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Reliability and Validity of the Yale Global Tic Severity Scale

Eric A. Storch, Tanya K. Murphy, Gary R. Geffken, Muhammad Sajid, and Pam Allen
University of Florida

Jonathan W. Roberti
New College of Florida

Wayne K. Goodman
University of Florida

To investigate the reliability and validity of the Yale Global Tic Severity Scale (YGTSS), 28 youth aged 6 to 17 years with Tourette's syndrome (TS) participated in the study. Data included clinician reports of tics and obsessive–compulsive disorder (OCD) severity, parent reports of tics, internalizing and externalizing problems, and child reports of depression and anxiety. All children participated in a 2nd YGTSS administration by the same rater 48 days later. Good internal consistency and stability were found for the YGTSS scores. YGTSS scores demonstrated strong correlations with parent-rated tic severity (r = .58–.68). YGTSS scores were not significantly related to measures of clinician ratings of OCD severity (r = .01–.15), parent ratings of externalizing and internalizing behavior (r = −.07–.20), and child ratings of depression (r = .02–.26) and anxiety (r = −.06–.28). Findings suggest that the YGTSS is a reliable and valid instrument for the assessment of pediatric TS.

Keywords: Tourette's syndrome, Yale Global Tic Severity Scale, clinician-rated, validity, reliability

Gilles de la Tourette syndrome, or Tourette's syndrome (TS), is characterized by involuntary motor and vocal tics that last over 1 year and begin in childhood or early adolescence (American Psychiatric Association, 2000; Leckman & Cohen, 1999; World Health Organization, 2000). Motor tics are repetitive, automatic, and rapid movements of a complex or simple nature that affect multiple muscle groups. Vocal tics are varied and include sniffing, throat clearing, grunting, and repeating words or phrases. Childhood TS runs a waxing and waning course and is often comorbid with other psychiatric conditions, including attention-deficit/hyperactivity disorder (ADHD; Comings, 1994; Robertson, Banerjee, Eapen, & Fox-Hiley, 2002; Sukhodolsky et al., 2003), obsessive–compulsive disorder (OCD; Hebebrand et al., 1997; Pauls, Towbin, Leckman, Zahner, & Cohen, 1986; Robertson, 2003), disruptive behavior (Budman, Bruun, Park, Lesser, & Olson, 2000; Riddle, Hardin, Ort, Leckman, & Cohen, 1988; Sukhodolsky et al., 2003), and depressive and anxiety disorders (Carter et al., 2000; Coffey, Biederman, Smoller, et al., 2000; Coffey & Park, 1997; Robertson et al., 2002).

Eric A. Storch, Department of Pediatrics, University of Florida, and Department of Psychiatry, University of Florida; Tanya K. Murphy, Gary R. Geffken, Muhammad Sajid, Pam Allen, and Wayne K. Goodman, Department of Psychiatry, University of Florida; Jonathan W. Roberti, Department of Psychology, New College of Florida.

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Correspondence concerning this article (and requests for an extended report of this study) should be addressed to Eric A. Storch, Department of Psychiatry, University of Florida, Box 100234, Gainesville, FL 32610. E-mail: estorch@psychiatry.ufl.edu

Although clinicians and researchers have uniformly recognized the importance of assessing tic severity among youth, it has been measured differently across instruments. The Tourette Syndrome Severity Scale (TSSS; Shapiro & Shapiro, 1984) contains five ordinal scales with differing ranges and item weights that focus on TS-related social impairment. The Tourette Syndrome Global Scale (TSGS; Harcherik, Leckman, Detlor, & Cohen, 1984) assesses the frequency and disruption of simple and complex tics, as well as common comorbid problems (e.g., behavioral problems, functional impairment). Finally, short, structured videotape protocols have been used to count tics (Shapiro & Shapiro, 1984; Tanner, Goetz, & Klawans, 1982). Although these instruments represent important advancements in pediatric TS assessment, numerous concerns about their use have been raised, including issues with scoring structures, practicality and efficiency, and limited psychometric support (Leckman et al., 1989).

To address these limitations, Leckman and colleagues (1989) developed the Yale Global Tic Severity Scale (YGTSS). The YGTSS is a semistructured clinician-rated instrument that assesses the nature of motor and phonic tics over the previous week. The clinician initially notes the presence of motor and phonic tics based on child and parent(s) reports and behavioral observations. Following this, the clinician rates the severity of motor and phonic tics on five separate dimensions each: number, frequency, intensity, complexity, and interference. The YGTSS also includes a separate impairment rating focusing on distress and impairment experienced in interpersonal, academic, and occupational realms. Five index scores are obtained: Total Motor Tic Score, Total Phonic Tic Score, Total Tic Score, Overall Impairment Rating, and Global Severity Score. The Total Motor Tic Score is derived by adding the five items pertaining to motor tics (range = 0–25); the Total Phonic Tic Score is derived by adding the five items pertaining to phonic tics (range = 0–25); the Total Tic Score is derived by

adding the Total Motor Tic Score and the Total Phonic Tic Score; and the Overall Impairment Rating is rated on a 50-point scale anchored by 0 (*no impairment*) and 50 (*severe impairment*). A Global Severity Score is derived by summing the Total Motor Tic Score, Total Phonic Tic Score, and Overall Impairment Rating (range = 0–100).

Despite being widely used, only one psychometric investigation has been published on the YGTSS (Leckman et al., 1989). This sample included 105 children and adults (age range = 5–51 years) with a tic disorder. Good interrater agreement among three raters was found for the YGTSS scores in a sample of 20 children and adolescents with TS (with intraclass correlation coefficients [ICCs] for index scores ranging from .62 to .85). Walkup, Rosenberg, Brown, and Singer (1992) corroborated this finding in a second sample of 20 children and adolescents (the average Spearman rank coefficient among three raters for YGTSS Global Severity Score was .93). Convergent validity was supported as YGTSS scores were strongly related to corresponding TSGS scores (Pearson product–moment correlations ranged from .86 to .90). In addition, YGTSS scores were moderately to strongly related to clinician ratings of TS impairment (Pearson correlations ranged from .65 to .82) and moderately to strongly related to the TSSS (Pearson correlations ranged from .54 to .76). Discriminant validity was demonstrated by weak to moderate relations with clinician ratings of impairment due to ADHD (Pearson correlations ranged from −.03 to .18) and OCD (Pearson correlations ranged from .30 to .39). Finally, studies have demonstrated that the YGTSS is sensitive to treatment effects (Gaffney et al., 2002; Gilbert, Batterson, Sethuraman, & Sallee, 2004; Gilbert et al., 2003; Gilbert, Sethuraman, Sine, Peters, & Sallee, 2000; Mueller-Vahl et al., 2003; Scahill, Leckman, Schultz, Katsovich, & Peterson, 2003).

Although encouraging, the following important psychometric questions have not been examined: What is the stability and internal consistency of YGTSS scores, and how does the YGTSS relate to parent-rated TS symptoms and measures of anxiety and depression? That the stability has not been reported is notable in light of recent data suggesting that scores on the second administration of clinician-rated instruments are often lower than on the first administration (Arrindell, 2001; Jensen, Roper, Fisher, & Piacentini, 1995). The implications of this finding are significant and may suggest that observed treatment effects are actually due to the retest effect rather than the impact of the treatment. Given this, it is important to document potential temporal fluctuations in YGTSS scores. In light of the high comorbidity with internalizing and externalizing disorders, along with the frequency with which child measures do not differentiate between disorders (Schniering, Hudson, & Rapee, 2000), it is also important to examine the extent to which the YGTSS taps unique constructs.

This research examined the psychometric properties of the YGTSS. The following questions were addressed: (a) What are the internal consistency and interscale correlations of the YGTSS? (b) What is the stability of the YGTSS over a period of approximately 7 weeks? And (c) does the YGTSS correlate strongly with a measure of TS symptomatology, and weakly with measures of externalizing behaviors, OCD, anxiety, and depressive symptomatology?

Method

Participants

A total of 28 (14 female and 14 male) children diagnosed with TS according to *DSM–IV–TR* (American Psychiatric Association, 2000) participated in this research. Participants were referred from area physicians and the University of Florida child psychiatry clinic. Diagnoses were derived from the Schedule for Affective Disorders and Schizophrenia for School-Age Children—Lifetime and Present versions (K-SADS–PL; Kaufman et al., 1997) and confirmed by Tanya K. Murphy, who was a board certified child psychiatrist with 10 years of experience. The sample was composed primarily of White participants (94.5%), followed by Latino American (4.5%). At the initial assessment, the children ranged in age from 6 to 17 years with a mean age of 10.47 years (*SD* = 2.51 years). Participants generally came from middle to higher socioeconomic status families (mean income = $116,607), although there was fair variation (*SD* = $81,996, range = $20,000–$340,000). All of these children were being treated pharmacologically at study onset with the most common medications including selective serotonin reuptake inhibitors, clonidine, guanfacine neuroleptics, and stimulants. Secondary diagnoses, when present, included ADHD (n = 6), OCD (n = 14), major depression (n = 2), generalized anxiety disorder (GAD; n = 1), oppositional defiant disorder (ODD; n = 3), and social phobia (n = 1). Tertiary diagnoses, when present, included ADHD (n = 4), GAD (n = 3), ODD (n = 1), and conduct disorder (n = 1).

Measures

YGTSS. The characteristics and psychometric properties of this measure were previously discussed.

Children's Yale–Brown Obsessive Compulsive Scale (CY-BOCS; Scahill et al., 1997). The CY-BOCS is a 10-item semistructured clinician-administered measure of obsession and compulsion severity. Items are rated over the previous week on a 5-point Likert-type scale ranging from 0 to 4, with higher scores corresponding to greater symptom severity. Items about obsessions and compulsions are summed to derive the Obsession and Compulsion Severity Scales, respectively. The Obsession and Compulsion Severity Scales are summed to derive the Total Severity Score. Only the Total Severity Score was used in this study. The CY-BOCS has exhibited good internal consistency (α = .90), test–retest reliability over 6 weeks (Total Score ICC = .79), and convergent and discriminant validity (Scahill et al., 1997; Storch et al., 2004b). Cronbach's alpha for the Total Severity Score in this sample was .94.

Tourette's Disorder Scale—Parent Rated (TODS–PR; Shytle et al., 2003). The TODS–PR is a 15-item parent-rated scale designed to measure a broad range of symptoms common to Tourette's disorder including tics, obsessions, compulsions, inattention, hyperactivity, aggression, and mood disturbances. The TODS–PR has four factorially derived subscales: Aggression, ADHD, Obsessive–Compulsive Disorder/Anxiety, and Tics. Internal consistency of the TODS–PR Total Score and factors has been found to be adequate: TODS–PR Total Score (15 items; .91), Tics factor (2 items; .64), Aggression factor (5 items; .91), ADHD factor (4 items; .91), and OCD/Anxiety factor (4 items; .81). In addition, the TODS–PR has demonstrated good convergent and discriminant validity (Shytle et al., 2003; Storch et al., 2004a). Cronbach's alpha in this sample for the Tics, Aggression, ADHD, and OCD factors were .69, .90, .92, and .74, respectively.

Children's Depression Inventory (CDI; Kovacs, 1981). The CDI is a widely used 27-item self-report measure that yields a severity rating of depressive symptomatology across affective, cognitive, somatic, and behavioral domains. On each item, the child is instructed to choose one of three statements that best describes his or her feelings over the past 2 weeks. Good psychometric properties have been reported including adequate internal consistency and test–retest reliability (Smucker, Craighead,

Craighead, & Green, 1986) and construct validity (Kovacs, 1992; Saylor, Finch, Spirito, & Bennett, 1984). Cronbach's alpha in this sample was .86.

The Multidimensional Anxiety Scale for Children (MASC; March, Parker, Sullivan, Stallings, & Conners, 1997). The MASC is a 39-item self-report questionnaire that assesses symptoms of general, social, and separation anxiety in children and adolescents. Items are rated on a 4-point Likert-type scale (0 = *never true about me*, 1 = *rarely true about me*, 2 = *sometimes true about me*, 3 = *often true about me*), and a total score is computed by summing all items. The MASC has good internal consistency ($\alpha = .90$) and test–retest reliability over intervals of 3 weeks and 3 months ($r = .88$ and .87; March et al., 1997; March, Sullivan, & Parker, 1999). The convergent and discriminant validity of the measure was supported, as the MASC correlated moderately with the Revised Children's Manifest Anxiety Scale (Reynolds & Richmond, 2000) ($r = .63$) and was not significantly correlated with the CDI (Kovacs, 1992) ($r = .19$) or the Abbreviated Symptom Questionnaire (Goyette, Conners, & Ulrich, 1978) ($r = .07$). Cronbach's alpha in this sample was .90.

Procedure

Following permission from the University of Florida institutional review board, parental consent and child assent were obtained. After this, children and their parent(s) were taken to a private, secure office and administered the K-SADS-PL to establish *DSM–IV* diagnoses. A board-certified child psychiatrist (Tanya K. Murphy) confirmed diagnoses based on all available clinical information. Following administration of the K-SADS-PL, a different clinician administered the YGTSS and CY-BOCS to the parent(s) and child jointly. Procedures for the YGTSS interviewer training were described in Leckman et al. (1989); procedures for CY-BOCS training were described in Scahill et al. (1997). Clinicians were three licensed psychiatrists and one psychiatric nurse with extensive clinical experience working with pediatric TS. Training consisted of an instructional meeting about the YGTSS content and structure with Tanya K. Murphy.

Following administration of the structured interviews, children completed the MASC and CDI, and parents completed the TODS–PR. All measures were completed in a private room. To examine the stability of the YGTSS over 47.8 days (*SD* = 21.4; range = 27 to 104 days), a different clinician readministered the YGTSS using identical procedures. This time distribution was primarily due to scheduling difficulties.

Data Analysis

Cronbach's alpha (Cronbach, 1951) was computed to assess the internal consistency of the YGTSS scores at both the first and second administration. To assess test–retest reliability across the first and second YGTSS administrations, one-way random effects ICCs (Shrout & Fleiss, 1979) were used to allow for intersubject variability. ICC is a measure of agreement for dimensional measurements. Scores range between 0 and 1, with scores greater than .75 indicating excellent reliability (Nunnally & Bernstein, 1994). Pearson product–moment correlations were computed to examine the relationships among YGTSS scores and measures of TS symptomatology, externalizing behaviors, OCD, anxiety, and depressive symptomatology.

Results

Internal Consistency

Cronbach's alpha reliability coefficients were high for the Total Motor Tic Score ($\alpha = .92$ and .92), Total Phonic Tic Score ($\alpha = .93$ and .93), and Total Tic Score ($\alpha = .93$ and .94) at first and second administrations.

Interscale Correlations

At the first assessment, the Total Motor Tic Score was moderately correlated with the Total Phonic Tic Score and YGTSS Overall Impairment Rating. The first administration Total Phonic Tic Score and YGTSS Overall Impairment Rating were strongly correlated (see Table 1). Similar results were found among second administration scores.

Table 1
Descriptive Statistics and Intercorrelations Between the YGTSS Scores and Various Measures of Psychological Functioning

	1	2	3	4	5	6	7	8	9	10	11	12
1. YGTSS Motor Score	—	.61*	.88**	.56*	.74**	.58*	.17	−.01	.05	.07	.02	−.06
2. YGTSS Phonic Score		—	.92**	.91**	.95**	.63**	.03	.04	−.07	.01	.09	.27
3. YGTSS Total Tic Score			—	.84**	.95**	.68**	.10	.02	−.02	.04	.06	.13
4. YGTSS Impairment score				—	.96**	.61*	.20	.17	.13	.15	.26	.28
5. YGTSS Total Score					—	.67**	.16	.11	.07	.10	.18	.22
6. TODS-PR Tic						—	.50*	.66**	.30	.50*	.21	.26
7. TODS-PR Aggression							—	.77**	.72**	.75**	.65**	.19
8. TODS-PR ADHD								—	.57*	.66**	.41	.21
9. TODS-PR OCD									—	.81**	.77**	.38
10. CY-BOCS Total										—	.68**	.36
11. CDI Total											—	.63*
12. MASC Total												—
M	5.75	11.75	17.50	19.64	37.14	10.41	19.0	20.52	8.63	17.62	8.19	44.54
SD	5.90	7.12	11.70	13.47	24.13	6.65	12.95	14.74	7.19	10.65	6.55	18.02
Range	0–16	0–23	0–34	0–50	0–74	0–23	0–40	0–45	0–22	0–34	0–26	4–73

Note. YGTSS Motor Score = Yale Global Tic Severity Scale Total Motor Tic Score; YGTSS Phonic Score = Yale Global Tic Severity Scale Total Phonic Tic Score; YGTSS Total Score = Yale Global Tic Severity Scale Global Severity Score; YGTSS Impairment Score = Yale Global Tic Severity Scale Overall Impairment Score; TODS-PR Tic = Tourette's Disorder Scale—Parent Rated Tics factor; TODS-PR Aggression = Tourette's Disorder Scale—Parent Rated Aggression factor; TODS-PR ADHD = Tourette's Disorder Scale—Parent Rated ADHD factor; TODS-PR OCD = Tourette's Disorder Scale—Parent Rated Obsessive—Compulsive Disorder/Anxiety factor; CY-BOCS Total = Children's Yale-Brown Obsessive Compulsive Scale Total Score; CDI Total = Children's Depression Inventory Total Score; MASC Total = Multidimensional Anxiety Scale for Children Total Score.
* $p < .01$. ** $p < .001$.

Stability

The stability of the YGTSS scores over 47.8 days (*SD* = 21.4) were examined using one-way random effects ICCs. ICCs ranged from fair to excellent for the Total Motor Tic Score (ICC = .77; 95% confidence interval [CI] = .49 to .89), Total Phonic Tic Score (ICC = .90; 95% CI = .78 to .95), Total Tic Score (ICC = .88; 95% CI = .73 to .94), Overall Impairment Rating (ICC = .88; 95% CI = .74 to .95), and Global Severity Score (ICC = .89; 95% CI = .75 to .95). ICCs were also computed separately for participants (n = 19) whose readministration interval was below 47.8 days. For this subsample, stability ranged from fair to excellent for the Total Motor Tic Score (ICC = .85; 95% CI = .62 to .94), Total Phonic Tic Score (ICC = .93; 95% CI = .83 to .97), Total Tic Score (ICC = .92; 95% CI = .78 to .96), Overall Impairment Rating (ICC = .88; 95% CI = .71 to .95), and Global Severity Score (ICC = .91; 95% CI = .78 to .96). Stability was not calculated for participants whose administration interval was above 47.8 days because of the small number of such participants (n = 9).

Convergent and Discriminant Validity

Table 1 presents Pearson product–moment correlations for children with TS between the YGTSS scores and measures of parent-rated tics, internalizing and externalizing symptoms, clinician-rated OCD, and child-rated depression and anxiety. Correlations were strong between all of the YGTSS scores and the TODS–PR Tic factor. Discriminant validity was demonstrated with weak, nonsignificant correlations between the YGTSS scores and CY-BOCS Total, TODS–PR Aggression, ADHD, and OCD scores, CDI Total, and MASC Total.

Discussion

This study examined the psychometric qualities of the YGTSS in children and adolescents with TS. Unlike other instruments that measure pediatric TS, the YGTSS contains separate scales to assess motor and phonic tics, as well as tic-related impairment. Within clinical trials, the YGTSS represents the "reference standard" in pediatric tic assessment. However, limited psychometric data have been reported, particularly regarding the stability of scores, internal consistency, and convergent and discriminant validity.

Overall, the results of the present study support both the reliability and the validity of the YGTSS. The internal consistency of the Total Motor Tic Score, Total Phonic Tic Score, and Total Tic Score were high at both the first and second administrations. The moderate level of intercorrelation between the Total Motor and Phonic Tic Scores suggests that each measures relatively distinct but related dimensions of TS. Of interest, the Total Phonic Tic Score was more strongly related to the impairment index than the Total Motor Tic Score. There are several interpretations of this finding. First, phonic tics are generally understood to be more impairing than motor tics alone by virtue of simultaneous motor and phonic tics. Second, motor tics may be more easily hidden than phonic tics. Attention or disruption resulting from phonic tics may invite peer ridicule and/or reprimands should someone not understand the nature of TS.

A primary goal of this study was to report data on the stability of YGTSS scores. Others have cited the retest effect to be a source of unreliability in symptom measurement that may have significant implications for measuring treatment effects (Arrindell, 2001; Jensen et al., 1995; Storch, Masia-Warner, Dent, Roberti, & Fisher, 2004). Our findings suggest that the retest effect was not substantial in YGTSS scores for this sample, as scores were relatively consistent across administrations even with children being maintained on their prestudy pharmacological regimen. It is worth noting that the use of different raters at each time point provides for a more stringent test of stability and helps to control for rater bias.

The convergent validity of the YGTSS scores was supported by strong correlations with parent reports of tics. Although the high relationships suggest that parent ratings of tics may be an easier manner of collecting information, the YGTSS holds numerous advantages over parent reports. For example, YGTSS scores are based on all available information (e.g., parent and child reports, behavioral observations) as opposed to parent ratings in isolation. In addition, the YGTSS provides a qualitatively rich account of the type and nature of symptoms. The pattern of weak relations with measures of externalizing behaviors, OCD, anxiety, and depression provides strong discriminant validity support. The demonstrated divergence with these measures is noteworthy given the high comorbidity with externalizing symptoms (Budman et al., 2000; Comings, 1994; Riddle et al., 1988; Robertson et al., 2002; Sukhodolsky et al., 2003), internalizing symptoms (Carter et al., 2000; Coffey, Biederman, Geller, et al., 2000; Coffey, Biederman, Smoller, et al., 2000; Coffey & Park, 1997; Robertson et al., 2002), and OCD (Hebebrand et al., 1997; Pauls et al., 1986; Robertson, 2003).

Several limitations of this study should be noted. First, our sample was small and consisted of primarily Caucasian children. Further, complete demographic information was not available for this sample. It is not clear whether our findings can be generalized to other populations with differing demographic characteristics. The small sample also prevents us from analyzing the YGTSS dimensional structure. Indeed, the high relationship of the Total Phonic Tic Score to the Total Tic score (.92), Overall Impairment Rating (.91), and Global Severity Rating (.95) may suggest that a different dimensional structure may best explain the YGTSS. Given that interscale correlations are as high as their reliabilities, it is possible that all ratings are measuring the same construct and that a single-factor may underlie the YGTSS latent structure. Second, the 47.8-day interval used to estimate the YGTSS's stability was relatively short; future research should examine stability using a longer interval, particularly because slightly higher ICCs for a subsample whose readministration interval was below the mean may suggest lower stability over longer intervals. Third, we did not investigate differences in YGTSS scores across various diagnostic groups. It is uncertain the extent to which YGTSS scores would differentiate between children with other conditions, particularly given the high comorbidity between TS and other disorders. Thus, it will be important to examine the ability of the YGTSS to discriminate between children with TS and other internalizing and externalizing disorders. Fourth, some participants were receiving pharmacological services prior to study onset. Although no reported changes in pharmacological management occurred during the readministration interval, prior clinical ser-

vices, changes in the effectiveness of medications, or the episodic nature of TS (Coffey, Biederman, Geller, et al., 2000) might have impacted the strength of the stability coefficients found. Finally, we do not have information on the interrater reliability of the study interviewers. On balance, one indication that rater agreement may be adequate is the strong ICC values over time even with the use of different raters. In other words, consistency is shown between two YGTSS administrations separated by time and completed by different interviewers.

Within these positive findings, further study and refinement of the YGTSS scoring structure may be necessary. For example, the distinction between motor and phonic tic has good face validity, but it is uncertain whether this scoring framework actually reflects the true latent structure. Using exploratory factor analysis, Leckman et al. (1989) found a two-factor model of motor and phonic tics that accounted for only 8% of the variance. Further study with factor analysis will provide information regarding the format and scoring structure of the YGTSS.

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