Original Paper

Diagnostic Performance of the Turkish Version of the Vancouver Obsessional Compulsive Inventory (VOCI) Versus Padua Inventory-Revised (PI-R): a Validation Study

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ABSTRACT:

Diagnostic Performance of the Turkish Version of the Vancouver Obsessional Compulsive Inventory (VOCI) versus Padua Inventory-Revised (PI-R): a validation study

Objective: The Vancouver Obsessional Compulsive Inventory (VOCI) is a self-report inventory developed to assess a wide range of obsessive-compulsive symptoms, including contamination (12 items), checking (6 items), obsessions (12 items), hoarding (7 items), just right (12 items), and indecisiveness (6 items). The English version of the VOCI has been shown to be a promising psychometric instrument, as have its French, Italian, and Spanish versions. The aim of this study was to investigate psychometric properties of the Turkish version of the VOCI in clinical and non-clinical samples.

Method: A questionnaire package including the VOCI, Padua Inventory-Revised (PI-R), Obsessional Beliefs Questionnaire (OBQ), and Beck Depression Inventory (BDI) was administered to volunteer undergraduates (n=365) and patients with obsessive-compulsive disorder (OCD) (n=46). Psychometric analyses were run to assess reliability and validity of the Turkish version of the VOCI. We converged a confirmatory factor analysis to test the factor structure. We also performed a receiver operating characteristic (ROC) analysis to determine cut-off scores and compared the diagnostic performance of the VOCI and PI-R. Convergent and discriminant validity of the VOCI were assessed through Pearson product-moment correlation coefficients. Internal consistency and temporal reliability were computed.

Results: Confirmatory factor analysis replicated the original six-factor structure. The maximum likelihood factor loading estimates were higher than 0.40. OCD patients scored significantly higher than control subjects on the contamination, checking, obsessions, things just right, and indecisiveness subscales of the VOCI but not on the hoarding subscale. The global VOCI scores highly correlated with the PI-R (r=0.89); correlation between the contamination subscale of the VOCI and washing subscale of the PI-R was r=0.88; correlation between the checking subscales of both screening tools was r=0.83; correlation between the just right subscale of the VOCI and precision subscale of the PI-R was r=0.71; and correlation between the obsession subscale of the VOCI and rumination subscale of the PI-R was r=0.71. Divergent validity of the VOCI was also high, so that correlations of the total and subscales of the VOCI with the total and subscales of the PI-R were from r=0.25 to a high of r=0.41; therefore, it can be said that the coefficients ranged from weak to moderate. These correlation coefficients were indicative of good convergent and divergent validity. Internal consistency of the VOCI global was 0.97, and that of the VOCI subscales ranged between 0.82 and 0.92 in the overall sample. Cronbach's Alphas of the VOCI subscales in the OCD group were between 0.73 and 0.88, and in the control group between 0.84 and 0.92. Fifteen-day test-retest intra-correlations for total scores of the VOCI were 0.75; for the subscales they ranged from 0.68 up to 0.88. The ROC analysis demonstrated a moderate diagnostic performance for the VOCI cut-off score of 87.5 with a sensitivity of 0.74 and a specificity of 0.73 immediately comparable to the PI-R cut-off point of 67.5.

Conclusion: The VOCI had good internal consistency, test-retest reliability, convergent and discriminant validity. It is concluded that the Turkish version of the VOCI has sound psychometric properties. Further studies are needed to develop psychometric tools with stronger diagnostic performance for OCD assessment.

Keywords: obsessive-compulsive disorder, confirmatory factor analysis, ROC curve, reliability, validity

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INTRODUCTION

Obsessive-compulsive disorder (OCD) is a chronic and debilitating condition affecting approximately 3% of the adult population[1,2]. According to the classification of the American Psychiatric Association in the DSM-IV-TR[3], obsessions are persistent ideas, thoughts or images experienced as intrusive and inappropriate; whereas compulsions are defined as repetitive behaviors or mental acts that individuals feel compelled to do in response to obsessions. A new diagnostic category of Obsessive-Compulsive and Related Disorders (OCRD) has been defined in the DSM-5, reflecting a distinction for the spectrum of anxiety disorders to provide a more comprehensive understanding of the multifariousness of the disorder. OCRD includes body dysmorphic disorder, trichotillomania, hoarding disorder and excoriation disorder, as well as OCD. Although in subsequent arrangements of the DSM obsessive-compulsive symptomatology is seemingly understood more heterogeneously in a spectrum rationale, pure OCD still represents a relatively homogeneous condition with obsessions and/or compulsions[4]. Nonetheless, research has long pointed out that obsessive-compulsive disorder appears to be a heterogeneous condition in nature[5-7].

The diagnosis of OCD can be reliably obtained by using structured clinical interviews such as the Structured Clinical Interview for DSM-IV Axis I Disorders – SCID-I[8], the Dimensional Yale-Brown Obsessive-Compulsive Scale (DY-BOCS)[9], and the Dimensional Obsessive-Compulsive Scale (DOCS)[10]. The structured clinical assessment approach allows more detailed information to be collected about symptoms peculiar to OCD and provides clarified items for test-takers. However, psychometric instruments are needed to collect information faster and more easily, particularly for research purposes. Miscellaneous self-report instruments have been developed to assess heterogeneous clinical features of OCD[11]. Most of these instruments have been translated into other languages and validated. The Maudsley Obsessional Compulsive Inventory (MOCI)[12], Padua Inventory (PI)[13], and Obsessive-Compulsive Inventory-Revised (OCI-R)[14] are the instruments that are most widely utilized for clinical and research purposes in OCD and are virtually the sole measures for which a validation process for the Turkish population has been carried out.

Of these measures, the MOCI has been the most widely used self-report psychometric instrument in assessing the severity of obsessive-compulsive symptoms; however, scholars have drawn attention to numerous shortcomings of the instrument. It has been pointed out that the MOCI does not tap into cognitive components of OCD, ensures only a limited assessment of the construct (a definition of obsessive-compulsive phenomena other than washing and checking is limited), and does not have adequate sensitivity to therapeutic change[15-17]. On the other hand, over the past three decades the MOCI has been shown to have good reliability with adequate internal consistency and good construct validity[18,19]. The Vancouver Obsessional Compulsive Inventory (VOCI) was developed to overcome the drawbacks mentioned above while retaining the strengths of this scale, and to provide a more valid and reliable self-report measure to be used in the assessment of OCD[16].

In an attempt to revise and expand the MOCI, a new psychometric instrument was designed to cover a wider range of obsessions, compulsions, personality characteristics and avoidance behaviors. To do so, the authors devised an item pool of 172 queries subsumed under 13 domains central to OCD. A pilot form of an 84-item scale, derived by extracting the best items from the pooled content, was grouped logically into four subscales and named the Maudsley Obsessional Compulsive Inventory-Revised (MOCI-R)[20]. In a further process, factor analysis with direct oblimin transformation of the 84 MOCI-R items along with the original 30 MOCI items in an OCD sample of 118 individuals provided a clear distinction within the subscales of Checking, Contamination, Indecisiveness/Perfection/Concern with Mistakes,

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Obsessions, Routine/Slowness/Counting, Thought–Action Fusion (TAF) Moral and TAF-Likelihood. The two TAF sub-scales emerging from the factor analysis of the MOCI-R constructed a separate measure of the Thought–Action Fusion Scale[21], and items subsumed under these two subscales were removed from the original scale. Finally, items displaying a lack of factorial complexity, demonstrating good discrimination ability between people with and without OCD, and yielding highly corrected item-total correlations were selected to construct a new measure of OCD. Items underwent a reduction process, and these phases of scale development were finalized as a new scale of 55 items, the Vancouver Obsessional Compulsive Inventory (VOCI)[16].

The initial validation study of the VOCI by Thordarson et al.[16] reported that the hypothetically assumed structure of the VOCI was largely supported in the factor analytic investigation of the data. The six subscales of the VOCI were Contamination (12 items), Checking (6 items), Obsessions (12 items), Hoarding (7 items), Just Right (12 items), and Indecisiveness (6 items). Forty-seven day interval test-retest correlation coefficients in the OCD group were excellent for all subscales ($\alpha > 0.90$); on the other hand, test-retest reliability was moderate for the students. Internal consistency for the VOCI total and subscale items was excellent for OCD and control groups. Correlations of the VOCI total and sub-scale scores with the PI and MOCI total and subscale scores as well as YBOCS were indicative of good convergent validity.

The VOCI has been translated into several languages. Arjona et al.[22] examined the psychometric properties of the Spanish version of the VOCI in two non-clinical Spanish samples. Exploratory factor analysis replicated the original six-factor structure. The Spanish translation of the VOCI showed good validity and reliability. Chiorri et al.[23] replicated the six-correlated-factor original structure, but a more parsimonious second-order-factor model indicated a statistically better fit to the data collected from a representative Italian community sample. Two studies, Radomsky et al.[15] and Gonner et al.[24], examined psychometric properties of the French, English and German versions of the VOCI. Radomsky et al.[15] reported that both the English and the French versions of the scale demonstrated excellent internal consistency, test-retest reliability, convergent and divergent validity. Gonner et al.[24] integrated and revised two self-report measures of obsessive-compulsive symptoms, the VOCI and the Symmetry Ordering and Arranging Questionnaire (SOAQ), based on data from an OCD-affected group. The authors suggested that the item pool of the VOCI covers many of the obsessive-compulsive symptom clusters representing the heterogeneous nature of OCD, but not symmetry preferences and ordering and arranging compulsions. In the study, both measures were integrated and revised on the basis of theoretical and statistical considerations. The 30-item Vancouver Obsessional Compulsive Inventory Revised (VOCI-R) had six components as well: contamination/washing, symmetry/ordering, hoarding, checking, harming obsessions, and immoral obsessions.

Sound assessment tools as well as evidence-based treatments would be of enormous importance to help OCD-affected people. To date, psychometric properties of the PI-R in clinical and non-clinical groups have received a growing interest. However, the concurrent validity of this scale has been reported to be problematic to an extent. On the other hand, weak discriminant validity for some scales is another drawback for the PI-R[25]. The Vancouver Obsessional Compulsive Inventory was designed to assess a broad range of obsessive-compulsive symptomatology including cognitive and behavioral characteristics associated with OCD. The instrument has been translated into several languages and revealed promising psychometric features. However, there has been no receiver operating characteristic data available for the VOCI as well as the PI-R. Our aim in this study was to assess reliability and validity of the Turkish version of the VOCI in clinical and non-clinical

samples. In addition, we planned to compare diagnostic performances of the VOCI and PI-R through receiver operating characteristic (ROC) curve analysis. This study would be the first evidence for the comparative diagnostic performance of these OCD screening tools.

METHODS

Participants

Volunteer undergraduate participants from Ankara University were recruited for participation in this study (n=365). The mean age of the university students was 20.62 (SD±1.85) and 66.03% of the student sample were women. Forty-six patients with OCD who had been admitted to Atatürk Education and Research Hospital psychiatry clinics in Erzurum, Turkey were recruited as the clinical group. The mean age of the patients with OCD was 28.28 (SD±8.93) and 39.13% of the patient group were women.

Psychometric Measures

Vancouver Obsessional Compulsive Inventory (VOCI): The VOCI is a 55-item self-report instrument designed by Thordarson et al.[16] to assess the severity of OCD symptoms. Each item is rated on a 5-point Likert type scale, ranging from 0 (not at all) to 4 (very much). The VOCI has six dimensions: a) Contamination; b) Checking; c) Obsessions; d) Hoarding; e) Just Right; and f) Indecisiveness. The VOCI revealed high inter-consistency in different samples, ranging from 0.90 to 0.96. Although test-retest reliability for the VOCI total score was high in the OCD group (r=0.96), it was not adequate in the student sample (r=0.52).

Padua Inventory – Revised (PI-R): The PI-R, a revision of the Padua Inventory[13], is a 41-item self-report instrument to assess the severity of OCD symptoms. Although the Padua Inventory offers many advantages in assessing a broad spectrum of OCD, research has demonstrated that the content of the Padua Inventory includes both obsessions and non-specific worry[26]. The PI was revised by Van Oppen[27] to correct this limitation. Items are rated on a 5-point Likert scale, ranging from 0 (not at all) to 4 (very much). The PI-R has five components: a) Impulses: b) Washing; c) Checking; d) Rumination; and e) Precision. The translation of the Turkish version of the PI-R was done by Besiroglu et al.[28].

Obsessional Beliefs Questionnaire (OBQ): The OBQ, a shortened 44-item self-report scale developed by the Obsessive Compulsive Cognition Working Group[29], measures belief domains peculiar to OCD. The revised version of the OBQ has three scales: Responsibility/Threat Estimation, Perfectionism/Certainty and Importance/Control of Thoughts. Boysan et al.[30] has reported sound psychometric properties for the Turkish version of the instrument, showing internal consistency with Cronbach alphas of 0.86, 0.89, and 0.87 for the three factors among OCD-affected outpatients.

Beck Depression Inventory (BDI): The BDI is a 21-item measure designed to assess the severity of depressive symptoms[31]. The Turkish adaptation was performed by Hisli[32]. A Cronbach's alpha of α=0.80 and a correlation coefficient with the Minnesota Multiphasic Personality Inventory Depression subscale of r=0.50 were reported for the Turkish version.

Statistical Analysis

At the outset, confirmatory factor analysis was conducted to test the validity of the original six-factor structure of the Turkish translation of the VOCI. In the confirmatory factor analysis, the Satorra-Bentler normality correction was used. The main advantage of this procedure is to derive more stable solutions, especially when the deviations from multivariate normality are significant[33]. We specified and converged three measurement models representing the relations between factors and the VOCI items. We compared and decided on the best model fit to the current data based on model fitness criteria suggested by Hu and

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Bentler[34] and model comparisons through Satorra-Bentler scaled difference chi-square testing by running an Excel script[35] relying on the algorithm developed by Bryant and Satorra[36]. Item analyses were performed to assess scale validity and reliability. We performed receiver operating characteristic (ROC) curves to understand the diagnostic performance of the VOCI and the PI-R. We computed z test comparisons between areas under ROC curves, consistent with the methodology suggested by Hanley and McNeil[37] to assess the diagnostic utility of the VOCI versus the PI-R. We adopted two criteria to maximize sensitivity and specificity in determining the cut-off values for both OCD screening tools: i) the point on the ROC curve corresponding to optimal sensitivity/specificity pair passes through the upper left corner[38], and ii) the point of intersection of the ROC curve line on which the sum of any sensitivity and 1-specificity pair is 1 or closer to 1[39,40]. In the further investigation, construct validity of the VOCI was assessed by performing the Pearson product-moment correlation coefficients of the scale scores of the VOCI with the PI-R total and subscale scores. Correlations with the OBQ-44 total and subscales and BDI scores were computed to explore convergent and divergent validity. Cronbach's alpha for internal reliability and 15-day test-retest correlations for temporal reliability were computed for the total 55-item scale and sub-scales of the VOCI.

Procedure

For this study, the VOCI was translated from English to Turkish by experts from the field. In the clinical group, all questionnaires were administered at the beginning of the treatment. In the student group, the study was announced in class and volunteers participated in their classrooms after their lectures. For the participants, a brief description of the study's purpose was given. Each volunteer participated in the study after written informed consent was given. Temporal validity of the Turkish version of the VOCI was tested in a non-clinical student group in which we conducted two applications with a time interval of 15 days. In the clinical group, all participants were diagnosed based on DSM-IV TR by psychiatrists with at least five years' experience. The diagnosis was confirmed by a structured clinical interview, SCID-I[8].

RESULTS

Confirmatory Factor Analysis

To assess the factor structure of the VOCI, confirmatory factor analysis with Satorra-Bentler correction was conducted. Since the covariance matrix was used in the factor analysis, missing data were not estimated in order to avoid even minor deviations from the original data. To detect the best model accounting for the relations between the VOCI items and the factor structure, we specified three measurement models to be tested through Satorra-Bentler scaled chi square difference testing[36]. Model 1 specified a general first-order factor on which all items were loaded. Model 2 specified the original factor structure suggested by Thordarson et al.[16] by which the VOCI items were loaded on six first-order subscales. Lastly, the third model (Model 3) specified six first-order factors and one second-

Table 1: Goodness of model fit indices							
	df	S-B χ^2	RMSEA	TLI	CFI	IFI	SRMR
One general factor	1430	4845.41	0.076	0.95	0.96	0.96	0.067
Six uncorrelated factors	1430	4625.44	0.074	0.96	0.96	0.96	0.31
Six correlated factors	1415	2644.86	0.046	0.98	0.98	0.98	0.058
Second-order and six first-order factors	1424	2673.44	0.046	0.98	0.98	0.98	0.059

df= degrees of freedom, S-B χ^2= Satorra-Bentler Scaled χ^2, RMSEA= Root mean square of approximation, TLI= Tucker-Lewis Index, CFI= Comparative Fit Index, IFI= Incremental Fit Index, SRMR= Standardized Root Mean Residuals

Table 2: Maximum likelihood estimations of factor loadings (n=411)							
	Contamination	Checking	Obsessions	Hoarding	Just Right	Indecisiveness	R²
Item 3	0.53						0.28
Item 8	0.70						0.49
Item 13	0.67						0.45
Item 15	0.60						0.36
Item 21	0.63						0.40
Item 23	0.73						0.53
Item 25	0.65						0.42
Item 32	0.62						0.38
Item 39	0.69						0.48
Item 44	0.81						0.66
Item 49	0.65						0.42
Item 50	0.74						0.55
Item 7		0.76					0.58
Item 20		0.80					0.64
Item 33		0.77					0.59
Item 37		0.83					0.69
Item 41		0.80					0.64
Item 43		0.86					0.74
Item 2			0.41				0.17
Item 6			0.59				0.35
Item 12			0.67				0.45
Item 16			0.52				0.27
Item 27			0.60				0.36
Item 28			0.51				0.26
Item 30			0.53				0.28
Item 34			0.69				0.48
Item 40			0.61				0.37
Item 46			0.67				0.45
Item 52			0.66				0.44
Item 54			0.66				0.44
Item 10				0.58			0.34
Item 22				0.71			0.50
Item 26				0.46			0.21
Item 35				0.72			0.52
Item 42				0.72			0.52
Item 45				0.54			0.29
Item 51				0.69			0.48
Item 1					0.52		0.27
Item 5					0.55		0.30
Item 9					0.55		0.30
Item 14					0.70		0.49
Item 18					0.69		0.48
Item 19					0.62		0.38
Item 24					0.59		0.35
Item 36					0.64		0.41
Item 38					0.66		0.44
Item 47					0.72		0.52
Item 53					0.71		0.50
Item 55					0.69		0.48
Item 4						0.70	0.49
Item 11						0.74	0.55
Item 17						0.80	0.64
Item 29						0.55	0.30
Item 31						0.61	0.37
Item 48						0.80	0.64
Variance explained	9.85%	7.05%	7.86%	5.20%	8.95%	5.44%	44.35%

order factor on which the six first-order factors were loaded. As can be seen in Table 1, all three models showed an acceptable fit to the data. We decided on the best model through model comparisons using a procedure for testing scaled χ^2 differences[36]. In the comparisons we found that the six first-order factor structure best fitted the data as compared to either one general factor (Model 1) (ΔS-B Scaled χ^2 [15]= 400.447; p<0.01) or six first-order factors loaded on a second-order general factor (Model 3) (ΔS-B Scaled χ^2 [9]= 18.534; p<0.05). Model goodness of fit indices are presented in Table 1.

In the selected best fit model with six first-order factors, Satorra-Bentler scaled chi-square was significant (χ^2=(1415)= 2644.86, χ^2/df= 1.87 p<0.001). In large samples inflated chi-square values are not unusual[33]. However, χ^2/df was lower than 3. Root mean square error of approximation (RMSEA) was 0.046, p=0.99; Tucker-Lewis Index (TLI) was 0.98; Comparative Fit Index (CFI) was 0.98; and Standardized Root Mean Square Residual (SRMR) was 0.058. According to the structural equation modeling literature, these model fit indices point out excellent model fit to the data[33,34]. The structural model explained a significant proportion of variance (44%). Moreover, maximum likelihood estimations of factor loadings were >0.40, indicative of excellent invariance across factors.

Descriptive Statistics

Descriptive statistics and results of the item analyses are presented in Table 3. Excellent item-total correlations were found for all VOCI subscales (rjt>0.40). Internal consistency and corrected item-total correlations were also acceptable for other measures utilized for testing criterion validity.

Comparisons Between OCD Patients Group and Healthy Controls

Group comparisons of the VOCI and subscales were conducted by using univariate ANOVA

Table 3: Descriptive statistics and item statistics for the measures (n=411)									
	n	α	Rjt	Inter-item r	SMC	M	SD	M range (items)	SD range (items)
Vancouver Obsessive Compulsive Inventory (VOCI)	406	0.97	0.34-0.76	0.06-0.72	0.35-0.75	72.56	39.88	0.44-1.93	0.81-1.41
VOCI Contamination	409	0.91	0.52-0.74	0.29-0.62	0.32-0.61	16.85	10.31	0.87-1.73	1.06-1.38
VOCI Checking	409	0.92	0.72-0.82	0.53-0.72	0.54-0.69	8.10	6.27	1.06-1.63	1.17-1.28
VOCI Obsessions	410	0.87	0.42-0.65	0.31-0.53	0.20-0.46	14.84	9.32	0.86-1.84	1.12-1.33
VOCI Hoarding	410	0.82	0.42-0.66	0.18-0.54	0.24-0.39	6.66	5.28	0.80-1.47	0.81-1.25
VOCI Just Right	409	0.89	0.46-0.68	0.27-0.59	0.25-0.49	17.27	10.07	0.92-1.88	1.12-1.41
VOCI Indecisiveness	409	0.85	0.48-0.75	0.30-0.67	0.26-0.52	8.85	5.51	1.18-1.93	1.19-1.26
Padua Inventory (PI)	384	0.96	0.26-0.75	-0.02-0.80	0.28-0.78	54.74	31.74	0.54-2.05	1.01-1.39
PI-Impulses	390	0.80	0.30-0.65	0.17-0.61	0.10-0.49	7.29	5.95	0.55-1.36	1.01-1.40
PI-Washing	390	0.92	0.62-0.76	0.42-0.79	0.42-0.71	14.58	9.59	1.03-1.86	1.18-1.34
PI-Checking	391	0.92	0.64-0.81	0.48-0.80	0.45-0.73	11.80	8.17	1.33-1.65	1.19-1.33
PI-Rumination	388	0.92	0.45-0.80	0.29-0.80	0.25-0.74	14.66	9.74	1.02-2.05	1.19-1.35
PI-Precision	390	0.82	0.52-0.67	0.20-0.70	0.41-0.59	6.40	5.28	0.77-1.38	1.10-1.33
Obsessive Beliefs Questionnaire (OBQ)	397	0.95	0.34-0.66	-0.02-0.72	0.29-0.68	167.11	49.13	2.27-5.49	1.54-2.29
OBQ-Responsibility/ Threat Estimation	398	0.89	0.33-0.65	0.01-0.63	0.19-0.53	61.89	19.16	2.42-5.19	1.82-2.08
OBQ-Perfectionism/ Certainty	397	0.90	0.34-0.66	0.06-0.73	0.23-0.62	65.84	19.75	2.50-5.49	1.75-2.10
OBQ-Importance/ Control of Thoughts	398	0.86	0.33-0.68	0.11-0.49	0.16-0.50	39.38	15.20	2.28-4.78	1.84-2.29
Beck Depression Inventory	391	0.92	0.33-0.72	0.12-0.55	0.21-0.57	13.66	10.85	0.28-0.97	0.63-1.14

n, sample size; α, Cronbach's; rjt, corrected item-total correlations (range); inter-item r, Spearman inter-item correlations (range); SMC range, squared multiple correlations (range); M, mean; SD, standard deviation; M range (items), item means (range); SD range (items), item standard deviations (range)

models. Missing data were imputed by using a linear interpretation procedure before ANOVA analyses. In the analyses, it was found that OCD patients reported significantly higher scores on the VOCI ($F_{(1, 408)}=42.388$, $\eta^2=0.09$; $p<0.001$), Contamination subscale ($F_{(1, 408)}=38.425$, $\eta^2=0.09$; $p<0.001$), Checking subscale ($F_{(1, 408)}=45.777$, $\eta^2=0.10$; $p<0.001$), Obsessions subscale ($F_{(1, 408)}=22.099$, $\eta^2=0.05$; $p<0.001$), Just Right subscale ($F_{(1, 408)}=48.819$, $\eta^2=0.11$; $p<0.001$), and Indecisiveness subscale ($F_{(1, 408)}=24.852$, $\eta^2=0.06$; $p<0.001$). There was an exception in that the Hoarding subscale ($F_{(1, 408)}=3.465$, $\eta^2=0.00$; $p=0.06$) could not satisfactorily discriminate patients from controls ($F_{(1, 408)}=38.425$, $\eta^2=0.10$; $p<0.001$). OCD outpatients also scored higher on the Padua Inventory and subscales, Obsessive Beliefs Questionnaire and subscales, and Beck Depression Inventory compared to controls.

Receiver Operating Characteristic (ROC) Analysis for the VOCI and the PI-R

We assessed and compared the clinical utility of two obsessive-compulsive symptoms screening tools, the VOCI and PI-R, using receiver operating characteristic (ROC) analysis. Each point on the ROC curve represents a sensitivity/specificity pair, and the curve passes through the point closest to the upper left corner representing the cut-off point indicative of the higher overall accuracy of the test[38]. The ROC curves plotted for both instruments are illustrated in Figure 1. As can be seen in Figure 1, both of the assessment tools, namely the VOCI and PI-R, revealed almost similar performance in discriminating false negatives; on the other hand, the sensitivity point on the curves was mildly higher for the PI-R total versus the VOCI total scores. Areas under the ROC curves lying within 95% confidence intervals for the VOCI and PI-R were 0.79 (95%CI=0.72-0.85; $p<0.001$) and 0.82 (95%CI=0.76-0.87; $p<0.001$), respectively. In comparing the areas under the ROC curves, we found an unsubstantial difference between these two areas ($z=0.528$; $p=0.598$). The cut-off score of
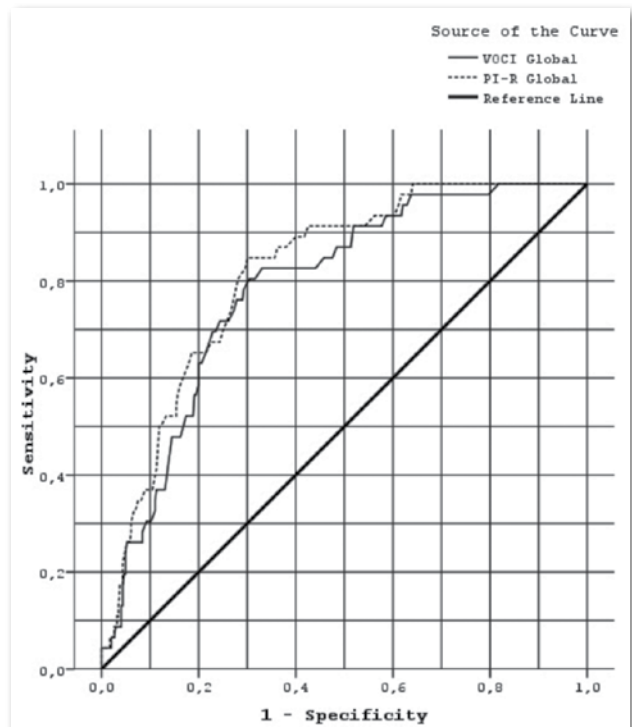

Figure 1: Receiving operating characteristic (ROC) curves plotted for the total scores of the VOCI and PI-R

87.5 for the VOCI Global scores had a sensitivity of 0.74 and a specificity of 0.73. The cut-off point for the PI-R was 67.5 where the sensitivity was 0.74 and specificity was 0.73 for the threshold.

Convergent and Discriminant Validity

Pearson product-moment correlation coefficients are presented in Table 4. Strong correlations between the VOCI subscales and Padua Inventory subscales were obtained. Significant correlations between the VOCI subscales and Obsessive Beliefs Questionnaire subscales were also strong. The results demonstrated that the VOCI had good convergent validity. Furthermore, correlations between the VOCI subscales and the Beck depression Inventory were moderate ($r=0.40$) to weak ($r=0.25$). Thus, the VOCI revealed adequate discriminant validity as well.

Reliability of the VOCI

The VOCI and its subscales revealed good to excellent internal consistency in the overall

Table 4. Comparisons of psychological variables across groups (n=411)

| | Group | | | | | | | |
| | Controls (n=365) | | OCD Outpatients (n=46) | | | | | |
	Mean	SD	Mean	SD	F	df	P	η²
Vancouver Obsessive Compulsive Inventory (VOCI)	68.21	38.37	106.93	34.98	42.388	1, 408	<0.001	0.094
VOCI Contamination	15.77	9.72	25.35	11.03	38.425	1, 408	<0.001	0.086
VOCI Checking	7.40	5.90	13.70	6.33	45.777	1, 408	<0.001	0.101
VOCI Obsessions	14.09	8.82	20.78	11.05	22.099	1, 408	<0.001	0.051
VOCI Hoarding	6.49	5.25	8.02	5.39	3.465	1, 408	0.063	0.008
VOCI Just Right	16.10	9.51	26.52	9.74	48.819	1, 408	<0.001	0.107
VOCI Indecisiveness	8.38	5.32	12.57	5.65	24.852	1, 408	<0.001	0.058
Padua Inventory (PI)	50.62	30.20	85.78	25.39	56.965	1, 390	<0.001	0.127
PI-Impulses	6.97	5.66	9.65	7.48	8.383	1, 390	0.004	0.021
PI-Washing	13.61	9.12	21.93	9.96	33.143	1, 390	<0.001	0.078
PI-Checking	10.78	7.65	19.50	7.97	52.235	1, 390	<0.001	0.118
PI-Rumination	13.26	9.00	25.17	8.66	71.676	1, 390	<0.001	0.155
PI-Precision	5.99	5.10	9.52	5.62	19.021	1, 390	<0.001	0.047
Obsessive Beliefs Questionnaire (OBQ)	161.77	47.38	208.24	42.85	39.982	1, 398	<0.001	0.091
OBQ-Responsibility/ Threat Estimation	60.42	18.51	73.24	20.47	19.047	1, 398	<0.001	0.046
OBQ-Perfectionism/Certainty	63.73	19.18	82.11	16.33	38.612	1, 398	<0.001	0.088
OBQ-Importance/Control of Thoughts	37.62	14.38	52.89	14.62	45.702	1, 398	<0.001	0.103
Beck Depression Inventory	12.22	9.75	24.63	12.48	61.365	1, 393	<0.001	0.135

Table 5. Pearson correlations of the VOCI total and subscales with psychological variables (N=411)

	Vancouver Obsessive Compulsive Inventory (VOCI)	VOCI-Contamination	VOCI-Checking	VOCI-Obsessions	VOCI-Hoarding	VOCI-Just Right	VOCI-Indecisiveness
Padua Inventory (PI)	0.89 **	0.75 **	0.73 **	0.74 **	0.65 **	0.83 **	0.75 **
PI-Impulses	0.56 **	0.34 **	0.41 **	0.63 **	0.46 **	0.50 **	0.46 **
PI-Washing	0.72 **	0.88 **	0.50 **	0.49 **	0.47 **	0.62 **	0.52 **
PI-Checking	0.78 **	0.56 **	0.83 **	0.61 **	0.57 **	0.75 **	0.66 **
PI-Rumination	0.81 **	0.59 **	0.65 **	0.71 **	0.61 **	0.78 **	0.79 **
PI-Precision	0.71 **	0.58 **	0.54 **	0.59 **	0.54 **	0.71 **	0.57 **
Obsessive Beliefs Questionnaire (OBQ)	0.61 **	0.50 **	0.47 **	0.54 **	0.45 **	0.58 **	0.52 **
OBQ-Responsibility/ Threat Estimation	0.54 **	0.43 **	0.42 **	0.50 **	0.42 **	0.49 **	0.45 **
OBQ-Perfectionism/Certainty	0.58 **	0.50 **	0.44 **	0.45 **	0.39 **	0.60 **	0.53 **
OBQ-Importance/Control of Thoughts	0.53 **	0.41 **	0.40 **	0.53 **	0.41 **	0.48 **	0.43 **
Beck Depression Inventory	0.40 **	0.25 **	0.30 **	0.41 **	0.27 **	0.40 **	0.40 **

**:p<0.01

Table 6: Reliability analyses for the VOCI

| | Cronbach's Alpha | | | 15-day test-retest intra-correlations (n=41) |
	Overall Sample (n=411)	Control (n=365)	OCD (n=46)	
Vancouver Obsessive Compulsive Inventory (VOCI)	0.97	0.97	0.93	0.75**
VOCI-Contamination	0.91	0.90	0.88	0.68**
VOCI-Checking	0.92	0.92	0.85	0.76**
VOCI-Obsessions	0.87	0.86	0.88	0.77**
VOCI-Hoarding	0.82	0.84	0.74	0.88**
VOCI-Just Right	0.89	0.89	0.82	0.71**
VOCI-Indecisiveness	0.85	0.85	0.73	0.79**

NOTE- Test-retest reliability of the VOCI was evaluated among 41 students

sample (0.82≤α≤0.97). Internal reliability was also adequate in the control (0.85≤α≤0.97) and OCD groups (0.73≤α≤0.93). Fifteen-day test-retest intra-correlation coefficients were also acceptable (0.71≤r≤0.79), with the exception of the contamination subscale, which revealed a slightly low temporal stability (r=0.68).

DISCUSSION

This study assessed the factor structure and psychometric properties of the Turkish version of the Vancouver Obsessive Compulsive Inventory (VOCI) in clinical and non-clinical samples. Our findings support the reliability and validity of the Turkish version of the VOCI. The original six-factor structure was replicated. Internal consistency, test-retest validity, convergent and divergent validity were excellent. The diagnostic performance of the Turkish translation of the VOCI was comparable to that of the PI-R. The Turkish translation of the scale demonstrated sound psychometric properties.

Research conducted in various cultures has consistently found evidence for the validity of the six-factor original structure proposed by Thordarson et al.[16] in the initial development study[15,22,23]. Although confirmatory factor analysis by Chiorri et al.[23] in a representative Italian community sample replicated the six-correlated-factor structure, it was shown by the authors that a more parsimonious second-order model demonstrated a statistically better fit to the data. Contrary to previous evidence for validity of the original six-factor structure, Gonner et al.[24] suggested that the original VOCI has structural deficits, particularly in the subscales of Obsessions, Indecisiveness, and Just Right. To solve the problem, the Indecisiveness and Just Right dimensions of the VOCI were suppressed and the remaining items were integrated with the 6 items of the Symmetry, Ordering, and Arranging Questionnaire. The 30-item revised and shortened version of the Vancouver Obsessional-Compulsive Inventory-Revised provides scores on five symptom clusters: Contamination, Checking,

Hoarding, Symmetry/Ordering, and Obsessions. However, our findings for the construct validity were in accord with the English, French and Spanish versions[15,16,22,23] in that the six-factor original structure of the scale was replicated for the Turkish version. Although either of the models specifying six first-order factors loaded on a general factor or 55 VOCI items loaded on a single factor had also revealed an adequate fit, the original factor structure in agreement with Thodarson et al. (2004) fitted the data better than the other two models. Model fitness indices were excellent for the six-factor original structure, indicative of high model fit for the current data, collected from clinical and non-clinical samples. Maximum likelihood standardized factor loadings were also high for all subscales.

In the literature, no data has been available about diagnostic performance and cut-off scores for either the VOCI or PI-R. We performed the ROC analysis in order to detect cut-off points for the total scores of the VOCI and PI-R. It is not specific for the VOCI and PI-R that there has been a dearth of research related to clinical cut-off scores and diagnostic performance of obsessive-compulsive assessment tools. To the best of our knowledge, the sole investigation of a PI-R cut-off point was the sensitivity to change of the scale by van Oppen et al.[41], where a cut-off point of 53 was reported using a reliable change index, a cut-off score indicative of reliable improvement of subjects after treatment. However, Anholt et al.[42] called attention to the fact that one third of the OCD patients were below the PI-R cut-off score of 53 at pre-treatment, in which a score below 53 was suggested to be indicative of recovery. In the current investigation, we performed ROC analyses to detect cut-off points for these screening tools and compared the areas under the curves computed for the scales to make an assessment of differences in diagnostic performances. The VOCI cut-off score of 87.5 revealed almost a diagnostic performance isomorphic to the PI-R with a cut-off score of 67.5 with the same sensitivity and specificity. In comparison to the previous cut-off point of 53 for recovery, the current value of the

PI-R is substantially higher. This may be because of cultural differences in help-seeking behaviors in OCD. Mean PI-R pre-treatment score of the OCD patients was 65.6 (SD=26.2) in the Anholt et al.[42] study and 71.4 (SD=22.1) in the study by van Oppen et al.[41]. The mean PI-R score of the current patient sample was 106.9 (SD=35), a greater mean score in comparison to these previous studies. It seems that Turkish patients with OCD seek help when the symptom severity of the disorder rises to an unsustainable level. Cultural differences should be kept in mind when using our cut-off score in further studies.

When we compared the areas under the ROC curves, the difference between the VOCI and the PI-R was not significant. The sensitivity and specificity of these two OCD screening tools were the same as well. These pilot findings revealed that the VOCI and PI-R have a similar diagnostic performance. However, the PI-R has a lower number of items, which may result in it being more readily used in application. Additionally, both sensitivity and specificity of these tools were moderate, and it appears that more advanced screening tools with higher sensitivity and specificity are needed.

Item reliability of the VOCI subscales was excellent. Moreover, item inter-correlations for the subscales were average to strong. These results were consistent with the previous findings concerning the psychometric properties of obsessive compulsive measures in Italian and Australian samples[23,43]. Reliability of the subscales in terms of internal consistency ranged from 0.84 to 0.90 among students and from 0.73 to 0.88 among OCD outpatients. Internal reliability of the Turkish translation was comparable to the English, French, Spanish and Italian versions of the VOCI. Test-retest reliability of the Turkish version was higher than those of the student sample in Thordarson et al.[16] and comparable with psychometric properties of Spanish, French and English versions studied by Arjona et al.[22] and Radomsky et al.[15]. In short, the Turkish version of the VOCI demonstrated high reliability.

The VOCI total and subscale scores consistently correlated with the PI-R total and subscale scores as well as the OBQ-44 subscales. As the correlations of the VOCI subscales with the PI-R subscales and OBQ subscales were consistently strong, the convergent validity of the Turkish version of the VOCI was excellent. These results were in line with previous studies, considering the relations between the instrument and PI in Italian, Spanish, Canadian and American samples[15,16,22,23]. Divergent validity of the scale was also demonstrated by computing mediocre to weak correlations between the VOCI sub-scales and the Beck Depression Inventory. The findings provided further support for the divergent and convergent validity of the VOCI in the Turkish sample.

In the original validation study, Thordarson et al.[16] reported insufficient concurrent validity for the Indecisiveness subscale because scores of OCD patients were not higher than those of controls. In the initial validation study it was claimed that indecisiveness was not closely associated with any major subtypes of OCD, which may account for this finding. Gonner et al.[24], in their revision study of the VOCI, suggested that the instrument has structural deficits, especially concerning the Obsession, Indecisiveness and Just Right subscales. It was proposed that Indecisiveness and Just Right components of the instrument do not take part in the concept of obsessions and compulsions defined in factor analytic studies[44,45]. These two scales of the instrument were suppressed, and items measuring symmetry and ordering were added in the revision study. On the contrary, in the current study, these two subscales satisfied in discriminating OCD outpatients from normal healthy controls. However, for the hoarding subscale, OCD participants did not score significantly higher than control subjects did. Our results seem to be more compatible with the literature. Research has provided strong evidence for the observation that compulsive hoarding appears to be a syndrome distinct from OCD[46-48]. Moreover, the DSM-5 incorporated hoarding disorder as a distinct nosological entity apart

from pure obsessive-compulsive disorder into the spectrum of obsessive-compulsive related disorders[4]. In further revisions of the VOCI, the hoarding subscale may be removed from the instrument or this subscale may be used separately from other subscales in the assessment of OCD. On the other hand, psychometric properties of the 30-item VOCI-R proposed by Gonner et al.[24] should be investigated in comparison to the 55-item VOCI in Turkish sample.

This study has several limitations. First, although we collected data from a relatively large non-clinical student sample, the sample size for the clinical group was relatively small. In addition, we did not include patients who had other disorders, particularly major depression. Second, comorbid conditions concomitant to OCD were not assessed in patients with OCD. Third, our study was not longitudinal and we did not assess the sensitivity of the VOCI to treatment. We evaluated test-retest reliability of the scale only among controls. However, in this study, we found that the Turkish version of the VOCI had quite sound psychometric properties with good reliability and validity.

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