

Attention-Deficit/Hyperactivity Disorder Symptoms, Adaptive Functioning, and Quality of Life in Children With Autism Spectrum Disorder

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KEY WORDS

autism, ADHD, adaptive functioning, quality of life

ABBREVIATIONS

ADHD—attention-deficit/hyperactivity disorder
 ADOS—Autism Diagnostic Observation Schedule
 AP—Attention Problems
 ASD—autism spectrum disorder
 ATN—Autism Treatment Network
 CBCL—Child Behavior Checklist
 DSM-IV-TR—*Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision*
 HRQoL—health-related quality of life
 PedsQL—Pediatric Quality of Life Inventory
 PPP—positive predictive value
 VABS-II—Vineland Adaptive Behavior Scales, Second Edition

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abstract

OBJECTIVE: The purpose of the current study was to evaluate the frequency of co-occurring attention-deficit/hyperactivity disorder (ADHD) symptoms in a well-defined cohort of children with autism spectrum disorders (ASDs) and to examine the relationship between ADHD symptoms and both adaptive functioning and health-related quality of life as reported by parents or other primary caregivers.

METHODS: T scores on 2 ADHD-related scales from the Child Behavior Checklist were used to indicate the presence of ADHD symptoms. Participants were divided into groups based on whether their parents/caregivers rated them as having clinically significant T scores on the Attention Problem and Attention Deficit Hyperactivity Problem subscales. Standard scores from the Vineland Adaptive Behavior Scales, Second Edition and raw scores from the Pediatric Quality of Life Inventory were then compared between groups with the use of multivariate analyses.

RESULTS: Approximately 40% of participants had 1 elevated T score, and 19% had both ADHD-related T scores elevated on the Child Behavior Checklist. The ASD + ADHD group had lower scores on the Vineland Adaptive Behavior Scales, Second Edition and the Pediatric Quality of Life Inventory in comparison with the ASD alone group.

CONCLUSIONS: Results suggest greater impairment in adaptive functioning and a poorer health-related quality of life for children with ASDs and clinically significant ADHD symptoms in comparison with children with ASDs and fewer ADHD symptoms. Physicians are encouraged to evaluate for the presence of ADHD symptoms in their patients with ASDs and, if present, include symptom treatment in the overall care plan. *Pediatrics* 2012;130:S91–S97

Autism spectrum disorders (ASDs) are a group of neurodevelopmental disorders defined by impairments in the areas of communication and socialization, as well as patterns of restricted or repetitive interests and behaviors.¹ ASD-specific behaviors have been found to negatively impact various aspects of the lives of individuals with ASDs. Multiple studies suggest that children with ASDs have more impairment in daily living than children without ASDs, despite their age or cognitive level. For example, Van Agt et al² found that language impairment in schoolchildren with ASDs had a negative impact on behavior. Children with ASDs also have been found to have lower health-related quality of life (HRQoL) scores than children with other chronic health conditions.³ Parents of children with ASDs have reported more concerns about their child's well-being than parents of unaffected children or those with attention-deficit/hyperactivity disorder (ADHD).⁴ Klin et al⁵ found that children with high-functioning ASDs were more impaired in adaptive functioning on the Vineland Adaptive Behavior Scales in comparison with those without ASDs.

In addition to ASD-specific behaviors, individuals with ASDs also demonstrate other behaviors that are potentially problematic. These problems range from oppositional and aggressive behavior to anxious and depressed behavior and represent potential comorbid psychiatric disorders. Although the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision* (DSM-IV-TR) currently does not allow ADHD to be diagnosed in children with ASDs, Leyfer et al⁶ found that ADHD was the third most common comorbid disorder in children with ASDs. Thirty-one percent of their sample met DSM-IV-TR diagnostic criteria for ADHD, and 53% evidenced clinical symptoms (but did not meet diagnostic criteria). In a review of the literature, Murray⁷ reported

that 41% to 78% of children with ASDs also met diagnostic criteria for ADHD. In addition, ADHD symptom severity was similar across ASD subtypes (ie, autistic disorder, Asperger's disorder, and pervasive developmental disorder not otherwise specified). Similarly, Goldstein and Schwebach⁸ found that 60% of children with pervasive developmental disorder met symptom criteria for one of the subtypes of ADHD.

ADHD alone is also related to multiple domains of HRQoL in children and adolescents. For example, Klassen and Miller⁹ found that there are more parent-reported problems in emotional-behavioral role function, mental health, and self-esteem in children with ADHD in comparison with those without ADHD. Children with ADHD have more problem behaviors in comparison with children with anxiety and mood disorders, but comorbid ADHD with other diagnoses did not influence overall quality of life.¹⁰ Therefore, it is likely that children with both ADHD and ASD symptoms would evidence a poorer HRQoL than children with symptoms of only 1 disorder.

The purpose of the current study was twofold: (1) document the frequency of parent-reported ADHD symptoms in a large, geographically diverse population of children with ASDs, and (2) further evaluate the differences between children with ASD and ADHD symptoms and those with few or no ADHD symptoms, with an emphasis on parent-report measures of adaptive functioning and HRQoL. Based on a review of previous studies, we hypothesized that children with ASDs and comorbid ADHD symptoms would have poorer HRQoL and greater impairment in adaptive functioning than children with ASDs and few to no ADHD symptoms.

METHODS

Recruitment and Sample Description

This research was conducted as part of the activities of the Autism Speaks

Autism Treatment Network (ATN), a registry collecting data on children with ASDs across 14 sites in the United States and Canada. Participants in the current study met the following inclusion criteria: (1) age 2.0 to 17.9 years; (2) a clinical ASD diagnosis according to 1 or more diagnostic measures: Autism Diagnostic Observation Schedule (ADOS)¹¹ or DSM-IV symptom checklist¹²; (3) planned or ongoing care at an established ATN site that allowed for completion of the research testing; and (4) parent/caregiver fluent in written and spoken English, and English spoken in the home with the child at least 75% of the time. Upon confirmation of a diagnosis of ASD, families were provided information regarding participation in the ATN Registry by a member of the ATN staff (clinician or study coordinator). Parents or legal guardians of all participants provided consent for participation, and an institutional review board at each participating ATN site reviewed and approved the study. Of 3452 children enrolled in the ATN at the time of database closure for this study (April 29, 2011), 3066 were eligible for participation. Those children excluded from the current study were missing >1 of the measures described below.

Measures

Behavior Functioning

The Child Behavior Checklist (CBCL)¹³ is a caregiver-completed measure of a variety of behavior problems exhibited during childhood. The CBCL has 2 age-adjusted forms: one for children between the ages of 1.5 and 5 years (99 items) and the other for children between the ages of 6 and 18 years (113 items). Both versions assess specific internalizing and externalizing problematic behaviors. The CBCL has 7 syndrome scales for the 1.5–5 version and 8 for the 6–18 version, including the Attention Problems (AP) scale and the DSM-oriented Attention Deficit

Hyperactivity Problem (ADHP) scale. A T score (mean = 50, SD = 10) of ≥ 70 for all syndrome and DSM-oriented scales is generally considered “clinically significant.” The manual for the CBCL reports adequate reliability and validity for all scale scores.

For the current study, the syndrome scale of AP and DSM-oriented scale of ADHP were used as indications of ADHD symptoms. No further evaluation of ADHD symptoms was part of the ATN baseline evaluation; therefore, it is not known whether participants with elevated AP and ADHP scores would meet DSM-IV-TR criteria for ADHD. To corroborate CBCL information, scores from the Overactivity item (item E1) on the ADOS were reviewed and percentages of participants obtaining scores of 2 (indicating problems with hyperactivity and impulsivity) were compared with percentages of participants with elevated AP and ADHP scores.

Adaptive Functioning

Parents were interviewed to complete the Vineland Adaptive Behavior Scales, Second Edition (VABS-II).¹⁴ The VABS-II is a semistructured caregiver interview of a child’s everyday living skills in the areas of Communication (expressive, receptive, and written language), Daily Living (self-care, domestic, and community skills), and Socialization (interpersonal skills, leisure, and coping skills). Interviews were conducted and protocols scored by trained clinicians at each participating ATN site. VABS-II scores have a mean of 100 and SD of 15 such that scores between 85 and 115 are considered average. Scores of < 70 are considered to be within the impaired range of ability (lower scores = greater impairment). The VABS-II has adequate reliability and validity¹⁵ and has been widely used for years as a measure of adaptive skill acquisition in children and adults with a wide variety of developmental and chronic health

conditions. The 3 domain scores and composite scores were used in the analyses.

HRQoL

The *Pediatric Quality of Life Inventory* (PedsQL) 4.0¹⁶ is a brief 23-item questionnaire designed to assess HRQoL of children and adolescents between the ages of 2 and 18 years. It evaluates 4 distinct areas of health-related functioning: physical functioning, emotional functioning, social functioning, and school functioning. The latter 3 subscales are combined to determine a broad psychosocial scale. The PedsQL includes 4 age-appropriate versions (2–4 years, 5–7 years, 8–12 years, and 13–18 years). All questionnaires use a 5-point scale (0 = never a problem, 1 = almost never, 2 = sometimes, 3 = often, and 4 = almost always) which respondents use to rate specific items related to HRQoL over the previous 1-month period. Because of the communication difficulties that are common among children with ASDs, in this study, child HRQoL was assessed by using the parent report version of the PedsQL. The PedsQL has good psychometric properties for measuring HRQoL among healthy populations as well as among children with chronic conditions. The items on the PedsQL questionnaires are reverse scored and converted into a 0 to 100 scale (0 = 100, 1 = 75, 2 = 50, 3 = 25, 4 = 0). One hundred indicates the best HRQoL. The 4 distinct areas of functioning and the psychosocial score were used in the analyses.

Cognitive Functioning

Cognitive scores were used in this study as covariates in the multivariate analyses. Participants were individually administered a cognitive instrument based on their age and ability to participate in standardized testing. Either the early learning composite from the Mullen Scales of Early Learning¹⁵ or the

Abbreviated IQ from the Stanford Binet Intelligence Scale, Fifth Edition,¹⁷ was used as a global indicator of cognitive functioning.

Procedure

Data used in the current study were derived from the baseline evaluation, which involved standardized instruments completed by parents of the child with ASDs, an autism-specific assessment, and cognitive or developmental testing. All data were deidentified and entered into a single data repository. The following data were extracted from the repository for analysis as part of the current study: age, gender, diagnostic classification, global indicator of cognitive functioning, and scores from the CBCL, VABS-II, ADOS, and PedsQL, as described above.

Analyses

The CBCL data were categorical (either < 70 or ≥ 70) and, therefore, were compared by age group (2–5 years, 6–11 years, and 12–18 years) by using the Fisher exact test, following the calculation of percentages based on data review. To corroborate percentages from the CBCL, percentages of participants with T scores ≥ 70 were compared with percentages of participants with specific scores on item E1 on the ADOS by using the Fisher exact test.

The VABS-II and PedsQL data were continuous, and their least-square means were computed by using a general linear model adjusted for age, gender, race, IQ, and the site where the participant was seen. Participants were grouped for analyses based on the 2 scores from the CBCL measuring ADHD symptoms. Participants with clinically elevated scores on both the AP syndrome scale and ADHP DSM-oriented scale (T score ≥ 70) were included in the ASD + ADHD group, whereas participants with both T scores < 70 were included in the ASD alone group. Post

hoc *t* tests were used to compare the continuous data by group (ASD alone versus ASD + ADHD).

RESULTS

Of the 3066 participants eligible for participation at the time of analysis, variability in parent completion of the forms across the ATN sites resulted in some missing data. For this reason, the number of subjects with complete data for certain analyses below will vary. Table 1 provides demographic and diagnostic characteristics of the sample, with most children having the diagnosis of autism, a large male predominance, and >50% of the sample ages 2 to 5 years.

Presence of ADHD Symptoms

Results from the CBCL presented in percentages suggest that >41% of children received T scores ≥ 70 on only 1 subscale (either the AP scale or ADHP DSM-oriented scale). Over 19% had elevated T scores on both subscales. Statistically significant differences in the percentage of participants with elevated T scores were found based on age for the ADHP scale, with the youngest group (ages 2–5) having a significantly

TABLE 1 Demographic and Clinical Characteristics of Sample

Variable	<i>n</i>	%
Diagnosis		
Autism	2041	66.6
Asperger's	273	8.9
PDD NOS	752	24.5
Gender		
Male	2586	84.3
Female	480	15.7
Cognitive skills		
<70	841	34.1
≥ 70	1625	65.9
Race		
Nonwhite	664	21.7
White	2402	78.3
Age, y		
2–5	1737	56.6
6–11	1020	33.3
12–18	309	10.1

PDD NOS, pervasive developmental disorder not otherwise specified.

lower percentage than the 2 older groups. Similarly, there were also age differences for the percentage of children with only 1 scale elevated, but not for the percentage of children with both scales elevated. Specific percentages by age can be found in Table 2.

Percentages of participants with specific scores on item E1 of the ADOS were calculated. Of 2819 participants with completed ADOS, 1237 (44%) received a score of zero (sits appropriately through the assessment), 1094 (39%) received a score of 1 (sits, but often fidgets), 334 (15%) received a score of 2 (difficulty sitting, moves up from chair), and 45 (2%) received a score of 7 (underactive). The percentage of participants with a score of 2 (15%) was similar to the percentage of participants receiving elevations on both the AP and ADHP scales (19%).

TABLE 2 Number of Participants With Elevated CBCL Scores, by Age Group

	AP Syndrome Scale, T ≥ 70	Attention Deficit Hyperactivity Problem DSM-oriented Scale, T ≥ 70	Only 1 Scale, T ≥ 70	Both Scales, T ≥ 70
Ages 2–5 y, <i>n</i> (%)	647 (37.2)	362 (20.8)	682 (39.3)	327 (18.8)
Ages 6–11 y, <i>n</i> (%)	405 (39.7)	255 (25.0)	451 (44.2)	209 (20.9)
Ages 12–17 y, <i>n</i> (%)	111 (35.9)	85 (27.5)	134 (43.4)	62 (20.1)
Total, <i>n</i> (%)	1163 (37.9)	702 (22.9)	1267 (41.3)	598 (19.5)
<i>P</i> value (by age)	<.35	<.01	<.03	<.54

Higher scores on the CBCL indicate greater behavior problems; scores ≥ 70 are considered clinically significant.

TABLE 3 Mean Domain and Composite Scores by Group on VABS-II

Variable	Comparison	<i>n</i>	Mean	SE	<i>P</i>
Vineland: adaptive behavior composite	ASD alone	2316	77.5	0.62	<.0001
	ASD + ADHD		74.09	0.64	
Vineland: communication	ASD alone	2313	82.51	0.75	<.0001
	ASD + ADHD		78.81	0.78	
Vineland: daily living skills	ASD alone	2316	80.69	0.81	<.0001
	ASD + ADHD		77.32	0.84	
Vineland: socialization	ASD alone	2316	74.68	0.69	<.0001
	ASD + ADHD		71.48	0.71	

Results from generalized linear equation models adjusted for age, gender, race, IQ, and the site where the participant was seen. VABS-II scores have a mean of 100 and SD of 15. Higher scores suggest better adaptive functioning. Scores <70 are indicative of clinical impairment.

Relationship Between ADHD Comorbidity and Adaptive Behavior

Scores from the VABS-II were compared across groups. We found that the ASD + ADHD group obtained statistically significantly lower scores on all domains (Communication, Daily Living Skills, Socialization, and Adaptive Composite) in comparison with the group of children with ASD alone ($P < .0001$). These data are summarized in Table 3.

Relationship Between ADHD Comorbidity and HRQoL

Analysis of responses to the PedsQL revealed that the ASD + ADHD group had lower scores in all areas measured (Total, Psychosocial Health Summary, School Functioning, Physical Functioning, Emotional Functioning, and Social Functioning) in comparison with the group of children with ASD alone ($P < .0001$). Results are summarized in Table 4.

DISCUSSION

The purpose of the current study was to document the frequency of ADHD symptoms as measured by the CBCL in a large, well-defined cohort of children with ASDs and to examine the relationship between ADHD symptoms and adaptive functioning and HRQoL. Results indicate that >41% of >3000 participants were elevated on 1 subscale and 19% on both subscales. Parents of schoolchildren reported significantly more ADHD symptoms as measured by the ADHP scale than parents of preschool-aged children. This finding is consistent with results from the National Health Interview Survey on ADHD prevalence, which found the highest percentages of ADHD in children aged 9 to 13 and the lowest in children aged 4 to 8.¹⁸ This finding may reflect changes in symptom presentation over time (ie, as children with ASDs get older, they demonstrate more ADHD symptoms) but may also represent changes in parent/caregiver perceptions or willingness to acknowledge or report co-occurring behavior concerns. Future research may want to address whether differences in parent report of ADHD symptoms at different ages reflects differences in actual child

behavior, differences in reporting, or both, particularly given the research suggesting that ASDs can evolve into ADHD in some children.¹⁹

Although the relationships between daily functioning and ASD or ADHD have been examined separately, there have been fewer studies that specifically examined the impact of comorbid ADHD symptoms in children with ASDs. This is likely due, in part, to the longstanding prohibition in the DSM, including the current version, of diagnosing ADHD in children with ASDs. Although the rationale for such prohibition lies in the assumption that ADHD symptoms are part of the ASD phenotype, recent research suggests that there are subgroups of children with ASDs with and without ADHD symptoms, and those with ADHD symptoms have more impairment in daily functioning.^{20,21} By using a population of preschool-aged children, Gadow, DeVincent, and Pomeroy²⁰ found that children who met DSM-IV-TR diagnostic criteria for both ASD and ADHD had more difficulties than children with ASD alone. Yerys et al²¹ found that children with ASD and ADHD symptoms had greater functional impairment, especially in adaptive behavior (specifically

the Daily Living Skills domain from the VABS-II), overall executive functioning, and verbal working memory, in comparison with children with ASD alone. The current study builds on these findings by using a group of children that better reflects the general population of children with ASDs.

Results from the current study supported our hypothesis that children with ASD and clinically significant ADHD symptoms have greater delays in adaptive functioning and a poorer HRQoL in comparison with children with ASDs and fewer ADHD symptoms. Children in the ASD + ADHD group had statistically significantly lower mean scores on all scales from both the VABS-II as well as the PedsQL in comparison with children in the ASD alone group. These results suggest that children with ASDs plus significant ADHD symptoms, as measured by the CBCL, have more difficulty developing age-appropriate adaptive skills across domains and a poorer overall HRQoL in many different areas than children with ASDs and fewer ADHD symptoms. These findings were true for adaptive skills and life domains commonly associated with ASDs, such as Communication, Socialization, and Psychosocial functioning, but also Daily Living Skills and Physical functioning, which are not inherently associated with ASDs. Our results support previous research on the negative relationship between ADHD symptoms and the development of functional life and other adaptive skills and provide further documentation regarding the relationship between comorbid symptoms and overall HRQoL. Overt behavior problems, including ADHD symptoms, have been found to have a stronger negative relationship with family functioning and parenting stress than autistic symptom severity in children with ASDs²² and level of cognitive functioning in children with developmental delay.²³ It may be that, by reducing ADHD symptoms in

TABLE 4 Mean Domain and Area Scores by Group on PedsQL

Variable	Comparison	n	Mean	SE	P
PedsQL: total	ASD alone	2202	68.90	0.99	<.0001
	ASD + ADHD		59.10	1.02	
PedsQL: psychosocial health summary score	ASD alone	2196	63.80	1.04	<.0001
	ASD + ADHD		52.96	1.08	
PedsQL: school functioning	ASD alone	2018	67.28	1.30	<.0001
	ASD + ADHD		55.27	1.36	
PedsQL: physical functioning	ASD alone	2203	78.51	1.32	<.0001
	ASD + ADHD		70.92	1.37	
PedsQL: emotional functioning	ASD alone	2193	68.14	1.36	<.0001
	ASD + ADHD		58.54	1.41	
PedsQL: social functioning	ASD alone	2186	56.94	1.51	<.0001
	ASD + ADHD		46.03	1.57	

Results from generalized linear equation models adjusted for age, gender, race, IQ, and the site where the participant was seen. Higher scores on the PedsQL indicate better HRQoL.

children with ASDs, in addition to treating core symptoms, families may see greater improvement in HRQoL and adaptive functioning. Improving adaptive functioning is important, because de Bildt et al²⁴ found that a child's level of adaptive functioning directly influenced their type of educational setting. Children with better adaptive skills had more opportunity to participate in grade-level activities.

There are limitations to the current study. First, and most important, is the method by which ADHD symptoms were collected. More specifically, information was gathered via the CBCL, which is not an ADHD-specific instrument but rather a global indication of behavior concerns. However, previous studies have indicated that children diagnosed with ADHD score higher on the parent-reported AP scale than controls.^{25,26} Chen et al²⁷ found that the AP scale was the best predictor of ADHD in their sample. They used a cutoff of $T > 65$ and demonstrated positive predictive value (PPP) of 1.00 for boys, 0.67 for girls; negative predictive value of 0.86 for boys, 0.93 for girls; sensitivity of 0.17 for boys, 0.22 for girls; and specificity of 1.00 for boys, 0.99 for girls. Derks et al²⁵ also used a cutoff of $T > 65$ as "high" and $T < 50$ as "low" and found PPP of 0.59 for boys and 0.36 for girls; negative predictive value of 0.96 for boys and 0.97 for girls; specificity of 0.92 for boys and 0.81 for girls; and sensitivity of 0.74 for boys and 0.80 for girls. The low PPP in the Derks study was attributed to the lower prevalence in this population (Dutch twins in the Netherlands Twin Registry; 14% in boys, 12% in girls) compared with the clinically referred sample in the Chen study. The 3 studies cited all worked with school age populations; no preschool-aged children were evaluated. However, recently Pandolfi et al²⁸ determined that both versions of the CBCL measure the same constructs in children with ASD as they do in the normative sample.

In a reliability/validation study of the CBCL, the odds ratio for the AP scale for children with a $T > 65$ was 5, with 27% of the referred group above this score, whereas only 7% of the nonreferred group achieved this score. For the ADHP scale, the odds ratio was 4 with 21% of the referred group meeting this score and only 7% of the nonreferred group scoring this high.²⁹ In combination, these studies indicate that there is support for using the CBCL to measure ADHD symptoms in preschool-aged children and schoolchildren with ASD.

As noted above, Derks et al found a high rate of false-positives in their population-based sample of schoolchildren by using a cutoff of > 65 . In the Preschool ADHD Treatment Study³⁰ the CBCL 1.5–5 was used as part of the evaluation battery. In their sample of 288 preschoolers with well-documented moderate to severe ADHD, only 130 (45%) scored above the clinical cutoff of $T > 70$ on the AP scale. This suggests that the AP scale may underidentify ADHD symptoms in the typically developing preschool-aged group. Because of the difficulty diagnosing ADHD in the preschool-aged group and the concerns with the ability of the CBCL to identify ADHD in schoolchildren, we used a cutoff of $T > 70$, rather than $T > 65$, to help ensure clinically significant ADHD symptoms.

A second limitation of the study was that information on ADHD symptoms was collected via parent report rather than by direct observation. Scores from the ADOS (item E1: Overactivity) suggest that 15% of children evidenced significant symptoms of ADHD during their ADOS assessment (E1 score of 2, the highest level), which is very similar to the 19% of participants receiving elevated scores on both AP and ADHP subscales of the CBCL. These data provide some support to the accuracy of our numbers as does the similarity between our percentages and those obtained by other researchers.

Results from the current study suggest the need for additional research in a number of areas. First, it would be important to determine if children with ASDs that definitively meet diagnostic criteria for ADHD differ in any meaningful way from children with ASD and ADHD symptoms (but not enough for an ADHD diagnosis) in the areas of adaptive skill development and HRQoL, as well as other important areas. This question becomes increasingly important with the impending publication of DSM-V, which likely will allow comorbid ADHD diagnosis in children with ASDs. Second, previous research on the use of the CBCL in identifying ADHD symptoms has focused on the AP syndrome scale but not the ADHP DSM-oriented scale. It will help to determine if using both scales improves the sensitivity and specificity of the CBCL as a screening tool for ADHD.

CONCLUSIONS

Results from the current study, with the use of a large cohort of different ages from geographically diverse regions of North America, suggest that over one-third of children with ASD have some comorbid ADHD symptoms, and that the presence of ADHD symptoms is related to greater problems in adaptive skills and poorer overall HRQoL. These results suggest that primary care and other providers should screen for symptoms of ADHD in their patients with ASDs and, if present, consider these symptoms when developing a care plan.

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REFERENCES

1. *Diagnostic and Statistical Manual of Mental Disorders*. Revised 4th ed. Washington, DC: American Psychiatric Association; 2000
2. Van Agt H, Verhoeven L, Van Den Brink G, De Koning H. The impact on socio-emotional development and quality of life of language impairment in 8-year-old children. *Dev Med Child Neurol*. 2011;53(1):81–88
3. Kuhlthau K, Orlich F, Hall TA, et al. Health-Related Quality of Life in children with autism spectrum disorders: results from the autism treatment network. *J Autism Dev Disord*. 2010;40(6):721–729
4. Lee LC, Harrington RA, Louie BB, Newschaffer CJ. Children with autism: quality of life and parental concerns. *J Autism Dev Disord*. 2008;38(6):1147–1160
5. Klin A, Saulnier CA, Sparrow SS, Cicchetti DV, Volkmar FR, Lord C. Social and communication abilities and disabilities in higher functioning individuals with autism spectrum disorders: the Vineland and the ADOS. *J Autism Dev Disord*. 2007;37(4):748–759
6. Leyfer OT, Folstein SE, Bacalman S, et al. Comorbid psychiatric disorders in children with autism: interview development and rates of disorders. *J Autism Dev Disord*. 2006;36(7):849–861
7. Murray MJ. Attention-deficit/hyperactivity disorder in the context of autism spectrum disorders. *Curr Psychiatry Rep*. 2010;12(5):382–388
8. Goldstein S, Schwabach AJ. The comorbidity of pervasive developmental disorder and attention deficit hyperactivity disorder: results of a retrospective chart review. *J Autism Dev Disord*. 2004;34(3):329–339
9. Klassen AF, Miller A, Fine S. Health-related quality of life in children and adolescents who have a diagnosis of attention-deficit/hyperactivity disorder. *Pediatrics*. 2004;114(5). Available at: www.pediatrics.org/cgi/content/full/114/5/e541
10. Bastiaansen D, Koot HM, Ferdinand RF, Verhulst FC. Quality of life in children with psychiatric disorders: self, parent, and clinician report. *J Am Acad Child Adolesc Psychiatry*. 2004;43(2):221–230
11. Lord C, Risi S, Lambrecht L, et al. The autism diagnostic observation schedule-generic: a standard measure of social and communication deficits associated with the spectrum of autism. *J Autism Dev Disord*. 2000;30(3):205–223
12. DSM-IV Checklist developed specifically for the Autism Treatment Network based on DSM-IV-TR criteria for Pervasive Developmental Disorders.
13. Achenbach T, Rescorla L. *Child Behavior Checklist*. Burlington, VT: ASEBA; 2000
14. Sparrow SS, Cicchetti DV, Balla DA. *Vineland Adaptive Behavior Scales*. 2nd ed. Circle Pines, MN: AGS Publishing; 2005
15. Mullen E. *Mullen Scales of Early Learning: AGS Edition*. Circle Pines, MN: American Guidance Systems; 1995
16. Varni JW, Seid M, Kurtin PS. PedsQL 4.0: reliability and validity of the Pediatric Quality of Life Inventory version 4.0 generic core scales in healthy and patient populations. *Med Care*. 2001;39(8):800–812
17. Roid G. *Stanford-Binet Intelligence Scale*. 5th ed. Chicago, IL: Riverside; 2003
18. Cuffe SP, Moore CG, McKeown RE. Prevalence and correlates of ADHD symptoms in the national health interview survey. *J Atten Disord*. 2005;9(2):392–401
19. Fein D, Dixon P, Paul J, Levin H. Brief report: pervasive developmental disorder can evolve into ADHD: case illustrations. *J Autism Dev Disord*. 2005;35(4):525–534
20. Gadow KD, DeVincent CJ, Pomeroy J. ADHD symptom subtypes in children with pervasive developmental disorder. *J Autism Dev Disord*. 2006;36(2):271–283
21. Yerys BE, Wallace GL, Sokoloff JL, Shook DA, James JD, Kenworthy L. Attention deficit/hyperactivity disorder symptoms moderate cognition and behavior in children with autism spectrum disorders. *Autism Res*. 2009;2(6):322–333
22. Lecavalier L, Leone S, Wiltz J. The impact of behaviour problems on caregiver stress in young people with autism spectrum disorders. *J Intellect Disabil Res*. 2006;50(pt 3):172–183
23. Baker BL, Blacher J, Olsson MB. Preschool children with and without developmental delay: behaviour problems, parents' optimism and well-being. *J Intellect Disabil Res*. 2005;49(pt 8):575–590
24. de Bildt A, Sytema S, Kraijer D, Sparrow S, Minderaa R. Adaptive functioning and behaviour problems in relation to level of education in children and adolescents with intellectual disability. *J Intellect Disabil Res*. 2005;49(pt 9):672–681
25. Derks EM, Hudziak JJ, Dolan CV, Ferdinand RF, Boomsma DI. The relations between DISC-IV DSM diagnoses of ADHD and multi-informant CBCL-AP syndrome scores. *Compr Psychiatry*. 2006;47(2):116–122
26. Steinhausen HC, Winkler Metzke C, Meier M, Kannenberg R. Behavioral and emotional problems reported by parents for ages 6 to 17 in a Swiss epidemiological study. *Eur Child Adolesc Psychiatry*. 1997;6(3):136–141
27. Chen WJ, Faraone SV, Biederman J, Tsuang MT. Diagnostic accuracy of the Child Behavior Checklist scales for attention-deficit hyperactivity disorder: a receiver-operating characteristic analysis. *J Consult Clin Psychol*. 1994;62(5):1017–1025
28. Pandolfi V, Magyar CI, Dill CA. Confirmatory factor analysis of the child behavior checklist 1.5-5 in a sample of children with autism spectrum disorders. *J Autism Dev Disord*. 2009;39(7):986–995
29. Achenbach TM, Rescorla LA. *Manual for the ASEBA Pre-school Forms and Profiles*. University of Vermont. Burlington, VT: Research Center for Children, Youth and Families; 2000
30. Posner K, Melvin GA, Murray DW, et al. Clinical presentation of attention-deficit/hyperactivity disorder in preschool children: the Preschoolers with Attention-Deficit/Hyperactivity Disorder Treatment Study (PATS). *J Child Adolesc Psychopharmacol*. 2007;17(5):547–562

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