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ORIGINAL PAPER

Anxiety and Depression Symptoms in Children with Asperger Syndrome Compared with Attention-Deficit/Hyperactivity Disorder and Depressive Disorder

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Abstract The objective of this study was to examine (a) anxiety and depression symptoms in children with Asperger syndrome (AS) compared to children with attention-deficit/hyperactivity disorder (ADHD) and children with depressive disorder; (b) parental anxiety and depressive symptoms in the three groups; and (c) the association between the anxiety and depression symptoms of children and their parents. The emotional and behavioral problems of 56 children with AS (48 boys, 8 girls, mean age, 9.39 ± 2.01 years) were compared with 56 ADHD children and 56 depressive disorder children, matched for age and sex. Their parents' anxiety and depression symptoms were also compared. Trait-anxiety and internalizing problems in AS children were higher than those in ADHD children and as high as those in depressive disorder children ($F = 8.83$, $p < 0.001$ and $F = 8.21$, $p < 0.001$). Parents' anxiety and depression symptoms did not differ among the three groups, but correlations between maternal anxiety and depression and children's emotional and behavioral problems were most prominent in the AS group. We suggest that the assessment and treatment of children with AS should involve detailed assessment, possible concomitant treatment for comorbid anxiety and depression, and parental education about the effect of parental emotional states on children.

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Introduction

Asperger syndrome (AS), as defined in the ICD-10 (World Health Organization 1992), refers to a pervasive developmental disorder in which there are autistic-like abnormalities in reciprocal social interaction and patterns of behavior and interests, without clinically significant delays in spoken or receptive language or cognitive development.

There is growing evidence that people with AS and high-functioning autism are at high risk of associated psychiatric disorder, particularly anxiety and depression (Farrugia and Hudson 2006; Ghaziuddin et al. 1998; Gillott et al. 2001; Green et al. 2000; Kim et al. 2000; Kuusikko et al. 2008; Mattila et al. 2010; Stewart et al. 2006). Both self- and parental reports showed that adolescents with AS had significantly higher levels of anxiety than adolescents in the general population (Farrugia and Hudson 2006; Kim et al. 2000). Gillott et al. (2001) found that children with high-functioning autism reported significantly higher anxiety levels than typically developing (TD) children; however, when compared to the clinically anxious population, children with high-functioning autism reported lower anxiety levels. Studies using structured clinical interview also found high levels of anxiety disorders in AS. For example, Green et al. (2000) reported that 65 % of adolescents with AS and 20 % of those with conduct disorder had emotional disorders, and Mattila et al. found that 42 % of the children and adolescents with AS and high-functioning autism met full criteria for at least one anxiety disorder. The rates of depression among individuals with AS and autism vary widely from study to study (Stewart

et al. 2006), with the highest being 34 % (Ghaziuddin et al. 1998).

There are several hypotheses about the origins of anxiety and depression symptoms in AS. Generally, anxiety and depression in childhood and adolescence are associated with temperament or traits such as behavioral inhibition to the unfamiliar (Feng et al. 2008; Fox et al. 2005; Ollendick and Hirshfeld-Becker 2002), psychosocial distress or poor coping skills (Costello et al. 2002). Because abnormal reactions, such as "excessive fearfulness in response to harmless objects" and "sensory over-responsivity", are included as associated features of autistic disorder in the DSM-IV (American Psychiatric Association 2000), these anxious temperaments may play an important role in the high level of anxiety disorders in AS (Green and Ben-Sasson 2010; Pfeiffer et al. 2005). Social impairments and lack of close relationships may also make individuals with AS vulnerable to secondary affective symptoms that are similar to those that can arise in other socially impaired individuals (e.g., those with ADHD and conduct disorder) (Bachevalier and Loveland 2006; Green et al. 2000; Wing 1981). In addition to innate temperament and social difficulties and distress, parental depressive and anxiety levels could affect a child's affective symptoms via both genetic and parenting factors (Downey and Coyne 1990; Feng et al. 2008; Forbes et al. 2006; Lieb et al. 2000; Ollendick and Hirshfeld-Becker 2002). For example, behavioral inhibition as well as anxiety and depressive disorders have genetic components, and parents with high levels of anxiety and depression symptoms could model anxious responses and negative thinking styles.

To determine which hypothesis best explains the high prevalence of anxiety and depressive disorders in children with AS, it is necessary to differentiate trait anxiety, which reflects innate temperament, and state anxiety, which reflects acquired characteristics. It is also necessary to examine the effect of parental mood symptoms. However, none of previous studies differentiated between the trait-anxiety and state-anxiety of AS children or examined the association between anxiety and depression symptoms of AS children and their parents. In addition, most of the studies cited above did not differentiate the AS from high-functioning autism (Gillott et al. 2001; Kim et al. 2000; Kuusikko et al. 2008; Mattila et al. 2010; Stewart et al. 2006;).

Therefore, it seems appropriate for us to study trait anxiety, state anxiety, and depression symptoms among children with AS and their parents as well as the relationship between children's emotional and behavioral problems and parental affective symptoms. We used two comparison groups, a group of children with ADHD and a group of children with depressive disorder, who also experienced social difficulty and who were vulnerable to secondary or comorbid affective/anxiety symptoms (Costello et al. 2002; Jensen et al. 1997). The rate of anxiety disorders among children with depressive disorder has been estimated to range from 15.9 to 61.9 % (Brady and Kendall 1992; Ford et al. 2003). The prevalence of anxiety disorders comorbid with ADHD is as high as 50 % (Mancini et al. 1999), and the rate of major depressive disorder among children with ADHD has been estimated to range from 10 to 30 % (Biederman et al. 1992: Bird et al. 1993: Pliszka et al. 1999). A group of children with depressive disorder was selected as a comparison group to determine whether the level of anxiety/depression among children with AS is comparable to a clinically depressive population, and a group of children with ADHD was selected to examine whether the affective/anxiety symptoms of children with AS are mainly associated with anxious temperament related to the AS disorder or are secondary to social difficulty and distress, similar to children with ADHD. Anxiety and depression in ADHD often occur due to an inability to function in daily life because of social and cognitive limitations associated with ADHD, rather than typical development of internalizing symptoms associated with temperament (Daviss 2008; Jensen et al. 1997).

Our purpose was to answer the following questions:

1. Are the levels of trait-anxiety, state-anxiety, and depression in children with AS higher than or as high as those in children with ADHD and children with depressive disorder?
2. Do the parents of the children in the three diagnostic groups differ significantly in their levels of anxiety and depression? Is there a correlation between any of these parental factors and children's emotional and behavioral problems in each group?

Method

Subjects

Our psychiatric outpatient clinic is in a general hospital located in Seongnam city, a mid-sized city near Seoul, Korea. As part of a thorough clinical evaluation, we administered several psychiatric symptom rating scales to patients and their parents at their first visit to the outpatient clinic.

Patients aged 6–13 years at their first visit, who were diagnosed with AS based on the International Classification of Disease 10th revision (ICD-10) (F84.5) (World Health Organization 1992) and visited the psychiatric outpatient clinic from 2006 to 2010, were identified from electronic medical records and initially included in the study. Two board certified child psychiatrists reviewed the subjects'

electronic medical records and ascertained psychiatric diagnosis based on the ICD-10. They also obtained information regarding patients' Intellectual Quotients (IQs) and scores on several psychiatric symptom rating scales from electronic medical records.

Among the 184 patients initially included, 56 AS children (without ADHD or depressive disorder) with normal intelligence (IQ > 70) and sufficient information on psychiatric symptom rating scales and whose diagnosis was ascertained by both two board certified psychiatrists were finally selected. The subjects consisted of 48 males (85.7 %) and 8 females (14.3 %). We only selected patients aged 6–13 years because different scales were administered according to the patients' age ranges [e.g., Children's Depression Inventory (CDI) for children and younger adolescents and Beck Depression Inventory (BDI) for older adolescents].

As comparison groups, 56 age- and sex-matched children with ADHD and 56 age- and sex-matched children with depressive disorder were randomly selected from patients who visited the outpatient clinic from 2006 to 2010. The ADHD group was diagnosed with hyperkinetic disorder based on the ICD-10 (F90), as ascertained by a board certified psychiatrist who has substantial clinical experience on a child and adolescent psychiatry for more than ten years, based on electronic medical records, and did not have a diagnosis of pervasive developmental disorder or depressive disorder. The depressive disorder group was diagnosed with depressive disorder based on the ICD-10 (F32–F33), as ascertained by a board certified psychiatrist who has substantial clinical experience on a child and adolescent psychiatry for more than ten years, based on electronic medical records, and did not have a diagnosis of pervasive developmental disorder or ADHD.

Procedures

We retrospectively investigated the scores of these psychiatric symptoms rating scales and other clinical information by reviewing the subjects' electronic medical records. This review of electronic medical records and ascertainment of diagnosis was undertaken for the current study. Children in the comparison groups also had normal intelligence and sufficient information on psychiatric symptom rating scales. The study was approved by the institutional review board (IRB) for human subjects at the Seoul National University Bundang Hospital.

Measures

The children's internalizing symptoms were measured using the Child Behavior Checklist (CBCL), the Children's Depression Inventory (CDI), and the State-Trait Anxiety Inventory for Children (STAIC), and their parents' depression and anxiety were measured using the Beck Depression Inventory (BDI) and the State-Trait Anxiety Inventory (STAI). Their IQs were measured by the Korean Educational Development Institute Wechsler Intelligence Scale for Children-Revised (KEDI-WISC-R).

The KEDI-WISC-R (Park et al. 1991) consists of 5 verbal subtests, including Information, Similarities, Arithmetic, Vocabulary, and Comprehension, and 6 performance subtests, including Digit Span, Picture Completion, Picture Arrangement, Block Design, Object Assembly, and Digit Symbol/Coding. The IQ was calculated based on Korean age norms.

The Child Behavior Checklist (CBCL) (Achenbach 1991), which has been translated into Korean, was used to investigate several domains of psychopathology. The CBCL is a parent-report questionnaire on which the child is rated on various behavioral and emotional problems. The reliability and validity of the Korean version of the CBCL (K-CBCL) are well-established in Korean children and adolescents (Oh et al. 1997). It assesses internalizing (i.e., anxious, depressive, and overcontrolled) and externalizing (i.e., aggressive, hyperactive, noncompliant, and undercontrolled) behaviors. Several subareas are measured including social withdrawal, somatic complaints, anxiety and depression, social problems, thought problems, attention problems, delinquent behavior, and aggressive behavior. The K-CBCL score was computed based on Korean normative samples, with the total problem behavior score computed by summing the scores obtained for each item (Oh et al. 1997).

The CDI consists of 27 self-rating questions, with a Likert scale of 0 (not present) to 2 (present and marked) and a total score ranging from 0 to 54 (Kovacs 1985). The item domains include negative mood, interpersonal problems, negative self-esteem, ineffectiveness, and anhedonia. The Korean version of the CDI was standardized by Cho and Lee (1990), and its validity and reliability in Korean have been well established (Cho and Lee 1990). A total score of 29 is considered the cutoff point for severe depressive symptoms in the Korean version.

The STAIC consists of two 20-item scales that measure the level of anxiety in children (Spielberger 1972). The State-Anxiety Inventory for Children (STAIC-S) asks the subjects to describe how they feel at the present time and how their anxiety increases in response to situational stress and declines under relaxed conditions. The Trait-Anxiety scale for Children (STAIC-T) asks the subjects to describe how they generally feel and measures relatively stable individual differences in anxiety proneness. The total score ranges from 20 to 60 for the 20 questions of each scale (STAIC-S and STAIC-T). The Korean version of the STAIC was standardized by Cho and Choi (1989).

The BDI consists of 21 items that measure the subjective severity of depression and emotional, cognitive, motivational, and physiological symptoms of depression (Beck et al. 1961). Each question has a set of 4 possible answer choices, ranging in intensity, with each answer scored on a scale value of 0 (no symptom) to 3 (the most severe symptom). Accordingly, the total score ranges from 0 to 63. In Korea, Han et al. (1986) conducted a standardization study. The STAI consists of two 20-item scales that measure the level of anxiety in adults. The State-Anxiety Inventory (STAI-S) measures the temporary condition of state-anxiety, and the Trait Anxiety Inventory (STAI-T) measures relatively stable individual differences (Spielberger et al. 1983). The total score ranges from 20 to 80 for the 20 questions of each scale (STAI-S and STAI-T). The Korean version of the STAI was standardized by Lee et al. (1996).

Statistical Analysis

Group differences in scores on psychiatric symptom rating scales were computed using a one-way analysis of variance (ANOVA). In the second stage, the analyses of covariance (ANCOVA) test was used to determine whether scores on children's psychiatric symptom rating scales are significantly different among the three groups when adjusted for possible confounders (age, gender, and IQ). In the third stage, we conducted Pearson correlation analyses to investigate the correlates of anxiety and depression in each group. In the fourth state, we conducted hierarchical regression analyses to explore independent correlates of emotional and behavioral symptoms in children with AS.

All statistical analyses were performed using SPSS (version 12.0; SPSS Inc., Chicago, IL), with statistical significance defined as an alpha level <0.05.

Results

The mean age was 9.39 years (SD: 2.01) in all three groups, and there was no significant group difference in IQs (Table 1). The mean and standard deviation of the CDI, STAIC-T, STAIC-S, and CBCL scores are shown in Table 1 for each group. The three groups were significantly different on the CDI ($F = 7.86$, $p = 0.001$), STAIC-T ($F = 8.83$, $p < 0.001$) and withdrawal ($F = 4.81$, $p < 0.001$), anxiety/depression ($F = 6.22$, $p = 0.003$), social problems ($F = 11.75$, $p < 0.001$), thought problems ($F = 8.13$, $p < 0.001$), internalizing problems ($F = 8.21$, $p < 0.001$), and externalizing problems ($F = 4.26$, $p = 0.016$) of the CBCL. Post hoc Tukey HSD revealed that the AS group had significantly higher STAIC-T ($p = 0.024$), withdrawal ($p = 0.016$), anxiety/depression ($p = 0.014$), thought problems ($p < 0.001$), and internalizing problems ($p = 0.008$) scores and significantly lower externalizing problems ($p = 0.016$) than the ADHD group and significantly higher social problems scores than both the ADHD ($p < 0.001$) and depressive disorder ($p = 0.003$) groups.

The ANCOVA revealed that group difference in the STAIC-T ($F = 6.09$, $p = 0.003$), anxiety/depression ($F = 7.18$, $p = 0.001$), social problems ($F = 9.73$, $p < 0.001$), thought problems ($F = 7.08$, $p = 0.001$), and internalizing problems ($F = 8.06$, $p = 0.001$) scores persisted at an alpha level <0.01 after the adjustment for age, gender, and IQs. Group differences in the CDI ($F = 2.56$, $p = 0.082$) and withdrawal ($F = 4.68$, $p = 0.011$) scores disappeared after the adjustment for age, gender, and IQs.

The ANOVA revealed that there were no significant group differences in the parental BDI, STAI-T, and STAI-S scores (data not shown, but available on request).

Table 2 shows the correlations between the children's psychopathologies and their age and IQs and parental psychopathology in the AS group. To provide some control for type I error, we report only correlations that were significant at a probability level of $p < 0.01$ in the correlation analyses. The CDI score of the AS group was positively correlated with IQ ($r = 0.44$, $p = 0.009$). The social problems score of the AS group was positively correlated with age ($r = 0.45$, $p = 0.001$). The anxiety/depression score of the AS group was positively correlated with maternal STAI-T score ($r = 0.43$, $p = 0.002$). The inattention score of the AS group was positively correlated with maternal STAI-T and STAI-S scores ($r = 0.55$, $p < 0.001$ and $r = 0.61$, $p < 0.001$, respectively). The aggressive behavior, internalizing problems, externalizing problems, and total behavioral problems scores of the AS group were positively correlated with maternal BDI ($r = 0.39$, $p = 0.006$; $r = 0.37$, $p = 0.009$; $r = 0.38$, $p = 0.007$ and $r = 0.39$, $p = 0.006$, respectively), STAI-T ($r = 0.47$, $p = 0.001$; $r = 0.47$, $p = 0.001$; $r = 0.44$, $p = 0.001$, and $r = 0.52$, $p < 0.001$, respectively), and STAI-S ($r = 0.52$, $p < 0.001$; $r = 0.42$, $p = 0.002$; $r = 0.48$, $p < 0.001$, and $r = 0.47$, $p = 0.001$, respectively).

The delinquent behavior and externalizing problems scores of the ADHD group were positively correlated with maternal BDI ($r = 0.39$, $p = 0.009$ and $r = 0.44$, $p = 0.003$, respectively) and STAI-T ($r = 0.45$, $p = 0.003$ and $r = 0.40$, $p = 0.008$, respectively) scores, and the total behavioral problems scores of the ADHD group were positively correlated with maternal STAI-S score ($r = 0.39$, $p = 0.010$).

The inattention score of the depressive disorder group was negatively correlated with IQ ($r = -0.50$, $p = 0.005$), and the aggressive behavior and externalizing problems

Table 1 Comparison of children with Asperger syndrome, attention-deficit/hyperactivity disorder, and depressive disorder

	AS (n = 56) Mean (SD)	ADHD (n = 56) Mean (SD)	DD (n = 56) Mean (SD)	F	*p*	Post hoc
Children's IQ	114.11 (17.40)	109.04 (14.33)	107.97 (16.04)	1.91	0.151	
CD I	13.64 (5.64)	14.27 (7.02)	18.72 (7.66)	7.86	0.001**	DD > ADHD, AS
STAIC-T	36.12 (8.84)	31.78 (6.69)	38.15 (8.07)	8.83	<0.001***	DD, AS > ADHD
STAIC-S	32.02 (8.31)	32.91(7.57)	34.48 (7.24)	0.61	0.545	
CBCL						
Withdrawal	66.17 (11.51)	58.98 (13.71)	65.57 (13.43)	4.81	0.009**	DD, AS > ADHD
Somatization	53.42 (7.37)	52.92 (8.66)	56.22 (9.69)	2.05	0.133	
Anxiety/depression	63.72 (11.58)	57.94 (8.77)	64.59 (9.87)	6.22	0.003**	DD, AS > ADHD
Social problems	69.94 (10.54)	60.70 (9.13)	63.20 (10.34)	11.75	<0.001***	AS > DD, ADHD
Thought problems	62.92 (8.46)	56.06 (8.69)	61.20 (9.67)	8.13	<0.001***	DD, AS > ADHD
Inattention	63. 45 (8.45)	64.00 (8.57)	61.70 (9.21)	0.90	0.407	
Delinquent behavior	54.58 (8.45)	57.88 (1.37)	56.89 (8.47)	1.62	0.201	
Aggressive behavior	57.62 (10.09)	62.50 (10.88)	61.41 (10.94)	3.00	0.053	
Internalizing problems	63.09 (9.76)	57.16 (9.26)	64.87 (10.56)	8.21	<0.001***	DD, AS > ADHD
Externalizing problems	56.87 (9.47)	62.56 (10.85)	60.94 (10.32)	4.26	0.016*	ADHD > AS
Total behavior problems	62.36 (8.41)	61.04 (8.84)	63.76 (8.37)	1.21	0.300	

ADHD attention-deficit/hyperactivity disorder, *IQ* Intellectual quotient, *CDI* Children's Depression Inventory, *STAIC-T* Trait-Anxiety Inventory for Children, *STAIC-S* State-Anxiety Inventory for Children, *CBCL* Child Behavior Checklist

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 2 Correlation coefficients between children's psychopathology and age, IQ, and parental emotional symptoms in children with Asperger syndrome

	Age	IQ	Paternal BDI	Paternal STAI-T	Paternal STAI-S	Maternal BDI	Maternal STAI-T	Maternal STAI-S
CD I	−0.11	0.44**	−0.25	−0.28	−0.26	0.19	0.08	0.05
STAIC-T	−0.14	0.42*	−0.15	−0.28	−0.24	0.23	0.30	0.24
STAIC-S	−0.08	0.41*	−0.24	−0.32	−0.18	0.20	0.25	0.26
Withdrawal	0.29*	0.16	0.08	0.09	0.01	0.24	0.22	0.17
Somatization	−0.11	0.07	0.07	−0.07	0.09	0.32*	0.36*	0.34*
Anxious/depressed	0.28*	0.24	−0.10	−0.08	−0.16	0.28	0.43**	0.35*
Social problems	0.45**	−0.12	−0.05	−0.08	−0.03	0.08	0.22	0.20
Thought problems	0.05	−0.11	0.02	0.05	0.09	0.11	0.32*	0.30*
Inattention	0.13	−0.30	0.20	0.16	0.24	0.32*	0.55***	0.61***
Delinquent behavior	−0.04	0.18	0.10	0.24	0.18	0.21	0.25	0.18
Aggressive behavior	−0.12	0.18	0.11	0.11	0.13	0.39**	0.47**	0.52***
Internalizing problems	0.27	0.21	−0.08	−0.08	−0.11	0.37**	0.47**	0.42**
Externalizing problems	−0.12	0.20	0.13	0.14	0.14	0.38**	0.44**	0.48***
Total behavior problems	0.20	0.16	0.00	0.04	0.04	0.39**	0.52***	0.47**

IQ Intellectual quotient, *CDI* Children's Depression Inventory, *STAIC-T* Trait-Anxiety Inventory for Children, *STAIC-S* State-Anxiety Inventory for Children, *CBCL* Child Behavior Checklist, *BDI* Beck Depression Inventory, *STAI-T* Trait-Anxiety Inventory, *STAI-S* State-Anxiety Inventory

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

scores of the depressive disorder group were positively correlated with maternal STAI-S score (r = 0.41, $p = 0.007$, and r = 0.40, $p = 0.008$, respectively).

The other correlations were not significant at a probability level of $p < 0.01$ in the ADHD or depressive disorder group (data not shown but available on request).

Table 3 Hierarchical regression analysis of psychopathology of AS children as a function of the level of parental emotional symptoms, controlling for age and IQ

	STAIC-T	STAIC-S	Anxious/ depressed	Social problems	Thought problems	Inattention	Aggressive behaviors	Internalizing problems	Externalizing problems	Total behavior problems
Step1: R^2 *change*	0. 17	0.21	0.18*	0.13	0.03	0.14	0.04	0.14	0.04	0.07
Age	0.05	0.22	0.46**	0.63**	−0.02	0.11	−0.24	0.46**	0.23	0.42*
IQ	0.45*	0.47*	0.46**	0.09	−0.05	−0.21	0.25	0.42*	0.27	0.38*
Step2: R^2 *change*	0.19	0.31*	0.38***	0.22*	0.30*	0.51***	0.48***	0.36**	0.45*	0.51***
Maternal BDI	−0.33	−0.26	−0.36	−0.17	−0.37	−0.19	−0.21	−0.19	−0.19	−0.24
Maternal STAI-T	0.17	−0.26	0.63*	0.19	0.71*	0.22	0.30	0.47	0.32	0.56*
Maternal STAI-S	0.58	0.89**	0.38	0.45	0.08	0.69**	0.64*	0.41	0.58*	0.44
Step3: R^2 *change*	0.14	0.06	0.08	0.06	0.02	0.01	0.03	0.06	0.03	0.02
Paternal BDI	0.01	0.01	−0.12	−0.06	−0.17	−0.04	−0.20	−0.12	−0.20	−0.09
Paternal STAI-T	0.48	−0.18	0.12	−0.44	−0.11	−0.14	0.14	−0.08	0.19	−0.06
Paternal STAI-S	−0.80	−0.08	−0.36	0.36	0.14	0.14	−0.17	−0.15	−0.19	−0.04

Chindren's Depression Inventory, withdrawal, somatization, and delinquent behavior scores were not associated with any explanatory variables at a probability level of $p < 0.05$ in the hierarchical regression analyses; therefore, they are not shown in the table

IQ Intellectual quotient, *BDI* Beck Depression Inventory, *STAI-T* Trait-Anxiety Inventory, *STAI-S* State-Anxiety Inventory, *STAIC-T* Trait-Anxiety Inventory for Children, *STAIC-S* State-Anxiety Inventory for Children

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

A hierarchical regression analysis was performed to explore emotional and behavioral symptoms in AS children with the level of parental emotional symptoms after controlling for age and IQ (Table 3). We entered children's age and IQ in the first step of the model. Maternal scores on the CDI, STAI-T, and STAI-S were entered in the second step, and paternal scores on the CDI, STAI-T, and STAI-S were entered in the third step. Within each block, the variables were entered simultaneously. The R^2-change values are reported for each step, and standardized regression coefficients are reported for the final step. The results of hierarchical regression analyses were generally consistent with the results of Pearson's correlation analyses. One significant finding was that the level of maternal anxiety was not significantly correlated with the level of self-reported anxiety in Pearson's correlation analyses but was significantly associated with the level of self-reported trait anxiety ($\beta = 0.58$, $p < 0.05$) and state anxiety ($\beta = 0.89$, $p < 0.01$) in regression analyses.

Discussion

Our major finding is that the self-reported trait anxiety and parent-reported internalizing problems, including anxiety and depression, of AS children were higher than those of the ADHD children and were as high as those of children with depressive disorder, suggesting the clinical significance of these symptoms in AS. The anxiety and depression symptoms of the parents of the AS group did not differ from those of the ADHD and depressive disorder groups, but correlations between maternal anxiety and depression and children's emotional and behavioral problems were most prominent in the AS group. In particular, maternal state anxiety was associated with self-reported anxiety as well as parent-reported anxiety/depression in children with AS.

In the self-reported scales, the three groups did not differ on levels of state-anxiety, but the depressive disorder group and AS group showed higher levels of trait-anxiety than the ADHD group. These results suggest that the emotional problems of AS may be partially attributed to these children's anxious temperaments, similar to children with depressive disorder (Sportel et al. 2011), whereas the emotional problems of children with ADHD may be secondary to negative feedback from others due to their behavioral problems rather than to temperamental characteristics (Daviss 2008).

As expected, children with AS showed significantly more social problems than the comparison groups in the parent-reported scale. In addition, withdrawal, anxiety/depression, thought problems, and internalizing problems of children with AS were higher than those of children with ADHD and comparable to those of children with depressive disorder. These results were consistent with findings of higher anxiety and depression symptoms in the AS group compared to typically developing controls (Farrugia and Hudson 2006; Meyer et al. 2006), a conduct disorder group (Green et al. 2000), and an anxiety disorder group (Farrugia and Hudson 2006). Comparing self-reported and parent-reported anxiety and depression symptoms, the AS group reported significantly higher state-anxiety/depression than the ADHD group in the parental report, but not in the children's report. Due to children with AS' poor insight and limited emotional expression, self-reported emotional problems may be under-reported. Externalizing problems, including delinquent behavior and aggressive behavior, were lower in the AS group compared to the depressive disorder and ADHD groups.

The positive correlation between IQ and self-reported anxiety and depression symptoms may reflect the greater insight about their social abnormality and greater recognition of inner emotion of children with higher IQs (Nelson et al. 2009). Previous studies also reported that higher IQs are associated with more anxiety and depression symptoms (Gadow et al. 2005; Sukhodolsky et al. 2008), but these studies included subjects with AS and other autistic disorders as well as intellectually disabled and normal intelligence subjects. We extend the previous results by revealing the correlation between higher IQ and higher anxiety and depression symptoms in AS children with normal intelligence.

Maternal anxiety and depression symptoms were positively correlated with the parent-reported emotional and behavioral problems of children with AS. These correlations could be due to that anxious and depressed mothers evaluated their children more negatively. However, in the ADHD and depressive disorder groups, these correlations were only found for children's externalizing problems, not for internalizing problems, whereas in the AS group, these correlations were found both for children's externalizing problems and for internalizing problems. These results suggest that the correlations between maternal anxiety and depression and the internalizing problems of AS children are not entirely due to biased parental reports. In addition, maternal state anxiety was associated with self-reported anxiety as well as parent-reported anxiety/depression in a regression analysis of children with AS.

We propose several explanations for the observed associations. First, anxious and depressed mothers may be limited in their ability to help their children cope with social difficulties or join social groups. For example, in a study observing family discussions about how to cope with ambiguous social situations, Barrett et al. (1996) found that parents of children with anxiety disorders were more likely to influence children to adopt more avoidant strategies.

Such parental effects may be common in the three diagnostic groups but more prominent in the AS group with the highest social difficulties and lowest coping skills. Inversely, the emotional and behavioral problems of children with AS may increase maternal anxiety and depression symptoms (Allik et al. 2006; Wolf et al. 1989; Yamada et al. 2007). Mothers of children with ADHD and children with depressive disorder have also been shown to experience higher emotional stress and be more affected by their children's behavioral problems and symptom severity (Johnston and Mash 2001; Nelson et al. 2009; Pelham and Lang 1999; Podolski and Nigg 2001). However, in the current study, the correlation between the internalizing problems of children and the emotional states of their mothers was only found in the AS group. Because we cannot explain the reason for this discrepancy between groups, we support the prior explanation that anxious and depressed mothers affect their children's internalizing problems, which are most prominent in the AS group. Another explanation is a genetic association between children's and parent's anxious temperaments. However, the non-association between scores on the STAIC-T of children and the STAI-T of their parents in any diagnostic group does not support this explanation. In addition, the observed results that the level of trait-anxiety was higher in AS children than ADHD children but was not different in the parents of the two groups suggest that anxious temperament in children with AS is disease-related rather than inherited from their parents. The present results that children's emotional and behavioral problems were correlated with maternal emotional state but not with paternal emotional state is also suggestive of an environmental effect rather than a genetic effect because mothers tend to be more involved in the care of their children than fathers (Milgram and Atzil 1988).

Several limitations may have influenced our findings. First, the study employed a retrospective methodological design. As with most retrospective studies, there were no standardized procedures for arriving at diagnoses. In addition, because data were gathered from electronic medical charts, without data from face-to-face interviews, some important information may not have been available. Second, the work was cross-sectional in design, making it impossible to identify a causal relationship between parental anxiety and depression symptoms and their children's emotional and behavioral problems. Third, we included only the subjects with sufficient information among the AS children who visited our outpatient clinic in the study period and randomly selected age- and sex-matched comparison groups; therefore, the sample is not representative of the outpatient clinic. Finally, the small number of cases reviewed may have reduced the likelihood of finding statistical significance.

Despite these considerations, we extended the findings of prior studies by examining a homogenous group of AS children with normal intelligence, using other socially impaired individuals as comparison groups, and examining parental anxiety and depression symptoms and their correlations with AS children's emotional and behavioral problems. In terms of clinical implications, we suggests that the assessment and treatment of children with AS should involve detailed assessment, possible concomitant treatment for comorbid anxiety and depression, and parental education about the effect of parental emotional states on children.

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