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### The premonitory urge to tic: Measurement, characteristics, and correlates in older adolescents and adults

Hannah E. Reese  
*Harvard Medical School*

Lawrence Scahill  
*Emory University*

Alan L. Peterson  
*University of Texas Health Science Center at San Antonio*

Katherine Crowe  
*Fordham University*

Douglas W. Woods  
*University of Wisconsin-Milwaukee*

*See next page for additional authors*

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**Authors**

Hannah E. Reese, Lawrence Scahill, Alan L. Peterson, Katherine Crowe, Douglas W. Woods, John Piacentini, John T. Walkup, and Sabine Wilhelm

## The Premonitory Urge to Tic: Measurement, Characteristics, and Correlates in Older Adolescents and Adults

**Hannah E. Reese**

Massachusetts General Hospital/Harvard Medical School

**Lawrence Scahill**

Yale Child Study Center

Emory University

**Alan L. Peterson**

University of Texas Health Science Center at San Antonio

**Katherine Crowe**

Massachusetts General Hospital/Harvard Medical School

Fordham University

**Douglas W. Woods**

University of Wisconsin–Milwaukee

Texas A & M University

**John Piacentini**

University of California at Los Angeles

**John T. Walkup**

Johns Hopkins Medical Institutions

Weill Cornell Medical College

**Sabine Wilhelm**

Massachusetts General Hospital/Harvard Medical School

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Address correspondence to Hannah E. Reese, Ph.D., Massachusetts General Hospital, 185 Cambridge Street, Suite 2000, Boston, MA 02114; e-mail: [hreese@partners.org](mailto:hreese@partners.org).

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In addition to motor and/or vocal tics, many individuals with Tourette syndrome (TS) or chronic tic disorder (CTD) report frequent, uncomfortable sensory phenomena that immediately precede the tics. To date, examination of these premonitory sensations or urges has been limited by inconsistent assessment tools. In this paper, we examine the psychometric properties of a nine-item self-report measure, the Premonitory Urge to Tic Scale (PUTS) and examine the characteristics and correlates of the premonitory urge to tic in a clinical sample of 122 older adolescents and adults with TS or CTD. The PUTS demonstrated

adequate internal consistency, temporal stability, and concurrent validity. Premonitory urges were endorsed by the majority of individuals. Most individuals reported some relief from the urges after completing a tic and being able to stop their tics even if only temporarily. Degree of premonitory urges was not significantly correlated with age, and we did not observe any gender differences. Degree of premonitory urges was significantly correlated with estimated IQ and tic severity, but not severity of comorbid obsessive–compulsive disorder or attention-deficit hyperactivity disorder. Also, it was not related to concomitant medication status. These findings represent another step forward in our understanding of the premonitory sensations associated with TS and CTD.

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*Keywords:* Tourette syndrome; chronic tic disorder; premonitory urge; older adolescents; adults

TOURETTE SYNDROME (TS) AND CHRONIC TIC DISORDER (CTD) are characterized by sudden, rapid, recurrent motor and/or vocal tics (American Psychiatric Association, 2000). In addition to these observable symptoms, many individuals with TS or CTD also experience frequent, uncomfortable sensory phenomena that immediately precede the tics (see Scahill, Leckman, & Marek, 1995, for review). These sensory phenomena have been variously described as an itch, pressure, tension, urge, or ache that is temporarily relieved by the completion of the tic. Although first documented in the medical literature in the early 20th century (Patrick, 1905), it is only in the past 20–30 years that the scientific community has begun to systematically assess the nature and frequency of such premonitory sensations in the TS and CTD population.

In contrast to early reports (e.g., Shapiro & Shapiro, 1988), recent evidence suggests that premonitory sensations are experienced by the vast majority of individuals with TS or CTD (e.g., Cohen & Leckman, 1992; Kwak, Dat Vuong, & Jankovic, 2003; Leckman, Walker, & Cohen, 1993). The sensations are also very salient, as many individuals with TS describe the premonitory sensations as more distressing than the tics themselves (Cohen & Leckman, 1992).

Premonitory sensations or urges to tic are also thought to play a central role in the maintenance of tics. Current behavioral models posit that tics are negatively reinforced every time they rid the individual of the discomfort associated with the premonitory urge (Woods et al., 2008). Within this framework, the movements and vocalizations are understood as actions that the individual performs to alleviate the discomfort associated with the premonitory sensations. This conceptualization fits with many patients' understanding of their illness. For example, Kwak

et al. (2003) observed that 71% of individuals with TS believed their tics would no longer occur if the premonitory sensations were eliminated. Similarly, Lang (1991) found that two thirds of individuals with tics described *all* of their tics as voluntary responses to involuntary urges. Another 25% of individuals reported that this was true for at least some of their tics. Clearly, a comprehensive understanding of TS and CTD must include examination of the associated premonitory phenomena.

To date, research examining premonitory sensations has primarily employed unpublished interviews and self-report measures. Methods have not been consistently replicated across studies, making cross-sample comparisons difficult. Woods, Piacentini, Himle, and Chang (2005), however, recently developed and published a brief, self-report scale, the Premonitory Urge for Tics Scale (PUTS), for assessing the presence and intensity of premonitory urges to tic in a dimensional manner.

In the first psychometric examination of the PUTS, Woods et al. (2005) administered the measure to 42 youths with TS or CTD ages 8–16. The original PUTS consisted of 10 items. Item 10 did not correlate well with the rest of the scale, however, and Woods et al. (2005) excluded it from the computation of the total score and further analyses. Using the 9-item PUTS, the authors observed interesting developmental differences in the psychometrics of the measure as well as the relationships among premonitory urges, tic severity, and comorbid psychiatric symptoms. For individuals 11–16 years of age, the measure proved to be internally consistent, temporally stable, and demonstrated good convergent validity with a measure of tic severity. PUTS total score was also significantly positively correlated with comorbid psychiatric symptoms including symptoms of withdrawal, somatic complaints, anxiety/depression, social problems, aggressive behavior, and symptoms of obsessive–compulsive disorder (OCD). For individuals 10 years of age or younger, however, the internal consistency of the measure was not acceptable, temporal stability was lower, and it did not demonstrate concurrent validity with a measure of tic severity. Similarly, PUTS total score was not significantly correlated with comorbid psychiatric symptoms. These findings are consistent with prior reports suggesting that awareness of the premonitory urge to tic does not typically develop until approximately 10 years of age (Leckman et al., 1993). These results would also suggest, in combination with the typical developmental course of TS characterized by a symptomatic peak in early adolescence and decline into adulthood (Leckman, Zhang, & Vitale, 1998) that, although there may be considerable overlap, we cannot assume

that the findings from children will hold true for older adolescents and adults. One very recent paper (Crossley, Seri, Stern, Robertson, & Cavanna, 2013) examined the psychometrics of the 10-item PUTS in an older adolescent and adult sample. However, given Woods et al.'s (2005) recommendation that the PUTS be used as a 9-item measure, data on the reliability and validity of the 9-item PUTS in an older adolescent and adult sample are lacking.

Accordingly, the present article has two aims: (a) to examine the psychometric properties of the nine-item PUTS in a clinical sample of older adolescents and adults with diagnosed TS or CTD; and (b) to examine the characteristics and correlates of the premonitory urge to tic, as measured by the nine-item PUTS, in a clinical sample of older adolescents and adults with diagnosed TS or CTD. More specifically, we aim to describe the nature, prevalence, and degree of the premonitory urge to tic, as well as the relationship between the degree of premonitory urges to tic and gender, age, an estimate of IQ, tic severity, and concomitant medication status. Additionally, because OCD and attention-deficit hyperactivity disorder (ADHD) are the most common comorbid conditions for individuals with TS and CTD (Zohar et al., 1999), we sought to explore the relationship between the degree of premonitory urges to tic and comorbid OCD and ADHD symptom severity.

We hypothesized that, similar to Woods et al.'s (2005) finding in youths, the PUTS would demonstrate good internal consistency, temporal stability, and concurrent validity in an older adolescent and adult sample. Also consistent with previous findings (Crossley et al., 2013; Woods et al., 2005) we hypothesized that premonitory urges would be endorsed by the majority of individuals and that feelings of being "wound up" or having an "energy in my body that needs to get out" would be the most commonly endorsed premonitory sensations. Consistent with the behavioral model of tics, we predicted that most individuals would report some relief from the urges to tic after completing the tic and would report being able to stop the tics, even if only for a short time. Because our sample was limited to older adolescents and adults, who have surpassed the age at which awareness of the premonitory urge typically develops (Leckman et al., 1993), we did not necessarily expect a correlation between age and premonitory urges. We did, however, hypothesize that total scores on the PUTS would be equal to or higher than those observed by Woods et al. (2005) in youths ages 11–16. Given the lack of an observed association between premonitory urges and IQ in children (Woods et al., 2005), we also hypothesized

that the degree of premonitory urges to tic would not be correlated with an estimate of IQ.

Further predictions regarding the characteristics and correlates of the premonitory urge to tic are more difficult to render. Prior work has produced mixed findings that may be partially related to differences in methodology (e.g., comparing individuals with premonitory urges with those without premonitory urges vs. examining relationships in a continuous manner) and differences in methods of measurement. Leckman et al. (1993) observed a gender difference such that men were more likely to report premonitory urges than women. Two more recent reports (Crossley et al., 2013; Sutherland Owens, Miguel, & Swerdlow, 2011), however, failed to observe any gender differences. As mentioned above, Woods et al. (2005) found a relationship between degree of premonitory urges and tic severity as well as symptoms of OCD, but not problems with attention. Similarly, Kurlan, Lichter, and Hewitt (1989) observed that all of the individuals in their sample who reported premonitory sensations also had comorbid obsessive–compulsive symptoms. In contrast, Leckman et al. (1993) found no relationship between the premonitory urge to tic and tic severity or obsessive–compulsive symptom severity. Cohen and Leckman (1992) also found no difference in tic severity between individuals with or without premonitory sensations. Additionally, Sutherland Owens et al. (2011) did not observe any relationship between premonitory urge and tic severity or comorbid OCD symptoms. Crossley et al. (2013) did not observe a correlation between medication use and the premonitory urge to tic. However, it has not yet been examined whether individuals not taking any medication differ from those taking medication in the degree of reported premonitory urges.

Consequently, we chose to conduct exploratory analyses examining the relationship between the premonitory urge to tic and gender, tic severity, severity of comorbid OCD and ADHD symptoms, and medication status. Because the PUTS is a dimensional measure, it may allow us to examine the relationship between the premonitory urge to tic and various demographic and symptomatic variables in a continuous manner, thereby providing some clarity regarding the previously mixed findings.

## Method

### PROCEDURE

Data were collected as part of a multisite randomized controlled trial comparing a comprehensive behavioral intervention for tics (CBIT) to psychoeducation and supportive therapy (PST) for individuals age 16 or older with TS or CTD (see Wilhelm et al., 2012, for full description). In brief, 122 individuals were

randomly assigned to receive eight sessions of CBIT ( $n = 63$ ) or PST ( $n = 59$ ) over 10 weeks. Participants were enrolled at Massachusetts General Hospital/Harvard Medical School, Yale University, and the University of Texas Health Science Center at San Antonio. All study procedures were approved by the Institutional Review Boards at each site. Participants provided written consent (or assent and parental consent in the case of participants under 18 years of age) prior to the initiation of any study procedures. Clinician-rated and self-report measures were collected at screening, baseline, midtreatment, posttreatment, and follow-up. For the purposes of this paper we report screening and baseline data only. Clinician-rated measures were administered by individuals with a master's degree or higher in a mental health care field. Raters received extensive training and were required to demonstrate reliability on three video-recorded assessments prior to the initiation of the study (see also Wilhelm et al., 2012, for a full description of rater supervision, monitoring, and reliability assessments).

#### PARTICIPANTS

The 122 individuals (78 male; 44 female; 98 White, non-Hispanic; 17 White, Hispanic; 1 Black; 5 Asian/Pacific Islander; 1 other) who completed the baseline assessment ranged in age from 16 to 69 (mean age = 31.6,  $SD = 13.7$  years). Of those, 103 met DSM-IV-TR (American Psychiatric Association, 2000) diagnostic criteria for TS; 19 (15.6%) met DSM-IV-TR diagnostic criteria for CTD (18 motor tics only; 1 vocal tic only); 19 (15.6%) met diagnostic criteria for OCD; and 34 (27.9%) met diagnostic criteria for ADHD. Seventy-one individuals (58.2%) were unmedicated; 8 (6.6%) were on a stable dose of tic medication only; 23 (18.9%) were on a stable dose of tic medication and other psychiatric medication; and 20 (16.4%) were on a stable dose of other psychiatric medication only at the time of enrollment.

#### MEASURES

##### *Diagnostic Assessment*

Our procedures for diagnostic assessment were modeled on those developed by the Tourette Syndrome Association International Consortium for Genetics (TSAICG, 2007). At study entry raters administered the *Structured Clinical Interview for DSM-IV-TR Axis I Disorders, Research Version, Patient Edition* (SCID-I/P; First, Spitzer, Gibbon, & Williams, 2002), a semistructured clinical interview, to establish DSM-IV diagnoses. Because the SCID does not include a module for the diagnosis of tic disorders, raters also administered a semistructured interview developed for this purpose by the TSAICG. Similarly, the SCID does not include a module for the

diagnosis of ADHD. In this case, we adopted the diagnostic procedures commonly used by researchers of adulthood ADHD (e.g., Safren et al., 2010) and administered the ADHD module of the Schedule for Affective Disorders and Schizophrenia for School-Age Children—Present and Lifetime Version (K-SADS-PL; Kaufman et al., 1997) to determine this diagnosis. Questions were phrased in the past tense and raters asked the participants if similar concerns were currently present.

*Premonitory Urge for Tics Scale (PUTS; Woods et al., 2005).* The PUTS is a nine-item<sup>1</sup> self-report questionnaire measuring premonitory sensations in individuals with tics. Each item is scored from 1 (*not at all true*) to 4 (*very much true*). The total score is computed by summing the nine items. Thus, total scores range from 9 to 36, and higher scores represent greater premonitory urges. The PUTS has demonstrated good internal consistency, test-retest reliability, and construct validity among youths between 11 and 16 years of age (Woods et al., 2005). The present paper reports the first psychometric data on the nine-item PUTS in an older adolescent and adult sample.

*Yale Global Tic Severity Scale (YGTSS; Leckman, Riddle, Hardin, & Ort, 1989).* The YGTSS is a clinician-rated measure of tic severity. Raters assess motor and phonic tics separately in five domains: number, frequency, intensity, complexity, and interference. Each domain is rated on a scale from 0 to 5, with 5 indicating greater severity. Total scores for motor and phonic tics can therefore range from 0 to 25. The total tic severity score is the sum of the motor and phonic tic scores and can range from 0 to 50. Additionally, raters provide an impairment score from 0 to 50 (with higher scores indicating greater impairment) reflecting the individual's overall impaired functioning due to his or her tics. The YGTSS total score combines the total tic severity and impairment scores, and ranges from 0 to 100. The YGTSS has demonstrated good internal consistency and interrater reliability, as well as excellent convergent and divergent validity (Leckman et al., 1989). In the present sample, the measure demonstrated adequate internal consistency ( $\alpha = .78$ ).

*Yale-Brown Obsessive Compulsive Scale (YBOCS; Goodman, Price, Rasmussen, & Mazure, 1989a,*

<sup>1</sup> Because this study was designed prior to the publication of the initial psychometric data on the PUTS (Woods et al., 2005), participants completed the original 10-item version of the PUTS. We focus our analyses on the first nine items, but present data regarding item 10 when indicated.



1989b). The YBOCS is a 10-item clinician-rated measure of OCD symptom severity. Raters assess obsessions and compulsions separately in five domains: time spent, interference, distress, resistance, and control. Each domain is rated on a scale from 0 to 4. Thus, total scores range from 0 to 40, with higher scores indicating greater symptom severity. The YBOCS has demonstrated good interrater reliability and internal consistency, as well as convergent and discriminant validity (Goodman et al., 1989a, 1989b). In the present sample, the measure demonstrated excellent internal consistency ( $\alpha = .94$ ).

*Attention-Deficit Hyperactivity Disorder Rating Scale (ADHD-RS; DuPaul, Power, Anastopoulos, & Reid, 1998).* The ADHD-RS is an 18-item self-report measure derived from the DSM-IV ADHD criteria. Each item is rated from 0 (*never or rarely*) to 3 (*very often*). Thus, total scores range from 0 to 54 with higher scores representing greater symptom severity. The scale was originally developed and validated in a pediatric population, but it has been previously used in adult ADHD populations (e.g., Spencer, Wilens, Biederman, & Faraone, 1995; Wilens et al., 1996). In the present sample, the measure demonstrated excellent internal consistency ( $\alpha = .93$ ).

*Wechsler Test of Adult Reading (WTAR; The Psychological Corporation, 2001).* The WTAR is a 50-item measure that provides an estimate of overall IQ. Subjects read a list of 50 words aloud, and for each word that they pronounce correctly they earn 1 point. The WTAR has excellent internal consistency, test-retest reliability, and convergent validity. In the U.S. Standardization Sample, correlations between WTAR scores and full-scale IQ, as measured by the Wechsler Adult Intelligence Scale-III (WAIS-III)

ranged from .63 to .80 for individuals 16–69 years of age. Correlations between WTAR score and verbal IQ and performance IQ ranged from .66 to .80 and from .45 to .72, respectively (The Psychological Corporation, 2001).

## Results

### PRELIMINARY ANALYSES

As previously discussed, Woods et al. (2005) found that the 10th item of the PUTS did not correlate well with the rest of the items and therefore recommended excluding it from the scale. To confirm that the same approach would be appropriate with our sample, we correlated each item with the 10-item total score and every other item. Item 10 was significantly correlated with the total score,  $r = .39$ ,  $p < .001$ . However, it demonstrated the weakest correlation with the total score relative to the other nine items. Moreover, it was significantly correlated with only two of the other nine items. In contrast, each of the other nine items was significantly correlated with at least six of the other nine items. Therefore, in keeping with Woods et al. (2005), we excluded item 10 from the measure. We have only included item 10 in our presentation of item-by-item results. Table 1 presents the correlation between each item and the nine-item total score.

### Psychometric Findings

*Internal consistency and temporal stability.* To examine the internal consistency of the PUTS, we computed Cronbach's alpha. The PUTS demonstrated good internal consistency,  $\alpha = .83$  (Groth-Marnat, 2003). To examine the temporal stability of the PUTS, we correlated total PUTS score at screening with total PUTS score at baseline, which occurred within 2 weeks of the screening visit. The PUTS demonstrated adequate temporal stability,  $r = .79$ ,  $p < .001$ .

Table 1  
Item Mean, Standard Deviation, and Correlation With Nine-Item Total Score

Item	Mean	SD	Correlation with total score
1. Right before I do a tic, I feel like my insides are itchy.	1.66	.93	.42 *
2. Right before I do a tic, I feel pressure inside my brain or body.	2.09	1.11	.64 *
3. Right before I do a tic, I feel "wound up" or tense inside.	2.53	1.03	.78 *
4. Right before I do a tic, I feel like something is not "just right."	2.48	1.07	.76 *
5. Right before I do a tic, I feel like something isn't complete.	2.20	1.08	.65 *
6. Right before I do a tic, I feel like there is energy in my body that needs to get out.	2.75	1.06	.69 *
7. I have these feelings almost all the time before I do a tic.	2.76	1.01	.75 *
8. These feelings happen for every tic I have.	2.30	1.01	.56 *
9. After I do the tic, the itchiness, energy, pressure, tense feelings, or feelings that something isn't "just right" or complete go away, at least for a little while.	2.76	1.05	.61 *
10. I am able to stop my tics, even if only for a short period of time.	2.81	1.01	N/A- not included in total

\* Significant at the .01 level.

**Concurrent validity.** To test concurrent validity, we examined the relationship between degree of premonitory urges and the dimensions of tic severity as measured by the YGTSS. Total PUTS score was moderately positively correlated with tic severity, as measured by the total tic score of the YGTSS,  $r = .32, p < 0.001$ . We also observed small to medium positive correlations between total PUTS score and number of tics,  $r = .29, p = .001$ ; frequency of tics,  $r = .20, p = .03$ ; complexity of tics,  $r = .25, p = .006$ ; and tic-related interference,  $r = .32, p < .001$ . Total PUTS score was not significantly correlated with tic intensity,  $r = .16, p = .08$ . Taken together, these results suggest that those individuals with greater premonitory urges also experience more severe tics. However, the modest size of the correlations (all between .16 and .32) and the differential relationships between PUTS and the dimensions of the YGTSS would suggest that the PUTS is measuring a feature of the disorder that is separable from tic severity.

**Summary Data**

Over 90% of individuals endorsed premonitory urges to some extent ( $n = 114, 93.4\%$ ). Eight individuals (6.6%) obtained a total score of 9, indicating the complete absence of premonitory urges. Total PUTS scores ranged from 9 to 33 with a mean score of 21.5 ( $SD = 6.1$ ).

**Phenomenology of the Urge**

The means and standard deviations for items 1–10 are listed in Table 1. Also see Figure 1 for depiction of item-by-item response frequencies. In the following

summary, we describe the percentage of individuals who endorsed each item to some degree (i.e., provided an item rating of 2 [a little true] or higher).

Items 1–6 assess the quality of the premonitory urge. As predicted, “an energy in my body that needs to get out” and an inner feeling of being “wound up” or tense were the most commonly endorsed sensations, with over 80% of individuals endorsing these items. Feelings of something being not “just right” or incomplete were endorsed by 76.2 and 65.6% of individuals, respectively. Feelings of “pressure inside my brain or body” were endorsed by 58.2% of individuals. Only 40.2% of individuals endorsed inner sensations of itchiness.

Items 7 and 8 assess the frequency of the premonitory urge to tic. Approximately 86% of individuals endorsed item 7 (*I have these feelings almost all the time before I do a tic*). Nearly three out of four (73.0%) participants endorsed item 8 (*These feelings happen for every tic I have*).

Item 9 (*After I do a tic, the itchiness, energy, pressure, tense feelings, or feelings that something isn't “just right” or complete go away, at least for a little while*) assesses the presumed functional relationship between the tic and the urges to tic. Consistent with the behavioral model of tics, it was endorsed by over 85% of individuals.

Item 10 (*I am able to stop my tics, even if only for a short period of time*) assesses the ability to suppress tics rather than the premonitory urge. Consistent with our understanding of tics as semivoluntary behaviors, 87.7% of individuals

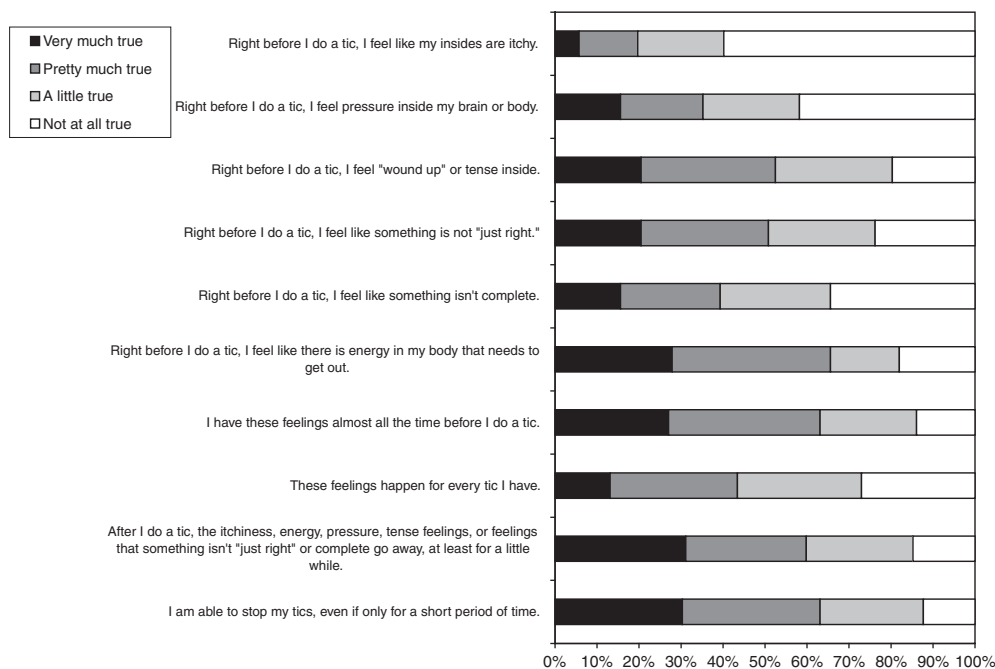


FIGURE 1 Item-by-item response frequencies.



reported being able to stop their tics even if only for a short period of time.

#### *Correlates of the Degree of Premonitory Urges*

To examine factors potentially associated with degree of premonitory urges, we conducted a *t* test comparing the total PUTS score for males with that of females, and conducted correlations between total PUTS score and the following variables: age, estimated IQ, tic severity, OCD symptom severity, and ADHD symptom severity. To examine the effect of medication status on the premonitory urge to tic, we conducted a between-groups ANOVA comparing those individuals taking no medication, tic medication only, tic and other psychiatric medication, or other psychiatric medication only.

Males and females did not significantly differ in the degree of premonitory urges,  $t(120) = .32, p = .75$  (male  $M = 21.4$ , female  $M = 21.8$ ). Total PUTS score was not significantly correlated with age,  $r = .10, p = .29$ . We did observe a small to medium positive correlation between total PUTS score and estimated full-scale IQ, as measured by the WTAR,  $r = .21, p = .02$ , such that greater premonitory urges were associated with higher estimated IQ.

As described above, total PUTS score was moderately positively correlated with tic severity, as measured by the total tic score of the YGTSS,  $r = 0.32, p < 0.001$ , suggesting that those individuals with greater premonitory urges also experience more severe tics. To examine whether degree of premonitory urges differentially correlated with motor or vocal tic severity, we repeated the above correlations for the motor tic and phonic tic subscale scores separately. A different pattern of results emerged. Total PUTS score was not significantly correlated with overall motor tic severity. Moreover, of the five motor tic subscales, we observed only one significant correlation, a small to medium positive relationship between total PUTS score and motor tic complexity,  $r = .19, p = .04$ . In contrast, total PUTS score was moderately positively correlated with overall phonic tic severity,  $r = .30, p = .001$ , and weakly to moderately positively correlated with all five phonic tic subscales (number:  $r = .30, p = .01$ ; frequency:  $r = .24, p = .01$ ; intensity:  $r = .21, p = .02$ , complexity:  $r = .19, p = .04$ ; interference:  $r = .34, p < .001$ ). Taken together, these results suggest the relationship between premonitory urge severity and overall tic severity may be primarily accounted for by the relationship between premonitory urge severity and phonic tic severity.

Overall OCD symptom severity, as measured by the YBOCS total score, was not significantly correlated with the total PUTS score,  $r = .11, p =$

.25. Because of previous work suggesting a relationship between “just right” perceptions (tapped by items 4 and 5) and symptoms of OCD among individuals with TS (Leckman, Walker, Goodman, Pauls, & Cohen, 1994), we decided to examine whether subjects with comorbid OCD endorsed these items more strongly than those without comorbid OCD. To do this, we conducted two independent sample *t* tests comparing individuals with ( $n = 19$ ) and without ( $n = 103$ ) current comorbid OCD on the mean score of items 4 (*Right before I do a tic, I feel like something is not “just right”*) and 5 (*Right before I do a tic, I feel like something isn’t complete*). Individuals with comorbid OCD did more strongly endorse item 4 (not “just right”),  $t(120) = 2.37, p = .02$ . Item 5 (*feelings of incompleteness*) was also more strongly endorsed by those with comorbid OCD, although not significantly so,  $t(120) = 1.89, p = .06$ .

Overall ADHD symptom severity, as measured by the ADHD-RS, was not significantly correlated with the total PUTS score,  $r = .08, p = .39$ . Total PUTS score also did not significantly differ based on medication status,  $F(3, 118) = .75, p = .52$ .

#### Discussion

In summary, the PUTS appears to be a reliable measure of the premonitory urge to tic among older adolescents and adults. The estimates of internal consistency and temporal stability were acceptable and comparable with those observed by Woods et al. (2005) in youths 11–16 years of age. It also showed good concurrent validity when compared with the YGTSS, demonstrating that it is tapping a related but distinct feature of the disorder.

Consistent with several previous reports, the premonitory urge to tic was endorsed to some degree by an overwhelming majority (93.4%) of individuals. Consistent with Crossley et al. (2013) and Woods et al. (2005), the present sample most frequently endorsed “energy in my body that needs to get out” and an inner feeling of being “wound up” or tense. Inner sensations of itchiness were the least commonly endorsed sensations. This differs from previous reports that have emphasized an itch-like quality to the urges. These findings could have implications for the language that we use when inquiring about the premonitory urge to tic among our patients. Describing the sensations in an accurate manner could improve patients’ ability to recognize them. We would recommend that clinicians focus their descriptions of the premonitory urge on a feeling of being wound up, tense, or having energy in the body that needs to get out.

The majority of participants reported experiencing some relief from the urge to tic upon completion

of a tic, as well as being able to stop their tics even if only for a short time. Taken together, these results provide further support for the functional relationship between the urge to tic and the tic itself that is so central to the behavioral model of tics.

We did not observe a relationship between age and the degree of premonitory urges to tic. The mean score among adults (adult  $M = 21.5$ ,  $SD = 6.1$ ) was slightly elevated relative to that observed in youths ages 11–16 by Woods et al. (2005; youth  $M = 18.6$ ,  $SD = 4.6$ ). This is not surprising. Previous work suggests that awareness of the premonitory urge to tic develops around 10 years of age (Leckman et al., 1993). It may be that by adulthood awareness of the urge is firmly established and remains relatively stable across the lifespan.

In contrast to Leckman and colleagues' (1993) observation that males were more likely to report premonitory urges than females, we did not observe any gender differences in the degree of premonitory urges. This is consistent with the more recent findings of Sutherland Owens and colleagues (2011) and Crossley et al. (2013).

The relationship between estimated IQ and the premonitory urge to tic was somewhat surprising. Although it is a modest relationship, it is possible that increased IQ is indicative of greater verbal ability, which enables patients to label and describe the premonitory sensations and their relationship to the tics. We would advise caution in the interpretation of this finding, however, given the brief nature of the IQ assessment. Future work employing a full IQ battery could confirm this preliminary hypothesis.

That premonitory urge severity was related to overall tic severity is not surprising. If tics are semivoluntary responses to the premonitory urges, as the behavioral model of tics suggests, then more severe urges should be related to more severe tics. However, the unique relationship between the degree of premonitory urges and phonic tic severity was unexpected. The reasons for this are not entirely clear. Because vocal tics are often more noticeable than motor tics, they may be more often associated with negative social consequences. Some researchers have hypothesized that negative social consequences (i.e., social punishment) may intensify the premonitory urges via conditioning (Capriotti, Brandt, Ricketts, Espil, & Woods, 2012). In other words, because the urges come to signal the onset of a tic that is then punished by the environment, the urge itself may become increasingly more aversive over time. Future work would of course be necessary to replicate the relationship between degree of premonitory urges and phonic tic severity and to test this and possibly other alternative explanatory hypotheses. It would also be interesting to directly assess the

premonitory urges for different types of tics (motor vs. phonic, simple vs. complex) to determine whether the quality, intensity, or frequency of the urges differs in any systematic manner.

We did not observe the relationship between degree of premonitory urges and overall severity of comorbid OCD symptoms previously observed by Woods et al. (2005). Our data supported a more specific relationship between “just right” premonitory sensations and OCD symptom severity consistent with that described by Leckman et al. (1994). Consistent with Woods et al. (2005), however, degree of premonitory urges was not related to degree of comorbid ADHD symptoms. Consistent with Crossley et al. (2013), it was also not related to medication status.

The present study is not without limitations. A primary limitation is that our sample consisted of a clinical sample of individuals. It is possible that our findings may not generalize to the larger population of individuals with TS or CTD. By restricting our examination to a clinical sample, we may have also limited the range of possible scores and therefore limited our ability to detect relationships with other variables. Additionally, our sample was limited to older adolescents and adults. Although our primary aim was to examine the PUTS and premonitory urges in this age range, future studies examining premonitory urges among individuals of all ages could provide more nuanced information on the developmental course of premonitory urges.

This work represents another step forward in our efforts to understand the premonitory sensations associated with TS and CTD. We hope that standardization in measurement of the premonitory urge to tic will facilitate the advancement of our knowledge regarding this important feature of the disorder. We also hope that a greater understanding of the characteristics and correlates of premonitory urges will inform treatment. Current behavioral treatments for tics (e.g., habit reversal training [HRT], comprehensive behavioral intervention for tics [CBIT]; see Woods et al., 2008) focus heavily on the premonitory urge. Patients are helped to increase their awareness of the premonitory urge to tic and to break the connection between the premonitory urge and the tic by implementing a competing response upon detecting this urge. Therefore, thorough understanding and assessment of the premonitory urges to tic are essential to the clinician and patient. Moreover, advances in our knowledge regarding the role that premonitory urges play in the etiology and maintenance of tic disorders may help us to further refine our treatment approaches.

#### Conflict of Interest Statement

Dr. Reese and Ms. Crowe declare no conflicts of interest.

Drs Wilhelm, Peterson, Piacentini, Woods, Walkup, and Scahill report receiving royalties from Oxford University Press for a treatment manual on tic disorders. Drs Wilhelm, Peterson, Piacentini, Woods, Walkup, and Scahill report receiving honoraria for continuing education presentations from the Tourette Syndrome Association. Drs Piacentini, Woods, and Walkup receive royalties from Guilford Press for a book on Tourette disorder.

Dr Wilhelm reports receiving support in the form of free medication and matching placebo from Forest Laboratories for clinical trials funded by the National Institutes of Health and receiving book royalties from Guilford Publications, New Harbinger Publications, and Oxford University Press.

Dr Piacentini reports receiving royalties from Oxford University Press for treatment manuals on child obsessive-compulsive disorder, research support from the Tourette Syndrome Association and Pfizer, speaking fees from the International OCD Foundation, and consultant fees from Bayer Schering Pharma.

Dr Woods reports receiving book royalties from New Harbinger and Springer Publications.

Dr Scahill has received royalties from Oxford University Press, Guilford and American Psychiatric Press; has served as a consultant for Biomarin, Bracket and Pfizer; and has had research support from Shire Pharmaceutical, Roche, and Pfizer. He also reports receiving support in the form of free medication and matching placebo from Shire Pharmaceuticals for a clinical trial funded by the National Institute of Mental Health.

Dr Walkup reports grant support and honoraria for educational meetings from the Tourette Syndrome Association. He has received consulting fees from Shire Pharmaceuticals. He has received royalties from Guilford Press and Oxford Press. He reports receiving free medication and matching placebo from Pfizer, Lilly and Abbott for clinical trials funded by the National Institute of Mental Health.

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