Eur Child Adolesc Psychiatry (2017) 26:281–291
DOI 10.1007/s00787-016-0887-5

ORIGINAL CONTRIBUTION

Structure and clinical correlates of obsessive–compulsive symptoms in a large sample of children and adolescents: a factor analytic study across five nations

D. R. M. A. Højgaard[1] · E. L. Mortensen[2] · T. Ivarsson[3] · K. Hybel[1] · G. Skarphedinsson[3] · J. B. Nissen[1] · R. Valderhaug[4,5] · K. Dahl[3] · B. Weidle[4,6] · N. C. Torp[3,12] · M. Grados[7] · A. B. Lewin[8,14] · K. H. Melin[9] · E. A. Storch[8,14,15] · L. H. Wolters[10,13] · T. K. Murphy[8,14] · E. J. S. Sonuga-Barke[11] · P. H. Thomsen[1]

Received: 13 January 2016 / Accepted: 30 June 2016 / Published online: 7 July 2016

Abstract The underlying structure of obsessive–compulsive disorder (OCD) remains to be confirmed in child and adolescent populations. In this paper we report the first factor analytic study of individual OCD items from Children's Yale-Brown Obsessive Compulsive Scale (CY-BOCS). OCD symptoms were assessed using the CY-BOCS symptom checklist in a sample of 854 patients with OCD (7–18 years of age) recruited from clinics in five countries. Pooled data were subjected to exploratory and confirmatory factor analysis (CFA) to identify the optimal factor structure. Various models were tested for age and gender subgroups. Also, the invariance of the solution across age and gender was tested and associations with demographic and clinical factors were explored. A three-factor model provided the best-fit solution. It consisted of the following factors: (1) harm/sexual, (2) symmetry/hoarding, (3) contamination/cleaning. The factor structure was invariant for age and gender across subgroups. Factor one was significantly correlated with anxiety, and factor two with depression and anxiety. Factor three was negatively correlated with tic disorder and attention-deficit/hyperactivity disorder (ADHD). Females had higher scores on factor two than males. The OCD symptom structure in children and adolescents is consistent across age and gender and similar to results from recent child and adolescents although hoarding may not be a separate factor. Our three-factor structure is almost identical to that seen in early studies on adults. Common mental

Electronic supplementary material The online version of this article (doi:10.1007/s00787-016-0887-5) contains supplementary material, which is available to authorized users.

✉ D. R. M. A. Højgaard
davmar@rm.dk

[1] Center for Child and Adolescent Psychiatry, Aarhus University Hospital Risskov, Risskov, Denmark

[2] Department of Public Health and Center for Healthy Aging, University of Copenhagen, Copenhagen, Denmark

[3] The Center for Child and Adolescent Mental Health, Eastern and Southern Norway (RBUP), Oslo, Norway

[4] Regional Centre for Child and Youth Mental Health and Child Welfare, Central Norway, Trondheim, Norway

[5] Department of Child and Adolescent Psychiatry, Hospital of Aalesund, Aalesund, Norway

[6] Department of Child and Adolescent Psychiatry, St. Olavs Hospital, Trondheim, Norway

[7] John Hopkins Children's Center, Baltimore, USA

[8] Department of Pediatrics, University of South Florida College of Medicine, Tampa, FL, USA

[9] Department of Child and Adolescent Psychiatry, Queen Silvia's Children's Hospital, Sahlgrenska University Hospital, Gothenburg, Sweden

[10] Department of Child and Adolescent Psychiatry, Academic Medical Center, Meibergdreef 5, 1105 AZ Amsterdam, The Netherlands

[11] Department of Psychology, University of Southampton, Southampton, UK

[12] Department of Child and Adolescent Psychiatry, Division of Mental Health and Addiction, Vestre Viken Hospital, Drammen, Norway

[13] Academic Center for Child and Adolescent Psychiatry, de Bascule, Meibergdreef 5, 1105 AZ Amsterdam, The Netherlands

[14] Department of Psychiatry and Behavioral Neurosciences, University of South Florida, St. Petersburg, FL, USA

[15] Department of Psychology, University of South Florida, St. Petersburg, FL, USA

disorders had specific patterns of associations with the different factors.

Keywords Obsessive–compulsive disorder · Factor analysis · CY-BOCS · Children and adolescents · Comorbidity · OCD symptom patterns

Introduction

Obsessive–compulsive disorder (OCD) is an often chronic and severely disabling disorder consisting of recurrent and persistent thoughts, urges, or images (obsessions) which for most individuals cause anxiety and distress. Repetitive behavior and/or mental acts are performed to relieve associated anxiety or prevent the occurrence of feared experience [1]. Between 0.25 and 4 % of all children and adolescents are affected [2, 3]. More than half of early diagnosed patients experience a chronic course with moderate to severe symptoms that last into adulthood [4, 5]. Common treatments for OCD include exposure and response prevention therapy [6, 7] and serotonin reuptake inhibitors [8].

OCD is a heterogeneous syndrome that consists of multiple overlapping elements [9, 10]. Children's Yale-Brown Obsessive Compulsive Scale (CY-BOCS) is the most commonly used method both to assess OCD symptoms in children and adolescents, and to monitor the treatment outcome [11]. The CY-BOCS checklist is currently divided into 19 symptom categories that measure each their variety of obsession or compulsion symptoms. This structure has, however, been challenged by factor analytic studies [12]. Interestingly, there is a difference between those who examine structure at the subscale level and those who examine at the item level. In a meta-analysis, studies based on subscales find a four-factor solution similar to that of Leckman et al. [10]: (1) symmetry; (2) forbidden thoughts including aggression, sexual and religious obsessions; (3) cleaning; and (4) hoarding. On the other hand, studies that examine structure at the item level showed a five-factor solution: (1) symmetry obsessions and repeating, ordering, and counting compulsions, as well as hoarding obsessions and compulsion; (2) aggression, sexual, and religious obsessions; (3) cleaning compulsions and contamination obsessions; (4) aggression obsessions and checking compulsions; and (5) somatic obsessions [12]. Few studies have been conducted with child and adolescent samples, and no studies have explored the structure based on individual symptoms in this age group. The importance of investigating the symptom structure in children and adolescents is clearly being highlighted by findings of developmentally heterogeneous OCD symptoms between age groups [13, 14]. The first two studies to explore the OCD symptom structure by means of CY-BOCS in a sample of children and adolescents were published in 2006. They concluded that a four-factor structure provided the best fit but with considerable difference in factor composition with one study confirming factors found in adult studies [15], and the other unable to corroborate adult findings [16]. Later studies of this age group included larger sample sizes and resulted in factor structures similar to the four-factor structure found in adults [17–19]. One of these studies conducted by Stewart et al. compared several factor structures between children, adolescents, and adults and found the four-factor structure described by Leckman [10] to be adequate for use in all age groups in spite of its imperfections [19].

The current study is the first one to look at the OCD factor structure at the item level in this age group. Hoarding is often seen in combination with OCD, and in some studies of OCD symptom structure, hoarding symptoms emerge as a factor of its own, providing some support for the concept that these symptoms belong to an etiologically distinct subgroup. Consistent with evidence from many studies—that hoarding forms a factor on its own, DSM-5 includes hoarding as a distinct disorder even though it is acknowledged that hoarding symptoms are frequently present in OCD [20].

In childhood and adolescence, OCD frequently co-occurs with other mental disorders, the most common of which are neuropsychiatric disorders, including tics, anxiety disorders, and depression [21]. Tics are a part of the familial OCD phenotype [22], and tic disorder with OCD appears to be a more severe type than tic disorder without OCD [23]. Tic disorder has been shown to occur with symmetry/ordering and aggressive/checking symptoms [24–26], and with impulsive symptoms [27]; anxiety and depression with aggressive, religious, and sexual symptoms [28]. Adult studies demonstrate that males have a tendency to religious, sexual, checking, and repeating symptoms and females to contamination symptoms [29, 30]. Identification of symptom subtypes in OCD is an important step in understanding the phenomenology of the disorder as well as being useful regarding diagnosis and treatment of the disorder, as symptom subtypes have been shown to impact treatment outcome [31].

The aims of this study were (1) to determine the factor structure of CY-BOCS at the item level in a large multinational sample of children and adolescents; (2) to test the invariance of the factor structure across age and gender; and (3) to examine the association of factors with age, gender, and comorbid psychopathology.

Methods

Participants

The sample included 854 patents with OCD recruited from USA ($n = 400$), Sweden ($n = 184$), Norway ($n = 111$), Denmark ($n = 101$), and The Netherlands ($n = 58$). All participants had an OCD DSM-IV diagnosis [32] based on either the Kiddie Schedule for Affective Disorders and Schizophrenia Present and Lifetime version (KSADS-PL) or the Anxiety Disorders Interview Schedule (ADIS). The mean age was 12.29 years (range 7–18), and 53 % were males. Exclusion criteria varied between sites and are presented in Online Resource Table 1; details about sample are found elsewhere [6, 33–39]. The study was approved by the national ethical committees and data authorities in all contributing countries.

Measures

OCD symptoms were measured by the use of CY-BOCS [11], a semi-structured interview designed specifically for the purpose. The interview consists of two parts. The first part poses 10 questions about obsessions and compulsions (5 of each) with the aim of measuring their severity on a five-point scale; the second part is a 74-item checklist that aims at assessing a broad range of current and past obsessions and compulsions. The CY-BOCS has been proved reliable and valid when used with samples of children [40]. Other disorders have been measured by means of the K-SADS-PL [41], among these the Swedish, Norwegian and Danish samples, and one part of the USA sample. The anxiety disorders interview schedule (ADIS) [42] was used in the Netherlands and in some of the USA sample as well.

Analysis

A calculation of Cronbach's alpha (α) was used to estimate the reliability of the standard CY-BOCS subscales [43]. In line with previous item-level exploratory factor analyses (EFA) in adults, we included all items in the analysis except for the last one in each category, the one labeled "other" (61 items included; Katerberg et al. [44]). First the data were subjected to exploratory principal axis factoring with direct oblimin rotation so as to allow the factors to be correlated, consistent with theoretical models of OCD. This approach was chosen because it is less affected by data skewing [45]. EFA was also conducted with a varimax rotation to evaluate possible differences and to compare to previous research. A factor analysis was carried out on a tetrachoric correlation matrix suited for binary variables [46], in STATA version 13 [47]. Missing item values were imputed from the mean of significantly correlated items ($p > 0.05$) rounded to 0 or 1. The final number of factors was chosen according to eigenvalues, scree-plot, and fit values from the CFA solutions. Cronbach's alpha was calculated for each new factor. In a second stage CFA was conducted by the use of Mplus Version 7.3 [48] on factor models 1-5 in order to determine which exploratory model would give the most parsimonious solution, and to estimate the invariance of the solution across gender, and child (7–12 years) and adolescent (13-18 years) groups. This approach is similar to the one used in a previous study of CY-BOCS [44]. Items were excluded from the CFA model if they loaded below 0.3 on all factors from the EFA. Cross loading items in the EFA were assigned to the factor with the highest loading. Estimates of fit were based on a range of indices—such as likelihood-ratio χ^2 test, comparative fit index (CFI), Tucker-Lewis index (TLI) [49], the root mean square error of approximation (RMSEA) [50], and weighted root mean square residual (WRMR) [51].

Factor scores, calculated by use of regression, were used in a multiple regression model with age and gender as predictors and correlated to co-morbid disorders using Pearson partial correlation, with pairwise deletion of missing data, controlled for the effect of age and gender. Comorbid disorders were selected on basis of relevance and availability and pooled from K-SADS and ADIS (Table 6). Co-morbid diagnoses were only available for a part of the sample ($n = 607$–665) and scored as a binary variable because we did not have measures on their severity.

Results

Demographic and clinical characteristics for each site are presented in Table 1. The Mean CY-BOCS severity score was similar to one seen in other pediatric OCD studies [32, 52, 53]. Norway had the highest proportion of males (62 %); Denmark had the lowest (37 %). There were also site-specific differences in CY-BOCS scores (Table 1).

Many of the CY-BOCS subscales had an unacceptably low level of internal consistency ranging from 0.34 to 0.74 (Online Resource Table 2). The three-factor solution was the most parsimonious when judged on the basis of a scree-plot, Eigenvalues, fit values for the CFA, and clinical evaluation of the factor structures. Scree-plot of eigenvalues can be seen in Online Resource diagram 1. Based on their item loadings they were labeled (1) harm/sexual, (2) symmetry/hoarding, and (3) contamination/cleaning (Table 2). Two items had a loading of less than 0.3 on all factors: "fear of saying certain things" and "other self-damaging or self-mutilating behaviors". Cross loading items were "checking tied to somatic obsession" and "fear of not saying just the right thing". Cronbach's alpha values for the three factors were between 0.79 and 0.81 (Table 2). When we used a

Table 1 Demographics and clinical characteristics by country

Country	*N*	Age (age range)	Gender (% male)	CY-BOCS severity score (SD)	Assessment used for diagnoses
Denmark	101	12.66 (7–17)	37.0	24.48 (5.14)	KSADS
Norway	111	12.95 (7–17)	62.0	25.39 (5.27)	KSADS
Sweden	184	12.96 (7–17)	41.0	23.53 (5.41)	KSADS
USA	400	11.62 (7–18)	61.0	22.69 (6.37)	KSADS/ADIS
The Netherlands	58	12.84 (8–18)	43.0	24.88 (4.17)	ADIS
Total	854	12.29 (7–18)	53.0	23.71 (5.74)	
p value		<0.001[a]	<0.001[b]	<0.001[a]	

[a] One-way ANOVA, [b] Pearson Chi Square

varimax rotation instead of an oblimin we found no major changes aside from "fear of not saying just the right thing" now loaded on both factor one (0.33) and factor two (0.33).

Fit indices for CFA models can be seen in Table 3. The three-factor solution provided the best fit measured on CFI, TLI, and χ^2 values. The four-factor solution was superior on RMSEA and WRMR measures. Items loading under 0.3 on any factor in the EFA were omitted, while all cross loading variables were kept in the CFA models. The three-factor solution was significant on the χ^2 test ($p < 0.001$). However, it is quite common that the χ^2 index reports unacceptable goodness-of-fit ($p < 0.05$), even if the data are highly compatible with the structure; therefore other indices are reported as well [54]. The four and five-factor solutions showed slightly poorer fit values than the three-factor solution, while the single and two-factor (obsessions/compulsions) solutions fitted poorly to the sample. Regarding item loading and cross loading differences between models, the four-factor solution had two items that loaded below 0.3 on all factors and 10 items loaded above 0.3 on more than one factor. In the five-factor solution three items loaded below 0.3 on any factor, and 20 items loaded above 0.3 on more than one factor. The four and five-factor solutions are presented in the Online Resource Tables 3 and 4. For comparison, a CFA was conducted on the five-factor solution provided by Katerberg and colleagues [44], resulting in a similar fit as our three- and four-factor solutions. Based on the slightly better fit indices, less cross loadings and clinical evaluation of the factor composition, we chose to proceed with the three-factor model.

The factor solution was invariant across age and gender groups (Table 4).

Females had higher score on factor two (symmetry/hoarding). Older patients had higher scores on all factors (Table 5).

There was no difference in factor scores between age groups on factor one (harm/sexual) ($M^{younger} = 0.08$, $SD = 0.33$; $M^{older} = 0.13$, $SD = 0.39$); $t(851) = -1.899$, $p = 0.058$. The younger group had significantly lower scores than the older group on factor two (symmetry/hoarding) (($M^{younger} = 0.32$, $SD = 0.32$) $M^{older} = 0.44$, $SD = 0.38$); $t(851) = -5.175$, $p = 0.000$ and factor three (contamination/cleaning) ($M^{younger} = 0.44$, $SD = 0.42$; $M^{older} = 0.51$, $SD = 0.44$); $t(851) = -2.386$, $p = 0.017$.

Tics and ADHD were correlated negatively with contamination/cleaning; depression was correlated with symmetry/hoarding factor scores. Anxiety was correlated almost equally to these two factors. Correlations found were small or insubstantial (Table 6).

Discussion

This paper reports the first item-level factor analysis of CY-BOCS in a large multinational sample of children and adolescents with OCD. The reliability of the standard CY-BOCS subscales was low for most categories, which supports the need for a revision of these subscales by means of item-level analysis. Similar to the three-factor structure found in the first studies on adults [55, 56], a three-factor solution proved to be the best model here too. Fit indices from CFA did not effectively differentiate between the three- and four-factor solution, but Screeplot and investigation of the factors suggested the three-factor solution. The four-factor solution had ten items that cross-loaded between factors making the solution unclear. Additionally, the four factor solution extracted a forth factor containing only five items which most were closely related to the items in factor one or two, as indicated by their factor loadings. This further supported the strength of the tree-factor solution over the four-factor solution. Finally, the three-factor solution was rated to be the most clinically sound solution by clinicians involved in this study. Direct comparison to previous childhood studies is difficult as the previous studies report on analyses at the subscale level. Stewart et al. [19] found the factor structure of child and adolescent OCD to fit Leckman's four-factor model better than Baer's original three-factor model, but the opposite is true for this study. However, our three-factor solution is highly comparable to most four-factor solutions presented

Table 2 Rotated solution of exploratory factor analysis with three factors: (1) harm/sexual, (2) symmetry/hoarding, and (3) contamination/cleaning

Item no.	CY-BOCS item	Factor 1	Factor 2	Factor 3
1	Content involves homosexuality	**0.75**	−0.26	−0.01
2	Fear will act on unwanted impulses	**0.70**	0.11	−0.08
3	Forbidden or upsetting sexual thoughts	**0.69**	−0.34	0.02
4	Fear of blurting out obscenities or insults	**0.68**	0.11	0.06
5	Fear might harm self	**0.67**	−0.03	−0.15
6	Fear might harm others	**0.62**	0.11	0.00
7	Excessive telling, asking, or confessing	**0.59**	0.05	0.14
8	Sexual behavior toward others	**0.59**	−0.21	0.07
9	Violent or horrific images	**0.57**	0.15	−0.17
10	Fear will steal things	**0.57**	0.00	0.09
11	Checking that did not/will not harm others	**0.56**	0.14	−0.04
12	Fear of doing something embarrassing	**0.53**	0.19	0.07
13	Excessive concern with right/wrong, morality	**0.50**	0.14	0.14
14	Excessive concern with body part or aspect of appearance	**0.49**	0.19	0.13
15	Overly concerned with offending religious objects	**0.46**	0.12	0.07
16	Checking that did not/will not harm self	**0.46**	0.10	0.06
17	Fear of not saying just the right thing	**0.43**	**0.32**	0.17
18	Fear harm will come to self	**0.43**	0.22	−0.09
19	Checking tied to somatic obsession	**0.43**	0.09	**0.32**
20	Fear harm will come to others	**0.41**	0.32	−0.13
21	The need to know or remember	**0.38**	0.29	0.02
22	Intrusive (non-violent) images	**0.37**	0.19	0.08
23	Checking that nothing terrible did/will happen	**0.31**	0.29	−0.01
24	Trichotillomania	**0.30**	0.22	−0.05
25	Arranging/ordering—evening up	−0.15	**0.69**	0.00
26	Behaviors such as stepping over certain spots on a floor, touching and object/self, certain number of times as a routine game to avoid something bad from happening	0.04	**0.68**	−0.08
27	Need to repeat routine activities	−0.02	**0.67**	−0.04
28	Need to do things until it feels just right	−0.03	**0.67**	1.14
29	Objects, words, etc.	−0.06	**0.65**	−0.03
30	Excessive touching, tapping, rubbing	−0.02	**0.64**	−0.13
31	Lucky/unlucky numbers, colors, words	0.04	**0.62**	0.05
32	Rereading, erasing or rewriting	0.06	**0.61**	0.04
33	Intrusive sounds, words, music, or numbers	0.19	**0.56**	−0.04
34	Checking that did not make mistake	0.21	**0.48**	0.16
35	Excessive list making	0.01	**0.48**	−0.05
36	Difficulty throwing things away, saving bits of paper, string, old newspapers, notes, cans, paper towels, wrappers and empty bottles; may pick up useless objects from street or garbage	0.05	**0.48**	0.00
37	Rituals involving blinking or staring	0.30	**0.47**	−0.04
38	Checking locks, toys, school books/items	0.12	**0.46**	0.15
39	Fear will be responsible for something terrible to happen	0.29	**0.42**	0.09
40	Hoarding obsessions	0.14	**0.39**	0.03
41	Ritualized eating behaviors	−0.09	**0.35**	0.26
42	Mental compulsions	0.24	**0.35**	0.11
43	Measures to prevent harm to self	0.15	**0.30**	−0.06
44	Excessive concern with dirt, germs, certain illnesses	0.04	−0.06	**0.90**
45	Excessive or ritualized hand washing	−0.09	−0.05	**0.85**
46	Other measures to prevent or remove contact with contaminants	−0.07	−0.04	**0.80**

Table 2 continued

Item no.	CY-BOCS item	Factor 1	Factor 2	Factor 3
47	Excessive or ritualized showering, bathing, tooth brushing, grooming, toilet routine, using a certain amount of toilet paper	−0.19	0.17	**0.73**
48	Excessive cleaning of items	−0.02	0.05	**0.69**
49	Concerned will get other sill by spreading contaminant	0.15	−0.03	**0.61**
50	Concerned will get ill because of contaminant	0.26	0.04	**0.60**
51	Excessive concern with contamination from household items	−0.03	0.08	**0.58**
52	Excessive concern about contamination from touching animals/insects	0.21	0.03	**0.52**
53	Excessive concern with environmental contaminants	0.03	0.03	**0.49**
54	Excessively bothered by sticky substances or residues	0.10	0.20	**0.48**
55	Rituals involving others	0.17	0.15	**0.47**
56	Checking associated with getting washed, dressed, or undressed	−0.11	0.29	**0.46**
57	Excessive concern/disgust with bodily waste or secretions	0.04	−0.31	**0.45**
58	No concern with consequences of contamination other than how it might feel	0.12	0.08	**0.36**
59	Excessive concern with illness or disease	0.26	0.09	**0.30**
60	Fear of saying certain things[a]	0.27	0.28	0.25
61	Other self-damaging or self-mutilating behaviors[a]	0.23	0.18	0.07
	Eigenvalue	13.51	5.46	3.90
	% of variance	22.15	8.95	6.39
	Cronbach's alpha	0.79	0.79	0.81

Loadings above 0.3 are marked in bold

[a] Has a loading below 0.3 on all factors

Table 3 Confirmatory factor analysis of EFA models, variables loading under 0.3 on any factor excluded

Fit indices	1 Factor	3 Factors	4 Factors	5 Factors	2 Factors (obsessions/compulsions)
CFI	0.641	0.848	0.844	0.823	0.659
TLI	0.628	0.842	0.837	0.815	0.647
RMSEA	0.051	0.034	0.033	0.035	0.047
WRMR	2.233	1.615	1.599	1.668	2.125
χ^2 (*df*)	5005.736	2942.752	3133.599	3267.464	5066.013
p value	<0.001	<0.001	<0.001	<0.001	<0.001

CFI comparative fit index, *TLI* Tucker-Lewis index, RMSEA root mean square error of approximation, *WRMR* weighted root mean square residual

Table 4 Confirmatory factor analysis of the 3-factor model for gender and age groups, variables loading under 0.3 on any factor excluded

Fit indices	Female	Male	7–12 years	13–18 years
CFI	0.857	0.820	0.813	0.846
TLI	0.851	0.812	0.806	0.840
RMSEA	0.032	0.031	0.030	0.032
WRMR	1.343	1.362	1.366	1.350
χ^2 (*df*)	2157.721	2199.106	2143.933	2203.446
p value	<0.001	<0.001	<0.001	<0.001

CFI comparative fit index, TLI Tucker-Lewis index, RMSEA root mean square error of approximation, WRMR weighted root mean square residual

in earlier studies on children and adolescents, with the exception that our symmetry/hoarding factor represents a combination of two factors—seemingly identical with the separate symmetry and hoarding factors [17–19]. Only McKay et al. found hoarding and ordering/arranging symptoms to combine as one factor in a sample of children and adolescents [16]. The reason for this difference is unclear, but it could in part be explained by the fact that hoarding is only represented by two items and will, therefore, influence the solution less than in a category analysis. The result is, however, not surprising, since a shared symmetry/hoarding factor has been evidenced in several previous studies [16, 44, 55, 57]. An alternative possibility is that hoarding

Table 5 Multiple regression analysis of factor scores using gender and age at assessment as predictors

Variables	Harm/sexual			Symmetry/hoarding			Contamination/cleaning		
	B	SE *B*	*B*	*B*	SE *B*	*β*	*B*	SE *B*	*β*
Gender	0.005	0.025	0.007	−0.068**	0.024	−0.095	−0.017	0.029	−0.020
Age	0.013**	0.004	0.104	0.023**	0.004	0.183	0.012*	0.005	0.078
R^2		0.011			0.043			0.007	
F		4.685**			19.124**			2.787	

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

Table 6 Correlation of co-morbid disorders and factor scores controlled for age and gender

Partial correlation (*df*)	Harm/sexual (*p*)	Symmetry/hoarding (*p*)	Contamination/cleaning (*p*)
Tic disorder (602)	0.076 (0.062)	0.045 (0.271)	**−0.115 (0.005)**
Depressive disorders (658)	0.053 (0.170)	**0.091 (0.019)**	0.040 (0.303)
Anxiety disorders (660)	**0.133 (0.001)**	**0.133 (0.001)**	−0.002 (0.951)
Generalized anxiety disorder (660)	**0.106 (0.007)**	**0.098 (0.011)**	−0.015 (0.705)
Separation anxiety disorder (660)	0.025 (0.521)	−0.028 (0.478)	−0.073 (0.059)
Social anxiety disorder (660)	**0.085 (0.029)**	**0.144 (0.000)**	−0.019 (0.632)
Specific phobia (660)	0.019 (0.642)	0.070 (0.074)	−0.014 (0.725)
Panic disorder (660)	−0.017 (0.663)	−0.044 (0.257)	−0.033 (0.401)
ADHD (660)	−0.033 (0.396)	0.050 (0.201)	**−0.108 (0.005)**

Significant correlations in bold

symptoms are not fully developed at younger ages, which is why hoarding does not separate as a factor on its own before adulthood. Surprisingly, we found the item "Fear will be responsible for something terrible to happen" to have a higher loading on the symmetry/hoarding factor than on the harm/sexual factor, indicating that the item is too vague and may refer to two distinct types of OCD symptoms. Alternatively, a sub-category of "terrible" things are specifically related to symptoms of symmetry/hoarding. Our contamination/cleaning factor corresponds well to that found in most previous studies on children and adolescents [15, 17, 19]. However, one study found contamination obsessions and washing/cleaning compulsions to belong to separate factors [16]. In our study, somatic symptoms are divided between harm/sexual and contamination/cleaning factors and seem to be tied to both these factors, possibly indicating two distinct sub-categories of somatic symptoms. Symptoms of checking are distributed between all three factors, indicating that checking behaviors are linked with various distinct obsessional themes. Also, this could explain the varying correlation of checking symptoms to factors in previous studies based on the CY-BOCS original symptom categories.

Due to category heterogeneity, items belonging to the miscellaneous categories in both obsessions and compulsions were excluded from most previous studies. We included these items in our study and found twelve out of fourteen of them belonging to two of the extracted factors, indicating a current misplacement in the miscellaneous categories and providing further support for our three-factor model. Only one of the miscellaneous items ("Fear of not saying just the right thing") cross loaded between factors, loading above 0.3 on harm/sexual and symmetry/hoarding factors. This may possibly represent generalized anxiety disorder (GAD) thoughts in patients with both OCD and GAD, which is a common combination. The following items correlated with factor one (harm/sexual): "Trichotillomania", "The need to know or remember", "Intrusive (non-violent) images" and "Excessive telling, asking or confessing". The following items were found to correlate with factor two (symmetry/hoarding): "Measures to prevent harm to self", "Intrusive sounds, words, music or numbers", "Ritualized eating behaviors", "Excessive list making", "Excessive touching, tapping and rubbing", "Need to do things until it feels just right", and "Rituals involving blinking or staring" (Table 2). In this study only two miscellaneous items ("fear of saying certain things" and "other self-damaging or self-mutilating behaviors") failed to correlate significantly to any factor. These items may need to be split and/or re-worded, as it is possible that they refer to other obsessions. "Fear of saying certain things" can, for example, refer not only to sexual content but also to magical events happening in case the word is expressed (thought-action fusion). Contrary to the notion of the miscellaneous items as less "true" OCD symptoms in the Katerberg study, where many of these items formed a factor

on their own [44], locating miscellaneous items on specific symptom factors in this study supports the view that these items are in fact true OCD symptoms. However, the Katerberg study was based on an adult sample and a slightly different methodology which may explain the different outcome. Since one of the samples included in this study contains children diagnosed with Pediatric Autoimmune Neuropsychiatric Disorders Associated with Streptococcal Infections (PANDAS), we chose to exclude this sample when conducting the EFA so as to investigate whether a possible difference in symptom structure in PANDAS might have influenced our results. This was, however, not the case, and the factor structure remained stable with the sample excluded.

Overall our factor structure shows considerable similarity to the original factor solutions found in adult studies [55, 56], as well as to most studies on children and adolescents with the exception of hoarding which was associated with symptoms of symmetry in our study. For comparison, we conducted a CFA on the five-factor solution provided by Katerberg et al. [44], resulting in a CFI fit value of 0.856. This is, however, likely to be an overestimation since Katerberg et al.'s analysis included fewer CY-BOCS items because they excluded all items that cross loaded between factors in the initial EFA. The inclusion of cross loading items in our CFA could also explain the overall suboptimal fit indices. It is noticeable that the symmetry/hoarding factor is consistent with some previous item-level studies in which hoarding loads with symmetry, ordering, repeating and arranging items [44, 56, 58–61], and does not constitute a separate factor. Also, hoarding did not separate as a factor on its own in any of the solutions that we tested (supplementary Tables 3, 4). DSM-5 hoarding disorder is classified as a separate disorder and is as such no longer part of the OCD classification, although it should be noted that symptoms of hoarding are still recognized as a part of OCD if they are a consequence of typical obsessions [1]. It is possible that variation in samples regarding number of patients with co-morbid hoarding disorder and OCD related hoarding could affect the factor structure in both this and previous studies that have used category-based factor analysis which tends to isolate hoarding as a separate factor as this method is unable to detect any correlation to individual items from the CY-BOCS categories. There is, however, a limitation to CY-BOCS in that it does not distinguish between OCD-associated hoarding and hoarding disorder per se. To differentiate between hoarding disorder and OCD-related hoarding we suggest that OCD-related hoarding items should be rephrased.

In regard to the factor analysis, we consider the three-factor solution presented here to be generally compatible with factor solutions from previous studies although it suggests fewer factors than most of those. This could indicate a possible difference in symptom factor structure in child and adolescent samples, but if this is to be confirmed, more studies on individual symptoms are required. CFA model fit was acceptable for the three, four- and five-factor solutions, but since extracting more factors did not make the model stronger, the three-factor solution was considered the sturdiest (Table 3). CFA for groups of males, females, children, and adolescents did not reveal any difference in symptom structure, indicating no gender or age differences and confirming previous research [17]. Generally, the CFI and TLI values for model fit are below 0.95 which could be caused by the large number of items, their heterogeneity, or both.

We did not find support for gender predicting either contamination/cleaning or harm/sexual as would have been expected from previous research [29]. However, contrary to previous research, being female predicted higher scores on the symmetry/hoarding factor. Tic-related OCD has previously been found to correlate with aggressive, sexual, religious, and symmetrical obsessions and checking, ordering, counting, repeating, and symmetry compulsions [24–26], but this was not confirmed by our results. We did, however, find tics and ADHD to be slightly negatively correlated to the contamination/cleaning factor, thus providing some support for our factor structure. However, this is not compatible with the view of OCD as a disorder of impulsivity/compulsivity [62]. In adults, anxiety and depression have been found to correlate highly with OCD sexual and aggressive symptoms [63]. In this study, however, a low correlation was found with the symmetry/hoarding factor while generalized anxiety disorder and social anxiety disorder had a low or insubstantial correlation with the factors of harm/sexual and symmetry/hoarding. Neither anxiety disorder nor depression correlated with the contamination/cleaning factor, thereby underlining the different nature of these factors. The partial correlations between comorbid disorders and OCD symptom factors were generally low or insubstantial in our sample. Still, however, they provide some support for the observed factor structure, particularly in the need to separate the contamination/cleaning factor from the remaining two.

This study is the first to apply factor analysis to individual CY-BOCS items in a sample of children and adolescents. In addition, comorbidity data were used to support the factor structure, and a particular strength of the study strength was its ability to pool data from several clinics to obtain a large sample. On the other hand, multi-center studies pose a challenge in regard to sample homogeneity, as language and cultural differences can be associated with differential item functioning. Thus, this study's methodology was limited by a possible selection bias, differences in exclusion criteria, and varying use of instruments between sites. In particular, heterogeneity in instruments used to

evaluate co-occurring disorders may limit the conclusions that can be drawn from the comorbidity analyses. Invariance and inter-rater reliability across sites were not tested although rater interpretation for the CY-BOCS items may differ between sites. Identification of symptom dimensions in child and adolescent OCD can facilitate understanding of diverse etiological factors underlying each symptom dimension, as well as benefit future studies investigating treatment outcome, and prediction of immediate and longitudinal outcome of OCD.

Conclusion

This study found three symptom dimensions in an international sample of children and adolescents with OCD. The results are based on a very large sample and this is the first study to conduct an explorative factor analysis on CY-BOCS items in a sample of children and adolescents. The factor structure was similar across groups of gender and age. The solution is to some extent compatible with previous studies of this age group and of adults, although most previous studies found 4–5 factors. The results of this study may be of clinical importance as they strengthen the view of OCD being a heterogeneous disorder with possible differences in etiology and treatment demands that needs further research.

Acknowledgements The authors would like to thank TrygFonden, Lundbeck Foundation and Central Region Denmark's Research Fund for supporting the research presented in this article through project grants. They would also like to thank the participants and staff from the contributing clinics.

Compliance with ethical standards

Conflict of interest Edmund Sonuga-Barke: Speaker fees, consultancy, research funding and conference support from Shire Pharma. Speaker fees from Janssen Cilag, Consultancy from Neurotech solutions, Aarhus University, University of Copenhagen and Berhanderling, Skolerne, Copenhagen, KU Leuven. Book royalties from OUP and Jessica Kingsley. Grants awarded from MRC, ESRC, Wellcome Trust, Solent NHS Trust, European Union, Child Health Research Foundation New Zealand, NIHR, Nuffield Foundation, Fonds Wetenschappelijk Onderzoek-Vlaanderen (FWO), MQ—Transforming Mental Health. Eric A. Storch: Research Funding: National Institutes of Health, All Children's Hospital Research Foundation Agency for Healthcare Research and Quality. Book Royalties: Wiley, Springer, American Psychological Association, Lawrence Erlbaum. Consultant: Prophase, INC, Rogers Memorial Hospital. Tord Ivarsson: Speakers bureau of Shire. Per Hove Thomsen: Speakers bureau of Shire and MEDICE. Tanya Murphy has received research funding from the Florida Agency for Healthcare Administration, AstraZeneca Research &Development, Brain and Behavior Research Foundation, the Centers for Disease Control and Prevention (CDCP), F. Hoffmann-La Roche Ltd., Indevus Pharmaceuticals, IOCDF, NIMH, Otsuka Pharmaceuticals, Pfizer, Inc., Psyadon Pharmaceuticals, Inc, and Shire Pharmaceuticals. She is on the Scientific and Clinical Advisory Board for the IOCDF. She has received travel support from the TSA and honoraria from grand rounds/CME lectures. Adam Lewin has received research funding from All Children's Hospital, Florida Agency for Healthcare Administration, the International OCD Foundation (IOCDF), and the Centers for Disease Control and Prevention (CDC). He is on the Scientific and Clinical Advisory Board for the IOCDF and is on the Board of Directors for the Society for Clinical Child and Adolescent Psychology (SCCAP) and the American Board of Clinical Child and Adolescent Psychology (ABCCAP). He has received honorarium and/or travel support from the Tourette Association of America (TAA), American Psychological Association, Springer, Oxford Press, University of Central Oklahoma, Rogers Memorial Hospital, and James Cook University. He is on the speaker's bureau for IOCDF and TAA. Consultant for Prophase, LLC and Bracket. Remaining authors: No conflict of interest.

Ethics National committees for Medical and Health Research in Denmark, Norway, Sweden, USA and the Netherlands approved the data collection. Informed consent was obtained from the participants and/or their parent(s) or legal guardian(s).

References

1. American Psychiatric Association (2013) Diagnostic and statistical manual of mental disorders, 5th edn. American Psychiatric Publishing, Arlington
2. Thomsen PH (1993) Obsessive–compulsive disorder in children and adolescents. Self-reported obsessive–compulsive behaviour in pupils in Denmark. Acta Psychiatr Scand 88:212–217. doi:10.1111/j.1600-0447.1993.tb03441.x
3. Heyman I, Fombonne E, Simmons H et al (2001) Prevalence of pervasive developmental disorders in the British nationwide survey of child mental health. J Am Acad Child Adolesc Psychiatry 40:820–827. doi:10.1097/00004583-200107000-00017
4. Eisen JL, Mancebo MA, Pinto A et al (2006) Impact of obsessive–compulsive disorder on quality of life. Compr Psychiatry 47:270–275. doi:10.1016/j.comppsych.2005.11.006
5. Sørensen CB, Kirkeby L, Thomsen PH (2004) Quality of life with OCD. A self-reported survey among members of the Danish OCD Association. Nord J Psychiatry 58:231–236. doi:10.1080/08039480410006287
6. Torp NC, Dahl K, Skarphedinsson G et al (2015) Effectiveness of cognitive behavior treatment for pediatric obsessive–compulsive disorder: acute outcomes from the Nordic long-term OCD Treatment Study (NordLOTS). Behav Res Ther 64:15–23. doi:10.1016/j.brat.2014.11.005
7. Freeman J, Garcia A, Frank H et al (2013) Evidence base update for psychosocial treatments for pediatric obsessive–compulsive disorder. J Clin Child Adolesc Psychol 43:7–26. doi:10.1080/15374416.2013.804386
8. Geller DA, March J (2012) Practice parameter for the assessment and treatment of children and adolescents with obsessive–compulsive disorder. J Am Acad Child Adolesc Psychiatry 51:98–113. doi:10.1016/j.jaac.2011.09.019
9. Mataix-Cols D, do Rosario-Campos MC, Leckman JF (2005) A multidimensional model of obsessive–compulsive disorder. Am J Psychiatry 162:228–238. doi:10.1176/appi.ajp.162.2.228
10. Leckman JF, Grice DE, Boardman J et al (1997) Symptoms of obsessive–compulsive disorder. Am J Psychiatry 154:911–917
11. Scahill L, Riddle MA, McSwiggin-Hardin M et al (1997) Children's Yale-Brown obsessive compulsive scale: reliability and validity. J Am Acad Child Adolesc Psychiatry 36:844–852. doi:10.1097/00004583-199706000-00023
12. Bloch MH, Landeros-Weisenberger A, Rosario MC et al (2008) Meta-analysis of the symptom structure of obsessive–compulsive

disorder. Am J Psychiatry 165:1532–1542. doi:10.1176/appi.ajp.2008.08020320
13. Farrell L, Barrett P (2006) Obsessive–compulsive disorder across developmental trajectory: cognitive processing of threat in children, adolescents and adults. Br J Psychol 97:95–114. doi:10.1348/000712605X58592
14. Geller DA, Biederman J, Faraone S et al (2001) Developmental aspects of obsessive compulsive disorder: findings in children, adolescents, and adults. J Nerv Ment Dis 189:471–477
15. Delorme R, Bille A, Betancur C et al (2006) Exploratory analysis of obsessive compulsive symptom dimensions in children and adolescents: a prospective follow-up study. BMC Psychiatry 6:1. doi:10.1186/1471-244X-6-1
16. McKay D, Piacentini J, Greisberg S et al (2006) The structure of childhood obsessions and compulsions: dimensions in an outpatient sample. Behav Res Ther 44:137–146. doi:10.1016/j.brat.2005.02.001
17. Mataix-Cols D, Nakatani E, Micali N, Heyman I (2008) Structure of obsessive–compulsive symptoms in pediatric OCD. J Am Acad Child Adolesc Psychiatry 47:773–778. doi:10.1097/CHI.0b013e31816b73c0
18. Stewart SE, Rosario MC, Brown TA et al (2007) Principal components analysis of obsessive–compulsive disorder symptoms in children and adolescents. Biol Psychiatry 61:285–291. doi:10.1016/j.biopsych.2006.08.040
19. Stewart SE, Rosario MC, Baer L et al (2008) Four-factor structure of obsessive–compulsive disorder symptoms in children, adolescents, and adults. J Am Acad Child Adolesc Psychiatry 47:763–772. doi:10.1097/CHI.0b013e318172ef1e
20. Torres AR, Fontenelle LF, Ferrão YA et al (2012) Clinical features of obsessive–compulsive disorder with hoarding symptoms: a multicenter study. J Psychiatr Res 46:724–732. doi:10.1016/j.jpsychires.2012.03.005
21. Ivarsson T, Melin K, Wallin L (2008) Categorical and dimensional aspects of co-morbidity in obsessive–compulsive disorder (OCD). Eur Child Adolesc Psychiatry 17:20–31. doi:10.1007/s00787-007-0626-z
22. Grados MA, Riddle MA, Samuels JF et al (2001) The familial phenotype of obsessive–compulsive disorder in relation to tic disorders: the Hopkins OCD family study. Biol Psychiatry 50:559–565. doi:10.1016/S0006-3223(01)01074-5
23. Lebowitz ER, Motlagh MG, Katsovich L et al (2012) Tourette syndrome in youth with and without obsessive compulsive disorder and attention deficit hyperactivity disorder. Eur Child Adolesc Psychiatry 21:451–457. doi:10.1007/s00787-012-0278-5
24. Nikolajsen KH, Nissen JB, Thomsen PH (2011) Obsessive–compulsive disorder in children and adolescents: symptom dimensions in a naturalistic setting. Nord J Psychiatry 65:244–250. doi :10.3109/08039488.2010.533386
25. Mataix-Cols D, Rauch SL, Manzo PA et al (1999) Use of factor-analyzed symptom dimensions to predict outcome with serotonin reuptake inhibitors and placebo in the treatment of obsessive–compulsive disorder. Am J Psychiatry 156:1409–1416
26. Robertson MM (2000) Tourette syndrome, associated conditions and the complexities of treatment. Brain 123(Pt 3):425–462. doi:10.1093/brain/123.3.425
27. Cath DC, Spinhoven P, Hoogduin CA et al (2001) Repetitive behaviors in Tourette's syndrome and OCD with and without tics: what are the differences? Psychiatry Res 101:171–185. doi:10.1016/S0165-1781(01)00219-0
28. Nestadt G, Di CZ, Riddle MA et al (2009) Obsessive–compulsive disorder: subclassification based on co-morbidity. Psychol Med 39:1491. doi:10.1017/S0033291708004753
29. Cherian AV, Narayanaswamy JC, Viswanath B et al (2014) Gender differences in obsessive–compulsive disorder: findings from a large Indian sample. Asian J Psychiatr 9:17–21. doi:10.1016/j.ajp.2013.12.012
30. De Mathis MA, De Alvarenga P, Funaro G et al (2011) Gender differences in OCD: a literature review. Rev Bras Psiquiatr 33:390–399
31. Williams MT, Farris SG, Turkheimer EN et al (2014) The impact of symptom dimensions on outcome for exposure and ritual prevention therapy in obsessive–compulsive disorder. J Anxiety Disord 28:553–558
32. American Psychiatric Association (2000) Diagnostic and statistical manual of mental disorders, 4th edn (text revision), American Psychiatric Association, Washington, DC. doi:10.1002/jps.3080051129
33. Lewin AB, Piacentini J, De Nadai AS et al (2014) Defining clinical severity in pediatric obsessive–compulsive disorder. Psychol Assess 26:679–684. doi:10.1037/a0035174
34. Murphy TK, Storch EA, Lewin AB et al (2012) Clinical factors associated with pediatric autoimmune neuropsychiatric disorders associated with streptococcal infections. J Pediatr 160:314–319. doi:10.1016/j.jpeds.2011.07.012
35. Pols R (2014) Towards improving treatment for childhood ocd: analysing mediating mechanisms and non-response. Kind Adolesc Prakt 13:93. doi:10.1007/s12454-014-0026-8
36. Storch EA, Caporino NE, Morgan JR et al (2011) Preliminary investigation of web-camera delivered cognitive-behavioral therapy for youth with obsessive–compulsive disorder. Psychiatry Res 189:407–412. doi:10.1016/j.psychres.2011.05.047
37. Storch EA, De Nadai AS, Jacob ML et al (2014) Phenomenology and correlates of insight in pediatric obsessive–compulsive disorder. Compr Psychiatry 55:613–620. doi:10.1016/j.comppsych.2013.09.014
38. Holmgren Melin K, Skärsäter I, Mowatt Haugland BS, Ivarsson T (2015) Treatment and 12-month outcome of children and adolescents with obsessive–compulsive disorder: a naturalistic study. J Obsessive Compuls Relat Disord 6:1–6. doi:10.1016/j.jocrd.2015.04.002
39. Wolters LH (2013) Towards improving treatment for childhood OCD: analyzing mediating mechanisms and non-response. University of Amsterdam, Amsterdam
40. Storch EA, Murphy TK, Geffken GR et al (2004) Psychometric evaluation of the children's Yale-Brown obsessive–compulsive scale. Psychiatry Res 129:91–98. doi:10.1016/j.psychres.2004.06.009
41. Kaufman J, Birmaher B, Brent D et al (1997) Schedule for affective disorders and schizophrenia for school-age children-present and lifetime version (K-SADS-PL): initial reliability and validity data. J Am Acad Child Adolesc Psychiatry 36:980–988. doi:10.1097/00004583-199707000-00021
42. Silverman WK, Saavedra LM, Pina AA (2001) Test-retest reliability of anxiety symptoms and diagnoses with the Anxiety Disorders Interview Schedule for DSM-IV: child and parent versions. J Am Acad Child Adolesc Psychiatry 40:937–944. doi:10.1097/00004583-200108000-00016
43. Cronbach LJ (1951) Coefficient alpha and the internal structure of tests. Psychometrika 16:297–334
44. Katerberg H, Delucchi KL, Stewart SE et al (2010) Symptom dimensions in OCD: item-level factor analysis and heritability estimates. Behav Genet 40:505–517. doi:10.1007/s10519-010-9339-z
45. Fabrigar LR, Wegener DT, MacCallum RC, Strahan EJ (1999) Evaluating the use of exploratory factor analysis in psychological research. Psychol Methods 4:272–299. doi:10.1037//1082-989X.4.3.272
46. Kubinger KD (2003) On artificial results due to using factor analysis for dichotomous variables. Psychology 45:106–110

47. StataCorp (2013) Stata statistical software: release 13. StataCorp LP, College Station, TX
48. Muthén LK, Muthén BO (1998-2015) Mplus user's guide, 7th edn. Muthén and Muthén, Los Angeles, CA
49. Bentler PM, Bonett DG (1980) Significance tests and goodness of fit in the analysis of covariance structures. Psychol Bull 88:588–606. doi:10.1037/0033-2909.88.3.588
50. Cabrera HN, Cuda G, López M, Costa JA (1984) Basal cell epithelioma of the vulva in chronic endemic regional arsenic poisoning. Med Cutan Ibero Lat Am 12:81–85. doi:10.1207/s15327906mbr2502_4
51. Yu C (2002) Evaluating cutoff criteria of model fit indices for latent variable models with binary and continuous outcomes. University of California, Oakland
52. Geller DA, Hoog SL, Heiligenstein JH et al (2001) Fluoxetine treatment for obsessive–compulsive disorder in children and adolescents: a placebo-controlled clinical trial. J Am Acad Child Adolesc Psychiatry 40:773–779
53. Abramowitz JS, Franklin ME, Street GP et al (2000) Effects of comorbid depression on response to treatment for obsessive–compulsive disorder. Behav Ther 31:517–528. doi:10.1016/S0005-7894(00)80028-3
54. Floyd FJ, Widaman KF (1995) Factor analysis in the development and refinement of clinical assessment instruments. Psychol Assess 7:286–299. doi:10.1037/1040-3590.7.3.286
55. Baer L (1994) Factor analysis of symptom subtypes of obsessive compulsive disorder and their relation to personality and tic disorders. J Clin Psychiatry 55(Suppl):18–23
56. Hantouche EG, Lancrenon S (1996) Modern typology of symptoms and obsessive–compulsive syndromes: results of a large French study of 615 patients. Encephale 22(Spec No):9–21
57. Stein DJ, Carey PD, Lochner C et al (2008) Escitalopram in obsessive–compulsive disorder: response of symptom dimensions to pharmacotherapy. CNS Spectr 13:492–498
58. Girishchandra BG, Khanna S (2001) Phenomenology of obsessive compulsive disorder: a factor analytic approach. Indian J Psychiatry 43:306–316
59. Denys D, De Geus F, Van Megen HJGM, Westenberg HGM (2004) Symptom dimensions in obsessive–compulsive disorder: factor analysis on a clinician-rated scale and a self-report measure. Psychopathology 37:181–189. doi:10.1159/000079509
60. Stein DJ, Andersen EW, Overo KF (2007) Response of symptom dimensions in obsessive–compulsive disorder to treatment with citalopram or placebo. Rev Bras Psiquiatr (São Paulo, Brazil 1999) 29:303–307. doi:10.1590/S1516-44462007000400003
61. Storch EA, Lack CW, Merlo LJ et al (2007) Clinical features of children and adolescents with obsessive–compulsive disorder and hoarding symptoms. Compr Psychiatry 48:313–318. doi:10.1016/j.comppsych.2007.03.001
62. Fineberg NA, Chamberlain SR, Goudriaan AE et al (2014) New developments in human neurocognition: clinical, genetic, and brain imaging correlates of impulsivity and compulsivity. CNS Spectr 19:69–89. doi:10.1017/S1092852913000801
63. Hasler G, LaSalle-Ricci VH, Ronquillo JG et al (2005) Obsessive–compulsive disorder symptom dimensions show specific relationships to psychiatric comorbidity. Psychiatry Res 135:121–132. doi:10.1016/j.psychres.2005.03.003