

## Further Psychometric Examination of the Tourette's Disorder Scales

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**Abstract** The Tourette's Disorder Scales (Shytle et al., 2003) are parent- (Tourette's Disorder Scales–Parent Rated; TODS–PR) and clinician-rated (Tourette's Disorder Scales–Clinician Rated; TODS–CR) measures that assess tics, obsessions, compulsions, inattention, hyperactivity, aggression, and emotional disturbances among children with tics. Although the TODS–PR/CR are being increasingly used in clinical trials, relatively little psychometric data have been reported. Subjects were 44 children and adolescents recruited in a university tic specialty clinic. Families were administered the TODS–CR and Yale Global Tic Severity Scale. Completion of the TODS–PR and Child Behavior Checklist were counterbalanced. Results indicated adequate to excellent internal consistency for the TODS–PR/CR scores. Excellent inter-rater agreement and convergent and divergent validity was found. These results provide further psychometric support for the TODS–PR and TODS–CR.

**Keywords** Tourette's Disorder Scale · Tourette's Disorder · Tics · Children · Reliability · Validity

Gilles de la Tourette syndrome (TS) is a childhood–onset disorder characterized by motor and vocal tics that persist for greater than 12 months. Once considered rare, recent childhood epidemiological studies have suggested that the prevalence rates

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Given that the primary distinction between Tourette's syndrome and other tic disorders is the duration of diagnosis, all chronic tic disorders are hereafter referred to generically as 'tic disorders.'

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for TS and tics are approximately 1% and 10%, respectively. [1] Comorbid behavioral and emotional problems are often present in children with tic disorders, with the most common comorbidities including attention-deficit/hyperactivity disorder [2–3] obsessive-compulsive disorder [4–5], disruptive behavior [3, 6–7], and depressive and anxiety disorders. [2, 8–10] Although many youth with tic disorders experience distress and/or impairment related to tics, families often report that the comorbid disturbances are most disturbing and impairing, and the primary motivator for seeking treatment. [11]

The prevalence and severity of tics have resulted in increased attention from researchers and clinicians alike in the realms of treatment. Yet, until recently, assessment efforts have lagged behind, particularly with regards to assessing the full constellation of symptoms (e.g., tics, externalizing behaviors, and internalizing symptoms) that are often present in youth with tic disorders. The Yale Global Tic Severity Scale (YGTSS) [12] is considered the ‘gold standard’ index for tic severity. Other established measures of tic severity include the Tourette Syndrome Severity Scale [13], Tourette Syndrome Global Scale [14], and structured videotape protocols used to count tics. [13, 15] Although psychometrically sound in tic severity assessment, these measures do not assess other clinically-significant symptoms (e.g., ADHD, OCD, disruptive behavior), which are often found in youth with tic disorders and frequently represent the primary reason for seeking treatment. Relying solely on measures of tic severity may yield an incomplete understanding of the clinical presentation and/or prognosis for treatment response.

Given this, Shytle et al. [16] developed the Tourette’s Disorder Scales (TODS) as a measure of clinically significant symptoms that are frequently comorbid with tic disorders. The TODS has two parallel 15-item measures that are completed by the clinician (Tourette’s Disorder Scales–Clinician Rated; TODS–CR) and the parent (Tourette’s Disorder Scales–Parent–Rated; TODS–PR). Each measure has identical items, which assess tics, obsessions, compulsions, inattention, hyperactivity, aggression, and emotional disturbances on a 10-point scale. Two psychometric studies have been published on the TODS thus far—one on both the TODS–CR and TODS–PR [16], and one on the TODS–PR only. [17] A four-factor model has been identified with factors named Aggression, Attention Deficit Hyperactivity Disorder (ADHD), Obsessive–Compulsive Disorder (OCD), and Tics. [16, 17] The TODS Total Score has demonstrated excellent internal consistency ( $\alpha = 0.92$  for the TODS–PR,  $\alpha = 0.93$  for the TODS–CR) and sensitivity to treatment changes. [16, 18] Interrater reliability of the TODS–CR has ranged from 0.70 to 0.94 across items. In addition, research has shown that the TODS–PR and TODS–CR Total Scores are strongly related ( $r = 0.88$ ), although interfactor correlations were not reported. [16] Finally, good convergent validity data has been found with significant positive relations between the TODS–PR/CR Total Scores and the YGTSS ( $r_s = 0.47$  and  $0.49$ ), the Sheenan Disability Scale ( $r_s = 0.65$  and  $0.62$ ), the Connor’s Parent Report Form Impulsivity Scale ( $r_s = 0.89$  and  $0.61$ ), the Connor’s Parent Report Form Hyperactivity Scale ( $r_s = 0.65$  and  $0.65$ ), and the Child/Adolescent Symptom Inventory Depression Scale ( $r_s = 0.55$  and  $0.59$ ). [16] Further convergent validity has been shown as individual items correlated positively and strongly with similar constructs. For example, the TODS items associated with ADHD were strongly correlated with similar symptom factors on the Connor’s Parent Report Scale (CPRS). Support for divergent validity was found as the TODS–PR/CR Total Scores did not significantly relate to the psychosomatic and learning subscales of the CPRS.

Although these data are encouraging, a number of important psychometric questions have yet to be addressed; namely, what are the inter-factor correlations among the TODS–PR/CR and do TODS–PR/CR factor scores correlate with corresponding subscales on the Child Behavior Checklist? Despite use of the TODS in clinical trials [18], only one report on the psychometrics of the TODS–CR and two reports on the TODS–PR have been published. The TODS holds promise as a thorough and efficiently administered measure to assess a constellation of symptoms seen in youth with tics. Use of the TODS in addition to more traditional tic frequency/severity measures will provide details about important areas of functioning in children with tic disorders. Thus, further evaluation of the psychometric properties of the TODS is warranted.

The current study examined the psychometric properties of the TODS–PR and TODS–CR. The following questions were addressed: (1) What are the internal consistencies of the TODS–PR and TODS–CR scores? (2) What is the parent–clinician agreement for the TODS scores? and (3) Do TODS–PR and TODS–CR scores demonstrate significant positive correlations with corresponding subscales on the Child Behavior Checklist (CBCL) [19] and Yale Global Tic Severity Scale [12], while not correlating significantly with subscales assessing divergent constructs? Specifically, we hypothesize that the TODS Total score should correlate with the CBCL total; the TODS Tic scale should correlate with all YGTSS subscales; the TODS ADHD scale should correlate with the CBCL Attention problems, Social problems, and Aggressive subscales; the TODS Aggression scale should correlate with the CBCL Aggressive subscale; and the TODS OCD scale should correlate with the CBCL Thought problems and Anxiety/Depression scale.

## Method

### Participants and Procedures

The sample consisted of 44 children and adolescents (68.2% male) who attended an outpatient psychiatry clinic for pharmacological and/or psychotherapeutic management of their tic disorder. All participants met DSM-IV-R criteria for a chronic tic disorder (84.1% ( $n = 37$ ) had a primary diagnosis of Tourette's Syndrome or Chronic Tic Disorder; 15.9% ( $n = 7$ ) had a primary diagnosis of OCD with a secondary diagnosis of Tourette's Syndrome or Chronic Tic Disorder). Other comorbid diagnoses included ADHD ( $n = 26$ ), Oppositional Defiant Disorder (ODD,  $n = 6$ ), Generalized Anxiety Disorder (GAD,  $n = 6$ ), Major Depressive Disorder ( $n = 4$ ), Social Phobia ( $n = 2$ ), Asperger's Syndrome ( $n = 2$ ), Anxiety Disorder NOS ( $n = 1$ ), Panic Disorder with Agoraphobia ( $n = 1$ ), and Psychotic Disorder NOS ( $n = 1$ ) Tic (and comorbid) diagnoses were derived using [19] best estimate procedures, which included an unstructured clinical interview by the attending psychiatrist (who has over 10 years of clinical experience in working with children with tics), the YGTSS, and behavioral observations. Data since the time of onset was not systematically collected. Participants ranged in age from 8 to 17 years old ( $M = 11.6$ ,  $SD = 2.45$ ) with an ethnic distribution as follows: 95.5% Caucasian and 4.5% Hispanic American. Thirty-one mothers, 11 fathers, and two "other" caregivers participated.

The University of Florida Institutional Review Board approved all study procedures. Masters or doctoral level clinical psychology research assistants (RAs) administered the TODS–CR and YGTSS to participants. All RAs had extensive clinical experience working with children with tics and were trained in measurement administration by the first author of this study. Training included an instructional meeting, four mock–practice interviews, and four interviews observed by the first or final author. Clinician-rated indices were administered to parent(s) and children jointly, with the final ratings based on the responses, clinician judgment, and behavioral observation of the child. After obtaining appropriate written consent and assent, the nature of motor and phonic tics was defined for families. Instructions were given on completing the TODS–PR and CBCL. For approximately half of the participants, parents independently completed the TODS–PR and CBCL after administration of the TODS–CR and YGTSS. For the other half, the TODS–PR and CBCL were completed prior to the clinician-rated instruments. Families were compensated \$5 for their participation. Our consent rate was 88% (44/50).

## Measures

### *Tourette's Disorder Scales*

The TODS–PR and TODS–CR [16] are 15-item parent—or clinician—rated scales that assess a range of symptoms commonly found in youth with tics (e.g., “Motor tics” and “Difficulty paying attention”) over the past week. Items are rated on a Likert-type scale ranging from 0—“Not at all” to 10—“Extremely” (see Table 1). Psychometric properties are reviewed in detail above. For this study, the four-factor subscales (i.e., Tics, OCD, ADHD, and Aggression subscales) identified by Storch et al. [17] were utilized for analyses. The TODS total score reflects a quick measure of global distress across dimensions most commonly seen in children with tic disorders.

### *Yale Global Tic Severity Scale*

The YGTSS [12] is a clinician-rated semi-structured interview designed to measure tic severity over the previous week. Items assess the number, frequency, intensity,

**Table 1** Items on each subscale of the TODS

Subscale	Subscale
ADHD	OCD
Difficulty paying attention	Obsessions
Loud or talkative	Compulsions
Restless or hyper	Tense, anxious, nervous
Impulsive	Depressed or uninterested in things
Tics	Aggression
Motor tics	Irritable or grouchy
Vocal tics	Argumentative
	Sudden mood changes
	Demands attention
	Hot temper

complexity, and interference of motor and phonic tics. A global impairment rating (0–50) is made based on the degree of impairment and distress associated with tics. The YGTSS also yields a Motor and a Vocal Severity score (0–50), and a Total Severity Score (0–100), which is created by combining the Motor + Vocal Severity and Impairment Scales. Psychometric properties of the YGTSS are positive. Good interrater agreement (intra-class correlation coefficients [ICC] for index scores ranging from .62 to 0.85) [12] and 7 week stability (ICCs for index scores ranging from 0.77 to .90) [20] were found for the YGTSS scores. Convergent validity was supported as YGTSS scores were moderately to strongly related to TSGS scores ( $r_s$  ranging from 0.86 to 0.90), TSSS scores ( $r_s$  ranging from 0.54 to 0.76), the TODS-PR tic factor ( $r_s$  ranging from 0.58 to 0.68), and clinician-ratings of TS impairment ( $r_s$  ranging from 0.65 to 0.82). [12] Discriminant validity was demonstrated by weak to moderate relations with clinician-ratings of ADHD impairment ( $r_s$  ranging from 0.03 to 0.18) and OCD ( $r_s$  ranging from 0.30 to 0.39), child-rated anxiety ( $r_s$  ranging from 0.06 to 0.28) and depression ( $r_s$  ranging from 0.02 to 0.26), and parent-rated aggression ( $r_s$  ranging from 0.03 to 0.17) and ADHD ( $r_s$  ranging from .01 to 0.17). [12]

### *Child Behavior Checklist*

The CBCL [21] is a widely used 118-item parent-report measure of childhood internalizing and externalizing symptoms. Items are rated on a 0–2 scale, with 0 = “Not True (as far as you know),” 1 = “Somewhat or Sometimes True,” and 2 = “Very True or Often True” within the past 6 months. The CBCL consists of eight syndrome scales (withdrawn, somatic complaints, anxious/depressed, social problems, thought problems, attention problems, delinquent behavior, and aggressive behavior) and two composite scales (externalizing and internalizing problems). Overall, the CBCL has excellent psychometric properties including 1 week test-retest reliability, adequate internal consistency ( $\alpha = .62-.92$ ), and construct validity (e.g., strong associations with subscales of other measures that assess similar constructs). The internal consistency of the total score for the current sample was  $\alpha = .94$ .

## **Results**

### Internal Consistency Analyses

Cronbach’s alpha coefficients were computed for the TODS-PR and TODS-CR subscales and Total Scores. For the current sample, the overall internal consistency of the TODS-PR was excellent ( $\alpha = 0.92$ ). Factor alphas ranged from adequate to excellent (Tic factor  $\alpha = 0.70$ ; OCD factor  $\alpha = 0.85$ ; ADHD factor  $\alpha = 0.81$ ; and Aggression factor  $\alpha = 0.93$ ). Similarly, the internal consistency of the TODS-CR Total Score was excellent ( $\alpha = .91$ ). Factor alphas ranged from adequate to excellent (Tic factor  $\alpha = 0.66$ ; OCD factor  $\alpha = 0.85$ ; ADHD factor  $\alpha = 0.81$ ; and Aggression factor  $\alpha = 0.92$ ). Given that the tic factor is comprised of only two items (see Table 1), reliabilities of greater than .50 are considered acceptable.

## Parent-Clinician Agreement Analyses

In order to evaluate parent–clinician agreement, Pearson product-moment correlations were computed among TODS–PR/CR scores (see Table 2). Due to the large number of correlations being computed, the significance level was set at  $p < 0.01$  to control for Type I error. Parent and clinician ratings were very strongly correlated for each factor, as well as the Total Score. However, clinicians generally rated the symptoms as more bothersome to the patient than did parents. Paired-samples  $t$ -tests were conducted to examine the significance of differences reported among parents and clinicians. As seen in Table 2, clinician ratings of symptom-related distress were significantly higher than parent ratings for the Tic factor, the ADHD factor, and the TODS Total Score.

## Convergent and Divergent Validity Analyses

Pearson product-moment correlations were computed among the TODS scores and the YGTSS and CBCL subscales (see Table 3). Due to the large number of correlations being computed, the significance level was set at  $p < 0.01$  to control for Type I error. Age and gender were not significantly related to outcomes; thus, results are reported for the entire sample.

When examining the relations among the YGTSS and the parent-rated TODS-PR factors, as expected, only the Tic factor was strongly related to the YGTSS Motor Tic subscale ( $r = 0.57$ ,  $p < 0.001$ ), Phonic Tic subscale ( $r = 0.81$ ,  $p < 0.001$ ), Impairment scale ( $r = 0.73$ ,  $p < 0.001$ ) and Total score ( $r = 0.79$ ,  $p < 0.001$ ). TODS-PR scales assessing OCD, ADHD, and Aggression were not significantly related to the YGTSS subscales. Results were similar when examining relations among the YGTSS and the clinician-rated TODS–CR factors. As expected, the TODS–CR Tic scale was strongly correlated with each of the YGTSS subscales, including Motor Tics ( $r = 0.60$ ,  $p < 0.001$ ), Phonic Tics ( $r = 0.82$ ,  $p < 0.001$ ), Impairment ( $r = 0.71$ ,  $p < 0.001$ ), and Total score ( $r = 0.79$ ,  $p < 0.001$ ). However, the TODS–CR OCD factor also demonstrated moderate correlations with the YGTSS Phonic Tic subscale ( $r = 0.40$ ,  $p < 0.01$ ), Impairment subscale ( $r = 0.49$ ,  $p < 0.01$ ), and Total score ( $r = 0.45$ ,  $p < 0.01$ ).

Correlations among the TODS and the Child Behavior Checklist (CBCL) also followed expected patterns. The TODS–PR Total Score was significantly related to

**Table 2** Parent–clinician agreement for TODS

Scale	Mean	Correlation ( $r$ )	$t$ -value
TODS-PR Total Score	47.47	0.87 <sup>b</sup>	-2.34
TODS-CR Total Score	53.30		
TODS-PR Tic Factor	7.39	0.94 <sup>b</sup>	-2.98 <sup>a</sup>
TODS-CR Tic Factor	8.34		
TODS-PR OCD Factor	11.00	0.85 <sup>b</sup>	-1.70
TODS-CR OCD Factor	12.39		
TODS-PR ADHD Factor	13.42	0.76 <sup>b</sup>	-2.28
TODS-CR ADHD Factor	15.93		
TODS-PR Aggression Factor	15.66	0.89 <sup>b</sup>	-1.04
TODS-CR Aggression Factor	16.63		

<sup>a</sup>  $p < .01$ ; <sup>b</sup>  $p < .001$

**Table 3** Correlations among the TODS and the CBCL

	CBCL Withdrawn	CBCL Somatic	CBCL Anx/Depress	CBCL Soc. Problems	CBCL Thought Probs	CBCL Attention	CBCL Delinquent	CBCL Aggressive
TODS-PR Tic	0.03	0.08	0.13	0.25	0.27	0.17	0.24	0.09
TODS-PR OCD	0.46 <sup>b</sup>	0.20	0.54 <sup>c</sup>	0.42 <sup>b</sup>	0.49 <sup>b</sup>	0.40 <sup>b</sup>	0.30	0.42 <sup>b</sup>
TODS-PR ADHD	0.35	0.15	0.33	0.56 <sup>c</sup>	0.38	0.66 <sup>c</sup>	0.34	0.69 <sup>c</sup>
TODS-PRv Aggression	0.53 <sup>c</sup>	0.24	0.56 <sup>c</sup>	0.33	0.29	0.55 <sup>c</sup>	0.36	0.78 <sup>c</sup>
TODS-CR Tic	0.02	0.07	0.05	0.20	0.21	0.09	0.17	0.04
TODS-CR OCD	0.40 <sup>b</sup>	.08	0.45 <sup>b</sup>	0.50 <sup>b</sup>	0.47 <sup>b</sup>	0.43 <sup>b</sup>	0.38	0.28
TODS-CR ADHD	0.25	0.04	0.22	0.48 <sup>b</sup>	0.35	0.52 <sup>c</sup>	0.23	0.45 <sup>b</sup>
TODS-CR Aggression	0.53 <sup>c</sup>	0.21	0.58 <sup>c</sup>	0.39 <sup>b</sup>	0.30	0.47 <sup>b</sup>	0.42 <sup>b</sup>	0.60 <sup>c</sup>

<sup>b</sup>  $p < .01$ ; <sup>c</sup>  $p < .001$

the CBCL Total Problems score ( $r = 0.67, p < 0.001$ ). The TODS–PR Tic factor was not significantly related to any CBCL subscales. However, the TODS–PR OCD factor was correlated with the following CBCL subscales: Anxious/Depressed ( $r = 0.54, p < 0.001$ ), Withdrawn ( $r = 0.46, p < 0.01$ ), Social Problems ( $r = 0.42, p < 0.01$ ), Thought Problems ( $r = 0.49, p < 0.01$ ), Attention Problems ( $r = 0.40, p < 0.01$ ), and Aggressive ( $r = 0.42, p < 0.01$ ). The TODS–PR ADHD factor also correlated with theoretically-related CBCL subscales. For example, it correlated strongly with the CBCL Attention Problems subscale ( $r = 0.66, p < 0.001$ ), Aggressive subscale ( $r = 0.69, p < 0.001$ ), and Social Problems subscale ( $r = 0.56, p < 0.001$ ), but was not related to the others (i.e., Withdrawn, Somatic, Anxious/Depressed, Thought Problems, or Delinquent Behavior). Finally, the TODS–PR Aggression factor was strongly related to the CBCL Aggressive subscale ( $r = 0.78, p < 0.001$ ), and showed moderate correlations with the Withdrawn subscale ( $r = 0.53, p < 0.001$ ), Anxious/Depressed subscale ( $r = 0.56, p < 0.001$ ), and Attention Problems subscale ( $r = .55, p < .001$ ).

Correlations among the TODS–CR and the CBCL showed very similar patterns. Again, the TODS–CR Total Score was significantly correlated with the CBCL Total Problems score ( $r = 0.54, p < 0.001$ ). The TODS–CR Tic factor was unrelated to CBCL scores. The TODS–CR OCD factor was moderately correlated with the CBCL Anxious/Depressed subscale ( $r = 0.45, p < 0.01$ ), Withdrawn subscale ( $r = 0.40, p < 0.01$ ), Social Problems subscale ( $r = 0.50, p < 0.01$ ), Thought Problems subscale ( $r = 0.47, p < 0.01$ ), and Attention Problems subscale ( $r = 0.43, p < 0.01$ ), but not to the CBCL Somatic, Aggressive, or Delinquent Behavior subscales. The TODS–CR ADHD factor showed significant correlations with the CBCL Attention Problems ( $r = 0.52, p < 0.001$ ), Social Problems ( $r = 0.48, p < 0.01$ ), and Aggressive subscales ( $r = 0.45, p < 0.01$ ). The TODS–CR Aggression factor was strongly related to the CBCL Aggressive subscale ( $r = 0.60, p < 0.001$ ), and also correlated with the following subscales: Withdrawn ( $r = 0.53, p < 0.001$ ), Anxious/Depressed ( $r = .58, p < .001$ ), Social Problems ( $r = 0.39, p < 0.01$ ), Attention Problems ( $r = 0.47, p < 0.01$ ), and Delinquent Behavior ( $r = 0.42, p < 0.01$ ).

## Discussion

This research examined the internal consistencies, parent-clinician agreement, and convergent and divergent validity of the TODS–PR and TODS–CR in a sample of youth with a chronic tic disorders. Given that the TODS is increasingly being used in clinical trials, further evaluation of its psychometric properties was warranted. Overall, results of the present study provide evidence that the TODS–PR and CR are psychometrically sound measures of symptoms commonly present in youth with tic disorders. Specifically, we found excellent internal consistency for the TODS–PR/CR Total Scores, with individual factors demonstrating adequate to excellent internal consistency. These results are similar to those found in previous research on the TODS–PR. [17]

Parent and clinician ratings were highly correlated for the TODS factors, and Total Scores. However, for the Tic factor, ADHD factor, and Total Score, clinicians rated the symptoms as being more distressing for the children than parents did. There are several possible explanations for these differences. First, parents may have

perceived symptoms as less distressing since entering treatment and thus provided lower ratings. Second, clinicians base their ratings on input from the parent, child, and behavioral observations; therefore, clinician ratings may be more sensitive to the distress of the child. Future research should continue to investigate the subtle differences in the relationship between the TODS–PR and TODS–CR.

The convergent and divergent validity of the TODS was examined by looking at the relationship between TODS scores, and the CBCL and YGTSS. As expected, the TODS–PR and TODS–CR Tic factors were significantly and positively related to YGTSS scores. Additionally, the other factors were not related to scores on the YGTSS, which suggests that the TODS has adequate divergent validity. The TODS–CR OCD factor was related to the YGTSS Phonic Tic, Impairment, and Total scores. Given the high comorbidity between OCD and tic disorders [4], this is not surprising. However, it is also possible that complex tics and compulsions have similar presentations and may both be endorsed because of difficulty distinguishing between the two. The TODS Aggression and ADHD factors also related to theoretically similar CBCL subscales and unrelated to theoretically dissimilar subscales providing further validity support. For example, items on the ADHD scale were significantly related to the social problems, attention problems, and aggression subscales of the CBCL.

A few limitations should be noted. First, the majority of participants were Caucasian and seeking treatment for tics or related behaviors, which limits the generalizability of study findings. Second, diagnoses were made without use of a structured diagnostic instrument and some information was not ascertained (e.g., time since diagnosis). Although many believe that best estimate procedures are more flexible and accurate methods of providing diagnoses, we acknowledge that some subjectivity may have influenced diagnoses. Finally, given the variability of tic symptoms, the sample size used in this study was relatively small. This study adds to the literature by examining the psychometric properties of the TODS–PR/CR in a sample of children with chronic tic disorders. The TODS was found to have adequate psychometric properties including good internal consistency, parent–clinician agreement, and convergent and divergent validity. The conciseness, ease of use, and good psychometric properties of the TODS make it a good measure for use in clinical work and research with children who have tics and may have utility for treatment planning and monitoring improvement.

## Summary

This study examined the psychometric properties of the TODS–PR/CR. Although they are increasingly being used, relatively little psychometric data have been reported. Overall, adequate to excellent internal consistency for the TODS–PR/CR scores was found. Child and parents reports correlated strongly and positively. Convergent and divergent validity of the TODS–PR/CR was supported vis-à-vis correlations in the expected directions with the YGTSS and CBCL subscales. These results provide further psychometric support for the TODS–PR and TODS–CR.

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