

ORIGINAL ARTICLE

The Dimensional Yale–Brown Obsessive–Compulsive Scale (DY-BOCS): an instrument for assessing obsessive–compulsive symptom dimensions

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Obsessive–compulsive disorder (OCD) encompasses a broad range of symptoms representing multiple domains. This complex phenotype can be summarized using a few consistent and temporally stable symptom dimensions. The objective of this study was to assess the psychometric properties of the Dimensional Yale–Brown Obsessive–Compulsive Scale (DY-BOCS). This scale measures the presence and severity of obsessive–compulsive (OC) symptoms within six distinct dimensions that combine thematically related obsessions and compulsions. The DY-BOCS includes portions to be used as a self-report instrument and portions to be used by expert raters, including global ratings of OC symptom severity and overall impairment. We assessed 137 patients with a DSM-IV diagnosis of OCD, aged 6–69 years, from sites in the USA, Canada and Brazil. Estimates of the reliability and validity of both the expert and self-report versions of the DY-BOCS were calculated. The internal consistency of each of the six symptom dimensions and the global severity score were excellent. The inter-rater agreement was also excellent for all component scores. Self-report and expert ratings were highly intercorrelated. The global DY-BOCS score was highly correlated with the total Yale–Brown Obsessive–Compulsive Scale score (Pearson $r=0.82$, $P<0.0001$). Severity scores for individual symptom dimensions were largely independent of one another, only modestly correlated with the global ratings, and were also differentially related to ratings of depression, anxiety and tic severity. These results indicate that the DY-BOCS is a reliable and valid instrument for assessing multiple aspects of OCD symptom severity in natural history, neuroimaging, treatment response and genetic studies when administered by expert clinicians or their highly trained staff.

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Introduction

Obsessive–compulsive disorder (OCD) has a lifetime prevalence of 2–3%,¹ affecting all age groups, across different cultures.² Obsessive–compulsive disorder is considered to be the fourth most common mental disorder and is frequently accompanied by family, social, school and work dysfunctions.³ The World Health Organization (WHO) estimated OCD to be among the top 10 causes of years lived with illness-related disability by 2020.⁴ Obsessive–compulsive disorder is characterized by intrusive unwanted thoughts, fears or images (obsessions) and/or ritua-

lized behaviors or mental acts (compulsions), generally performed to relieve the anxiety and/or distress caused by the obsessions.

Current classification manuals, such as the DSM-IV and the ICD-10 (WHO), regard OCD as a unitary nosological entity. While this approach has added specificity to research studies, it may be misleading. In fact, obsessive–compulsive (OC) symptoms are remarkably heterogeneous.

In addition to the clinical diversity seen in OCD, genetic and treatment studies also support the view that OCD is a heterogeneous disorder. This heterogeneity obscures the findings from natural history studies, neuroimaging and clinical trials, and complicates the search for vulnerability genes.⁵ Therefore, many investigators have emphasized the need for identifying more homogenous subgroups in order to better understand the OCD complexity. Examples include dividing patients according to the age of

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onset of OC symptoms^{6–8} and the presence of specific clinical features, including subjective experiences preceding OC symptoms,^{9–11} comorbidity patterns,¹² or clinical course.¹³ Although these subtyping strategies have been useful, they have had limited success in identifying predictors of treatment response, endophenotypic markers, or vulnerability genes.

More recently, dimensional strategies have been introduced to more accurately characterize individual differences among OCD patients. Similar efforts have been undertaken with other disorders, including schizophrenia,^{14,15} bipolar disorder,¹⁶ Tourette's syndrome,¹⁷ eating disorders,¹⁸ and learning disabilities.¹⁹

In OCD, there have been at least 12 factor-analytic studies published, involving more than 2000 patients.²⁰ These studies have consistently identified 3–5 symptom factors or dimensions, accounting for nearly 70% of the variance.²⁰ A similar factor structure has been observed in both adults^{22–24} and children²⁵ and in mixed samples.²¹ These factors are temporally stable,^{26,27} and correlate meaningfully with various genetic^{28–31} and neuroimaging variables^{32,33} as well as treatment response.^{22,34–37}

Obsessive–compulsive disorder genetic studies have reported that the use of a dimensional approach may provide a powerful approach to detect the genetic susceptibility loci that contribute to the heterogeneous OCD presentations.⁵ For instance, Alsobrook *et al.*²⁷ found that the relatives of OCD probands who had high scores on the obsessions/checking and symmetry/ordering factors were at greater risk for OCD than were relatives of probands who had low scores on those factors. Using similar methods, Leckman *et al.*²⁹ found that the obsessions/checking and symmetry/ordering factors were significantly correlated in sib-pairs concordant for TS. Using the same data set, Zhang *et al.*³⁰ observed significant allele sharing for the hoarding factor for loci at 4q34, 5q35.2 and 17q25. Similarly, Cavallini *et al.*³¹ performed a candidate gene study with a functional polymorphism in the promoter region of the serotonin transporter locus at 17q11. They found a significant association of the long/long haplotype in patients with tics and high scores on the 'repeating/counting' factor.

Despite the potential usefulness of using dimensional ratings and the availability of psychometrically sound self-report measures,^{38,39} there are currently no severity scales designed for use by expert raters capable of properly assessing the dimension-specific OC symptom severity. In an effort to address this need, we have developed a new instrument – the Dimensional Yale–Brown Obsessive–Compulsive Scale (DY-BOCS). Practically, by dividing symptoms by dimension, it is possible to inquire about symptom types that are inherently ambiguous. For example, checking compulsions are now asked about in several of the domains – checking related to sexual and religious obsessions vs checking related to contamination worries. Another important innovation is the

decision to focus on frequency, distress and interference as the best estimates of symptom severity within each dimension, as well as for all OC symptoms considered in aggregate.^{40,41} After an extensive period of refinement and preliminary testing in both pediatric and adult populations, we conducted a multinational, multi-site cross-sectional study in order to determine the psychometric properties of the DY-BOCS. The results of these efforts are reported below. A secondary aim was to explore potential differences between pediatric and adult subjects.

Materials and methods

Subjects

One hundred and thirty-seven outpatient subjects, aged 6–69 years were assessed. Fifty-nine subjects were under 18 years of age and 78 were 18 years of age or older. Patients were recruited from four different sites: the Child Study Center at Yale University, USA ($N=85$); the OCD Spectrum Disorders Project at the OCD Spectrum Disorders Project at Getulio Vargas Medical Hospital, Porto Alegre, Brazil ($N=39$), the Institute of Living at Hartford Hospital, USA ($N=10$) and the University of British Columbia, Canada ($N=3$). Subjects were either being followed for OCD treatment or had been followed in the past at one of the sites. Inclusion criteria required a DSM-IV diagnosis of OCD. Exclusion criteria included an intelligence quotient (IQ) < 75, head trauma resulting in loss of consciousness and current psychiatric disorder that could interfere with an individual's ability to report accurately on their OC symptoms, such as psychosis or pervasive developmental disorders.

The project was approved by institutional review boards at each of the sites. After a thorough description of the study and the assurance that their decision to participate would not interfere with their clinical treatment, all patients were asked to sign an informed consent document. A separate assent form was used to ensure the informed participation of the child and adolescent subjects.

Instruments

The DY-BOCS was initially developed by three individuals then at Yale University (JFL, SW and MCR-C). The instrument was then refined by a larger group of investigators from the United States (RAK, DF and LS), Brazil (EM) and Japan (YK). The DY-BOCS is based on the Yale–Brown Obsessive–Compulsive Scale (Y-BOCS) created by Goodman *et al.*,^{42,43} the Schedule for Tourette's and Other Behavior Syndrome (STOBS) developed by Pauls and Hurst,⁴⁴ as well as the results of earlier factor analyses^{21–25} and the DSM-IV field trial for OCD.⁴⁵

The DY-BOCS consists of semi-structured scales for assessing the presence and severity of OC symptom dimensions. The DY-BOCS includes a self-report instrument and an instrument to be used by expert

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raters. The DY-BOCS self-report is composed of an 88-item self-report checklist, designed to provide a detailed description of obsessions and compulsions that are divided into six different OC symptom dimensions: (1) obsessions about harm due to aggression/injury/violence/natural disasters and related compulsions; (2) obsessions concerning sexual/moral/religious obsessions and related compulsions; (3) obsessions about symmetry/'just-right' perceptions, and compulsions to count or order/arrange; (4) contamination obsessions and cleaning compulsions; (5) obsessions and compulsions related to hoarding and (6) miscellaneous obsessions and compulsions that relate to somatic concerns and superstitions, among other symptoms.

By dividing OC symptoms according to these dimensions, the DY-BOCS is capable of inquiring about symptoms that are inherently ambiguous (such as checking, mental rituals, repetition and avoidance behaviors) and that may be present in more than one symptom domain. For example, checking compulsions could be related to obsessional worries about harm coming to a close family member or to ensure that an item is clean or 'just right'. Similarly, mental rituals, avoidance and repetitive behaviors could be related to one or more symptom domains depending on their content. Patients are asked to endorse both lifetime and current symptoms, which are then reviewed by the clinician in order to increase the reliability of the information, and to ensure that the endorsed items are truly OC symptoms.

In addition to the symptom checklist, the DY-BOCS self-report also includes items that ask the patient to assess the overall symptom severity in each of the dimensions for the previous week, on scales ranging from 0 (no symptoms) to 10 (symptoms are extremely troublesome). Patients are also asked explicitly about avoidance behaviors accompanying their OC symptoms within each dimension.

Expert ratings of symptom severity involve reviewing the symptoms endorsed in each dimension. Avoidance was included as an integral part of each of these severity ratings based on the findings of Woody *et al.*⁴⁰ Severity for each dimension is measured on three ordinal scales with six anchor points that focus on symptom frequency (0–5), the amount of distress they cause (0–5) and the degree to which they interfered with functioning (0–5) during the previous week.

In addition to the symptom severity ratings for each dimension, the expert raters are asked to estimate the global OC symptom severity using the same three ordinal scales. Finally, the expert raters are asked to assess an individual's overall level of current impairment due to OC symptoms on a scale that ranges from 'none' (0 points) to 'severe' (15 points). The total global score is obtained by combining the sum of the global severity scores for frequency, distress and interference and the impairment score (0–15), yielding a maximum total global severity score of 30.

The DY-BOCS was piloted over a 6-month period in the OCD/Tic Disorders Clinic of the Child Study Center at Yale with adult and child cases. During this period refinements were made in the wording of the checklist items, in the descriptive anchor points for the impairment scale and the instructions manual describing the rationale for administering the DY-BOCS.

The Y-BOCS^{42,43} and the Children's Yale–Brown Obsessive–Compulsive Scale (CY-BOCS)⁴⁶ were used for measurement of convergent validity. These are clinician-rated, semi-structured interview-based scales that are widely used to assess OC symptom severity. Considerable data support the reliability and validity of both the adult and child versions of this scale. They yield an obsession score (maximum = 20), a compulsion score (maximum = 20) and a combined total score (maximum = 40).

The Yale Global Tic Severity Scale (YGTSS),⁴⁷ the Children's Depression Rating Scale (CDRS),⁴⁸ the Hamilton Scale for Depression (Ham-D),⁴⁹ and the Hamilton Scale for Anxiety (Ham-A)⁵⁰ were used to assess the divergent validity of the component scales of the DY-BOCS.

The YGTSS is a clinician-rated, semi-structured scale with excellent psychometric properties developed to evaluate the presence and severity of tics, and the impairment caused by them. The motor (maximum = 25) is added to the phonic (maximum = 25), and the impairment scores (maximum = 50), thus yielding a maximum total score of 100. The YGTSS has been widely used to assess tic severity in both pediatric and adult populations.

The CDRS is a clinician-rated, semi-structured interview for assessing current depressive symptoms in children. The CDRS yields a total maximum score of 113, and has been shown to possess good reliability and validity. A score of '40' is considered to be a reliable indicator of clinically significant depression.

The Ham-D is a clinician-rated, semi-structured interview for assessing current depressive symptoms in adults. The Ham-D yields a total score of 63, and possesses good psychometric properties. A score of '>14' is considered to be a reliable indicator of moderate to severe depression.

The HAM-A is a clinician-rated, semi-structured, valid and reliable interview for assessing current anxiety symptoms. It yields a total maximum score of 56. A score of '>14' has been suggested to indicate clinically significant anxiety.

Procedures

Interviews

Informants included a parent and the child in the case of younger subjects. Adolescents had the choice to be interviewed individually and additional information was sought from parents as needed. Adults were interviewed individually. Each subject was evaluated separately by two different interviewers. Before starting the interview the order of the interviews

was decided, according to a coin toss. The first rater reviewed the consent forms, and asked the subjects to sign them. If the coin toss was ‘heads’, the first interviewer reviewed the DY-BOCS self-report and then completed the component ratings of the DY-BOCS. If the coin toss was ‘tails’, the first interviewer reviewed the Y-BOCS/CY-BOCS self-report and then completed the Y-BOCS/CY-BOCS scores. The first interviewer then completed the other clinician ratings, including the HAM-D or the CDRS, the HAM-A and the YGTSS. After completing the first interview, the subjects were introduced to the second rater and invited to have a 15-min break. After the break, the second interviewer completed either the DY-BOCS or Y-BOCS/CY-BOCS ratings with them, depending upon which scale still needed to be completed.

Training of the interviewers

In order to improve reliability across sites, all interviewers were trained on the DY-BOCS by MCR-C, an experienced clinician. All interviewers had at least a bachelor’s degree and were trained to reliability in the other instruments.

Translation of the instruments

The translation of the DY-BOCS into Portuguese was made by MCR-C, a fluent speaker of both languages. Afterwards, a certified translator was hired to do the back-translation into English. The two versions were then compared and resolved. All other instruments had previously been translated into Portuguese.

Statistical analyses

Before pooling the data, possible differences between the North-American and Brazilian samples were investigated. Demographic and clinical characteristics in these two groups were compared using chi-square or Fisher’s exact tests for categorical data and *t*-test for continuous data. All tests were two-tailed, with $\alpha = 0.05$.

The internal consistency of the DY-BOCS was determined by using Cronbach’s alpha to assess the three severity items (time, distress and interference) in each of the dimensions. Inter-rater reliability was determined for a subset of 29 (21.2%) patients drawn mostly from the Yale and Brazilian sites. These ratings were done with two raters sitting in the same room, with no communication between the two during the interviews. Pearson correlation coefficients were used to evaluate the association between the patient self-report and the clinician measures of severity for each dimension on 98 patients. Thirty-nine patients were excluded from this analysis because they did not fill out the questions assessing symptoms severity in the self-report.

Pearson correlation coefficients were used to assess the convergent and divergent validities of the component scores of the DY-BOCS, with the other clinical instruments described above. Fisher’s *Z* transformation was used to compare the correlations within the pediatric age group matrix with those correlations

obtained from the adult subject matrix. A test statistic and *P*-value were computed for each pair of correlations testing the hypothesis that the sample correlations estimate the same population correlation value.

Results

The 137 subjects (75 males and 62 females) had a mean age of 25.1 years (s.d. = 14.3, range 6–69), with a median age of 21. Children and adolescents were interviewed at two sites in Connecticut ($N = 68$), with a mean age of 13.5 (s.d. = 3.4, range 6–20) and a median age of 12. When considering only adult subjects ($N = 69$), Brazilian and North American subjects had no statistically significant age differences ($t_{67} = -1.38$; $P = \text{NS}$, two-tailed).

There were no statistically significant differences between the Brazilian and the North-American sites with regard to gender (North-American sites: 57 male and 41 female subjects; Brazilian site: 18 male and 21 female subjects; $\chi^2(1) = 1.6$, NS) or ethnicity. Nearly 96% ($N = 131$) of the subjects were Caucasian. Three patients from the North-American sites were Hispanic (2.2%) and one patient was from India (0.7%). All Brazilian subjects were Caucasian. The mean scores on each of the DY-BOCS dimensions, on the Y-BOCS/CY-BOCS and on the other scales are presented in Table 1. The pediatric and adult samples were largely indistinguishable, with the adult sample being slightly more severe on the DY-BOCS Global Score ($t_{135} = 2.2$, $P = 0.04$, two-tailed), DY-BOCS Global Impairment rating ($t_{135} = 2.7$, $P = 0.007$, two-tailed), and Sexual and Religious Dimension ($t_{135} = 2.04$, $P = 0.04$, two-tailed).

Table 2 presents the number of patients presenting symptoms in each of the dimensions for both the pediatric and adult groups. As a group, the pediatric sample had a greater frequency of symptoms in the Symmetry dimension and less within the Aggression dimension, but these differences in frequency were not statistically significant. However, adult patients had significantly higher frequency of symptoms in the Sexual and religious dimension ($\chi^2(1) = 4.1$, $P = 0.04$). The age of onset of OC symptoms ranged from 2 to 46 years, with a mean of 10.5 years (s.d. = 6.7) and a mode of 10.

When dividing the sample into adults and children, the two groups exhibit very similar rates of avoidance behaviors (78 vs 80%, respectively). This was also true when each dimension was considered separately: Aggression dimension (49% of adults and 32% of children); Sexual/religious dimension (26% of adults and 25% of children); Contamination dimension (56% of adults and 54% of children); Symmetry dimension (59% of adults and 52% of children); Hoarding dimension (29% of adults and 15% of children) and in the Miscellaneous dimension (67% of adults and 54% of children).

Table 1 Mean scores on the DY-BOCS, the Y-BOCS and measures of tic, depression and anxiety severity

	Pediatric age group			Adults		
	Subjects (N)	Mean (s.d.)	Range	Subjects (N)	Mean (s.d.)	Range
DY-BOCS global score	59	17.8 (4.8)*	7–28	78	19.6 (4.8)*	7–29
<i>DY-BOCS dimensions</i>						
Aggression	59	4.2 (4.3)	0–13	78	5.3 (4.2)	0–14
Sexual/religious	59	2.3 (3.6)*	0–11	78	3.7 (4.2)*	0–12
Symmetry	59	6.7 (3.9)	0–14	78	6.7 (4.6)	0–15
Contamination	59	5.5 (5.0)	0–15	78	6.1 (4.8)	0–15
Hoarding	59	2.3 (3.5)	0–11	78	2.5 (3.7)	0–15
Miscellaneous	59	6.2 (3.8)	0–14	78	6.6 (4.5)	0–15
DY-BOCS impairment	59	7.5 (2.9) [†]	2–13	78	8.9 (2.8) [†]	3–14
Y-BOCS total score	59	23.0 (6.3)	8–35	78	24.2 (6.9)	5–38
Y-BOCS obsessions	59	11.2 (3.7)	0–18	78	12.2 (3.8)	0–19
BOCS compulsions	59	11.8 (3.5)	3–18	78	12.1 (3.8)	1–19
Yale Global Tic Severity Scale	26	15.7 (9.3)	2–34	17	20.9 (11.7)	3–38
Children' Depression Rating Scale – Revised	50	27.7 (11.1)	17–73	—	—	—
Hamilton Depression Scale	—	—	—	73	10.5 (6.5)	0–28
Hamilton Anxiety Scale	—	—	—	72	11.6 (8.2)	0–40

DY-BOCS = Dimensional Yale–Brown Obsessive–Compulsive Scale; Y-BOCS = Yale–Brown Obsessive–Compulsive Scale;

* $P < 0.05$.

[†] $P < 0.01$.

Table 2 Number of subjects presenting lifetime obsessive–compulsive symptoms in each of the dimensions

Dimension	Pediatric group N (%)	Adult group N (%)
Aggression	33 (56)	55 (71)
Sexual/religious	20 (34)*	40 (51)*
Symmetry	51 (86)	63 (81)
Contamination	36 (61)	54 (69)
Hoarding	22 (37)	32 (41)
Miscellaneous	50 (85)	64 (82)

* $P < 0.05$, χ^2 test.

Reliability

Interrater reliability. The interrater reliability between the expert raters on the DY-BOCS was excellent. Intraclass correlation coefficients (ICCs) were > 0.98 for each component score of the DY-BOCS.

Level of agreement between self-report and expert ratings. The correlations between the self-report and clinician measures of severity were highly significant. Pearson correlation coefficients were 0.87 for the Aggressive, 0.86 for the Sexual/religious, 0.78 for the Symmetry, 0.83 for the Contamination/washing, 0.86 for the Hoarding and 0.75 for the Miscellaneous dimensions ($P < 0.0001$ for all dimensions).

When considering adults and children separately, the levels of agreement between the self-report and expert ratings are very similar to those of the entire sample. Pearson correlation coefficients were 0.84 in adults and 0.90 in children for the Aggressive dimension; 0.83 and 0.89 (for adults and children, respectively) for the Sexual/religious dimension; 0.81 and 0.75 (for adults and children, respectively) for the Symmetry dimension; 0.91 and 0.76 (for adults and children, respectively) for the Contamination dimension; 0.87 and 0.85 (for adults and children, respectively) for the Hoarding dimension; and 0.82 and 0.67 (for adults and children, respectively) for the Miscellaneous dimension. All of the Pearson correlations for both adults and children were highly significant ($P < 0.0001$). There was a significant difference in the correlations for the Contamination dimension between the adult and pediatric groups (Fisher's $Z = 2.48$, $P < 0.05$).

Internal consistency. The internal consistency across the domains of time, distress and interference for each dimension was excellent. Cronbach's alphas were 0.94 for Aggressive, 0.95 for Sexual/religious, 0.95 for Symmetry, 0.96 for Contamination, 0.95 for Hoarding and 0.94 for Miscellaneous dimensions.

In adult and child groups, Chronbach's alphas were 0.94 for the Aggressive dimension for both adults and children; 0.95 for the Sexual/religious dimension for both adults and children; 0.96 for adults and 0.93 for children for Symmetry; 0.97 for Contamination in both adult and child groups; 0.96 for adults and 0.94 for children in the Hoarding dimension and 0.96 and

Table 3 Correlations between the dimensional DY-BOCS global score and the symptom severity ratings for each dimension, the components of the global severity ratings and the impairment rating

	Pediatric group		Adult group	
	Pearson <i>r</i>	<i>P</i>	Pearson <i>r</i>	<i>P</i>
<i>Dimensions</i>				
Aggression	0.24	NS	0.28	0.02
Sexual/ religious	−0.03	NS	0.22	NS
Symmetry	0.33	0.01	0.46	<0.0001
Contamination/ cleaning	0.54	<0.0001	0.46	<0.0001
Hoarding	0.43	0.001	0.20	NS
Miscellaneous	0.39	0.002	0.40	<0.0001
<i>Global severity</i>				
Time	0.76	<0.0001	0.76	<0.0001
Distress	0.85	<0.0001	0.77	<0.0001
Interference	0.83	<0.0001	0.88	<0.0001
Impairment rating	0.94	<0.0001	0.95	<0.0001

DY-BOCS = Dimensional Yale–Brown Obsessive–Compulsive Scale. There were no significant differences between the groups in correlations for any dimensions or the components of the global severity ratings or the impairment rating (data not shown).

0.93 for the Miscellaneous dimension in adults and children, respectively.

Validity

Construct validity. There were no statistically significant differences between the Brazilian and the North-American sites with regard to any of the scores on these clinical ratings (data not shown). When including only adult subjects ($N=78$), there were also no significant differences between the Brazilian and the North-American sites with regard to the DY-BOCS ($t_{75}=0.23$, $P=NS$, two-tailed) or Y-BOCS ($t_{75}=0.18$, $P=NS$, two-tailed) total scores.

Correlations between each of the DY-BOCS dimensions and the total DY-BOCS scores are presented in Table 3. With the exception of the severity ratings for sexual and religious symptoms (both for children and adults), aggressive obsessions and compulsions (children only) and hoarding symptoms (adults only), each of the other severity ratings was positively correlated with the DY-BOCS Global severity score, with Pearson correlations ranging from 0.28 to 0.54.

Table 4 presents the intercorrelations between each of the different OC symptom dimensions. With a few exceptions, each dimension-specific severity rating was largely independent of the others.

Convergent validity. The correlation between the DY-BOCS total global score and the Y-BOCS total score was excellent (Pearson $r=0.82$, $P<0.0001$), indicating

Table 4 Intercorrelations between estimates of current symptom severity within each of the dimensional components of the DY-BOCS^a

<i>Dimensions</i>	<i>Sexual/religious</i>	<i>Symmetry</i>	<i>Contamination</i>	<i>Hoarding</i>	<i>Miscellaneous</i>
Aggressive	0.23	−0.06	−0.01	0.30 ($P=0.02$)	0.12
	0.27 ($P=0.02$)	−0.02	0.04	−0.02	0.25 ($P=0.03$)
	0.27 ($P=0.001$)	−0.03	0.02	0.12	0.20 ($P=0.02$)
Sexual/religious		−0.24	0.25	−0.002	−0.02
		−0.04	0.13	0.002	0.27 ($P=0.02$)
		−0.11	0.18 ($P=0.03$)	0.0004	0.17 ($P=0.04$)
Symmetry			0.07	0.28 ($P=0.03$)	0.27 ($P=0.04$)
			0.15	0.35 ($P=0.002$)	0.51 ($P=0.0001$)
			0.12	0.32 ($P=0.0001$)	0.43 ($P=0.0001$)
Contamination				0.32 ($P=0.01$)	0.15
				−0.06	−0.003
				0.11	0.06
Hoarding					0.34 ($P=0.008$)
					0.25 ($P=0.03$)
					0.28 ($P=0.001$)

^aCorrelations for the pediatric age group are listed first, followed by the adult and then the total group.

Numbers in bold are significant Pearson r correlations, two-tailed.

There were no significant differences in correlations for any of the dimensions between the children and adult groups (data not shown). DY-BOCS = Dimensional Yale–Brown Obsessive–Compulsive Scale

the convergent validity of the DY-BOCS total global severity score. For the adult and child groups separately, these correlations were also highly significant (Pearson $r_{\text{adult}}=0.84$, $P<0.0001$, Pearson $r_{\text{children}}=0.79$, $P<0.0001$). Similarly, the correlation between DY-BOCS impairment rating and the Y-BOCS total score (Pearson $r=0.71$, $P<0.0001$) was also robust across all patients as well as for the pediatric and adult groups, when considered separately ($r_{\text{adult}}=0.76$, $P<0.0001$, Pearson $r_{\text{children}}=0.65$, $P<0.0001$). The correlations between impairment and the obsession (Pearson $r=0.58$, $P<0.0001$) and the compulsion (Pearson $r=0.68$, $P<0.0001$) subscales of the Y-BOCS were also significant. Among the adults, the correlations between impairment and the obsession and the compulsion subscales of the Y-BOCS were also significant (Pearson $r=0.62$, $P<0.0001$ and Pearson $r=0.75$, $P<0.0001$). In the child group, these correlations were slightly lower than in the adult group, but still significant (Pearson $r=0.51$, $P<0.0001$ for obsessions and Pearson $r=0.62$, $P<0.0001$ for compulsions).

Divergent validity. Divergent validity uses measurement approaches that differentiate psychometric constructs from one another. The constructs that are at the heart of the DY-BOCS are the severity ratings for the dimensional constructs, not the DY-BOCS Global Score. Evidence in support of the divergent validity of the dimensional constructs include the orthogonal character of the dimensional severity ratings (Table 4) as well as the differential relationships between the dimensional severity scores and measures of tic severity, as well as clinician-rated estimates of mood and anxiety severity (Table 5).

Of note is the fact that the correlation coefficients varied according to the specific OC symptom dimensions, with the most robust relationships being seen between the severity of anxiety and mood symptoms and the severity of the OC symptoms in the Aggressive dimension on one hand and the severity of tics and the severity of Symmetry dimension on the other. Comparable results were obtained when the sample was restratified with regard to the presence of clinical significant levels of anxiety and depression (data not shown). However, when the sample was restratified according to the presence of a chronic tic disorder ($N=43$) vs the absence of a tic disorder ($N=89$), the severity of the OC symptoms in the Contamination dimension was found to be reduced in the OCD patients with a history of tics (data not shown).

Feasibility

On average, the self-report of the DY-BOCS usually takes about 40 min to complete (mean = 41 min; s.d. = 13.3 min; range 10–120 min). On average, expert raters take slightly longer to complete the DY-BOCS (mean = 49 min, s.d., 23.3 min, range 20–65 min) depending on the diversity of symptoms endorsed by

Table 5 Correlations between the each of the DY-BOCS dimensions and scores of the HAM-D, the HAM-A and the YGTSS^a

Dimensions	HAM-A	HAM-D	YGTSS
Aggression	0.46 ($P=0.0001$)	0.45 ($P=0.0001$)	0.14
Sexual/ religious Symmetry	0.11	0.01	−0.18
Contamination	0.09	0.17	0.19
Hoarding	0.12	0.13	−0.21
Miscellaneous	0.17	0.14	0.64 ($P=0.005$)
	0.21	0.14	0.31

^aCorrelations presented for just the adult age group ($N=78$). Numbers in bold are significant Pearson r correlations, two-tailed. DY-BOCS = Dimensional Yale–Brown Obsessive–Compulsive Scale; HAM-D = Hamilton Scale for Depression; HAM-A = Hamilton Scale for Anxiety; YGTSS = Yale Global Tic Severity Scale.

the patient. Subsequent ratings of the same patient take substantially less time, as symptom validation is less of an issue. There were no significant differences in DY-BOCS or self-report completion time between adult and pediatric groups (data not shown).

Discussion

A growing body of data indicates that a dimensional approach to OC symptoms may have heuristic value in genetic, neurobiological, comorbidity and treatment response studies.^{5,20} Some very compelling data have also come from brain imaging studies, where it appears that each OC symptom dimension reflects the dysregulation of complex and partially overlapping neural systems that serve to detect, appraise and respond to potential threats that are content-specific.^{5,20,32,33}

A major limitation in adopting a dimensional approach to OCD research had been the lack of assessment tools capable of encompassing the dimensionality of OC symptoms.^{5,20} This work presents the development and initial psychometric properties of a new instrument designed to focus on OC symptom dimensions. As hypothesized, our results suggest that the DY-BOCS is a valid and reliable tool for assessing OC symptom dimensions using either expert clinicians or relying solely on self-reports. This appears to be true for both adult patients as well as children with OCD. Indeed, a careful examination of potential differences between children and adults with OCD revealed relatively few. This suggests that regardless of the age of the patient the psychometric structure of OC symptoms is similar. This result is consistent with

the recent report by Stewart *et al.*²⁵ in which the factor structure was examined in 327 children and adolescents using the Y-BOCS symptom checklist and found to be nearly identical with that regularly seen in adult and mixed samples.²⁰ We hasten to add that this similarity does not imply that there are no important differences with regard to family history, comorbidity and sex distribution between subjects with an early versus a late age of onset.^{5,20}

As expected, the OC symptom dimensions showed only modest correlations with each other, suggesting that they are largely independent of one another, and from the estimates of global severity. The one exception concerns the Miscellaneous dimension, which was found to have significant correlations with four of the five other dimensions in the adult group and with two other dimensions in the pediatric age group. Additional work is needed to sort through these miscellaneous symptoms and determine which symptoms are associated with which of the other dimensions and which symptoms, if any, uniquely define a true Miscellaneous category. Similar efforts are currently underway by other groups of investigators.^{51,52}

The DY-BOCS has excellent content validity. The self-report checklist assesses the presence of the most common OC symptoms, and includes items that are usually underrepresented in other scales, such as mental rituals, checking, repetition and avoidance behaviors. Similarly, the severity scales evaluate the time, distress and interference parameters described in the DSM-IV diagnostic criteria for OCD.

The DY-BOCS is based in part on the Y-BOCS^{42,43} and the very similarly constructed CY-BOCS.⁴⁶ Although the Y-BOCS and CY-BOCS remain the gold standard for assessing OC symptom severity, the DY-BOCS has some advantages over previously developed clinician- and self-rated instruments such as the Leyton Obsessional Inventory,⁵³ the Maudsley Obsessional–Compulsive Inventory,⁵⁴ the National Institute of Mental Health Global Obsessive–Compulsive Scale,⁵⁵ Obsessive–Compulsive Inventory³⁸ and the Vancouver Obsessional Compulsive Inventory.³⁹ First, the DY-BOCS self-report checklist has greater clarity and offers examples after each symptom description. This has made the instrument more patient-friendly, and likely contributed to the high correlations between the self-report and clinician measures of severity, ranging from 0.75 to 0.87, and suggests that either version could be used alone. Second, the fact that each dimension assesses the severity of both thematically related obsessions and compulsions has eliminated the bias in collecting information from patients with either obsessions or compulsions only. Third, the DY-BOCS does not include items about resistance or control as part of the assessment of OC symptom severity. This decision was based on previous work suggesting that the resistance/control items in the Y-BOCS do not meaningfully contribute to the measurement of OCD symptom severity.⁴⁰ Recent data have reinforced this decision.⁴¹ Fourth,

the ordinal scales used for assessing the three severity domains expanded from 5 to 6 anchor points in the DY-BOCS. This expansion should allow investigators to refine the assessment of subjects with subclinical presentations of OCD.⁵⁶ In the case of genetic studies, family members presenting with OC symptoms below the threshold for a DSM-IV diagnosis could be more accurately assessed.⁵ In the general population, there are periods in life, such as childbirth, when otherwise normal individuals experience marked OC behaviors and mental states, and when a diagnosis of OCD would be inappropriate.⁵⁷ These are all the unique and distinguishing features of the DY-BOCS from earlier instruments.

Another DY-BOCS innovation was the inclusion of avoidance behaviors in each dimension of the symptom checklist, and also as an integral part of the severity ratings. This decision was reinforced by the findings that more than 75% of our sample reported some kind of avoidance behavior, and that the frequencies of these avoidance symptoms varied according to the specific dimensions. These findings are in accordance with studies suggesting that avoidance symptoms are commonly reported by OCD patients and should be included in assessment measures.⁴⁰

The results concerning the reliability and validity of this scale are promising. For example, the DY-BOCS showed an excellent concordant validity with both the Y-BOCS and the CY-BOCS, currently used as the gold standards for assessing OCD severity. In addition, the individual DY-BOCS dimensional severity ratings showed excellent divergent validity with anxiety, depression and tic severity scales. The one exception is that the severity of the Aggression dimension was related to the severity of mood and anxiety symptoms. This result largely replicates in a larger sample of OCD patients the finding by Hasler *et al.*²⁴ Similarly, the Symmetry dimension was differentially associated with the YGTSS scores, reinforcing its close relationship with the tic-related phenotype.

Finally, the time burden of the DY-BOCS instruments needs to be emphasized, since the time of administration may be a major limitation. Its initial use in clinical settings may provide the therapist with a valuable perspective on the dimensional landscape of their patients' OC symptoms. In research studies, the advantages of being able to chart the course of particular symptom dimensions may or may not outweigh the time cost associated with their use.

Conclusions and future directions

Despite the time burden of these instruments, they may have much to offer in clinical practice and research studies. Specifically, the data suggest that the DY-BOCS is a useful tool in assessing OC symptom dimensions, while continuing to provide valid overall estimates of OC symptom severity. Future investigations with the DY-BOCS should

include clinical and epidemiological samples, twin populations, genetic family studies, as well as individuals participating in neuroimaging and treatment response studies. It is also clear that other instruments may be more time-efficient tools for the initial screening of large numbers of individuals for possible OCD.^{38,39,53}

Success in refining the measurement of OC phenotypes is likely to lead to greater clarity concerning course and outcome, and should facilitate genetic, neurobiological and treatment response studies. Likewise, dissecting the phenotype into less complex components may be an important tool for the identification of susceptibility genes for OCD.^{28–31}

A dimensional approach may also advance our nosology, as these dimensions may well cut across diagnostic boundaries (e.g. eating disorders, body dysmorphic disorder, as well as the elusive boundary that divides normal from abnormal psychological functioning). However, the combined use of both categorical and dimensional strategies is likely to offer the greatest promise for a better understanding of the complex picture of OCD throughout development and across the spectrum of related diseases.

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