The OCI-12: A syndromally valid modification of the obsessive-compulsive inventory-revised

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ABSTRACT

The 18-item Obsessive-Compulsive Inventory-Revised (OCI-R) is a widely used self-report measure of Obsessive-Compulsive Disorder (OCD) symptoms, yet its factor structure does not converge with contemporary dimensional models of OCD symptoms. In addition to assessing the four core OCD dimensions, the OCI-R includes hoarding and neutralizing factors. However, since its publication, hoarding has been designated as a separate disorder, and there are concerns about the neutralizing factor's reliability and validity. The aim of this study was to evaluate a syndromally valid modification of the OCI-R. Adult samples of individuals diagnosed with OCD ($n = 1087$), anxiety related disorders ($n = 1306$), and unselected community volunteers ($n = 423$) completed the OCI-R and measures of anxiety and mood. Analyses excluded the 3 OCI-R hoarding items and suggested the removal of the 3 neutralizing items. Internal consistency, sensitivity and specificity to OCD clinical status, test-retest reliability, sensitivity to treatment, and convergent and discriminant validity were evaluated for the resultant 12-item scale (termed the OCI-12). The OCI-12 evidenced good to excellent psychometric properties. Clinical norms, severity benchmarks, and a clinical cutoff score were computed. In conclusion, the OCI-12 represents a syndromally valid update of the OCI-R with comparable psychometric properties and superior sensitivity and specificity.

1. Introduction

Obsessive-Compulsive Disorder (OCD) is characterized by persistent unwanted distressing thoughts (obsessions) and attempts to control or dismiss these thoughts and reduce the distress they provoke (compulsions). It is a prevalent (1.3%; Fawcett et al., 2020) and frequently disabling disorder that is associated with significant functional impairments and poor quality of life (Pozza et al., 2018), including lower subjective wellbeing (Stengler-Wenzke et al., 2006), decreased educational attainment (Pérez-Vigil et al., 2018), and work productivity (Markarian et al., 2010). Obsessions and compulsions are thematically diverse, yet numerous studies suggest that this heterogeneity can be distilled down to four replicable theme-based symptom dimensions, including (a) contamination, (b) responsibility for causing or preventing harm and mistakes, (c) the need for symmetry or completeness, and (d) taboo topics such as sex, blasphemy, and violence (Abramowitz et al., 2010; McKay et al., 2004). Effective treatment exists for OCD (McKay et al., 2015), yet accurate assessment is essential for determination of type and intensity of treatment, tracking progress, and for continued clinical and psychopathological research (Koran and Simpson, 2013).

Of the instruments available for assessing OCD symptoms in clinical and nonclinical samples, the Obsessive-Compulsive Inventory-Revised (OCI-R; Foa et al., 2002) is among the most widely used. This 18-item self-report measure contains six 3-item subscales assessing washing, checking, ordering, neutralizing, obsessing, and hoarding symptoms. Items include descriptions of symptoms (e.g., I check things more often than necessary) that respondents rate on a scale from 0–4 based on the degree of associated distress. The scale has been translated into numerous languages and has a consistent factor structure and psychometric properties cross-culturally. Moreover, it takes a matter of minutes to complete and is therefore ideal for use in clinical and research settings.

Despite these strengths, previous authors have noted limitations that detract from the OCI-R's validity as a syndromally accurate measure of OCD. The first concerns the hoarding subscale. When the OCI-R was published in 2002, hoarding was still considered a symptom of OCD (Steketee and Frost, 2003) and had not yet been set aside as its own disorder in the Diagnostic and Statistical Manual (DSM). This changed in

2013 with the addition of Hoarding Disorder (HD) to DSM-5 (American Psychiatric Association, 2013) on the basis of research showing critical differences between the symptoms of hoarding and those of OCD (e.g., Abramowitz et al., 2008; Mataix-Cols et al., 2010; Rachman et al., 2009). Accordingly, Wooten et al. (2015) found that removing the hoarding subscale improved the OCI-R's ability to reliably and validly differentiate between individuals with a diagnosis of OCD versus those with HD. Yet these authors also called for additional research to further evaluate the convergent and discriminant validity of this version of the scale (termed the OCI-OCD), which is one aim of the present study.

In addition, various psychometric studies of the OCI-R have raised concerns about the neutralizing subscale (Abramowitz and Deacon, 2006; Gonner et al., 2008; Sica et al., 2009; Woo et al., 2010). Conceptually, the term "neutralizing" has been used to refer to overt (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). Importantly, however, the 3 items on the neutralizing subscale all relate to numbers, and assess functionally distinct phenomena that are observed across the various presentations of OCD (Calamari et al., 2004; McKay et al., 2004). Specifically, item 4 pertains to counting rituals, item 10 to repeating certain numbers, and item 16 to good and bad numbers. Accordingly, this subscale lacks face validity and does not correspond to the 4 core theme-based symptom dimensions of OCD. It is therefore not surprising that relative to the other OCI-R subscales, the neutralizing scale often demonstrates inferior internal consistency and greater difficulty discriminating between individuals with and without OCD (e.g., Abramowitz and Deacon, 2006; Huppert et al., 2007). Thus, as a second aim of this study, we critically evaluated the contribution of the neutralizing factor to the validity and reliability of the scale.

While the OCI-R is well-studied and widely used, the addition of HD in the DSM-5 and concerns about the neutralizing subscale suggest an update is necessary to ensure that the scale remains consistent with a contemporary understanding of OCD. Accordingly, in addition to the 2 aims previously specified, we sought to evaluate the psychometric properties of the updated measure, including the scale's factor structure, internal consistency, test-retest reliability, and convergent and discriminant validity, and provide clinical normative values, determine clinical severity benchmarks, and evaluate treatment sensitivity and clinical cutoff scores.

2. Methods

2.1. Participants

OCD group. The OCD sample included 1040 adults meeting DSM-IV (American Psychiatric Association, 2000) or DSM-5 (American Psychiatric Association, 2013) criteria for primary OCD who presented for treatment at several sites around the United States between 2010 and 2019: various residential, partial hospitalization, and intensive outpatient OCD treatment centers within the Rogers Behavioral Health System network ($n = 804$), the Anxiety and Stress Disorders Clinic outpatient OCD program at the University of North Carolina at Chapel Hill (UNC; $n = 183$), and the Mayo Clinic Outpatient OCD Program in Rochester, MN ($n = 53$).

Anxiety-related disorders (ARD) group. The ARD sample ($n = 423$) included individuals diagnosed with a primary DSM-IV or DSM-5 anxiety related disorder (ARDs; Asmundson, 2019). This sample was comprised of adult patients recruited from the Rogers ($n = 179$) and UNC sites ($n = 244$) between 2010 and 2019 with primary social anxiety disorder (23.3%), generalized anxiety disorder (21.9%), panic disorder (18.3%), anxiety disorder not otherwise specified (15.1%), panic disorder with agoraphobia (12.3%), trichotillomania (9.7%), specific phobia (5.9%), and post-traumatic stress disorder (2.5%). None of these individuals met DSM criteria for OCD.

Non-clinical community (NCC) sample. The NCC sample ($n = 1194$) included samples of students from the UNC site ($n = 1106$), and a group of participants from the Mayo Clinic site ($n = 88$) who completed

Table 1
Demographic and clinical characteristics of the three main samples. .

Variable	OCD ($n = 1040$)	ARD ($n = 423$) Mean (SD);%(n) / Range	NCC ($n = 1194$)
Gender			
Female	53.2% (550)	49.6% (210)	30.1% (358)
Male	46.8% (483)	50.4% (213)	69.9% (833)
Age (years)	31.8 (12.4); 18–79	34.5 (13.4); 18–70	20.1 (3.5); 18–54
Education			
Did not complete high school	9.1% (65)	4.1% (15)	–
High school diploma	25.5% (182)	17.8% (65)	4.5% (4)[a]
Some vocational or college	27.4% (196)	32.1% (117)	17.0% (15)
Vocational or college degree	15.5% (111)	23.3% (85)	47.7% (42)
Graduate degree	22.5% (161)	22.7% (83)	30.7% (85)
Marital Status			
Married	58.3% (501)	36.6% (147)	90.9% (80)[b]
Not married	30.7% (264)	53.5% (215)	9.1% (8)
Separated/Divorced	6.5% (56)	9.9% (56)	–
Widowed	4.5% (39)	–	–
Ethnicity			
Asian American	2.4% (32)	1.2% (5)	5.1% (60)
Black American	1.4% (19)	2.4% (10)	10.5% (124)
Hispanic American	1.3% (18)	2.6% (11)	5.3% (62)
non-Hispanic White American	70.8% (948)	92.1% (383)	75.5% (889)
Other/not identified	1.0% (13)	1.7% (7)	3.7% (43)
*OCD Severity**			
Y-BOCS Total Score	25.31 (6.47)	–	–
Y-BOCS Obsessions	12.87 (3.42)	–	–
Y-BOCS Compulsions	12.44 (3.72)	–	–

OCD: Obsessive-compulsive disorder; ARD: Anxiety related disorders; NCC: None-clinical controls; Y-BOCS: Yale-Brown obsessive-compulsive scale; *All OCD participants received a primary diagnosis of OCD, and those with a total score of zero on the OCI-R were not included in any analyses; Two participants had a Y-BOCS total score of zero.

[a] Educational status information was only available for 12% of the NCC sample

[b] Marital status information was only available for 7% of the NCC sample.

the OCI-R as part of other studies between the years of 2003 and 2019. To ensure that the sample was sufficiently heterogeneous, but unlikely to include individuals meeting DSM criteria for OCD, individuals were only included in the NCC sample if they scored below the original OCI-R clinical cutoff score for a likely diagnosis of OCD (>21; Foa et al., 2002). Demographic information for the OCD, ARD, and the NCC samples is presented in Table 1.

Additional samples. Two additional samples were used to assess treatment sensitivity and test-retest reliability. To calculate test-retest reliability, students at Vanderbilt University (n = 212) completed two administrations of the OCI-R within a 12-week interval. This sample had a mean age of 18.9 years (SD = 1.2, range = 18–30) and 58% were female and was fairly ethnically diverse (17% Black American, 4% Asian American, 3% Hispanic American, and 71% non-Hispanic White American). Participants were contacted via e-mail to complete the second administration.

The treatment sensitivity sample included 47 participants with primary OCD (64% female, mean age = 33.82, SD = 19.88) who completed the OCI-R and were administered the Yale-Brown Obsessive-Compulsive Scale (Y-BOCS) before and after receiving exposure and response prevention (ExRP) treatment delivered at the UNC site.

Data were collected between 2010 and 2019. Clinical participants presented for services at one of the study sites and were screened using one of the following measures administered by a trained interviewer: The Structured Clinical Interview for DSM-IV, the Anxiety Disorder Interview Schedule for DSM-IV, and the Mini International Neuropsychiatric Interview. Then, interviewers reviewed assessment data with an expert clinician (e.g., senior clinician, site director) who subsequently met with each patient to review the assessment data. This study included only participants for whom full diagnostic consensus that OCD (or an ARD) was the primary diagnosis. Participants were excluded if they had any psychotic disorder, mania, or high risk for suicide. Across all study samples, the respective institutional review boards approved data collection, and all participants gave informed consent.

2.2. Measures

2.2.1. OCI-R

The OCI-R (Foa et al., 2002) is an 18-item self-report measure of distress associated with common OCD (and hoarding) symptoms (e.g., *I sometimes have to wash or clean myself simply because I feel contaminated*'). Items load onto 6 symptom factors each comprised of 3 items (washing, checking, ordering, obsessing, neutralizing, and hoarding). Overall, the OCI-R demonstrates good internal consistency across populations and geographic locations (Cronbach's alpha ranged 0.81- 0.95; Hajcak et al., 2004; Hon et al., 2019). In the present study the OCI-R exhibited moderate-excellent internal consistency Cronbach's αs = 0.85, 0.90, and 0.75, for the OCD, ARD, and controls, respectively.

2.2.2. Yale-Brown obsessive-compulsive scale (Y-BOCS)

The Y-BOCS severity scale (Goodman et al., 1989a, 1989b) includes 10 items that assess the 5 parameters of obsessions (items 1–5) and compulsions (items 6–10): time, interference, distress, resistance, and control. Items are rated from 0 (none) to 4 (severe), yielding a total score ranging from 0–40. Developed as a clinician administered interview, it demonstrates good to excellent internal consistency, test–retest reliability, and interrater reliability (Goodman et al., 1989b; Rapp et al., 2016; Storch et al., 2005). In the present study the Y-BOCS demonstrated good internal constancy for the total score (Cronbach's α = 0.86). A self-report version (i.e., Y-BOCS-SR) was later developed (Baer et al., 1993), that also demonstrates good psychometric properties (Federici et al., 2010; Steketee et al., 1996). Data were available from 500 participants with OCD who completed the YBOCS: 375 (75%) completed the self-report version and 125 (25%) were administered the interview version. Previous research indicates the two versions may be used interchangeably (Steketee et al., 1996), but a later study suggested that

the clinician administered version produces a slightly elevated total score (M_{Diff} = 1.4, Cohen's d = 0.21; Federici et al., 2010). However, no significant difference on the scale's total scores was found in the present investigation between the two administration modalities (Y-BOCS-SR M = 25.44, SD=6.73; Y-BOCS M = 24.90, SD=5.61; t(604) = 0.80, p = .42.).

2.2.3. Dimensional obsessive–compulsive scale (DOCS)

The DOCS (Abramowitz et al., 2010) is a 20-item self-report measure that assesses OCD severity across the four empirically supported symptom dimensions (i.e., contamination, responsibility for harm and mistakes, symmetry, and unacceptable/taboo thoughts). Within each dimension (subscale), five items assess (a) time occupied by obsessions and compulsions, (b) avoidance behaviors, (c) associated distress, (d) functional interference, and (e) difficulty disregarding the obsessions and refraining from the compulsions over the past month. DOCS subscale scores demonstrate good to excellent reliability in both clinical and student samples (α = 0.83–.96), and test–retest reliability has been found to be adequate (Abramowitz et al., 2010). In the present study the DOCS total score exhibited good-excellent internal consistency (Cronbach's αs = 0.88, 0.91, and 0.90, for the OCD, ARD, and controls, respectively).

2.2.4. Penn state worry questionnaire (PSWQ)

The PSWQ, (Meyer et al., 1990) is a 16-item self-report inventory designed to capture the severity of pathological worry without regard to its specific content. Each item is rated on a 1 (not at all typical of me) to 5 (very typical of me) Likert type scale (e.g., "My worries overwhelm me"). The PSWQ possesses good test-retest reliability and internal consistency in clinical samples and is correlated with other measures of trait worry (Molina and Borkovec, 1994). In the present study the PSWQ exhibited good internal consistency (Cronbach's αs = 0.80, 0.87, and 0.87, for the OCD, ARD, and controls, respectively).

2.2.5. Beck depression inventory (BDI)

The BDI (BDI; Beck et al., 1996)**.** is a widely used 21-item self-report scale that assesses the severity of various types of symptoms of depression. The BDI has good psychometric properties (Beck et al., 1996). The OCD group completed the BDI in the present study. In the present study the BDI exhibited good-excellent internal consistency Cronbach's αs = 0.92, 0.90, and 0.80, for the OCD, ARD, and controls, respectively.

2.2.6. Beck anxiety inventory (BAI)

The BAI (Beck et al., 1988) is a 21-item self-report measure assessing common symptoms of anxiety. Respondents indicate the degree to which they have recently been bothered by each symptom during the past week. The BAI assesses symptoms of anxiety independently from symptoms of depression and demonstrates good reliability and validity (Beck et al., 1988). In the present study the BDI exhibited good-excellent internal consistency Cronbach's αs = 0.91, 0.93, and 0.79, for the OCD, ARD, and controls, respectively.

3. Results

3.1. Item selection

Our goal in developing a syndromally valid version of the OCI was to eliminate superfluous subscales that exist on the OCI-R. As hoarding is no longer considered a symptom of OCD, and as advised by Wooton et al. (2015), we first removed the hoarding subscale. To evaluate whether the neutralizing subscale might also be unnecessary, we computed regression analyses in which the five remaining OCI-R subscales were examined as simultaneous predictors of each DOCS subscale among the OCD group. As can be seen in Table 2, each overall model explained a significant portion of variance. Yet inspection of the beta weights (see Table 2) reveals that within each model, one of the OCI-R

Table 2
OCI-R subscales predicting scores on the DOCS factors.

OCI-R subscale	β	t	p
Predicting DOCS Contamination ($R^2 = 0.78$; F [5, 807] = 563.88, $p < .001$)			
Checking	.025	1.35	.17
Neutralizing	−0.036	−2.01	.05
Obsessing	−0.023	−1.37	.17
Ordering	.051	2.71	.01
Washing	**.871**	51.06	< 0.01
Predicting DOCS Responsibility for harm and mistakes ($R^2 = 0.32$; F [5, 807] = 74.53, $p < .001$)			
Checking	**.433**	13.15	< 0.01
Neutralizing	.069	2.18	.03
Obsessing	.282	9.41	< 0.01
Ordering	−0.051	−1.56	.12
Washing	.028	0.94	.35
Predicting DOCS Unacceptable/taboo thoughts ($R^2 = 0.46$; F [5, 807] = 136.06, $p < .001$)			
Checking	.023	0.79	.43
Neutralizing	.088	3.12	< 0.01
Obsessing	**.644**	24.18	< 0.01
Ordering	.022	0.75	.45
Washing	−0.086	−3.24	< 0.01
Predicting DOCS Symmetry ($R^2 = 0.42$; F [5, 807] = 115.12, $p < .001$)			
Checking	.069	2.26	.02
Neutralizing	.167	5.68	< 0.01
Obsessing	.008	0.29	.77
Ordering	**.555**	18.27	< 0.01
Washing	−0.084	−3.01	< 0.01

OCI-R: Obsessive-compulsive inventory-revised; DOCS: Dimensional obsessive-compulsive scale;.
Bold beta weights indicate those expected to be greater based on conceptual overlap between the OCI-R and DOCS subscales.

subscales emerged as the strongest predictor (i.e., had a substantially larger beta weight relative to the others). In none of the regression models, however, did the neutralizing subscale evidence a large beta weight and emerge as a strong individual predictor of the corresponding DOCS subscale. For these reasons, both theoretical and empirical, we decided to remove the neutralizing items. Accordingly, we determined that a 12-item version of the OCI (the OCI-12) would be subjected to psychometric scrutiny, comprised of items putatively assessing checking, obsessing, ordering, and washing.

3.2. Confirmatory factor analyses (CFA)

CFAs were conducted using AMOS version 26 (Arbuckle, 2019) with data from the 1040 OCD patients. As suggested by Pincus et al. (2009), we used multiple complementary fit indices to evaluate the specified factor structure. Although chi-square is often used for examining model fit, as sample size (and therefore, power) increases, this statistic overestimates lack of fit (Bollen, 1989). Joreskog and Sorbom (1989) and Bentler (1990) therefore advise against using chi-square to judge overall model fit. Accordingly, as suggested by Hu and Bentler (1999), we also evaluated goodness of fit using the standardized root mean-square residual (SRMR), root-mean-square error of approximation (RMSEA), the comparative fit index (CFI), and the Tucker-Lewis index (TLI). Good model fit was defined by the following criteria (Hu and Bentler, 1999; Schmitt, 2011): RMSEA $\leq$.06; SRMR $\leq$ 0.05; CFI $\geq$ 0.95; and TLI $\geq$.95. The use of multiple indices provides a conservative and reliable evaluation of model fit relative to the use of a single-fit index.

Fig. 1 presents the factor loadings and correlations among the latent factors for the CFA examining the four-factor solution. As expected, chi-square was significant, CHISQ (48, $N = 1040$) = 171.1, $p < .001$; however, all of the other goodness-of-fit indices converged in supporting the fit of the data to the four-factor model: RMSEA = 0.050, SRMR = 0.036, TLI = 0.98, CFI = 0.98. Factor loading estimates revealed that the indicators were strongly related to their purported latent factors, consistent with the position that the OCI-12 measures four OCD
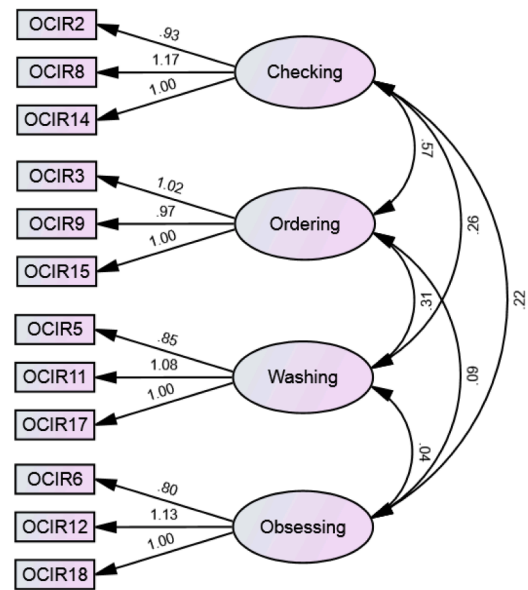

Fig. 1. Factor loadings and correlations among the latent factors, for the four-factor solution of the 12-Item Obsesasive-Compulsive Inventory (OCI-12).

symptom dimensions. Moreover, the latent factors were generally weakly to moderately correlated with one another, an exception being the fairly strong correlation between the checking and ordering factors.

Next, we tested a higher order CFA model to determine whether a single higher order factor accounted for the interrelationships between the lower order factors. The factor loadings are shown in Fig. 2. Again, aside from the expected chi-square result, all of the goodness-of-fit indices suggested that the higher order model fit the data well, CHISQ (50, $N = 1040$) = 179.80 $p < .001$, RMSEA = 0.05, SRMR = 0.043, TLI = 0.977, CFI = 0.983. Inspection of standardized residuals indicated no localized points of ill fit in the solution (e.g., largest standardized residual = 0.12). The first-order factors loaded weakly to very strongly on the higher order factor (range of loadings = 0.27 – 1.00). The results indicated that the higher order factor accounted for a significant proportion of the variance in the first-order factors (R^2s: Checking = 0.57, Ordering = 0.37, Washing = 0.06, Obsessing = 0.04). Given that the
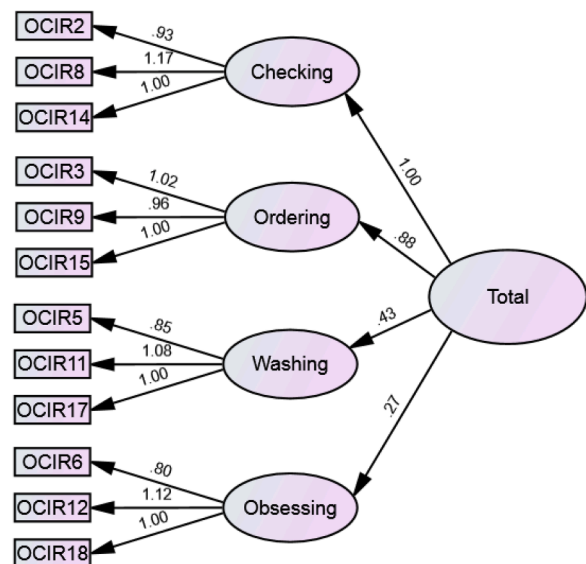

Fig. 2. Factor loadings for the higher order confirmatory factor analysis model of the 12-Item Obsesasive-Compulsive Inventory (OCI-12).

higher order solution did not result in a significant decrease in model fit, we concluded that the model provided a good account for the correlations among the first order factors (Brown, 2006).

3.3. Reliability

3.3.1. Internal consistency

Internal consistency using Cronbach's α and McDonald's ω was calculated separately within the OCD, ARD, and NCC samples. Within the three groups internal consistency calculated for the OCI-12 was good to very good (Taber, 2018): NCC (α=0.71, ω=0.69) OCD (α=0.79, ω=0.71), and ARD (α=0.89, ω=0.89). These coefficients were only slightly lower than the ones we calculated for the OCI-R: NCC (α=0.75, ω=0.74) OCD (α=0.83, ω=0.80), and ARD (α=0.90, ω=0.90).

3.3.2. Test-retest reliability

Paired t-tests indicated no significant changes in mean scores over the 12-week test-retest interval for the OCI-12 (M_{T1}= 9.91, SD_{T1}=8.63, M_{T2}= 9.26, SD_{T2}=8.80; $t(214)$=1.515, p=.131) ps = 0.550), and the OCI-R (M_{T1}= 14.24, SD_{T1}=12.05, M_{T2}= 13.87, SD_{T2}=12.51; $t(211)$=0.603, p=.547). Pearson correlation coefficients between T1 and T2 scores were strong for both the OCI-12 (r = 0.74, p<.001), and the OCI-R (r = 0.74, p<.001). Test retest reliability was examined using the McGraw & Wong (1996) two-way mixed effect interclass correlation coefficient (ICC). Results indicated good test retest reliability for the OCI-12 (ICC = 0.85, p<.001, CI 0.80–0.88), which was nearly identical the OCI-R (ICC = 0.85, p<.001, CI 0.80–0.87),

3.4. Construct, convergent, and discriminant validity

The OCI-12 total score was strongly and significantly correlated with the OCI-R total score among the OCD, ARD, and NCC groups (rs = 0.93, 0.97. and 0.92 respectively; all ps < 0.001). Correlations between OCI-12 scores and measures of OCD and non-OCD symptoms (i.e., depression, general anxiety, and worry) in the OCD group are presented in Table 3. The OCI-12 was strongly associated with the DOCS total score, but weakly correlated with measures of depression, anxiety, and worry. Moreover, these correlation coefficients were nearly identical to those with the OCI-R total score. Of note, correlations between the Y-BOCS total score and the OCI-12 (and OCI-R) were substantially weaker. This was expected given that the Y-BOCS is an idiographic measure of OCD symptom severity, whereas the approach taken by the OCI-R/OCI-12 is nomothetic. In sum, these results indicate that the OCI-12 possesses good convergent and discriminant validity as a measure of OCD symptoms, which was found to be comparable to that of the OCI-R.

Results from the regression analyses presented in Table 2 also provide evidence for convergent and discriminant validity of the OCI-12 subscales as measures of the robust domains of OCD symptoms. Specifically, the pattern of beta weights was conceptually consistent: the

Table 3
Correlations between the OCI-12, OCI-R, and symptom measures among patients with OCD.

Measure	n	OCI-12	OCI-R
OCD symptoms			
Y-BOCS total score	500	.30**	.30**
DOCS total score	808	.67**	.68**
Other symptoms			
BAI	76	.27*	.26*
BDI	266	.28**	.29**
PSWQ total score	485	.33**	.29**

OCD: Obsessive-compulsive disorder; OCI-12: The 12-item obsessive-compulsive inventory; OCI-R: Obsessive-compulsive inventory – revised; Y-BOCS: Yale-Brown obsessive-compulsive scale; DOCS: Dimensional obsessive–compulsive scale; BDI: Beck depression inventory; BA: Beck anxiety inventory; PSWQ: Penn state worry questionnaire; * = p<.05; ** = p<.001.

OCI-12 washing subscale was by far the strongest significant predictor of DOCS contamination scores; the OCI-12 checking subscale was the strongest significant predictor of DOCS responsibility for harm scores (which primarily tap into checking rituals), the OCI-12 obsessing subscale was the strongest significant predictor of DOCS unacceptable/taboo thoughts scores; and the OCI-12 ordering subscale was the strongest significant predictor of DOCS symmetry scores (which primarily tap into ordering rituals).

3.5. Norms

Norms for the 12-item OCI-12 total score and factor scores in Table 4. A univariate analysis of variance (ANOVA) revealed a significant main effect for group on the total score, $F(2, 2654) = 901.44$, $p < .001$, Partial η^2= 0.40. Post hoc contrasts (Games-Howell) revealed that the OCD group had a significantly higher mean score than the ARD group, which had a significantly higher score than the NCC group (all ps < 0.001). A MANOVA analyses across factors revealed a significant main effect (Wilks' Lambda = 0.479, $F(8, 5302) = 295.33$, $p < .001$, Partial η^2= 0.31). Similarly, univariate analyses Indicated a significant main effect for all factors (all ps < 0.001). Planned contrasts (Games-Howell) revealed that the OCD sample scores were significantly higher than the ARD sample and the NCC sample on all factors (all ps < 0.001), and that the ARD scores were significant higher than the NCC sample on the 'checking' and 'obsessing' factors (all ps < 0.001), but no significant difference between the two samples were found on the 'washing' (p= .282), and the 'ordering' (p= .199) factors.

3.6. Sensitivity to treatment

Table 5 shows the treatment sensitivity sample's mean pre- and post-treatment scores on the OCI-12, OCI-R, and YBOCS. Whereas at pre-treatment the mean Y-BOCS total indicated severe OCD symptoms, at post-test the mean score fell within the mild range, indicating substantial improvement following ExRP treatment. Paired t-tests indicated that all pre- to post-treatment contrasts were significant at the $p < .001$ level. Effect sizes (Cohen, 1988) were calculated to assess the magnitude of change (also shown in Table 5). As expected, the effect size derived from the Y-BOCS was the largest of the group of measures. Identical large effect sizes were found for the OCI-12 and the OCI-R. Finally, changes on the OCI-12 were significantly correlated with changes on the OCI-R (r = 0.89, $p < .001$) and the YBOCS (r = 0.42, $p < .001$). In concern, these findings provide evidence that the OCI-12 is sensitive to the effects of empirically supported treatment for OCD to the same extent as the OCI-R.

3.7. Diagnostic sensitivity

We examined the OCI-12's potential as a diagnostic tool in three steps. First, we conducted receiver operating characteristic (ROC) analyses, which uses the association between sensitivity and specificity to estimate the area under the curve (AUC) to indicate how well scores on a measure distinguish between positive (i.e., a diagnosis of OCD) and negative (i.e., NCC or ARD) cases. Second, we compared the diagnostic accuracy of OCI-12 scores to OCI-R scores. Finally, we established cutoff scores with optimal diagnostic accuracy for distinguishing between individuals with OCD and those in the NCC and ARD groups.

3.7.1. Diagnostic accuracy of OCI-12 total and subscale scores

We conducted ROC analyses for the OCI-12 total and subscale scores to determine which best distinguished individuals with OCD from (a) the NCC group and (b) the ARD group. In distinguishing the OCD group from the NCC group, AUC estimates for the four OCI-12 subscales ranged from 0.60 (ordering) to 0.90 (obsessing). The OCI-12 total score, however, evidenced the highest AUC (0.91, 95% confidence interval [CI] = 0.90 to 0.92). In distinguishing individuals with OCD from those with ARDs,

Table 4

Norms for the OCI-12 factors and total scores across clinical and non-clinical samples.

OCI-12 Scores	OCD				ARD				NCC			
	Mean	SD	Mdn	IQR	Mean	SD	Mdn	IQR	Mean	SD	Mdn	IQR
Total Score	19.62	9.42	19	13	10.16	9.2	8	11	6.24	4.29	6	6
Washing	4.62	4.29	4	9	1.16	2.16	0	1	0.99	1.42	0	2
Checking	4.09	3.56	3	5	2.10	2.69	1	3	1.44	1.43	1	2
Ordering	4.00	3.68	3	6	2.80	3.29	2	4	2.50	2.22	2	3
Obsessing	6.89	3.75	7	6	4.10	3.61	3	6	1.30	1.68	1	2

OCI-12: The 12 Item obsessive-compulsive inventory; OCD: Obsessive-compulsive disorder; ARD: Anxiety related disorders; NCC: Non-clinical controls; SD: Standard deviation; Mdn: Median; IQR = Inter-quartile range.

Table 5

Pre- and post-treatment mean scores for 47 patients with OCD treated with exposure and response prevention.

Total Score	Pre-treatment M (SD)	Post-treatment M (SD)	t	Cohen's d
Y-BOCS	25.66 (4.80)	10.17 (5.03)	17.75*	2.59
OCI-12	22.15 (7.64)	9.13 (6.62)	12.92*	1.89
OCI-R	28.06 (11.70)	12.15 (9.69)	12.96*	1.89

OCD: Obsessive-compulsive disorder; Y-BOCS: Yale-Brown obsessive-compulsive scale; OCI-12: The 12 item obsessive-compulsive inventory; OCI-R: Obsessive-compulsive inventory-revised; ES: Effect size; * $p < .001$; Degrees of freedom for each analysis = 46.

AUC estimates for the four subscales ranged from 0.60 (ordering) to 0.75 (washing). Again, however, the OCI-12 total score evidenced the highest AUC (0.78, 95% CI = 0.75 to 0.81). These data indicate that the OCI-12 total score discriminates individuals with OCD extremely well from nonclinical individuals, and quite well from those with other anxiety disorders. Accordingly, we used total scores in the analyses that follow.

3.7.2. Diagnostic accuracy of the OCI-12 relative to the oci-r

The ROC analysis of the OCI-R total score revealed AUC estimates of 0.88 (OCD vs. nonclinical participants) and 0.77 (OCD vs. ARD). As shown in Fig. 3, direct comparisons between the two measures revealed significantly greater AUC estimates for the OCI-12 relative to the OCI-R in discriminating between OCD patients and the NCC group (Fig. 3a; difference in AUC = 0.03; $Z = 8.87$, $p < .001$) and between OCD patients and the ARD group (Fig. 3b; difference in AUC = 0.01; $Z = 2.62$, $p = .01$). Thus, the OCI-12 total score appears to have greater diagnostic accuracy than the OCI-R total score for identifying individuals relative to nonclinical and ARD samples.

3.7.3. Diagnostically accurate cutoff scores

Next, we examined the accuracy of different OCI-12 cutoff scores in correctly classifying patients as having a primary diagnosis of OCD versus belonging to the NCC group. Diagnostic accuracy was evaluated by calculating the sensitivity and specificity of various OCI-12 total scores. A cutoff score of 11 or higher provided the best balance between sensitivity and specificity, correctly classifying about 83% of OCD patients (sensitivity) and 81% of NCC participants (specificity). Similar analyses revealed that a cutoff score of 14 or higher provided the best balance between sensitivity and specificity in classifying OCD patients versus ARD patients, correctly classifying about 72% (sensitivity) of OCD patients and 73% of ARD patients (specificity).

3.7.4. Sensitivity to different levels of ocd severity

We used the recent empirically established OCI-R severity cutoff scores (Abramovitch et al., 2020) as benchmark for evaluating the OCI-12's ability to differentiate individuals at various levels of OCD severity. According to this system, OCI-R total scores from 0–15 indicate mild OCD symptoms, those from 16–27 indicate moderate symptoms, and those of 28 and over correspond to severe symptoms. Table 6 presents the sample sizes and OCI-12 total and subscale means and standard
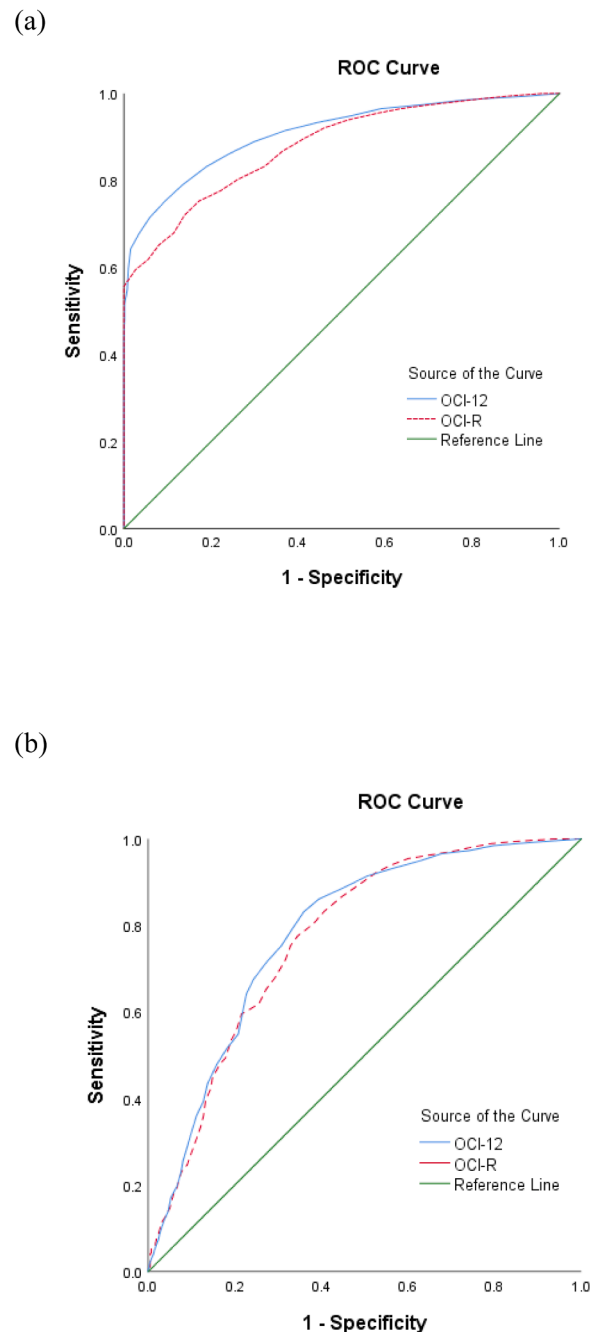
(a)

(b)

Fig. 3. OCI-12 and OCI-R receiver operating characteristic curves for the (a) OCD/NCC samples (AUC$_{OCI-12}$=0.91; AUC$_{OCI-R}$ = 0.88), and (b) and the OCD/ARD samples (AUC$_{OCI-12}$=0.78; AUC$_{OCI-R}$ = 0.77).

Table 6
OCI-12 total and subscale mean scores (standard deviations) by OCI-R severity benchmarks.

Severity level*		OCI-12				
	n	Total score	Washing	Checking	Ordering	Obsessing
Mild	257	8.85[a]	1.85[a]	1.26[a]	1.15[a]	4.59[a]
		(3.72)	(3.01)	(1.57)	(1.70)	(3.58)
Moderate	373	17.32[b]	4.13[b]	3.34[b]	3.09[b]	6.76[b]
		(4.07)	(4.13)	(2.63)	(2.86)	(3.63)
Severe	410	28.45[c]	6.81[c]	6.56[c]	6.63[c]	8.46[c]
		(6.74)	(3.98)	(3.57)	(3.51)	(3.16)

OCI-12: The 12-item obsessive-compulsive inventory; Means on each measure with different superscript were significantly different from one another ($p >$ .001); *Severity levels based on OCI-R total scores; OCI-R: Obsessive-compulsive inventory revised.
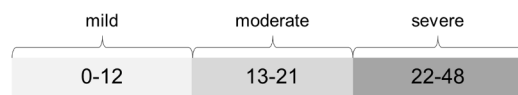

Fig. 4. Empirically derived severity benchmarks for the 12-item Obsessive-Compulsive Inventory (OCI-12). Note, a score ≥11 represents an optimal clinical cutoff.

deviations for individuals falling within each OCI-R severity group. As can be seen, for the OCI-12 total and each of the four subscales, the severe group had significantly greater scores than did the moderate group, which had significantly greater scores than the mild group.

Next, we conducted a series of receiver operating characteristic (ROC) analyses to evaluate how well OCI-12 total and subscale scores distinguish between the mild, moderate, and severe states. In distinguishing between mild and moderate cases, AUC estimates for the subscales ranged from 0.67 (obsessing) to 0.76 (checking); and in distinguishing between moderate and severe cases, from 0.64 (obsessing) to 0.78 (ordering). In both comparisons, however, the OCI-12 total score had the greatest AUC (0.94 for both) and was therefore best at distinguishing between individuals at each OCD severity level.

3.7.5. Establishing optimal cutoff scores for ocd severity levels

Lastly, we calculated the sensitivity and specificity of various OCI-12 total scores with the optimal degree of accuracy for correctly classifying individuals with different levels of OCD severity. In differentiating mildly from moderately severe patients, sensitivity refers to the percentage correctly classified by a given OCI-12 score as having moderate OCD as determined by their OCI-R score (i.e., true positives), while specificity refers to the percentage correctly classified as having mild OCD (i.e., true negatives). Fig. 4 shows the OCI-12 cutoff scores that provided the best balance between sensitivity and specificity in classifying patients of different severity levels along with each score's sensitivity and specificity. A score of 12 correctly classified 89% of moderate and 84% of mild OCD cases, and a total score of 21 correctly classified 85% of severe and 86% of moderate cases.

4. Discussion

At the time the OCI and OCI-R were developed, hoarding was classified as a symptom of OCD, and a great deal of attention was focused on identifying non-ritualistic cognitive and behavioral strategies, such as neutralizing, that patients often used to manage obsessions (e.g., Salkovskis et al., 1997). Since that time, however, four robust theme-based symptom dimensions have emerged from research on the structure of OCD symptoms (e.g., Abramowitz et al., 2010) and four of the OCI-R's six subscales capture these dimensions: washing, ordering, obsessing,

and checking. Moreover, hoarding is now understood as a separate condition altogether (Mataix-Cols et al., 2010). Finally, neutralizing is conceptualized less as a primary *dimension* of OCD and more as an ineffective coping strategy that occurs across symptom domains (discussed in Parrish et al., 2008). As a result, the item composition of the OCI-R warrants a revision to remain up to date with the current conceptual and empirical consensus.

In conducting our analyses, we employed a top-down approach to determine the items to retain from the OCI-R. Specifically, we first eliminated the hoarding subscale given hoarding's association with different neurocognitive and cognitive-behavioral characteristics compared to other symptom dimensions of OCD (e.g., Tolin and Villavicencio, 2011). Following this, and consistent with concerns raised by previous authors (e.g., Gonner et al., 2008; Sica et al., 2009; Woo et al., 2010) we eliminated the neutralizing scale on the basis of analyses indicating that this subscale does not converge with the aforementioned OCD symptom structure. The remaining 12 items thus comprise the OCI-12, which contains four 3-item subscales assessing washing, ordering, obsessing, and checking (the same symptom domains tapped by the four items that comprise the OCI-4; Abramovitch et al., 2021). Our CFAs further empirically verified this factor structure.

Our analyses of internal consistency and test–retest coefficients revealed that the OCI-12 possesses comparable reliability to its parent scale. Moreover, our theoretically and empirically informed approach to assessing validity suggests that the OCI-12 and its subscales are valid indicators of the severity of the four most empirically supported OC symptom dimensions. The similar pattern of convergent and discriminant relationships we observed in the clinical and student samples indicate that the OCI-12 has relevance for use with both populations. Finally, the OCI-12 appears to be as sensitive as its progenitor to change as a result of empirically supported treatment for OCD.

Our ROC analyses provide evidence that the OCI-12 is useful for identifying likely cases of OCD, and that it differentiates individuals with OCD from nonclinical individuals and from those with ARDs with a high degree of accuracy, and slightly more accurately than the OCI-R. Total scores of ≥11 and ≥14 represent cut points for identifying cases relative to nonclinical and individuals and those with ARDs, respectively. Notably, similar to the OCI-R, the OCI-12 is not a diagnostic tool, and the clinical cutoff score should not be used by itself to diagnose OCD. Indeed, a score above the clinical cutoff should be interpreted only as an indicator of increased likelihood of the presence of OCD, and cannot replace a clinical diagnostic interview. Finally, we found that the OCI-12 discriminates quite well between different OCD severity levels. Taken together, our findings suggest that the OCI-12 can effectively replace the OCI-R as a syndromally valid measure of OCD symptoms in both clinical and research settings. Notably, in light of the need to remove hoarding from other measures assessing obsessive-compulsive symptoms, we suggest that researchers would consider revising other OCD measures such as the Florida Obsessive-Compulsive Inventory (FOCI; Storch et al., 2007) accordingly.

The results of the present study should be considered in light of several issues. Primarily, the large multi-sample dataset was both a strength and a limitation. Although participants were clinically and geographically diverse, which optimized the generalizability of our findings, the clinical samples in particular, were primarily non-Hispanic White American. It is possible that scores on the OCI-12 are impacted by one's cultural or ethnic background. Given that our sample size did not allow for psychometric examination of ethnicity, we hope that the present study will stimulate additional testing to evaluate the structure of OCD symptoms among diverse samples. It is also important to note that the non-clinical sample did not undergo a semi-structured interview to exclude participants with OCD. However, we excluded participants from this sample who scored above the OCI-R's clinical cutoff. In addition, most individuals diagnosed with OCD meet criteria for other concomitant disorders; however comorbidities were not formally assessed across all study sites and thus not reported here. Although the

presence of comorbidities may attenuate internal validity, it increases the generalizability of our findings because the measure's properties are examined in a sample of treatment seeking OCD patients in naturalistic settings. Moreover, comorbidity information is not regularly integrated in most psychometric analyses, including development of measures, severity benchmarks and norms. This is also the case in the field of OCD (Abramowitz et al., 2010; Foa et al., 2002; Goodman et al., 1989a, 1989b; Huppert et al., 2007; Storch et al., 2015). It also is important to point out that items for the OCI-12 were embedded within the larger pool of OCI-R items, and it therefore remains to be seen whether our results generalize to the use of the OCI-12 as a stand-alone instrument. It is, however, noteworthy that Foa and colleagues developed the OCI-R from items embedded within the original OCI (Foa et al., 2002). Finally, 75% of participants completed the Y-BOCS-SR, and 25% underwent the Y-BOCS interview. However, both methods have been shown to yield equivalent scores (Federici et al., 2010; Steketee et al., 1996).

5. Conclusion

The OCI-12 is a 12-item syndormally valid self-report measure of OCD that is derived from the OCI-R. The measure adheres to the prevailing 4-factor model of OCD dimensions, that similar to the OCI-R, possesses good to excellent psychometric properties including reliability, validity, and sensitivity to treatment. The OCI-12 also possesses improved sensitivity and specificity for its clinical cutoff and severity benchmark scores. Thus, the OCI-12 is a psychometrically sound measure of OCD severity in both research and clinical settings. The complete scale including instructions (derived from the original OCI-R; Foa et al., 2002), new item numbering, and scoring guidelines can be found in Appendix A.

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Author contributions

All authors contributed substantially to the manuscript and approved its final iteration.

Declaration of Competing Interest

None

Appendix A

OCI-12

The following statements refer to experiences that many people have in their everyday lives. Circle the number that best describes **HOW MUCH** that experience has **DISTRESSED or BOTHERED you during the PAST MONTH.** The numbers refer to the following verbal labels:

0 Not at all	1 A little	2 Moderately	3 A lot			4 Extremely		
1. I check things more often than necessary.				0	1	2	3	4
2. I get upset if objects are not arranged properly.				0	1	2	3	4
3. I find it difficult to touch an object when I know it has been touched by strangers or certain people.				0	1	2	3	4
4. I find it difficult to control my own thoughts.				0	1	2	3	4
5. I repeatedly check doors, windows, drawers, etc.				0	1	2	3	4
6. I get upset if others change the way I have arranged things.				0	1	2	3	4
7. I sometimes have to wash or clean myself simply because I feel contaminated.				0	1	2	3	4
8. I am upset by unpleasant thoughts that come into my mind against my will.				0	1	2	3	4
9. I repeatedly check gas and water taps and light switches after turning them off.				0	1	2	3	4
10. I need things to be arranged in a particular way.				0	1	2	3	4
11. I wash my hands more often and longer than necessary.				0	1	2	3	4
12. I frequently get nasty thoughts and have difficulty in getting rid of them.				0	1	2	3	4

The 12-Item Obsessive-Compulsive Inventory (OCI-12)

Administration & Scoring

The OCI-12 is self-report measure of OCD symptoms, derived from the OCI-R (Foa et al., 2002). It consists of 12 items that a person endorses on a 5-point Likert scale (0–4).

Checking: 1, 5, 9
Ordering: 2, 6, 10
Washing: 3, 7, 11
Obsessing: 4, 8, 12

Scores are generated by adding the item scores. The possible range of scores is 0–48.

Clinical cutoff score: The mean total score for persons with OCD is 19.62 (*SD* = 9.42). Recommended total cutoff score is 11, with scores at or above this level indicating the likely presence of OCD.

Severity Benchmarks: 0–12 = Mild; 13–21 = Moderate; 22–48= Severe.

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