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Obsessions and Compulsions are Strongly Associated with Anxiety and Depressive Symptoms in Childhood and Adolescent Autism Spectrum Disorder

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Abstract

Background

Autism spectrum disorder (ASD) is highly comorbid with obsessive-compulsive disorder (OCD) in children. Although the association between obsessions and compulsions (OC) and anxiety and depressive symptoms has been acknowledged, some researchers maintain that in individuals with ASD, OC are less related to anxiety symptoms. The purpose of this study was to examine correlations between OC and other factors, including anxiety and depressive symptoms, in both ASD and non-ASD groups.

Methods

We assessed a referral sample of 138 children (aged 9-15 years, 41.3% male). Multiple regression analyses were performed separately for the ASD group and the non-ASD group to examine correlations between OC (as measured by the Leyton Obsessional Inventory-Child Version) and age, sex, socioeconomic status, OCD, attention deficit hyperactivity disorder (ADHD), chronic tic disorder (CTD), Tourette's syndrome (TS), scores on the State-Trait Anxiety Inventory for Children, and scores on the Birleson Depression Self-Rating Scale for Children.

Results

Multiple regression analyses revealed that anxiety, depression, and OCD were significantly related to OC in both the ASD and the non-ASD groups. ADHD, CTD, and TS were not related to OC.

Conclusions

Our findings suggest that OC are associated with anxiety and depressive symptoms, regardless of the presence of ASD.

Key Words: Autism Spectrum Disorder; Obsessive-compulsive Disorder; Anxiety; Depression

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Introduction

Autism spectrum disorder (ASD) is characterized by substantial impairment in social communication and social interactions across multiple contexts and by restricted, repetitive patterns of behavior, interests, or activities[1].

One research indicates that obsessions and compulsions (OC) are related to anxiety and depressive symptoms and can lead to isolation and hopelessness[2]. In one 3-year follow-up study of children and adolescents, anxiety and depressive symptoms predicted the severity of OC after follow-up[3]. Although ASD is highly comorbid with obsessive-compulsive disorder (OCD) in children[4,5], some researchers have suggested that, unlike typical OCD patients, patients with ASD appear to enjoy their OC and do not experience anxiety from them[6]. One review suggests that repetitive behavior in children with OCD is provoked by unwanted and bothersome thoughts that cause anxiety. In contrast, repetitive behavior in children with ASD may not cause distress[7]. It has been proposed that individuals with ASD tend not to subjectively evaluate OC as negative (as distressing, unwanted, senseless, and ego-dystonic) and that they might have little awareness about their OC, partially owing to autistic individuals' impaired ability to process and talk about their own internal state of mind[8]. Furthermore, some studies have identified different types of OC between individuals with ASD and those without ASD (non-ASD)[9-14]. OCD and neurodevelopmental disorders such as ASD, attention deficit hyperactivity disorder (ADHD), and tic disorder (TD) may share underlying genetic factors[15]. Therefore, OC in patients with ASD, ADHD, and TD could be attributed to underlying some genetic factors rather than to anxiety and depressive symptoms.

However, many researchers have reported that autistic children and adolescents have a higher prevalence of major depressive disorder and anxiety disorders, including OCD[16-21]. Moreover, as our clinical experience asserts, patients with OCD experience substantial anxiety and depressive symptoms, regardless of the presence of ASD.

As above, difference of association between OC and anxiety and depressive symptoms in ASD and non-ASD is controversial. Hence, we investigated the association between OC and anxiety and depressive symptoms, taking into account factors that has associated with OCD in previous research, such as ADHD, chronic TD (CTD), and Tourette's syndrome (TS). Our aims were 1) to ascertain that anxiety and depressive symptoms are positively correlated with OC regardless of the presence of ASD, 2) to investigate the relationship between OC and other factors such as anxiety, depression, ADHD, CTD, and TS.

Methods

Subjects

The study subjects were 164 elementary or junior high school students aged 9-15 years, who were consecutively referred to the children's psychiatry outpatient clinic of Osaka City University Hospital (Osaka, Japan) between January 2011 and December 2013. The subjects attended the clinic for at least 3 months to be assessed by a trained multidisciplinary team, which included experienced child psychiatrists, a psychologist, and a psychiatric social worker. Children with intellectual disability (n =17) (IQ <70; Wechsler Intelligence Scale for Children-Third Edition; WISC-Ⅲ[22]), children with acute psychotic states (n=5), and children with severe neurological impairments or intractable epilepsy (n=4) were excluded from this study. The WISC-Ⅲ was used to evaluate the intelligence of

all subjects with ASD. For the non-ASD group, we obtained information about academic achievement and daily living skills from parents and teachers. All children with suspected intellectual disability (full IQ <70) were assessed using the WISC-Ⅲ.

The remaining 138 children were divided into two groups, 73 ASD children and 65 non-ASD children. The diagnostic approach for ASD was based on the following three sources: 1) a comprehensive developmental history; 2) the clinician's interview with each child and their parents; and 3) direct observations of the children by two child psychiatrists. A diagnosis of ASD was made using the criteria in the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM 5)[1].

Procedure

We explained to participants the study purpose, procedures, potential risks, and alternatives to participation. We obtained written informed consent from all the children and their parents. The study protocol was reviewed and approved by the Human Subject Review Committee of Osaka City University. The approval number was 2382.

To diagnose comorbid psychiatric disorders, we used the Japanese version of the Schedule for Affective Disorders and Schizophrenia for School-Age Children-Present and Lifetime version (K-SADS-PL-J). This is a semi-structured interview designed to assess current and past episodes of psychopathology in children and adolescents according to DSM-Ⅳ-TR criteria and is administered through interviews with the child and a parent. This diagnostic tool is known for its scrupulousness and high inter-rater reliability[23]. Finally, a multidisciplinary team meeting was held to elucidate the best-estimate diagnosis for all participants once the interviews were completed.

Measures

Individuals who met the inclusion criteria were administered a series of clinical interview and self-report measures, which assessed OC, anxiety, and depressive symptoms. All measures were presented in Japanese and had been validated in that language.

1. Leyton Obsessional Inventory-Child Version (LOI-CV)

The LOI-CV is a self-report 20-item questionnaire that measures the presence or absence (using Yes/No responses) of several obsessive preoccupations and behaviors. Items with a positive response are rated in terms of interference with personal functioning (range 0-3, no interference-interferes a lot)[24]. Therefore, this instrument comprises two subscales: symptom presence (maximum score, 20) and interference (maximum score, 60). The LOI-CV has been shown to be a valid screening instrument for assessing OC in children and adolescents[25]. Internal reliability was high for the total scale (α=0.86)[26]. The LOI-CV showed acceptable internal consistency (α=0.79) in a study of 50 American children and adolescents with OCD[27]. We chose the LOI-CV from several published OC measures because it has been widely used in Japan with community samples and was therefore suitable for our subjects, almost all of whom had not been diagnosed with OCD.

2. The State-Trait Anxiety Inventory for Children (STAIC)

The STAIC is designed to assess state and trait anxiety in children and contains two 20-item scales. The child responds to each item by selecting one of several options. Each subscale score ranges from 20 to 60. The STAIC-State scale asks children how they feel at a particular moment in time; for example, "I feel very nervous, nervous, not nervous". The STAIC-Trait scale asks how they generally feel; for example, "I am shy hardly ever, sometimes, often[28]".

3. The Birleson Depression Self-Rating Scale for Children (DSRS)

The DSRS is a self-rating depression scale for children[29]. Unlike the Children's Depression Inventory (CDI), which was developed from the Beck Depression Inventory for adults, the DSRS was developed in clinical practice with children and makes fewer cognitive demands than the CDI[30,31]. It contains 18 statements. The young person is asked to match these statements to his/her own situation during the last week and to assign an intensity rating (applies "most of the time", "sometimes", or "never"). A score of 2, 1, or 0 is awarded depending on the direction of the statement. Its usefulness in child populations has been demonstrated[32,33].

Statistical analysis

All statistical analyses were performed using SPSS version 22.0 statistical software (SPSS Japan, Inc., Tokyo, Japan). Descriptive data were presented as means, standard deviations, medians, and ranges. Statistical significance was determined using the Mann-Whitney U test or Student's t-test, as appropriate. The chi-square test was used to compare categorical variables. Spearman correlation coefficients were used to test relationships between LOI-CV score, STAIC score, and DSRS score separately for the ASD and the non-ASD groups. To identify the factors associated with LOI-CV score, we conducted separate multiple regression analyses for the ASD group and non-ASD group using LOI-CV score as the dependent variable and age, sex, STAIC total score, DSRS total score, diagnosis of OCD, ADHD, CTD or TS, and parental absence as independent variables. P-values <0.05 (two-sided probability) were deemed to indicate statistical significance.

Results

Table 1 shows the comparison of demographic characteristics of the participants in the ASD and non-ASD groups. Of the 138 children (57 males and 81 females; mean age, 12.7 years), 73 were diagnosed with ASD. The ASD group had a mean age of 12.4 years and contained 40 males (54.8%). The non-ASD group had a mean age of 13.1 years and contained 17 males (26.2%). The ASD group contained a significantly higher proportion of males than the non-ASD group ($\chi^2=11.63$, df=1, p=0.001). There were no significant between-group differences in socioeconomic status (receiving public assistance or not and having a parent absent or not), comorbid rate (for all comorbidities but anorexia nervosa, enuresis, and ADHD), LOI-CV score, and DSRS score. The mean age (p=0.015), the comorbid rate of anorexia nervosa (p=0.011), and STAIC scores were significantly lower in the ASD group than in the non-ASD group. Proportion of males (p=0.001) and comorbid rates of enuresis (p=0.039) and ADHD (p=0.024) were significantly higher in the ASD group than in the non-ASD group.

Table 2 shows between-group comparisons of LOI-CV scores for several variables. LOI-CV total scores were significantly higher in females (p=0.044), the parent-absent group (p=0.004), and the OCD group (p=0.001).

Tables 3 shows correlations between continuous variables in the ASD group and non-ASD group (age, LOI-CV total score, STAIC total score, DSRS score). Both groups showed significant correlations for the same variables (and no significant correlations between age and other variables). LOI-CV score was significantly correlated with STAIC and DSRS scores. STAIC and DSRS scores were highly and significantly correlated (r=0.715 in both groups).

We had planned to use age, sex, STAIC score, DSRS score, diagnosis of OCD, ADHD, CTD or TS, and parental absence as independent variables in the multiple regression analyses. However, because of the high correlation between STAIC total scores and DSRS scores (r=0.715), we were unable to use both these variables as independent variables in the multiple regression analyses owing

Table 1. Participant characteristics

	All (n=138)		ASD group (n=73)		Non-ASD group (n=65)		χ^2/t/U	p
Demographic variables								
Age	12.7 (1.8)	13.2 (8.3-15.8)	12.4 (1.8)	12.7 (8.3-15.8)	13.1 (1.8)	13.3 (9.2-15.8)	2058 [b]	0.015*
Male gender, n (%)	57	(41.3)	40	(54.8)	17	(26.2)	11.634 [c]	0.001*
Socioeconomic status								
Receipt of public assistance, n (%)	7	(5.1)	3	(4.1)	4	(6.2)	0.298 [c]	0.707
Absence of a parent, n (%)	40	(29.0)	20	(27.4)	20	(30.8)	0.19 [c]	0.709
K-SADS-PL-J diagnoses								
Major depressive disorder	24	(17.4)	13	(17.8)	11	(16.9)	0.019 [c]	1.000
Dysthymia	9	(6.5)	3	(4.1)	6	(9.2)	1.479 [c]	0.192
Adjustment disorder	16	(11.6)	5	(6.8)	11	(16.9)	3.404 [c]	0.108
Bipolar disorder	4	(2.9)	2	(2.7)	2	(3.1)	0.014 [c]	0.645
Psychotic disorder not otherwise specified	1	(0.7)	0	(0.0)	1	(1.5)	1.131 [c]	0.471
Panic disorder	8	(5.8)	2	(2.7)	6	(9.2)	2.653 [c]	0.148
Separation anxiety disorder	7	(5.1)	5	(6.8)	2	(3.1)	1.016 [c]	0.447
Social phobia	31	(22.5)	17	(23.3)	14	(21.5)	0.06 [c]	0.841
Specific phobia	13	(9.4)	7	(9.6)	6	(9.2)	0.005 [c]	1.000
Generalized anxiety disorder	25	(18.1)	14	(19.2)	11	(16.9)	0.118 [c]	0.826
Obsessive-compulsive disorder	16	(11.6)	12	(16.4)	4	(6.2)	3.548 [c]	0.068
Posttraumatic stress disorder	1	(0.7)	0	(0.0)	1	(1.5)	1.131 [c]	0.471
Enuresis	5	(3.6)	5	(6.8)	0	(0.0)	4.619 [c]	0.039*
Encopresis	0	(0.0)	0	(0.0)	0	(0.0)		
Anorexia nervosa	29	(21.0)	9	(12.3)	20	(30.8)	7.044 [c]	0.011*
ADHD	24	(17.4)	18	(24.7)	6	(9.2)	5.696 [c]	0.024*
Oppositional defiant disorder	27	(19.6)	18	(24.7)	9	(13.8)	2.554 [c]	0.134
Conduct disorder	20	(14.5)	9	(12.3)	11	(16.9)	0.586 [c]	0.476
Chronic tic disorder or Tourette's syndrome	18	(13.0)	13	(17.8)	5	(7.7)	3.102 [c]	0.127
Chronic motor or vocal tic disorder	13	(9.4)	10	(13.7)	3	(4.6)	3.325 [c]	0.084
Tourette's syndrome	5	(3.6)	3	(4.1)	2	(3.1)	0.105 [c]	1.000
Self-report scores								
LOI-CV total scores	18.8 (13.6)	16 (0-64)	18.7 (12.6)	16 (0-50)	18.9 (14.7)	15 (0.0-64.0)	2315 [b]	0.808
STAIC								
Total scores	77.7 (17.8)	76 (45-67)	74.0 (16.6)	71 (45-112)	81.9 (18.2)	83 (50-111)	1799.5 [b]	0.014*
State scores	35.9 (11.5)	34 (20-40)	33.3 (10.7)	30 (20-56)	38.8 (11.7)	42 (20-60)	1736 [b]	0.006*
Trait scores	41.9 (9.1)	42 (22-38)	40.7 (8.9)	40 (22-60)	43.12 (11.7)	43 (24-57)	1985 [b]	0.098
DSRS total scores	15.4 (6.2)	15 (4-28)	14.6 (5.6)	14 (4-29)	16.4 (6.8)	17 (5-33)	1.782 [a]	0.077

Notes: Values are expressed as mean (SD) and median (range) or n (%). [a] t-test. [b] Mann-Whitney U-test. [c] Chi-square analysis. * $p<0.05$.

Abbreviations: K-SADS-PL-J, The Japanese version of the Schedule for Affective Disorders and Schizophrenia for School-Age Children-Present and Lifetime version; ASD, autism spectrum disorder; ADHD, attention deficit hyperactivity disorder; LOI-CV, Leyton Obsessional Inventory-Child Version; STAIC, State-Trait Anxiety Inventory for Children; and DSRS, Birleson Depression Self-Rating Scale for Children.

Table 2. Comparison of Leyton Obsessional Inventory-Child Version (LOI-CV) scores

		LOI-CV total scores		U	p
		Mean (SD)	Median (range)		
Sex					
Male	n=57	16.2 (12.7)	14 (0-50)	1844.000	0.044*
Female	n=81	20.6 (14.0)	17 (2-64)		
Public assistance					
(+)	n=7	21.0 (14.7)	15 (5-46)	408.500	0.636
(−)	n=131	18.7 (13.5)	16 (0-64)		
Absence of a parent					
(+)	n=40	24.0 (14.5)	17.5 (4-58)	1344.000	0.004*
(−)	n=91	16.6 (12.6)	14.5 (0-64)		
Obsessive-compulsive disorder					
(+)	n=16	30.0 (15.0)	26 (9-58)	483.000	0.001*
(−)	n=122	17.3 (12.7)	15 (0-64)		
ASD					
(+)	n=73	18.7 (12.6)	16 (0-50)	2315.000	0.808
(−)	n=65	18.9 (14.7)	15 (0-64)		
ADHD					
(+)	n=24	19.8 (13.2)	17 (3-46)	1271.000	0.589
(−)	n=114	18.6 (13.7)	15 (0-64)		
Chronic tic disorder/Tourette's syndrome					
(+)	n=18	17.6 (11.7)	16 (1-46)	1059.000	0.896
(−)	n=120	18.9 (13.8)	16 (0-64)		

Notes: Mann-Whitney U test was used because the LOI-CV scores were not normally distributed. Values are expressed as mean (SD), median (range) or n (%).

Abbreviations: ASD, autism spectrum disorder; ADHD, attention deficit hyperactivity disorder; and LOI-CV, Leyton Obsessional Inventory-Child Version.

Table 3. Spearman's correlations between age and LOI-CV, STAIC, and DSRS scores

		Age	LOI-CV total score	STAIC total score	DSRS-C total score
ASD group	Age				
	LOI-CV total score	−0.034			
	STAIC total score	0.214	0.589**		
	DSRS total score	0.137	0.557**	0.715**	
non-ASD group	Age				
	LOI-CV total score	−0.032			
	STAIC total score	0.201	0.562**		
	DSRS total score	0.125	0.594**	0.715**	

Notes: ** $p<0.01$.

Abbreviations: LOI-CV, Leyton Obsessional Inventory-Child Version; STAIC, State-Trait Anxiety Inventory for Children; DSRS, Birleson Depression Self-Rating Scale for Children; and ASD, Autism Spectrum Disorder.

to multicollinearity. Therefore, we performed (for both the ASD group and the non-ASD group) two multiple regression analyses with STAIC or DSRS score as an independent variable. Table 4 shows the results of multiple regression analyses For the ASD group. In the analysis 1 (including STAIC score as independent variable), the independent variables that predicted LOI-CV total score were

Table 4. Multiple regression results showing predictors of LOI-CV total scores in the autism spectrum disorder group

	Variable	B	SE	β	p-value	95% CI of B		VIF
analysis 1	Constant	4.326	11.684		0.712	−19.008	27.661	
	Sex	1.461	2.633	0.058	0.581	−3.797	6.719	1.203
	Age	−0.240	0.898	−0.033	0.790	−2.033	1.554	1.717
	Absence of a parent	1.289	2.852	0.046	0.653	−4.407	6.985	1.134
	OCD	8.788	3.778	0.261	0.023*	1.243	16.332	1.374
	ADHD	5.642	3.530	0.195	0.115	−1.408	12.692	1.622
	CTD or TS	−1.484	3.559	−0.045	0.678	−8.592	5.625	1.300
	STAIC	0.403	0.078	0.533	<0.001*	0.247	0.560	1.171
analysis 2	Constant	−2.476	11.775		0.834	−25.992	21.040	
	Sex	1.461	2.669	0.064	0.550	−3.727	6.934	1.202
	Age	0.107	0.894	0.015	0.905	−1.679	1.893	1.655
	Absence of a parent	0.218	2.900	0.008	0.940	−5.575	6.010	1.140
	OCD	10.287	3.782	0.305	0.008*	2.374	17.840	1.338
	ADHD	3.271	3.668	0.113	0.376	−4.054	10.596	1.702
	CTD or TS	−1.087	3.603	−0.033	0.764	−8.282	6.109	1.294
	DSRS	1.149	0.235	0.509	<0.001*	0.680	1.627	1.148

Notes: R^2=0.406; Durbin-Watson=2.071 in analysis 1; and R^2=0.389; Durbin-Watson=1.958 in analysis 2.

Abbreviations: B, unstandardized coefficient; SE, standard error; β, standardized partial regression coefficient; VIF, variance inflation factor; LOI-CV, Leyton Obsessional Inventory-Child Version; ASD, autism spectrum disorder; OCD, obsessive-compulsive disorder; ADHD, attention deficit hyperactivity disorder; CTD, chronic tic disorder; TS, Tourette's syndrome; STAIC State-Trait Anxiety Inventory for Children; and DSRS, Birleson Depression Self-Rating Scale for Children.

STAIC score (β=0.533; p<0.001) and OCD (β=0.261; p=0.023); in the analysis 2 (including DSRS score as independent variable), the predictors were DSRS score (β=0.509; p<0.001) and OCD (β=0.305; p=0.008). Table 5 shows the result of multiple regression analyses for the non-ASD group. In the analysis 3 (including STAIC as independent variable), the independent variables that predicted LOI-CV total score were STAIC score (β=0.435; p<0.001), OCD (β=0.259; p=0.019), and parental absence (β=0.274; p=0.014); in the analysis 4 (including DSRS score as independent variable), the predictors were DSRS score (β=0.519; p<0.001) and OCD (β=0.261; p=0.012).

Discussion

To the best of our knowledge, no studies have compared ASD and non-ASD groups on the association between OC and anxiety and depressive symptoms and simultaneously considered factors possibly related to OC, such as age, sex, the diagnosis of ADHD, CTD, TS, and parental absence. In the present study, we aimed to 1) ascertain whether anxiety and depressive symptoms were positively correlated with OC regardless of the presence of ASD, 2) to investigate the relationship between OC and other possibly related factors. The results suggested that OC is related to the presence of OCD and anxiety and depressive symptoms, regardless of the presence of ASD. We expected parental absence to be a confounding factor in the non-ASD group because of its correlation with DSRS scores. In fact, in the non-ASD sample, the DSRS score mean in the parental absence group (mean=19.9; SD =6.7) was significantly higher than in the other group (mean=14.9; SD=6.3) (p=0.005).

Taking into account the relationship between OC severity and anxiety and depressive symptoms,

Table 5. Multiple regression results showing predictors of LOI-CV total scores in the non-autism spectrum disorder group

	Variable	B	SE	β	p-value	95% CI of B		VIF
analysis 3	Constant	−0.963	12.166		0.937	−25.325	23.398	
	Sex	−1.660	3.969	−0.050	0.677	−9.608	6.288	1.412
	Age	0.222	0.908	0.027	0.808	−1.596	2.041	1.223
	Absence of a parent	8.637	3.415	0.274	0.014*	1.799	15.476	1.153
	OCD	15.698	6.530	0.259	0.019*	2.623	28.773	1.143
	ADHD	0.262	5.590	0.005	0.963	−10.931	11.455	1.215
	CTD or TS	−1.722	6.220	−0.032	0.783	−14.178	10.734	1.275
	STAIC	0.350	0.094	0.435	<0.001*	0.163	0.538	1.330
analysis 4	Constant	−2.212	11.493		0.848	−25.225	20.802	
	Sex	0.734	3.635	0.022	0.841	−6.544	8.013	1.328
	Age	−0.048	0.863	−0.006	0.956	−1.777	1.681	1.239
	Absence of a parent	6.193	3.338	0.196	0.069	−0.491	12.877	1.235
	OCD	15.807	6.091	0.261	0.012*	3.609	28.004	1.115
	ADHD	−3.104	5.318	−0.062	0.562	−13.753	7.544	1.233
	CTD or TS	1.074	5.949	0.020	0.857	−10.839	12.987	1.308
	DSRS	1.127	0.237	0.519	<0.001*	0.652	1.602	1.313

Notes: R^2=0.420; Durbin-Watson=2.122 in analysis 3; and R^2=0.483; Durbin-Watson=2.193 in analysis 4.

Abbreviations: B, unstandardized coefficient; SE, standard error; β, standardized partial regression coefficient; VIF, variance inflation factor; LOI-CV, Leyton Obsessional Inventory-Child Version; ASD, autism spectrum disorder; OCD, obsessive-compulsive disorder; ADHD, attention deficit hyperactivity disorder; CTD, chronic tic disorder; TS, Tourette's syndrome; STAIC State-Trait Anxiety Inventory for Children; and DSRS, Birleson Depression Self-Rating Scale for Children.

these results are in accord with findings from several previous studies[2,3]. Mack et al compared clinical characteristics and symptom severity of children with OCD plus ASD with those of children with OCD plus TS or OCD alone, using the Children's Yale-Brown Obsessive Compulsive Scale (CY-BOCS), which is considered the gold standard measure of OC severity in youth[34,35]. They found that children in all groups experienced similar levels of impairment[12]. Mito et al compared the severity and prevalence of OC, anxiety, and depression in an ASD group and a non-ASD group of OCD patients. They reported that elevated ASD scores had little impact on severity and prevalence of OC[36]. However, they defined ASD simply as high autism quotient scores, which is an insufficient measure. These previous studies are limited because they focused only on patients diagnosed with OCD. Substantial numbers of adolescents suffer from subclinical OCD, which is characterized by OC that are not severe enough to meet the full OCD criteria and has a prevalence ranging from 2.7% to 19%[37,38].

Our results are inconsistent with findings from one previous study. Ruta et al examined OC features and symptom severity in children and adolescents with Asperger's syndrome using the CY-BOCS. The Asperger's syndrome group showed greater OC severity than the control group[13]. However, this study used a univariate analysis and did not consider possible confounding factors such as anxiety and depressive symptoms.

Although many studies have examined the association between OC and ASD from various perspectives, they suffer from methodological problems. We included subjects regardless of OCD diagnosis and used a range of information to more accurately diagnose ASD. We also investigated the

association between OC and factors thought to be related to OCD.

Many researchers have pointed that ASD, ADHD, and TS are highly comorbid with OCD in children[4,5,39,40]. However, some researchers have suggested that individuals with ASD appear to enjoy their OC and do not experience anxiety from them[4,5]. Moreover, individuals with ASD and other neurodevelopmental disorders may show a particular type of OC.

The concept of obsessive-compulsive spectrum disorders (OCSD) was proposed in response to observations of disparate disorders marked by obsessive thinking and/or compulsive behavior, including ASD and TS[41,42]. Hollander et al subdivided OCSD into three clusters: 1) body image/body sensitization/body weight concern disorders; 2) impulse control disorders; and 3) neurological disorders with repetitive behaviors. ASD and TD were included in the last category. They suggested that, for disorders in the last cluster, OC are based on underlying neurological dysfunction rather than on the anxiety typically found in OCD[41].

Ortiz et al investigated comorbidities and clinical characteristics of children with OCD and defined two subtypes of OCD: one subtype is characterized by childhood onset, a predominance of males, high familial aggregation, and comorbid neurodevelopmental disorders such as ADHD, TS, and CTD; the second subtype is phenotypically more related to anxiety and depressive disorders, is more common in females, and has a later onset during adolescence[43]. Other researchers have suggested that neurodevelopmental disorders such as ASD, ADHD, and TD share underlying genetic factors that converge at the level of cortico-striatal-thalamocortical circuits[15].

These previous research findings suggest that OC may be related to neurodevelopmental disorders such as ASD, ADHD, CTD, and TS, regardless of anxiety and depressive symptoms, and may be less related to anxiety and depressive symptoms in ASD. However, we found that OC was significantly associated with anxiety and depressive symptoms in both the ASD and non-ASD groups. We found no relation between OC and ADHD, CTD, and TS.

Many studies have reported that OC are distressing, impair function, and are related to anxiety and depressive symptoms[2,3,44-49]. Therefore, to prevent exacerbation of OCD symptoms, potential treatment of patients with OCD should focus on treatment of anxiety and depressive symptoms[3,50]. Hence, although recent research has focused on OCD heterogeneity, we should consider comorbid anxiety and depressive symptoms regardless of comorbid ASD and other neurodevelopmental disorders when we meet patients who present with OC.

Limitations

As our study samples were children and adolescents, we cannot generalize the findings to adult populations. Because we focused on patients' subjective symptoms in this study, we only used self-report measures. However, because of the difficulties that individuals with ASD can experience in describing their internal states, it is not known whether self-report measures are effective in identifying OC, anxiety, and depression in this group. Mazefsky et al reported the poor performance of a self-report measure to identify OCD in children with ASD[51]. However, other studies have shown strong correlations between parent and child self-reports of anxiety and depression in ASD[52-54].

We did not consider whether the participants had been received pharmacotherapy or not in this study. Because pharmacotherapy possibly alleviate OC, further study considering the history of pharmacotherapy are needed.

In this study, we examined OC in terms of symptom severity rather than clinical diagnoses and therefore did not investigate comprehensive OCD psychopathology. However, as mentioned above,

previous studies indicate that many adolescents suffer from subclinical OCD[37,38]. In one 2-year follow-up study, adolescents with subclinical OCD and those scoring highly on the LOI-CV were more likely to fulfill clinical OCD criteria after follow-up[55]. Moreover, OC in all age groups, particularly younger sufferers, is under-recognized because individuals tend to be secretive about their symptoms[35,56]. These characteristics of OC lead to delays in detection, diagnosis, and treatment. It is therefore important to investigate OC in children and adolescents regardless of whether they have OCD to prevent pathogenesis or exacerbation of OCD.

Conflicts of interest

The authors declare that they have no conflicts of interest.

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