalence between adolescents who did and did not meet criteria for ADHD, X^2 (1, N=100)=0.00, ns, OR=1.40, 95 % CI [0.27,7.25]).

It is difficult to compare rates of comorbidity between two groups in which any disorder may be higher in one group than the other; nonetheless the observed rates of comorbidity and the expected rates based on joint probability can be compared. The observed rate of ODD and ADHD comorbidity in the TD group was 5 %, which is slightly higher than the expected joint probability, which was 1.4 %. In contrast, among children with ID the observed comorbidity was 43.8 %, which is much higher than the expected joint probability (11 %) suggesting that the presence of ID makes children more vulnerable to the ADHD/ODD comorbidity.

Symptom Picture We examined ADHD symptom presentation in the ID and TD groups in several ways. First, among adolescents who met criteria for ADHD, the total number of ADHD symptoms endorsed did not differ by status group (ID, M=11.71 (2.97); TD, M=10.50 (2.81)). This was also true for the number of inattentive (ID; M=7.18 (1.59) and TD, M=6.00 (2.37)) and hyperactive symptoms (ID, M= 4.53 (2.48) and TD, M=4.50 (2.54)).

Second, we examined if specific ADHD symptoms were being endorsed at the same relative frequency in the two status groups at age 13 years. For youth meeting criteria for an ADHD diagnosis, symptoms were ranked in each group by the percent of respondents who endorsed them. A Spearman's rank correlation coefficient on the endorsement frequency of items for the two samples was moderately high (ρ=.50, p<.05) indicating that symptoms were endorsed at similar relative frequencies within the two groups. There was a marginally significant group difference in the endorsement of two symptoms. Mothers of adolescents with ADHD and ID reported more often that their child "has difficulty sustaining attention" (94.1 %) compared to mothers of TD adolescents (58.3 %), X^2 (1, N=29)=3.53, p=.06, OR= 11.43, 95 % CI [1.12, 116.70]. Mothers of TD adolescents who met criteria for ADHD reported more frequently that their "child talks more than other children his/her age" (75.0 %) compared to mothers of ID adolescents (35.3 %), X^2 (1, N=29)=2.99, p=.08, OR=.18, 95 % [CI 0.04, 0.94]. This difference is not surprising given that children with ID often have language delays.

Third, to investigate the ADHD factor structure in the two groups, separate exploratory factor analysis models were conducted on the CPRS items. In the Principle Components Analysis originally conducted by Conners (2000) three factors emerged (labeled Hyperactivity, Oppositional, and Cognitive Problems) and this 3-factor model was validated in a confirmatory factor analysis. Following Conners (2000), a 3-factor Principle Components Analysis was conducted and items were assigned to subscales where they had the highest factor loadings. In the TD group, three very similar factors emerged; all but one item mapped onto the same subscales as in the standardization sample. Item number 9 ("is difficult to control in malls or grocery stores") mapped onto the Hyperactive/ Impulsive factor in the standardization sample but loaded onto the Oppositional factor in the current TD sample. However, factor loadings for our sample were only slightly higher for the Oppositional factor (loading=.42) compared to the Hyperactive/Impulsive factor (loading=.34) and both were moderate in size. Similarly, in the ID group, the identical factor structure emerged with the exception of one item. Item 24 (deliberately does things that annoy other people) originally loaded onto the Oppositional scale in the standardization sample but loaded onto the Cognitive Problems/ Inattention subscale in the ID group (loading=.71). Nevertheless, very similar factor structures were found in both the ID and TD groups and these groupings paralleled those found in the original standardization of the instrument.

Developmental Course To examine the trajectories of inattention, hyperactive/impulsive, and total ADHD symptoms over time, multilevel growth model analyses were conducted using hierarchical linear modeling (HLM; Raudenbush and Bryk 2002). As discussed in Measures, the DISC was administered to mothers at ages 5, 6, 7, 8, 9 and 13, and symptom counts from these interviews were used to model symptom trajectories across middle childhood and early adolescence. The variable used to represent time ranged from 0 to 8 because there were five yearly time points, from child age 5 years to age 9 years (coded 0 to 4 respectively), and one time point

4 years later at age 13 years (coded as 8). Table 4 shows results of the unconditional growth models. For total and hyperactive symptoms, the model with linear time only was the best fit. Child total ADHD symptoms yielded a significant intercept and negative slope parameter indicating that the initial level of ADHD symptoms in the combined sample was significantly different from zero (intercept) and that there was a significant decrease in these symptoms over time (slope). A similar pattern was observed for hyperactive/impulsive symptoms. For inattention symptoms, the quadratic function significantly improved the fit of the model (χ^2 =17.31, p<.01) and, therefore, was included in the model as well. Results from the unconditional model examining inattention symptoms suggested a trend for inattention symptoms initially increasing over time (positive linear slope from age 5 to 13 years); however the rate of increase in inattention symptoms appears to be slowing down and eventually decrease over time (negative quadratic slope from age 5 to 13 years).

Conditional growth models were run to test whether the symptom trajectories were different in the two status groups (TD and ID). Table 4 and Fig. 1 show these results. The conditional models included status as a predictor of the dependent variable intercept and slope(s). No covariates were included, as none had a significant relationship (p<.05) with the independent variable (adolescent intellectual status) *and* the dependent variable (inattention, hyperactive/impulsive, or total symptom count). For both models, child developmental status (TD vs. ID) was specified so that the TD group was set to 0 and the ID group to 1. Similar to the unconditional models, there was a significant change in total and hyperactive/impulsive symptoms over time (slope was significant). However, adolescent status group did not predict the slope, indicating that changes over time were similar in the TD and ID groups.

With inattention symptoms, there were differences in the rates of change depending on status group. For the TD group, there was a significant linear and quadratic slope indicating that inattention symptoms were initially increasing over time on average (positive linear slope from age 5 to 13 years); however the rate of increase in inattention symptoms declined and eventually decreased over time (negative quadratic slope from age 5 to 13 years). In order to examine the rates of change in the ID group, the status variable was recoded (ID=0 and TD=1) so that the slope parameters represented the ID group (intercept and slope parameters represent the group coded as 0). These results showed a non-significant linear and quadratic slope indicating that there was no significant change over time for the ID group.

In sum, consistent with our hypotheses, youth in the ID group had higher levels of total and hyperactive/impulsive symptoms across time, but the downward symptom trajectory was similar in the two groups, indicating no difference in developmental course. Inattentive symptom results were less consistent, indicating an initial increase and later decrease over time for the TD group but no change for the ID group.

Impairment A univariate analysis of variance was conducted to examine the relationship between ADHD diagnosis and cognitive status in predicting mother reports of child functional impairment at age 13 years. There was a significant main effect for intellectual status in that adolescents with ID had higher levels of functional impairment (Mean=3.28, SD=2.17) compared to typically developing adolescents (Mean=1.26, SD=1.73); F(1,118)=23.83, p<.001. There was also a significant main effect for ADHD diagnosis such that

Table 4 Results of multilevel models

Variable	Total ADHD symptoms	ADHD hyperactive/impulsive symptoms	ADHD inattention symptoms
Unconditional growth model			
Intercept parameter (g_{00})	7.01***	3.49***	3.16**
Linear slope parameter (g_{10})	−0.35***	−0.24***	0.30†
Quadratic slope parameter (g_{20})	–	–	−0.05*
Intercept variance component (d_0)	16.30***	4.92***	5.65***
Linear slope variance component (d_1)	0.16**	0.03*	0.77**
Quadratic slope variance component (d_2)	–	–	0.001**
Conditional growth model			
Intercept parameter (g_{00})	6.20***	3.16***	2.22***
By status(g_{01})	2.66**	1.09	2.55***
Linear slope parameter (g_{10})	−0.39***	−0.26***	0.62**
By status (g_{11})	0.13	0.06	−0.79*
Quadratic slope parameter (g_{20})	–	–	−0.08**
By status (g_{21})	–	–	0.09**

†p<.10. *p<.05. **p<.01. ***p<.001

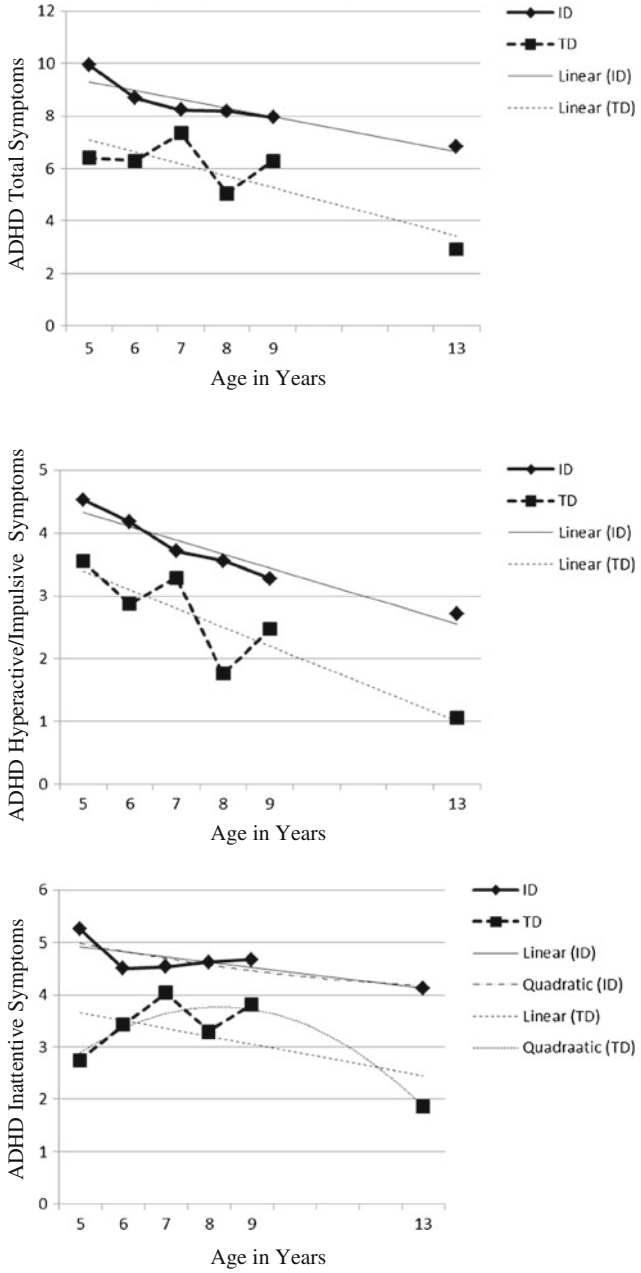

Fig. 1 Symptom trajectories of total, inattentive, and hyperactive/impulsive symptoms among typically developing adolescents and adolescents with ID

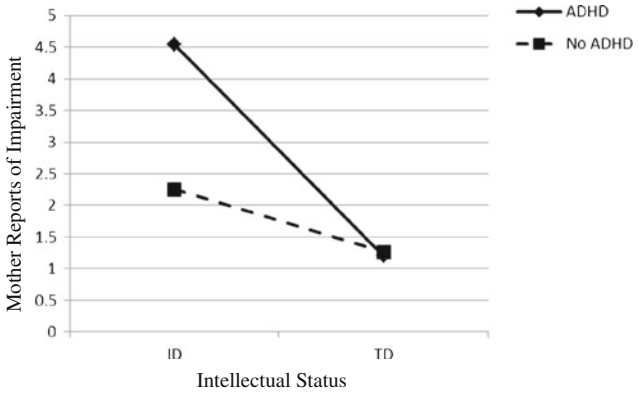

Fig. 2 Interaction between adolescent cognitive and ADHD functioning in predicting mother reports of adolescent functional impairment

adolescents with ADHD had higher levels of impairment (Mean=3.09, SD=2.31) compared to adolescents without ADHD (Mean=1.48, SD=1.85); $F(1,118)=6.30$, $p<.05$. Additionally, there was also a significant interaction between intellectual and ADHD status in predicting impairment; $F(1,118)=7.06$, $p<.01$. Figure 2 shows that adolescents with ADHD and ID were reported by mothers to have higher levels of impairment, compared to adolescents with ID alone. In contrast, typically developing adolescents with and without ADHD seemed to have similar levels of functional impairment. These findings suggest that ADHD is associated with adolescent functional impairment above and beyond intellectual functioning for adolescents with ID.

Discussion

We examined ADHD among adolescents with ID, a group that has been found to be at heightened risk for ADHD in previous studies with younger children. To our knowledge, this is the first study to examine the rates of ADHD and other mental disorders exclusively among early adolescents with ID. Adolescence is a critical period of development characterized by significant changes in cognitive development (e.g., increased social cognition, response inhibition, monitoring, and abstract thinking), emotional development (e.g. increased emotional arousablity, novelty seeking) and social development (e.g., increased motivation for peer acceptance, socialization pressures that include peer and adult expectations for mature, socially-considerate, and gender-typical behavior) (Galvan et al. 2006; Steinberg 2005). Additionally, adolescence is a developmental time characterized by heightened risk for psychopathology in the general population (Kessler et al. 2001), making it a critical period for study among youth with ID. Most previous studies used combined samples of youth with a range of ages (e.g. the deRuiter et al. 2008 and Dekker et al. 2002 samples were 6–18 years; the Emerson and Hatton 2007 sample was 5–15) and employed a cross-sectional design. These investigations are valuable in verifying that youth with ID are a high-risk group; however, they do not reveal much about development specifically during adolescence nor about the development of ADHD over time.

We examined the similarity of ADHD within ID and TD groups in five domains: youth sex, comorbidity of disorders, symptom picture, developmental course, and youth impairment. To address our first aim of characterizing the clinical

presentation of ADHD in the two groups, we examined prevalence, sex ratio, and comorbidity where we had hypothesized differences between ID and TD adolescents. Early adolescents with ID in our sample continued to be at heightened risk for ADHD compared to typically developing adolescents (relative risk 3.38:1). This finding is consistent with previous studies with younger children, showing heightened risk for ADHD among those with ID. Surprisingly, the rates of other disorders, particularly those that tend to increase in prevalence during adolescence (e.g., depression, eating disorders, anxiety disorders) were low in both groups.

With respect to prevalence of ADHD among adolescents with and without ID, we were interested in whether rates of ADHD varied by *sex*. Our findings indicated that rates of ADHD diagnosis between boys and girls did not differ for either ID or TD youth; however, of those with ADHD, boys were reported to have more symptoms than girls. This lack of sex differences is notably different from studies with TD samples, where ADHD is reported in the DSM-IV to have a 4:1 boy to girl ratio (APA 2000). However, our findings are consistent with several studies of behavior problems/mental disorder in children with ID (deRuiter et al. 2008; Gadow et al. 2004; Hastings et al. 2005). Among explanations for the lack of sex differences in psychopathology in adolescents with ID, Einfeld and colleagues (2010) have hypothesized that the absence may reflect differences based in chronological age versus mental age equivalents as well as neurocognitive factors that differentiate children with and without cognitive delays. *Comorbidity*, as hypothesized, was high and significantly more so for youth with ID. The two most common co-occurring disorders were ADHD and ODD, which is consistent with research among TD children (Jensen et al. 2001).

With respect to our second aim of examining whether ADHD is the same disorder in youth with and without ID, we found that the ADHD diagnosis appears to be reached in the same way in adolescents with or without ID. In youth meeting ADHD diagnostic criteria, the total number of symptoms endorsed did not differ, and the specific symptoms were endorsed at similar frequencies, in the two groups. To our knowledge no study has examined the patterns of DSM-IV ADHD symptoms in adolescents with and without ID, although similar results have been found among younger children with ID (Baker et al. 2010; Neece, et al. 2011). Further analyses of the factor structure of ADHD on the Conners scale within the two groups indicated a similar factor structure to that reported in the normative sample (Conners 2000). This is important in determining the validity of ADHD among youth with ID as it provides some indication that the construct is organized in the same way.

The Principle Components analyses presented in the current study only begin to ascertain the underlying factor structure of ADHD symptomatology among adolescents with ID. Future research should pursue multi-group confirmatory factor analysis with a larger sample of adolescents with and without ID to determine (1) whether the factor model identified in the normative sample has adequate fit in a sample of adolescents with ID, and (2) whether the factor loadings differ between a sample of with ID and a sample of typically developing adolescents (i.e., is the factor loading for a given item stronger in one group versus the other). While the present sample was too small to conduct such analyses, the Principle Components Analyses provide some evidence for a similar factor structure across the groups.

Further investigating whether ADHD is the same disorder in adolescents with ID and typical development, the *developmental course* of ADHD was examined by considering the symptom trajectories. In both status groups, hyperactive/impulsive and total ADHD symptoms decreased significantly from age 5 years to age 13 years. The decrease in hyperactive/impulsive symptoms is consistent with deRuiter et al's (2008) finding of decreased externalizing symptoms across childhood. Examining the trajectories more closely, it appears that symptoms decreased slightly across middle childhood (ages 5 to 9), but with a more pronounced reduction in symptoms by age 13 years. Perhaps the development of improved self-regulatory skills, as well as enhanced executive functioning abilities resulting from prefrontal cortical development during adolescence (Steinberg 2005), are responsible for the observed decreases.

Inattentive symptoms, however, initially increased and then decreased over time in the TD group and remained fairly steady in the ID group. This is consistent with other studies finding that inattentive symptoms increase during early to middle childhood and remain more stable relative to hyperactive/impulsive symptoms (Hart et al. 1995). More specifically, the increase in inattentive symptoms appeared to be most pronounced from age 5 to 7 years in the TD group. Indeed, ADHD symptoms, particularly inattentive symptoms, may not emerge or be recognized until school entry around age 6 years when cognitive demands of a structured school environment make attentional difficulties more evident. (Keenan and Shaw 1997; Loeber and Hay 1997).

The functional *impairment* analysis showed that ADHD diagnosis predicted adolescent functional impairment above and beyond the youth's intellectual functioning, indicating independent contributions for these two critical determinants. In many ways our preceding analyses indicated that children with ADHD/ID are more impaired as they had a higher rate of clinical diagnoses, higher levels of comorbid disorders, and higher levels of symptoms over time. The measure of functional impairment employed here examined how these problems impact the daily life of the adolescent

across multiple domains and how much he/she requires services as a result of these problems. The findings offer support to the validity of ADHD as a diagnosis for youth with ID. Scholars opposing the diagnosis of ADHD among children and adolescents with ID have argued that a diagnosis of ADHD in this population is a misclassification of symptoms arising from the cognitive impairment rather than a separate constellation of behaviors that constitute ADHD (Gjaerum and Bjornerem 2003; Reiss and Valenti-Hein 1994; Tonge, et al. 1996). However, if this perspective were accurate, cognitive functioning should have accounted for all the variance in the adolescent functional impairment, which it did not. ADHD functioning was associated with impairment independent of cognitive functioning, supporting the notion that ADHD is a separate and distinct set of symptoms for adolescents with ID.

Implications

There are important research and practical considerations for further examination of ADHD as a separate disorder in youth with ID. This comorbidity is referred to as dual diagnosis in the ID literature, and is associated with a host of negative outcomes for the individual with ID, his or her family, and society at large. Indeed, individuals with ID and a comorbid mental disorder are at increased likelihood for academic problems, failure in community living arrangements, frequent moves, social isolation and rejection, and reduced employment prospects (Bromley and Blacher 1991; Seltzer and Krauss 2001). Parents of persons with dual diagnosis report elevated levels of stress (Baker et al. 2010; Neece et al. 2012) and an increased need for services (Douma et al. 2006). Additionally, when the family's ability to manage the person with dual diagnosis is challenged, there is increased likelihood of placement out of the home (Blacher 1994; Bromley and Blacher 1991). Even among the majority of children and adolescents with ID who live at home, many of them have unmet mental health needs that have a high social cost (Blacher et al. 1999). General psychiatric and health care services often lack the staff experience and knowledge for assessing and treating psychopathology in individuals with ID, suggesting that the assessment and treatment—let alone prevention—of psychopathology in these individuals are likely inadequate (Sturmey et al. 2007).

Our findings must be considered within the context of several study limitations. First, the sample is small, limiting the detection of smaller effects if they were present and preventing robust comparisons across groups (e.g., ADHD and ID, ID only, ADHD only, and typically developing). Additionally, a methodological limitation of the current investigation is that the diagnostic classifications for ADHD were based on information gathered from a single reporter; however, mothers' reports on the DISC were consistent with father and teacher reports on the CBCL and TRF which supported the validity of the diagnostic classifications. Furthermore, given that there were no differences between adolescents in our sample with ID and those with borderline intellectual functioning, the two groups were combined in order to increase statistical power; however, as a result, a subset of the ID sample does not meet diagnostic criteria for intellectual disability, which may limit the generalizability of the findings. Further studies are needed to examine these findings with a pure ID group. Additionally, future studies must continue to investigate the validity of ADHD as a diagnosis for youth with ID, addressing other domains outlined by Robins and Guze (1970) and others (e.g. etiological correlates). Additionally, there is a need for studies examining potential mediating variables that place children and adolescents with ID at increased risk for ADHD and other comorbid disorders (e.g. poor emotion regulation strategies as discussed in Gerstein et al. 2011).

The present study has significant implications for intervention and policy. Currently under the U.S. Individuals with Disabilities Education Act (IDEA) (2004) all children with disabilities are entitled to a free and appropriate public education. This law applies to all children with ID and to children with ADHD in some states. However, under IDEA it is generally considered "best practice" to only to classify children with one eligibility criterion, which is ID for children with comorbid ID and ADHD. In public schools if a child has ID no further diagnostic consideration is needed. Therefore, it is difficult to know if public schools offer differential services to children with ID and ADHD. Individualized Educational Plans (IEPs) often lack individualization and do not sufficiently address the needs of the primary eligibility criterion (Ruble et al. 2010). Therefore, it is likely that secondary diagnoses, like ADHD, are also not being adequately assessed, discussed, and/or treated with educational accommodations.

In addition to policy implications, this study also has implications for intervention. Research examining the treatment of ADHD among children and adolescents with ID is limited; however, some studies suggest that empirically supported treatments for typically developing children with ADHD, specifically stimulant medication, behavior modification, or a combination of these, may be effective also in treating children with ID (Handen et al. 1999; Handen et al. 1996; Heyvaert et al. 2010). Given the high prevalence of ADHD among children with ID, it is critical that future research continues to examine interventions for this population.

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