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

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. 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 al 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. 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). Klin et al 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 al 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, Murray 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 Schwebach 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 Miller 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.

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) or DSM-IV symptom checklist; (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), 3086 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) 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 problem 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) 4.0β6 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, 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
**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 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%).

**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.2021 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>
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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 (PPV) of 1.00 for boys, 0.67 for girls; negative predictive value of 0.86 for boys, 0.95 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 PPV 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 PPV 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.

ACKNOWLEDGMENTS

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