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Research paper

An ultra-brief screening scale for pediatric obsessive-compulsive disorder: The OCI-CV-5

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ABSTRACT

Background: Obsessive-compulsive disorder (OCD) is an often disabling and chronic condition that is normally assessed using diagnostic interviews or lengthy self-report questionnaires. This makes routine screening in general health settings impractical, and as a result OCD is often under-(or mis-)recognized. The present study reports on the development of an ultra-brief version of the Obsessive-Compulsive Inventory-Child Version (OCI-CV) which may be administered routinely as a screener for pediatric OCD.
Method: A total of 489 youth diagnosed with OCD, 259 non-clinical controls, and 299 youth with other disorders completed the OCI-CV and other indices of psychopathology. Using item analyses, we extracted five items and examined the measure's factor structure, sensitivity and specificity, and convergent and discriminant validity.
Results: We extracted five items that assess different dimensions of OCD (washing, checking, ordering, obsessing, neutralizing/counting), termed the OCI-CV-5. Results revealed that the measure possesses good to excellent psychometric properties, and a cutoff off (≥2) yielded optimal sensitivity and specificity.
Limitations: Participants were predominantly White. In addition, more research is needed to examine the OCI-CV-5's test-retest reliability and sensitivity to treatment.
Conclusions: The OCI-CV-5 shows promise as an ultra-brief self-report screener for identifying OCD in youth when in-depth assessment is unfeasible.

1. Introduction

Obsessive-compulsive disorder (OCD) is a prevalent and burdensome psychological condition affecting 1–2 % of the population (Fawcett et al., 2020; Ruscio et al., 2010). Characterized by a bimodal onset (Geller, 2006), OCD symptoms may appear in late childhood-early adolescence, or in early adulthood (Anholt et al., 2014; Taylor, 2011). Early onset OCD is more common among males than females, and relative to a later age of onset, is associated with a poorer prognosis, elevated comorbidity rates, poorer insight, different brain morphology, and possibly poorer treatment response (Geller, 2006; Taylor, 2011). While cognitive behavioral therapy (CBT) using exposure and response prevention is an empirically supported treatment for pediatric OCD (McGuire et al., 2015), the majority of OCD-affected youth do not

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receive this treatment because of a shortage of providers knowledgeable in the assessment and treatment of OCD (Piacentini et al., 2021). In fact, misdiagnosis rates of up to 50 % have been observed (Glazier et al., 2015; Perez et al., 2022; Senter et al., 2021). Thus, there is need for a psychometrically sound, brief self-report screening measure for pediatric OCD to be utilized in non-specialized medical settings to improve detection and intervention.

The primary features of OCD are repetitive intrusive thoughts that provoke anxiety (obsessions) and persistent efforts to reduce anxiety using avoidance and mental or behavioral rituals (compulsions; American Psychiatric Association, 2013). Although the leitmotif of each person's symptoms is highly individualized, research has identified anywhere from 3 to 6 primary (yet overlapping) domains including: harming obsessions and checking rituals; contamination obsessions and washing rituals; ordering/symmetry concerns (McKay et al., 2004; Stewart et al., 2007; McKay et al., 2004), as well as tic-related OCD (Leckman et al., 2010). The wide array of symptom presentations may obscure the identification of OCD and makes it challenging to develop brief screening instruments as are available for other psychological problems (e.g., Kroenke et al., 2007; Löwe et al., 2005).

Accordingly, few such measures exist; and none are suitable as rapid screening tools (for a review of evidence-based assessments for pediatric OCD see Rapp et al., 2016). For example, an eleven-item version of the Leyton Obsessional Inventory (Bamber et al., 2002) has been studied with youth, but the original sample was extremely small ($n = 65$) and diagnostic sensitivity was under 80 %. Indeed, the measure was later deemed to have inadequate psychometric properties in American youth with OCD (Storch et al., 2011). There is also an eight-item obsessive-compulsive scale on the Child Behavior Checklist (CBCL; Nelson et al., 2001). However, this scale is embedded in the larger CBCL, and has limited diagnostic specificity. The Short OCD Screener (SOCS; Uher et al., 2007) is another short self-report screening scale for pediatric OCD. The SOCS is a 7-item self-report scale, but it is offered to youth between the ages of 11–15, and has low specificity in differentiating between OCD and other disorders (Uher et al., 2007). Recent work using clinical decision-tree methodology identified one to two items from the Spence Children's Anxiety Scale (Spence, 1998) that distinguished children with OCD from children with other anxiety disorders and a community sample (Sattler et al., 2018).

Foa et al. (2010) developed a child version of the Obsessive-Compulsive Inventory (the OCI-CV) to serve as a self-report tool for youth aged 7–17 years. The OCI-CV consists of 21 items assessing obsessions and compulsions over the past month. In addition to a total score, it includes six subscales: doubting/checking, obsessing, hoarding, washing, ordering, and neutralizing. The OCI-CV therefore affords the assessment of OCD symptom dimensions that correspond—to some degree—with empirically established symptom domains (McKay et al., 2004). With its brief and easy to read format, and acceptable reliability and validity (Foa et al., 2010; Jones et al., 2013; Martinez-Gonzalez et al., 2015), the OCI-CV is widely used in treatment and research on pediatric OCD. However, the number of items makes the instrument inefficient as a screening tool in general medical settings and community clinics where a wide range of other conditions must also be screened.

Given the current emphasis on ultra-brief scales (Rammstedt and Beierlein, 2014) and that busy clinic settings cannot integrate long measures into their workflow, we therefore aimed to develop a succinct iteration of the OCI-CV that could be used to quickly identify youth with likely OCD for referral for further assessment and treatment. In this paper we describe the development and psychometric properties of such a screening instrument. We first identified particular OCI-CV items that are aligned with the most empirically consistent OCD symptom domains. Next, we assessed reliability, construct validity, and predictive validity of OCD clinical status. We assessed these parameters compared to the OCI-CV, gold standard measures of OCD symptoms, and measures of anxiety and depression.

2. Methods

2.1. Participants

2.1.1. OCD group

The OCD group was comprised of 489 youth with a primary diagnosis of OCD established via semi-structured clinical interview using DSM-IV or DSM-5 criteria. Youth were assessed at different clinics, hospitals, and universities internationally, including the Massachusetts General Hospital ($n = 87$), the University of Michigan ($n = 138$), Griffith University in Australia ($n = 107$), the British Columbia Children's Hospital in Canada ($n = 31$), and the University of South Florida ($n = 126$).

2.1.2. Clinical control group (CC)

The CC sample included 299 children with an anxiety or developmental disorder diagnosis other than OCD or autism spectrum disorder. Like the OCD group, diagnoses were established via clinical interview. Participants in the CC group were recruited through the University of South Florida ($n = 12$) and the University of Michigan ($n = 287$).

2.1.3. Nonclinical control group (NCC)

The NCC group was comprised of 259 participants recruited through the University of South Florida ($n = 15$) and the University of Michigan sites ($n = 244$). Participants were recruited through existing relationships with their respective health centers or paid advertisements or flyers in their community. Youth in the NCC sample did not meet DSM-IV or DSM-5 diagnostic criteria for any disorder according to semi-structured clinical interviews. Demographic information for each sample is displayed in Table 1.

2.2. Measures

2.2.1. Obsessive-compulsive inventory – child version (OCI-CV; Foa et al., 2010)

All study participants completed the OCI-CV, which is a self-report measure of OCD symptomology in children and adolescents. The scale includes 21 items (e.g., *I get upset if my stuff is not in the right order*) rated on a Likert scale ranging from 0 (*never*) to 2 (*always*). Items fit into six factors: checking/doubting, ordering, neutralizing, washing, obsessing, and hoarding. In previous research, total scale scores for the OCI-CV demonstrate good internal reliability across different languages and populations (Cronbach's $\alpha > 0.85$; Foa et al., 2010; Martinez-Gonzalez et al., 2015; Opakunle et al., 2018). Good internal consistency was observed in the current study for the OCD, CC, and NCC samples (Cronbach's α of 0.86, 0.89, and 0.83, respectively), and very good internal consistency was found for the entire sample ($\alpha = 0.91$). A revised

Table 1
Demographic and clinical characteristics of the three samples.

Variable	OCD ($n = 489$)	CC ($n = 298$)	NCC ($n = 260$)
	Mean (SD); %(n)		
Gender			
Female	52.2 % (255)	51.0 % (152)	49.2 % (128)
Age (years)	12.39 (2.92)	13.01 (2.94)	13.26 (2.93)
Ethnicity			
Black American	0.8 % (4)	0.7 % (2)	1.5 % (4)
Hispanic American	2.0 % (10)	5.2 % (15)	4.2 % (11)
Asian American	3.1 % (15)	0.3 % (1)	0.0 % (0)
Non-Hispanic White American	83.0 % (406)	87.3 % (260)	89.2 % (232)
Other/not identified	11.1 % (54)	6.7 % (20)	5.1 % (13)
OCD severity			
CY-BOCS obsessions	10.92 (4.23)	–	–
CY-BOCS compulsions	11.84 (4.08)	–	–
CY-BOCS total score	22.76 (7.76)	–	–

OCD: obsessive-compulsive disorder; CC: clinical controls; NCC: non-clinical controls; CY-BOCS: children's Yale-Brown obsessive-compulsive scale.

version of this scale that excludes hoarding is also available (Abramovitch et al., 2022).

2.2.2. Children's Yale-Brown obsessive-compulsive scale (CY-BOCS; Scahill et al., 1997)

The 10-item CY-BOCS scale was used to assess the severity of obsessions (items 1–5) and compulsions (items 6–10) identified during the semi-structured interview. Time consumed with the symptom, resistance to the symptom, associated distress, control over the symptom, and interference of functioning were assessed. Responses range from 0 (*none*) to 4 (*severe*) for each of the 10 items, yielding a maximum score of 40 for the total score and 20 for each subscale. The CY-BOCS has previously demonstrated good to excellent internal consistency (Cronbach's $\alpha > 0.82$; Scahill et al., 1997; Storch et al., 2019), interrater reliability, and test-retest reliability; the internal consistency was excellent in the current study ($\alpha = 0.94$).

2.2.3. Multidimensional anxiety scale for children (MASC; March et al., 1997)

The MASC is a self-report measure of anxiety for children and adolescents. The MASC includes 39 items measured on a Likert scale ranging from 0 (*never true about me*) to 3 (*often true about me*). The 39 items create four factors of anxiety: social anxiety, physical symptoms, harm avoidance, and separation anxiety. The MASC has good internal consistency and discriminant validity for both clinical and community samples (Baldwin and Dadds, 2007; March et al., 1997). In the current study, the scale had excellent internal consistency (Cronbach's $\alpha = 0.92$).

2.2.4. Children's depression inventory (CDI; Kovacs, 1985; Kovacs and MHS, 2011)

The CDI is a commonly used measure of depression severity in children. The 27-item self-rated scale assessed different components of depression, such as anhedonia, sadness, and sleep disturbance, on a 3-point Likert scale. Reponses range from 0 (*not at all*) to 2 (*definite*), yielding a maximum total score of 54. A revised version of the CDI (CDI-2; Kovacs and MHS, 2011) was also administered in the current study. The CDI-2 is a 28-item self-report scale measured on the same 3-point Likert scale as the CDI, with total scores ranging from 0 to 56. Two subscales comprise the CDI-2: emotional problems and functional problems. Both the CDI and the CDI-2 have demonstrated good to excellent internal reliability for clinical and community samples (Bae, 2012; Saylor et al., 1984). The CDI-2 demonstrated good internal reliability in the present study (Cronbach's $\alpha = 0.87$).

2.3. Procedure

Participants ($n = 1047$) were recruited through their local clinic, hospital, or university to participate in the present study. Parental consent and assent were obtained for each participant. All diagnoses were determined through a semi-structured interview using one of the following instruments: the Anxiety Disorders Interview Schedule for DSM-IV, the Child/Parent Version (ADIS-IV; Silverman and Albano, 1996), the Schedule for Obsessive-Compulsive and Other Behavioral Syndromes (SOCOBS; Hanna, 2007), or the Schedule for Affective Disorders and Schizophrenia for School-Age Children-Present and Lifetime Version (K-SADS-PL; Kaufman et al., 1997). Diagnostic interviews were performed by a trained Master's or doctoral clinician and another research focused clinician confirmed all interview data for all clinical participants. Participants were only included in the present study if both clinicians agreed on the principal diagnosis.

3. Results

3.1. Missing data

The average missing rate of the OCI-CV items was 3.4 % (2.9–4.3 %), 0.1 % (0.0 %–0.3 %), 0.1 % (0.0 %–0.4 %) for the OCD, clinical control group (CC), and nonclinical control group (NCC). Little's missing completely at random test (Little and Rubin, 2019) shows that the means of the OCI-CV items were different across missing data patterns ($\chi^2(df = 440) = 561.52$, $p < .001$), suggesting that the items were not missing completely at random (i.e., nothing in the dataset are related to the probabilities that missing values occurred in the variables). We used *Mplus* 8.7 (Muthén and Muthén, 2017) to conduct multiple imputation, which assumes data are missing at random (i.e., the observed values in the dataset are related to the probabilities that missing values occurred in the variables), to create 30 datasets that imputed the missing values of the OCI-CV items. The correlations between the missingness of the items with CY-BOCS, CDI, MASC, gender, age, and ethnicity were weak (average = 0.07, ranging from 0.01 to 0.22). We decided not to add these variables to the imputation. We used the formulas by Little and Rubin (2019) to pool the parameter estimates and their statistical inferences across imputed datasets. Because there is no established pooling procedure for the ROC analysis, we removed cases with missing values in ROC analysis.

3.2. Item selection

To maximize sensitivity and specificity, the item selection process comprised both empirical and conceptual consideration, as well as consideration of contemporary phenomenological models of pediatric OCD. As a first step, since hoarding is no longer classified as a symptom of OCD (e.g., American Psychiatric Association, 2013), and rarely seen as the initial or primary symptoms in pediatric OCD, we omitted OCI-CV hoarding items. Next, we conducted item response theory (IRT) analysis using *Mplus* 8.7 to identify items most likely to be sensitive to a diagnosis of OCD, while also protecting against overidentification. We randomly split the sample into two subsamples of equal size and used the first subsample to fit a correlated five-factor model (checking/doubting, ordering, neutralizing, washing, and obsessing). We next fitted the graded response model under the categorical item factor analysis framework (Forero and Maydeu-Olivares, 2009) and weighted least squares means and variance adjusted (WLSMV; Muthén et al., 2015) estimation to handle the ordinal (3-point scale) items. To evaluate the model fit, we used the root mean square error of approximation (RMSEA; <0.08 suggesting satisfactory fit; Browne and Cudeck, 1993) and comparative fit index (CFI; >0.95 suggesting satisfactory fit; Hu and Bentler, 1999). We interpreted the items' standardized item loadings (strength of relationships between items and factors; ranging from -1 to 1) and standardized item thresholds (z scores of the latent response that separates the observed responses) to select one item of each factor. In each factor, we followed the suggestions by Wirth and Edwards (2007) to select an item with the highest standardized factor loadings yet ≤ 0.95 to avoid 'Heywood cases' (Heywood, 1931). We also selected the items with item thresholds within z scores of ± 2. We also calculated the item-total correlations between each item and the sum score of the 18 items to aid item selection. To ensure face validity, we considered how each item fits with the most up to date conceptual and theoretical understanding of pediatric OCD.

After selecting one item from each factor, we used the second subsample to fit a one-factor model where all five selected items load on a single factor. We calculated the item-total correlations between each item and the sum score of the selected 5 items. We also tested the factorial invariance of this factor model between age groups (ages 7–11, 12–17). In the invariance test, three sequential invariance models were tested: configural invariance, metric invariance, and scalar invariance. The configural invariance model refers to the groups having the same factor model, but the factor loadings and item thresholds are all freely estimated in groups. The metric invariance model is nested within the configural invariance model, and all factor loadings are constrained to be equal between groups. The scalar invariance model is nested within the metric invariance model, and all the factor loadings and item

thresholds are constrained to be equal between the age groups. We evaluated the three models using the small reduction of RMSEA (ΔRMSEA <0.015) and CFI (ΔCFI > −0.010) between consecutive nesting models. Small changes in values support the more restrictive model Chen (2007).[1] If scalar invariance is supported, we can compare the factor mean, variances, and covariances between groups.

In the first subsample, the correlated five-factor model had satisfactory fit to the data, $\chi^2(df = 125) = 417.56$, RMSEA = 0.07, CFI = 0.98. Table 2 shows the standardized factor loadings and item thresholds of the model, as well as the item-total correlations between each item and the sum score of the 18 items. In the second subsample, the one-factor model of the five selected items also had satisfactory fit, $\chi^2(df = 5) = 8.86$, RMSEA = 0.04, CFI = 0.99. Table 3 shows the standardized factor loadings and item thresholds of the model, as well as the item-total correlations between each item and the sum score of the 5 items. The factorial invariance tests of this one-factor model supported scalar invariance across age groups (configural invariance: RMSEA = 0.05, CFI = 0.99; metric invariance: ΔRMSEA = −0.03, ΔCFI = 0.007; scalar invariance: ΔRMSEA = −0.02 and ΔCFI = 0.002).

3.2.1. Checking/doubting

Unlike the other OCI-CV subscales, the items in this subscale tap into two aspects of a related construct: Doubting obsessions and checking compulsions. In the correlated five-factor model using the first subsample, item 13 had the highest standardized factor loading (=0.89) and thresholds within an acceptable range (0.25 and 1.27) among the three doubting obsession items (5, 13, 20) and checking items (4 and 15). Its item-total correlation with the 18 items = 0.72. In the one-factor model using the second subsample (Table 3), item 13 had the standardized factor loading = 0.74 and item-total correlation = 0.70.

3.2.2. Ordering

In the correlated five-factor model using the first subsample, item 19 had the highest standardized factor loading (=0.93) and thresholds within acceptable range (−0.05 and 1.28) among the three ordering items (8, 17, 19). Its item-total correlation with the 18 items = 0.65. In the one-factor model using the second subsample (Table 3), item 19 had the standardized factor loading = 0.77 and item-total correlation = 0.74.

3.2.3. Neutralizing

Within the neutralizing subscale (items 6, 9,12), item 6 had the highest standardized factor loading (=0.87) and thresholds within an acceptable range (−0.05 and 1.28) in the correlated five-factor model using the first subsample. Its item-total correlation with the 18 items = 0.57. In the one-factor model using the second subsample (Table 3), item 19 had the standardized factor loading = 0.64 and item-total correlation = 0.60. Accordingly, we retained item 6 to assess neutralizing. Interestingly, items on this subscale exclusively address counting and repeating. Therefore, given that the term "neutralizing" traditionally refers to covert (e.g., avoidance, mini-rituals) or cognitive (e.g., thought suppression) strategies some individuals with OCD practice to manage their obsessional thoughts (Salkovskis et al., 1997), we changed the name of this subscale to 'counting'.

3.2.4. Washing

Within the washing subscale (items 2, 10, 21), item 2 had the highest standardized factor loading (=0.97) yet it was above the Heywood case cutoff 0.95. Together with the consideration of face validity to represent the washing subscale, we decided to select item 21 which had the second highest standardized factor loading (=0.92) and thresholds within an acceptable range (0.38 and 1.01) in the correlated five-factor model using the first subsample. Its item-total correlation with the 18 items = 0.56. In the one-factor model using the second subsample (Table 3), item 21 had the standardized factor loading = 0.46 and item-total correlation = 0.60.

3.2.5. Obsessing

Within the obsessing subscale (items 1, 11, 14, 18), item 11 had the highest standardized factor loading (=0.96) yet it was above the Heywood case cutoff 0.95. Together with the consideration of face validity to represent the obsessing subscale, we decided to select item 14 which had the second highest standardized factor loading (=0.94) and thresholds within an acceptable range (0.10 and 0.94) in the correlated five-factor model using the first subsample. Its item-total correlation with the 18 items = 0.67. In the one-factor model using the second subsample (Table 3), item 14 had the standardized factor loading = 0.65 and item-total correlation = 0.70.

Based on the analyses above we identified the following items: 6 (counting), 13 (checking/doubting), 14 (obsessing), 19 (ordering), 21 (washing). These final five items comprised a new screener we named the Five Item Obsessive-Compulsive Inventory- Child Version (OCI-CV-5).

3.3. Norms and psychometric properties of the OCI-CV-5

3.3.1. Norms

The means and standard deviations for the OCI-CV-5 total score (the total for items 13, 19, 6, 21, and 14) and item scores by group are presented in Table 4. The OCD, CC, and NCC groups were different on the total score, $\chi^2(2) = 504.56$, $p < .001$, $\eta^2 = 0.33$. The OCD group had a significantly higher average total score than the CC group (mean difference = 2.26, $p < .001$, Cohen's $d = 0.98$), which, in turn, had a significantly higher total score than the NCC group (mean difference = 3.02, $p < .001$, Cohen's $d = 1.31$). For individual items, an omnibus test showed that the OCD, CC, and NCC groups were different on the five item scores, $\chi^2(10) = 597.83$, $p < .001$. Follow-up univariate ANOVAs revealed significant between-group differences on each item (Doubting: $\chi^2(2) = 115.07$, $p < .001$, $\eta^2 = 0.10$; Ordering: $\chi^2(2) = 152.25$, $p < .001$, $\eta^2 = 0.13$; Counting: $\chi^2(2) = 130.68$, $p < .001$, $\eta^2 = 0.11$; Washing: $\chi^2(2) = 237.32$, $p < .001$, $\eta^2 = 0.19$; Obsessing: $\chi^2(2) = 130.68$, $p < .001$, $\eta^2 = 0.22$). Post hoc tests (Bonferroni correction) revealed that the OCD group scored significantly higher than the CC ($ps < 0.001$; Cohen's d from 0.51 to 0.92) and the NCC groups for all 5 items ($ps < 0.001$; Cohen's d from 0.73 to 1.04). The CC group scored significantly higher than the NCC group on the ordering item ($p = .001$; Cohen's $d = 0.26$) and obsessing item ($p < .001$; Cohen's $d = 0.44$), but there were no significant differences on the doubting ($p = .01$; Cohen's $d = 0.22$), counting ($p = .15$; Cohen's $d = 0.12$) and washing ($p = .49$; Cohen's $d = 0.05$) items. Taken together, these findings provide evidence that the OCI-CV-5 total score and the 5 individual items can discriminate youth with OCD from non-clinical controls, as well as from clinical controls.

3.3.2. Reliability

We calculated the McDonald's ω (1999) as the internal consistency measure of the selected 5 items of the whole sample ω = 0.70. The correlations between the 5 items ranged from $r = 0.28$ to 0.54 (mean $r = 0.42$). Given the low number of items the selected 5 items had satisfactory internal consistency (Graham, 2006).

3.3.3. Correlations with other study measures

As expected, the OCI-CV-5 total score was strongly correlated with the OCI-CV total score among the OCD, NCC, and CC groups ($rs = 0.94$, 0.94. and 0.92 respectively; all $ps < 0.001$). Table 5 displays correlation coefficients between scores on the OCI-CV-5 and those on other study measures for the OCD group. The OCI-CV-5 was moderately associated with measures of general anxiety and depression, but these correlations

[1] There is no suggestion about pooling the likelihood ratio test of WLSMV estimation in multiple imputation. We decided not to calculate the likelihood ratio tests between configural, metric, and scalar invariance models.

Table 2
Standardized factor loadings and item thresholds of correlated five-factor model (first subsample).

Item	Standardized factor loading					Item threshold		Item-total *r*
	Doubting/checking	Ordering	Neutralizing	Washing	Obsessing	1	2	
4	0.82					0.18	1.16	0.70
5	0.78					0.00	1.40	0.64
13	**0.89**					**0.25**	**1.27**	**0.72**
15	0.78					0.72	1.59	0.61
20	0.88					0.10	1.24	0.73
8		0.89				0.14	1.32	0.61
17		0.84				−0.09	1.11	0.58
19		**0.93**				**−0.05**	**1.28**	**0.65**
6			**0.87**			**0.57**	**1.52**	**0.57**
9			0.83			0.70	1.45	0.56
12			0.83			0.86	1.62	0.51
2				0.97		0.52	1.35	0.60
10				0.91		0.29	1.26	0.65
21				**0.92**		**0.38**	**1.01**	**0.56**
1					0.89	0.04	1.28	0.67
11					0.96	0.04	0.97	0.67
14					**0.94**	**0.10**	**0.94**	**0.67**
18					0.79	0.63	1.48	0.59

Note. We used the item number of the original OCI-CV items, including the hoarding subscale; Bold indicates selected items.

Table 3
Standardized factor loadings and item thresholds of one-factor model (second subsample).

Item	Standardized factor loading	Item threshold		Item-total *r*
		1	2	
13 (Doubting)	0.74	0.20	1.38	0.70
19 (Ordering)	0.77	−0.06	1.13	0.74
6 (Counting)	0.64	0.63	1.58	0.60
21 (Washing)	0.46	0.43	0.91	0.60
14 (Obsessing)	0.65	−0.13	0.84	0.70

Note: We used the item number of the original OCI-CV which includes hoarding subscale.

were comparable to those with the OCI-CV total score. Notably, weaker correlations were found between the OCI-CV-5 (and the OCI-CV) and the CY-BOCS. This was not surprising considering that the CY-BOCS assesses OCD from an idiographic perspective, whereas the OCI-CV/OCI-CV-5 is a nomothetic measure.

3.3.4. Diagnostic sensitivity

Receiver operating characteristic (ROC) analyses were performed, using the relationship between sensitivity and specificity to assess the area under the curve (AUC) to determine the extent to which scores on the measure differentiate between the (a) OCD and NCC groups and (b) between the OCD and CC groups. An AUC of 1.0 indicates perfect prediction, whereas a value of 0.50 indicates the level of chance. In differentiating youths with OCD from NCC participants, the estimated AUC for the OCI-CV-5 was 0.88 (95 % CI = 0.85 to 0.90). In distinguishing youths with OCD from CC participants, the estimate AUC for the OCI-CV-5 was 0.79 (95 % CI = 0.75 to 0.82). These results suggest that the OCI-CV-5 differentiates youths with OCD from non-clinical youth quite well. Moreover, the OCI-CV-5 compares extremely well with the full scale OCI-CV: AUC = 0.90 (95 % CI = 0.87 to 0.92) for OCD vs. NC participants, and AUC = 0.77 (95 % CI = 0.74 to 0.81) for OCD vs. CC participants. Fig. 1 graphically displays the AUC estimates for the two measures.

3.3.5. Diagnostically relevant cutoff scores

We calculated sensitivity and specificity to assess the OCI-CV-5's optimal degree of accuracy for correctly classifying individuals diagnosed with OCD relative to nonclinical individuals. This analysis revealed that a score of 2 provided the best balance of sensitivity and

Table 5
Correlations between the OCI-CV-5, OCI-CV, and symptom measures among OCD participants.

Measure	*n*	OCI-CV-5	OCI-CV
OCD symptoms			
OCI-CV	489	0.94	
CY-BOCS total score	486	0.28	0.29
Other symptoms			
MASC	101	0.54	0.60
CDI	110	0.36	0.34
CDI-2	138	0.36	0.43

Note: OCD: Obsessive-compulsive disorder; OCI-CV-5, Obsessive-Compulsive Inventory – Child Version-5 items; OCI-CV: Obsessive-Compulsive Inventory-Child Version; CY-BOCS: Children's Yale-Brown obsessive-compulsive scale; MASC: Multidimensional Anxiety Scale for Children; CDI: Children's Depression Inventory; CDI-2: Children's Depression Inventory-2; All correlations $p < .001$.

Table 4
Norms for the OCI-CV-5 items and total scores across clinical and non-clinical samples.

OCI-CV-5	OCD			CC			NCC		
	Mean (*SD*)	Mdn	Range	Mean (*SD*)	Mdn	Range	Mean (*SD*)	Mdn	Range
Total score	4.08 (2.21)	4	0–10	1.82 (1.77)	1	0–8	1.05 (1.31)	1	0–6
13 (Doubting)	0.72 (0.72)	1	0–2	0.38 (0.60)	0	0–2	0.24 (0.44)	0	0–2
19 (Ordering)	0.89 (0.70)	1	0–2	0.50 (0.62)	0	0–2	0.32 (0.50)	0	0–2
6 (Counting)	0.55 (0.69)	0	0–2	0.18 (0.43)	0	0–2	0.12 (0.35)	0	0–2
21 (Washing)	0.90 (0.87)	1	0–2	0.19 (0.44)	0	0–2	0.15 (0.43)	0	0–2
14 (Obsessing)	1.02 (0.79)	1	0–2	0.56 (0.67)	0	0–2	0.22 (0.49)	0	0–2

Note, OCD: Obsessive-compulsive disorder; CC: Clinical controls; NCC: Non-clinical controls; OCI-CV-5: Obsessive-Compulsive Inventory-Child Version-5 Items; SD: Standard deviation; Mdn: Median.

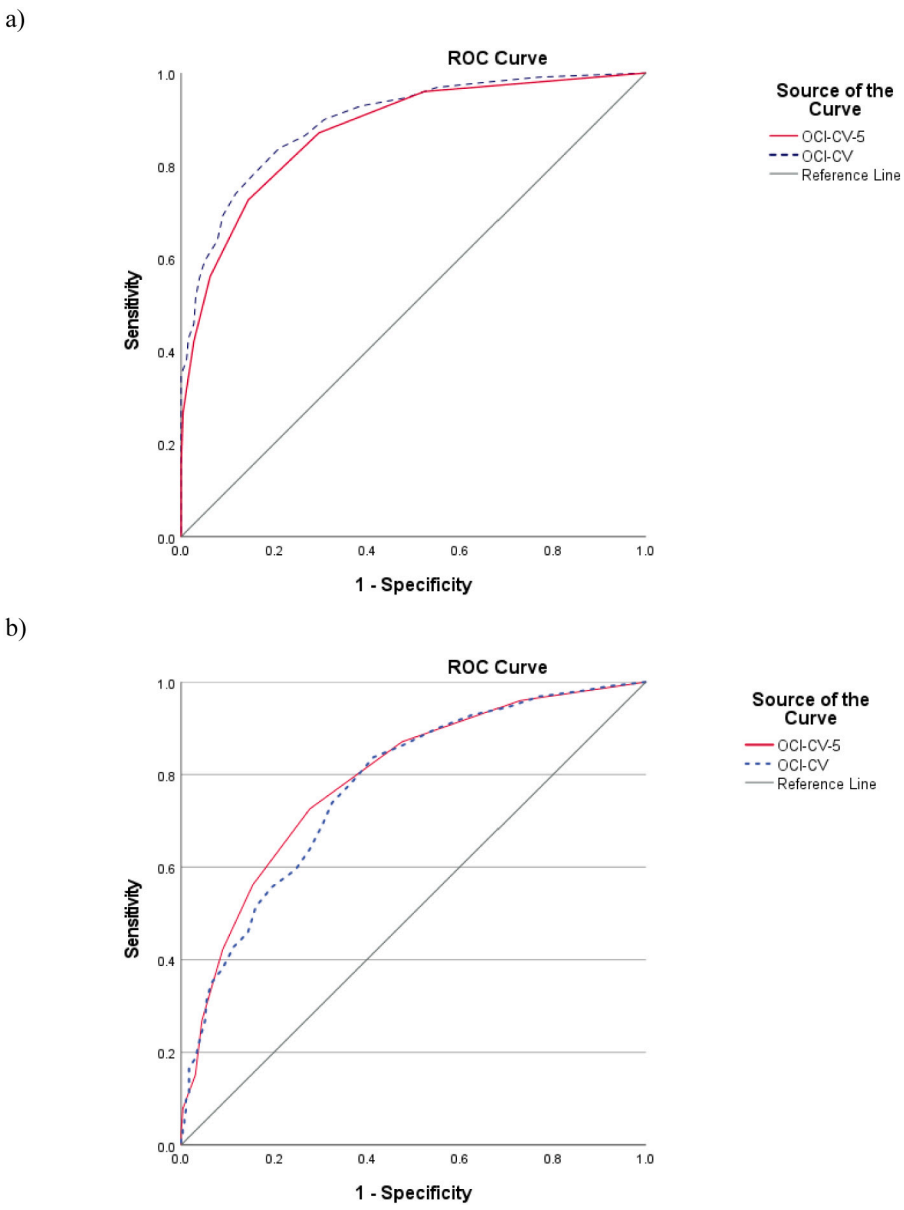

Fig. 1. OCI-CV-5 and OCI-CV receiver operating characteristics (ROC) curves for the (a) OCD-NCC sample and (b) OCD-CC sample. NCC: non-clinical controls; CC: clinical controls.

specificity (Youden's $J_{MAX} = 0.58$), correctly classifying 81.5 % of the entire sample of OCD and NCC participants. This cutoff correctly classified 87 % of individuals with OCD (i.e., sensitivity = 0.75) and 71 % of those in the NCC group (specificity = 0.71). Since positive and negative predictive values are heavily influenced by the base rate of the condition in the sample, and since the study sample is comprised of significantly more cases of OCD than what would be expected in a random healthcare setting, we calculated positive and negative likelihood ratios (PLR, NLR). PLR is the probability that a person with the condition (e.g., OCD) tested positive for the disorders as per the measure's cutoff, divided by the probability that a person without the condition tested positive. Conversely, NLR entails the probability that a person without the condition tested negative for the disorders as per the measure utilized, divided by the probability that a person without the condition tested negative. A PLR >1 indicates that individuals with the disorder are more likely to score above the measure cutoff than those without the condition, whereas a NLR <1 indicated that it is less likely that individuals without the condition will score above the cutoff. This computation yielded a PLR = 3.55 (95 % CI = 2.84 to 4.44), and NLR = 0.17 (95 % CI = 0.13 to 0.21). Furthermore, these analyses yielded a Diagnostic Odds Ratio = 20.88, that translates to the odds of the OCI-CV-5 screening positive in participants with OCD compared to the odds of the tool screening positive in individuals without OCD. Therefore, individuals who score above the cutoff (≥2) are nearly 21 times more likely to meet DSM diagnostic criteria for OCD. In terms of classification of youth with OCD compared to CC, a score of 3 provided the best balance of sensitivity and specificity (Youden's $J_{MAX} = 0.45$), correctly classifying 72 % of the members of these groups. This cutoff correctly classified 73 % of individuals with OCD (i.e., sensitivity = 0.73) and 72 % of those in the CC group (specificity = 0.72). These calculations yielded a PLR = 2.14 (95 % CI = 1.85 to 2.47), and NLR = 0.31 (95 % CI = 0.25 to 0.39) and a Diagnostic Odds Ratio = 6.85.

4. Discussion

OCD is associated with social, academic, and occupational impairments (Markarian et al., 2010; Ruscio et al., 2010). However, it is often underrecognized, particularly in non-specialized primary care settings

(Glazier et al., 2015; Sussman, 2003). Indeed, a significant degree of under-recognition of OCD in youth is reported both in non-specialized settings as well as among mental health professionals (Fineberg et al., 2008). Consequently, accurate screening for pediatric OCD in public health service settings is urgently needed (Fineberg et al., 2008). In fact, the National Institute for Health and Care Excellence (NICE) in the U.K. specifically declared an urgent need to develop brief reliable screeners for OCD (NICE, 2005).

In this study we aimed to extract ideal screening items from the OCI-CV to arrive at an ultra-brief version of the measure that efficiently identifies children and adolescents who likely meet diagnostic criteria for OCD, while also retaining items covering major syndromal aspects of the condition. The resulting instrument, the OCI-CV-5, includes a single item corresponding to each of the five core thematic dimensions of obsessive-compulsive symptoms, namely, checking, obsessing, neutralizing/counting, washing, and ordering. The measure demonstrates high levels of sensitivity and specificity in distinguishing between youth with and without OCD. Importantly, it is essential to note that the OCI-CV-5 is a screener, and elevated scores do not entail a formal diagnosis, but rather an indicator of increased probability for the presence of OCD that requires further assessment.

In terms of convergent and discriminant validity, OCI-CV-5 scores were only weakly correlated with the CY-BOCS. However, this is not a result of the reduction in the number of OCI-CV items, or a reflection of the scale's validity; rather, it is an artifactual effect of the methodological and conceptual differences between the OCI-CV/OCI-CV-5 and the CY-BOCS. Specifically, the OCI-CV/OCI-CV-5 includes a single distress rating for quintessential core OCD symptoms (i.e., a nomothetic approach), whereas the CY-BOCS assesses multiple severity indices of the child's most disabling obsessions and compulsions as identified using a comprehensive checklist of over 50 symptoms (i.e., idiographic approach). Therefore, akin to the OCI-CV, the OCI-CV-5 is likely to confound symptom-severity with the number of different types of obsessions and compulsions with which the child presents. Notably, an additional difference between the measure pertains to the time range. Whereas the CY-BOCS measures OCD severity in the past week, the OCI-CV, and the OCI-CV-5 assesses symptoms over the past month.

Despite this issue, sensitivity and specificity analyses support the use of the OCI-CV-5 as a screening tool in non-specialized medical settings with the goal of identifying likely pediatric OCD cases. Indeed, the OCI-CV-5 differentiates youth with OCD from non-psychiatric controls and those with other disorders with a high degree of accuracy. Compared to other ultra-brief screeners for anxious youth (e.g., PHQ-9 and the 5-item SCARED), the OCI-CV-5 clinical cutoff off ($\geq$2) yielded superior sensitivity, specificity, PLR, NLR, and Diagnostic OR estimators (Birmaher et al., 1999; Nandakumar et al., 2019). In fact, the clinical cutoff of the OCI-CV-5 produced a Diagnostic Odds Ratio = 20.88, that translates to a nearly 21 times greater probability of screening positive for OCD among youths with OCD compared to the non-psychiatric control groups. Notably, overall, the OCI-CV-5's psychometric properties suggest that it clearly outperforms existing brief measures for youth with OCD, namely the 11-item Leyton Obsessive Inventory — Children's Version (LOI-CV; Bamber et al., 2002), as well as the 8-item (Nelson et al., 2001), and the 6-item CBCL obsessive-compulsive scale (Storch et al., 2006).

The present study has several strengths as well as limitations. The sample was comprised of geographically and clinically diverse participants, which facilitates generalizability. Nevertheless, the sample was not racially or ethnically diverse, and was predominantly comprised of White youth participants. In addition, OCI-CV-5 items were embedded within the 21 items forming the OCI–CV, and thus it remains to be determined whether similar results would be obtained using the OCI-CV-5 items as a stand-alone instrument. Moreover, further research on the OCI-CV-5 is needed, including a test-retest study and examination of the measure's sensitivity to treatment. We also chose a method of item identification that ensures development of a brief scale that covered the thematic content domains of OCD. While the scale is longer than recently identified single and two item measures (Sattler et al., 2018), we determined this was desirable to ensure identification of youth who might have primary presentation of one facet of OCD. To that end, Sattler et al. (2018) used a decision-tree model using the Spence Children's Anxiety Scale to build a screening procedure to predicting respondents' OCD status. This decision-tree approach is different from our methodology in the following aspects. The decision tree model selects the items that are the most predictive to OCD status. The default algorithm does not ensure one item of each domain will be selected and utilized in the prediction model. Decision-tree model assumes all items are perfectly reliable. A single decision-tree model often has large standard error (Hastie et al., 2009), and although there are several tree ensemble methods such as random forests and boosting which involve multiple trees, these methods decrease standard errors while losing an interpretable model for researchers. We used item response theory analysis to select items with satisfactory factor loadings and item thresholds. These parameters are related to item difficulty and differentiation. Based on theoretical consideration, we selected one item from each domain, with the assumptions that items are unreliable to some extent.

5. Conclusion

The OCI-CV-5 is a 5-item ultra-brief iteration of the OCI-CV that taps into the core domains of obsessive-compulsive symptoms in youth. The measure possesses good to excellent predictive validity, sensitivity, and specificity, including good discriminability between OCD and clinical controls. Therefore, it can be readily employed in a variety of settings to rapidly screen for possible OCD. The complete scale including instructions for the OCI-CV-5 (derived from the original OCI-CV; Foa et al., 2010) can be found in Appendix A.

CRediT authorship contribution statement

AA, JA, and DM conceived the study. AA, JA, DM and CH drafted the manuscript. CH, AA, and DM conducted the statistical analyses. All other authors collected data, provided input in terms of the study conceptualization, and commented on the initial draft of the manuscript. All authors approved the final iteration of the article.

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Conflict of interest

Author **DAG** has received grant or research support from the Eunice Kennedy Shriver National Institute of Child Health and Human Development subcontract with Duke Clinical Research Center Pediatric Trials Network, the National Institute of Mental Health, Biohaven Pharmaceuticals, Boehringer Ingelheim, Eli Lilly and Co., Forest Pharmaceuticals, GlaxoSmithKline, the International OCD Foundation, Neurocrine Biosciences, Nuvelution Pharma, Peace of Mind Foundation, Pfizer, Solvay, Syneos Health, Teva Pharmaceutical Industries, Biohaven, the OCD Foundation and the Tourette Association of America. He has served as a consultant to the Arlington Youth Counseling Center. He has received honoraria from the Massachusetts Psychiatry Academy and the American Academy of Child and Adolescent Psychiatry. He has held stock options/ownership in Assurex Health, Revolutionary Clinics and CD Services of America. Author **JM** reports receiving research support from the Tourette Association of American (TAA), the American Academy of Neurology (AAN), American Psychological Foundation (APF),

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Following the first five authors, order of authorship was determined alphabetically.

Appendix A. OCI-CV-5

The 5-Item Obsessive-Compulsive Inventory – Child Version (OCI-CV-5)

OCI-CV-5

On this page there are several questions that we want you to answer. Read each sentence carefully and tell us how much it has happened to you **in the last month**. If it never happens to you, circle the word "never." If it sometimes happens to you, circle the word"sometimes." If it happens to you almost always, circle the word "always." This is not a test, so there are no right and wrong answers.

Example: I think a lot about dogs.	never	sometimes	always
1. Even after I'm done, I still worry that I didn't finish things.	never	sometimes	always
2. I need things to be in a certain way.	never	sometimes	always
3. I need to count while I do things.	never	sometimes	always
4. I wash my hands more than other kids.	never	sometimes	always
5. I get upset by bad thoughts that pop into my head when I don't want them to.	never	sometimes	always

Administration & scoring

The OCI-CV-5 is an ultra-brief screening scale for OCD in youth, derived from the OCI-CV (Foa et al., 2010). It consists of 5 items that a person endorses on a 3-point Likert scale (never = 0, sometimes = 1, always = 2). These items correspond to four of the original OCI-R OCD dimensions:

1. Checking/Doubting
2. Ordering
3. Counting
4. Washing
5. Obsessing

Scores are generated by adding the item scores. The possible range of scores is 0-10. The mean total score for youth with OCD is 4.08 ($SD = 2.21$). Recommended total cutoff score is 2, with scores at or above this level indicating the likely presence of OCD.

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