Autism Spectrum Symptoms in a Tourette's Disorder Sample

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Objective: Tourette's disorder (TD) and autism spectrum disorder (ASD) share clinical features and possibly an overlapping etiology. The aims of this study were to examine ASD symptom rates in participants with TD, and to characterize the relationships between ASD symptom patterns and TD, obsessive-compulsive disorder (OCD), and attention-deficit/hyperactivity disorder (ADHD).

Method: Participants with TD (n = 535) and their family members (n =234) recruited for genetic studies reported TD, OCD, and ADHD symptoms and completed the Social Responsiveness Scale Second Edition (SRS), which was used to characterize ASD symptoms.

Results: SRS scores in participants with TD were similar to those observed in other clinical samples but lower than in ASD samples (mean SRS total raw score = 51; SD = 32.4). More children with TD met cut-off criteria for ASD (22.8%) than adults with TD (8.7%). The elevated rate in children was primarily due to high scores on the SRS Repetitive and Restricted Behaviors (RRB) subscale. Total SRS scores were correlated with TD ($r = 0.27$), OCD ($r = 0.37$), and ADHD ($r = 0.44$) and were higher among individuals with OCD symptom-based phenotypes than for those with tics alone.

Conclusion: Higher observed rates of ASD among children affected by TD may in part be due to difficulty in discriminating complex tics and OCD symptoms from ASD symptoms. Careful examination of ASD-specific symptom patterns (social communication vs. repetitive behaviors) is essential. Independent of ASD, the SRS may be a useful tool for identifying patients with TD with impairments in social communication that potentially place them at risk for bullying and other negative sequelae.

Key words: Tourette's disorder, autism, obsessive-compulsive disorder, attention-deficit/hyperactivity disorder, heritability

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With recognition that chronic tic disorders, including Tourette's disorder (TD) and autism spectrum disorder (ASD), frequently co-occur and share clinical and behavioral features,[1,2] researchers are investigating potential overlapping pathophysiologies and genetic etiologies of these disorders.[1,3-6] However, the rates of ASD and tic disorder comorbidities are somewhat asymmetrical, depending on which is considered the "primary disorder," suggesting that at least some of the observed comorbidity may represent phenocopies rather than shared etiologies. Among individuals with a primary ASD diagnosis (typically ascertained in autism specialty clinics), the rate of co-occurring chronic tic disorders is reported to be 10% to 25%, compared to the population prevalence of 0.3% to 2.9%.[4,7-11] However, among those with a primary TD diagnosis, rates of ASD are reported to be 5% to 15%, compared to a population prevalence of 1.9%.[12-16] In addition, chronic tic disorders and ASD have many common features, including stereotyped repetitive behaviors that are aggravated or worsened by heightened emotional states (tics and stereotypies), and higher prevalence in males than in females.[17] However, the presence and profile of autism spectrum symptoms in individuals affected with TD has not been systematically assessed in a large sample.

This study used a population-based quantitative assessment, the Social Responsiveness Scale, Second Edition (SRS),[18] to investigate the overlap between ASD symptoms and TD in TD-affected individuals and their putatively unaffected family members. Self-report quantitative assessments such as the SRS can be efficiently administered to a large group of individuals and can be used to assign probable ASD diagnoses (although not necessarily formal *DSM*-based diagnoses). Assessing quantitative ASD symptom patterns in a large TD sample may also be informative in helping to determine whether some of the observed overlap between TD and ASD is due to symptom (rather than etiological) overlap between the two disorders, and for identifying TD subtypes based on ASD symptomatology. If identified, such subtypes may be useful for studies aimed at better understanding the etiology of TD, including the underlying biology and neural

Supplemental material cited in this article is available online.

circuitry that account for the frequent co-occurrence of developmental neuropsychiatric disorders such as ASD in patients with chronic tic disorders. Importantly, the inclusion of family members allows for heritability studies of specific symptom profiles, including examination of the genetic correlations between ASD symptoms and TD. Although symptom-based endophenotypes have been pursued for ASD[19,20] and TD[21-24] separately, efforts to identify endophenotypes that cross the diagnostic boundaries of TD and ASD have just begun.[5]

The aims of the present study were to examine the prevalence and patterns of ASD symptoms in relation to TD and other common comorbid developmental neuropsychiatric disorders (i.e., obsessive-compulsive disorder [OCD] and attention-deficit/hyperactivity disorder [ADHD]) in individuals with TD and their first-degree family members. We hypothesized the following: that rates of provisional ASD diagnoses would be higher in this sample than in the general population; that these rates would be comparable to those in other clinical, non-ASD samples; and that at least some of the increased prevalence would be due to increased repetitive and restricted behaviors commonly seen in TD (e.g., would represent ASD phenocopies).

METHOD

Study Sample

The sample included individuals diagnosed with TD and their first-degree family members recruited by Tourette Syndrome Association International Consortium for Genetics (TSAICG) for genetic studies from TD specialty clinics in the United States and from the Tourette Association of America. The methods for the parent study are described in detail elsewhere.[25,26] Briefly, the inclusion criteria for probands (children with TD identified for the genetic study) included age 6 years or older, established TD diagnosis, and availability of living parents for family-based genetic analyses. The exclusion criteria were known developmental disability and tics caused by neurological disorders other than TD (e.g., epilepsy, head trauma). Data collection for the parent study spanned multiple years, and the SRS was added at a later time point; therefore, only a subset of the sample was available for these analyses. A total of 846 individuals were included in the current sample. The majority were male (64.5%) and had a mean age of 30.9 years (SD = 18.2 years).

Procedures

Participants underwent a semi-structured interview and completed self-report measures regarding tic and other neuropsychiatric symptoms (those relevant to this study are described below). Interviews were conducted in person for most participants; for a few individuals, interviews were completed by Skype or over the phone, and self-report measures were returned via mail. The measure of ASD symptoms (SRS) was included for a subset of the participants: the earliest SRS was administered on April 7, 2006, and the most recent SRS was administered on April 15, 2014. All participants provided informed consent (written assent was also obtained for individuals younger than 18 years), and the study was approved by the institutional review board of each participating site.

Measures

The Social Responsiveness Scale Second Edition (SRS)[18] is a 65-item quantitative measure of autism spectrum symptoms that assesses an individual's ability to engage in emotionally appropriate reciprocal social interactions. It has a normal distribution in the general population and is highly heritable, with heritability estimates ranging from 56% to 95%.[20,27-29] It has good test–retest reliability ($r = 0.83$) and validity when compared with the gold standard for autism diagnoses, the Autism Diagnostic Interview–Revised (ADI-R; $r = 0.64$ and higher depending on the ADI-R algorithm)[30] and the ADOS (ADOS; $r = 0.26$–0.43).[31] The SRS contains five treatment subscales derived for clinical utility, including the following domains: social awareness, social cognition, social communication, social motivation, and restricted interests and repetitive behaviors. Factor analysis has identified a two-factor solution that mirrors *DSM-5* criteria for ASD (social communication and interaction deficits [SCI] and restricted interests and repetitive behaviors [RRB]).[18]

The SRS-2 comes in different versions, one for each of three different age ranges, and modified based on whether the respondent is rating their own behavior or another's. The current study used the parent report for individuals aged less than 18 years and the adult self-report for individuals aged 18 years and more (one participating site in this study asked adults to find a relative or someone who knows them well to rate them rather than to self-report, n = 3). Scoring procedures for this study followed those outlined in the SRS-2 administration manual: a case was excluded if seven or more responses were missing and, if fewer than seven were missing, the missing values were replaced with the median score. Total and subscale raw scores were computed, and when possible, age and gender-normed T scores were calculated for each individual.

Based on previous studies, the following ranges of raw scores are associated with different characteristics: in unaffected samples, SRS raw scores range from 23 to 53; in mixed or non-ASD clinical samples, SRS raw scores range from 40 to 75; and in ASD-affected samples, SRS raw scores range from 86 to 116.[18] For the current study, a total SRS raw score of $\geq$80 was used to identify individuals who likely meet criteria for ASD (e.g., had a provisional ASD diagnosis). Previous research has found a range of cut-off scores (65–85) provide good sensitivity and specificity in various samples for provisional ASD.[18] We chose a cut-off of $\geq$80 based on recommendations from the SRS manual; although a cut-off of 70 is recommended for general screening and a cut-off of 85 is recommended for ASD clinical settings, we wanted a cut-off that would not be as stringent as that used in ASD-specific clinical settings and not as loose as that used in general populations. T scores (normed based on age and sex distributions) were also examined for both the total score and treatment subscales. For the current study, an age-corrected T score of >75 was used to identify individuals with a probable autism spectrum disorder (ASD).[30]

The TSAICG Tic and Comorbid Symptom (TICS) Inventory[25,32] was administered by trained clinicians using a semi-structured interview format to assess tic, obsessive-compulsive, and attention-deficit/hyperactivity symptoms. Data from the TICS Inventory, in conjunction with other available clinical data (e.g., medical records), were used by raters to determine diagnostic status for TD, OCD, and ADHD using a best-estimate process.[33] Second, individual symptom responses were used to derive rates of TD, OCD, and ADHD symptom endorsement. The TICS Inventory includes a measure of tic severity derived from the Yale Global Tic Severity Scale, comprising worst-ever tic frequency, severity, and interference ratings; tic complexity was not included

in the severity measure. The OCD and ADHD assessments are modified from the Yale–Brown Obsessive Compulsive Scale (Y-BOCS)[34] and the Swanson, Nolan, and Pelham Questionnaire (SNAP-IV).[25,32,35]

Statistical Analyses

Descriptive statistics and correlation analyses were conducted in SPSS version 19. Using SRS raw scores and a cut-off score of 80, we examined the relationship between provisional ASD diagnoses and tic severity, TD, OCD, and ADHD diagnoses, as well as examining how these relationships differed by gender and age. Using SRS T-scores (cut-off score of 75), we examined the distributions of the treatment subscales and *DSM-5* factor-derived subscales among individuals affected and unaffected with TD, both children and adults.

A previous study using latent class analysis in this sample identified the following classes of individuals based on their likelihood of endorsing TD, OCD, and ADHD symptoms on the TICS inventory: TD+OCD+ADHD, OCD symmetry, TD+ADHD, Tics only, and unaffected.[36] For the current study, we used the SRS data as an auxiliary variable in the latent class analysis (Mplus version 7.1) to examine the pattern of SRS scores (total scores and *DSM-5* subscale scores) in each previously derived latent class. This test is similar to a χ^2 test but also takes into account the probability of an individual's class membership. This analysis was conducted on a restricted sample, as only 415 of the individuals (196 TD affected, 219 TD unaffected; 63% male; aged 5–77 years, mean = 32.04 years, SD = 18.86 years) in the original latent class analysis had SRS data available.

Familiality estimates were calculated for scores on *DSM-5* subscales (SCI and RRB) using the Sequential Oligogenic Linkage Analysis Routine (SOLAR) statistical package. SOLAR uses a variance components approach with information from all available family members across generations and calculates kinship coefficients (because the sample consisted of parent–child trios, we could not separate out the effects of shared genetics and shared environment in these analyses). Age, sex, and sex*age were used as covariates for all familiality analyses.

RESULTS

Rates of Autism Symptoms and Probable ASD

Among the 846 individuals (participants with TD, n = 535; participants without TD, n = 234), approximately 12% met criteria for probable ASD (SRS total raw score mean = 44.8, SD = 30.4) (Table 1 and Figure 1). Of those with TD, 18% (n = 96) met cutoff criteria for probable ASD, whereas 3% (n = 8) of individuals without TD met cutoff criteria. The SRS demonstrated acceptable internal consistency in the current sample for the total scale score (Cronbach's $\alpha = 0.96$) and the *DSM-5*-related subscales (SCI, $\alpha = 0.95$ and RRB, $\alpha = 0.88$). The average SRS scores for those with TD were similar to those observed in other published clinical samples of children but lower than in published ASD samples (mean SRS total raw score = 51; SD = 32.4) (Figure 1).[18] Rates of probable ASD were the highest among participants with TD, and, among these, more children than adults met the cut-off criteria for ASD (22.8% vs. 8.7%; because of limited data on children without TD, this subgroup was not included in subsequent analyses).

Next we examined the rates of individuals who met the cut-off score for the treatment subscales (Figure 2). The distribution of SRS T-scores for the total scale and subscales among children with TD, adults with TD, and adults without TD can be seen in Figure S1, available online. Overall, only children with TD met ASD cut-off score criteria across all the subscales at elevated rates; the rates of those meeting the cut-off for the four SCI subscales were 10.0% to 12.7%, whereas the proportion at or above the ASD cut-off on the SRS Repetitive and Restricted Behaviors (RRB) subscale was much higher (25%) (Figure S1, available online). In contrast, only 0.9% to 5.2% of adults with TD and 0.9% to 1.8% of adults without TD met cut-off criteria for any of the subscales.

Associations Between ASD and Other Disorders

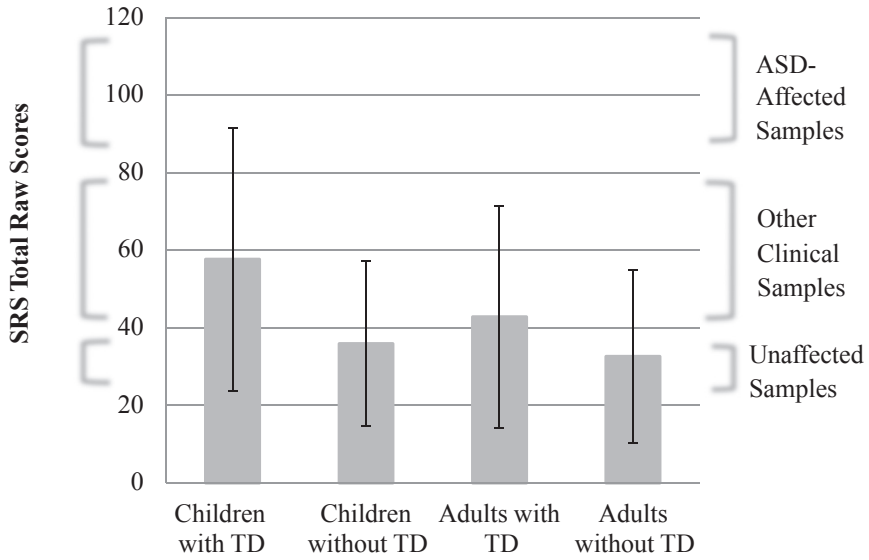
Significant correlations were observed between the SRS total raw score and tic severity ($r = 0.32$; $p < .001$) and TD diagnosis ($r = 0.27$; $p < .001$), but not OCD ($r = 0.04$; $p = .23$) or ADHD ($r = 0.06$; $p = .11$). We also examined differences in gender, OCD, and ADHD rates between those who did and did not meet the cut-off for probable ASD (SRS total raw score >80) among individuals with TD. The χ^2 analyses indicated no significant differences in gender (3.9% of participants with TD+ASD were female, compared to 21.2% of those with TD–ASD; $\chi^2 = 1.53$, $p = .25$). However, rates of

TABLE 1 Sample Characteristics

	All Children		Children With TD		Children Without TD		All Adults		Adults With TD		Adults Without TD	
	313		294		10		533		241		224	
	n	%	n	%	n	%	n	%	n	%	n	%
Male	251	80.2	240	81.6	6	60	295	55.3	161	66.8	100	44.6
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Age, y	11.4	3.6	11.5	3.7	9.7	2.9	42.4	12.8	37.6	15.0	46.9	9.2
SRS	56.5	33.7	57.6	33.8	35.8	21.3	37.8	25.8	42.7	28.6	32.5	22.4

Note: M = mean; SRS = Social Responsiveness Scale; TD = Tourette's disorder.

FIGURE 1 Social Responsiveness Scale (SRS) raw score distribution among adults and children affected and unaffected by Tourette's disorder (TD). Note: Range of SRS total raw scores for unaffected samples is 23 to 35, for mixed or non–autism spectrum disorder (ASD) clinical samples 40 to 75, and for ASD-affected samples 86 to 116, taken from the published literature.



comorbid OCD (83.3% vs. 52.3%; $\chi^2 = 30.78$, $p < .001$) and ADHD (78.5% vs. 38.3%; $\chi^2 = 49.20$, $p < .001$) were significantly higher among individuals with TD who also met criteria for ASD than among those who did not. In comparison, among participants with TD, 7.5% of individuals without OCD and 7.4% of individuals without ADHD met cut-off criteria for probable ASD.

SRS and TD Subphenotypes

Finally, we examined the relationship between the SRS total scores and previously identified TD subphenotypes.[36] These subphenotypes (TD+OCD+ADHD, OCD symmetry, TD+ADHD, tics only, and unaffected) were empirically derived using latent class analysis from the larger set of TD families; the names indicate the predominant symptom patterns seen in each group.[36] For example, individuals in the OCD symmetry class had predominantly OCD symmetry symptoms (e.g., evening-up); 20% also had simple motor tics. There were significant differences in SRS scores among the different classes ($\chi^2 = 128.41$, df = 4, $p < .01$). The highest SRS scores were found in the two classes of individuals who endorsed OCD symptoms (TD+OCD+ADHD; OCD symmetry) (Figure 3) and were the only classes with mean SRS total scores in the range of non-ASD clinical samples. The overall tests for the association between *DSM-5* SRS subscales and LCA classes were also significant (SCI: $\chi^2 = 39.31$, df = 4, $p < .01$; RRB: $\chi^2 = 186.02$, df = 4, $p < .01$). Again, the two classes of individuals who endorsed OCD symptoms at high rates had significantly higher SCI and RRB scores than other classes, with the same patterns seen when participants with and without OCD symptoms were compared.

Familiality Analyses

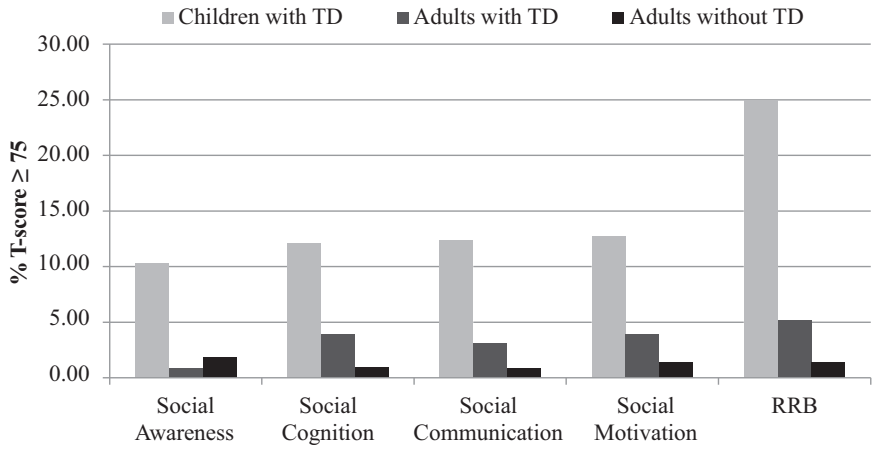
The familiality estimates for the SCI and RRB subscales were both significant (Table 2); familiality was higher for the SCI subscale ($h^2 = 0.44$) than for the RRB subscale ($h^2 = 0.30$). In addition, the fit of both models was improved by including TD and OCD as covariates; including these covariates in the models resulted in lower familiality estimates for the SCI and RRB subscales, and the log likelihood statistics showed a significant difference between the models with and without TD and OCD, suggesting that both SRS subscales have a genetic relationship with TD and with OCD.

DISCUSSION

This study was spurred by the increasing recognition and interest in the relationship of autism symptoms in the TD population. Using a large TD family-based sample, we explored the prevalence and patterns of ASD symptoms in relation to TD and other common comorbid disorders (i.e., OCD and ADHD). We were particularly interested in determining whether the rates of probable ASD diagnoses were elevated in individuals with TD, as has been previously reported, and, if so, whether this elevation could be fully or partially explained by the presence of TD-related (or OCD-related) symptoms that mimicked ASD symptoms or by shared genetic etiology.

Our results suggest that although ASD rates are likely to be elevated in individuals with TD, some of the previously observed elevations in other TD samples may be due to confounding of tic or OCD symptoms for ASD symptoms (or vice versa). The rates of probable ASD using SRS cutoff scores in our current sample are similar

FIGURE 2 Percentage of participants meeting Social Responsiveness Scale cut-off score (T score ≥75) on treatment subscales among adults and children affected and unaffected by Tourette's disorder (TD). Note: Children without TD were excluded due to small numbers (n = 10). RRB = restricted interests and repetitive behaviors.



to those found in mixed, non-ASD clinical samples—higher than in nonclinical samples and lower than in ASD samples.[18] Previous studies have shown that children with mood and anxiety disorders have elevated rates of ASD based on SRS cutoff criteria, suggesting that some of the elevation in SRS scores may reflect underlying psychiatric impairment rather than being specific to ASD. Our finding that 23% of participants affected by TD met cutoff criteria for probable ASD (83% of whom also met criteria for OCD) is in line with this work; in previous studies, 25% of children with anxiety disorders and 38% of children with depression had SRS scores that exceeded the suggested cutoff criteria.[37] However, this hypothesis requires testing by validating SRS-derived ASD diagnoses in participants with TD using current gold-standard assessments for ASD (e.g., the Autism Diagnostic Interview–Revised [ADI-R]). Our findings also suggest a role for shared genetic background between social impairment as measured by the SRS and TD and OCD, which may also partially explain the observed elevations in probable ASD rates in our sample. However, a recent study examining genetic correlations between neuropsychiatric disorders found no genetic relationships between TD and ASD; thus this relationship also requires further investigation in additional samples.[38]

Our other analyses provide additional support for the hypothesis that some of the elevation in SRS scores may be due to general psychiatric impairment. For example, among individuals with TD in our sample, children were more likely to meet ASD criteria than adults (22.8% vs. 8.7%),

FIGURE 3 Social Responsiveness Scale (SRS) total score and *DSM-5* subscale scores among Tourette's disorder (TD) subphenotypes. Note: Letters indicate significant differences between 2 classes ($p < .01$; a = TD-OCD-ADHD, b = OCD symmetry, c = TD-ADHD, d = tics only, e = unaffected). ADHD = attention-deficit/hyperactivity disorder; ASD = autism spectrum disorder; OCD = obsessive-compulsive disorder; RRB = restricted interests and repetitive behaviors; SCI = social communication and interaction deficits.

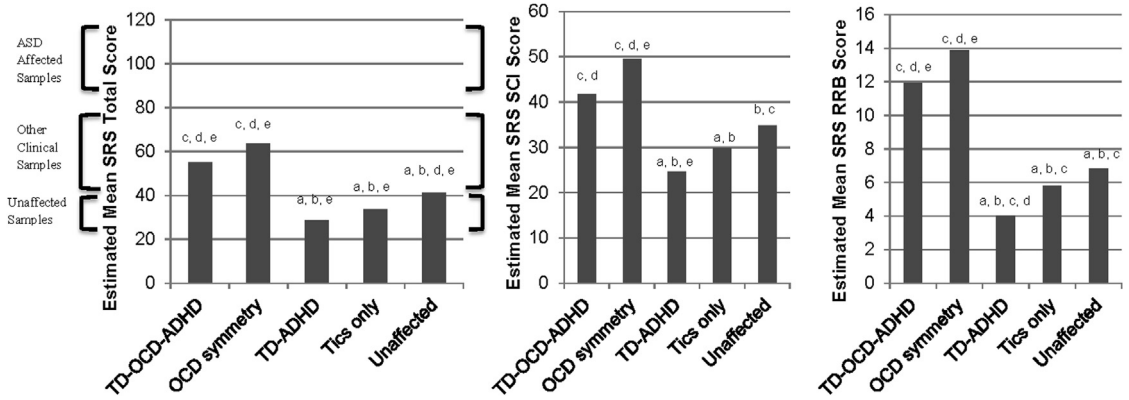


TABLE 2 Familiality Analyses and Model Comparisons for Social Responsiveness Scale *DSM-5* Subscales

	n	Familiality Estimate	SD
SCI			
Base model	489	0.44**	0.09
w/TD and OCD	275	0.30**	0.12
RRB			
Base model	490	0.30**	0.07
w/TD and OCD	276	0.20**	0.09
	Loglikelihood	**χ^2**	**df**
SCI			
All covariates	−495.40		
w/o age	−495.55	0.30	1
w/o sex	−495.72	0.65	1
w/o age*sex	−496.63	2.47	1
w/o TD	−497.07	3.35*	1
w/o OCD	−497.70	4.61*	1
w/o TD and OCD	−501.11	11.42*	2
RRB			
All covariates	−497.73		
w/o age	−498.13	0.79	1
w/o sex	−497.74	0.03	1
w/o age*sex	−497.82	0.17	1
w/o TD	−500.71*	5.96*	1
w/o OCD	−503.78*	12.10*	1
w/o TD and OCD	−510.32*	25.18*	2

*Note: All models included age, sex, and age*sex as covariates. OCD = obsessive-compulsive disorder diagnostic status; RRB = Restricted Interests and Repetitive Behaviors subscale; SCI = Social Communication and Interaction Deficits subscale; SRS = Social Responsiveness Scale; TD = Tourette's disorder diagnostic status; w/ = with; w/o = without.*
**p ≤ .1 significance level to screen covariates; **p ≤ .01.*

suggesting that as tics recede in adulthood, ASD-like symptoms may also be less apparent (although we acknowledge that in individuals with high-functioning ASD, social impairment can also improve substantially in adulthood[39]). Similarly, the rates of probable ASD in individuals with TD alone were comparable to the rates in individuals without TD, and the majority of the elevation in probable ASD rates was seen in participants with TD who also had comorbid OCD or ADHD. Finally, SRS total and subscale scores were substantially higher for participants who had prominent OCD symptoms in the latent class analysis than they were for individuals with tics but no or few OCD symptoms. The fact that scores on the RRB subscale were higher for individuals who endorsed symmetry and/or other OCD symptoms suggests that this SRS subscale may in fact be tapping into common repetitive behaviors seen in individuals with TD and/or OCD (e.g., evening-up behaviors), which could be confused with the stereotypies seen in ASD. This is also supported by previous research using factor analysis in children with TD, in which items measuring repetitive behaviors in autism loaded onto a factor with OCD-related items rather than onto a factor with social communication items.[5]

Similarly, the SRS RRB subscale scores were particularly elevated for children (but not adults) with TD. Given lower ASD rates in adults with TD in our sample, these higher RRB scores might represent, at least in part, a "false comorbidity" (i.e., the endorsement of similar items on TD and ASD scales that represent the same behavior) rather than separate symptoms from the two different disorders. The lower rate of ASD among adults with TD might be explained if repetitive behaviors on the SRS were endorsed in reference to tics rather than true ASD symptoms, as the majority of tics decrease in adulthood,[40] although as noted above, there is evidence to suggest that social skills deficits in ASD also improve with age.[39]

Taken together, the results of this study suggest that although ASD rates appear to be somewhat elevated over population rates, at least some of the ASD-like symptoms, particularly repetitive behaviors, are more strongly related to comorbid symptoms, in particular, OCD symptoms in this TD sample. Previous research on OCD and autism has been mixed; some studies have found higher rates of symmetry-type OCD symptoms in individuals with comorbid ASD, whereas other studies have not found this difference.[41-43] In the current study, there was not a significant correlation between the total SRS score and the presence of comorbid OCD or ADHD. However, when analyses were restricted to participants with TD, higher rates of comorbid OCD and ADHD were found among individuals who met criteria for ASD. In addition, the results of the latent class analyses suggest that comorbid OCD is strongly related to the presence of ASD symptoms in individuals with TD. The highest ASD symptom scores were associated with the TD subphenotypes that included OCD symptoms; this pattern held for the total SRS scores as well as for both the SCI and RRB subscale scores. Future research will be needed to examine how much of the relationship between OCD and ASD symptoms is due to false comorbidity and how much represents an underlying, possibly genetic relationship among TD, OCD, and ADHD.

The familiality estimates in our current study provide some interesting preliminary information about the genetic relationships underlying the elevation of ASD symptoms in our TD families. RRB scores, and SCI scores, which are less likely to be confounded with tics or symmetry symptoms than RRB scores, were both elevated in our sample, and our analyses indicated higher familiality estimates for the SCI subscale than for the RRB subscale. Interestingly, both familiality estimates were lower when TD and OCD were included in the models. These revised estimates ($h^2r = 0.30$ for SCI and 0.20 for RRB) represent the true familiality of each subscale and are not confounded by the familiality of TD or OCD. However, our work cannot determine whether the familiality and phenotypic variance of the SRS subscales that remains after controlling for TD and OCD is due to a true autism-spectrum phenotype, or whether it represents impairment in social interactions due to other causes (i.e., subclinical mood and/or anxiety symptoms).

Future research along this line should use clinical assessment instruments specifically designed to identify individuals with autism spectrum disorder to arrive at a true estimate of the comorbidity between TD and ASD and to examine the familiality of ASD in TD families. Similarly, additional focus on social communication symptoms, independent of ASD diagnoses, in participants with TD is warranted.

There are some limitations to this work. In particular, the small sample size available for the familiality estimates and the fact that most families were parent–child trios rather than extended families limits the interpretation of these results. Similarly, the analyses examining the relationship between SRS scores and previously derived latent classes were conducted on a subsample based on available data. In addition, the observed difference in rates of ASD symptoms between children and adults with TD may be due to an ascertainment bias, in that some of the adults with TD in our sample were parents of children with TD. Also, the SRS was completed by caregivers for children, but the majority of SRS for adults were self-reported; whether this caused the differences between children and adult ratings cannot be ruled out. Finally, it should be noted that we do not have clinical assessments of ASD symptoms or ASD diagnoses or measures of intellectual or language functioning in our sample. We relied on self or parent reports using the SRS, which is a commonly used instrument both in research, and more recently, because of its ease of administration and established cut-offs, in clinical practice.[44] Therefore, future research will be needed to replicate and extend our findings.

Nevertheless, this work has important implications for clinicians who diagnose or treat individuals with TD. In such individuals, particularly if there is concern about possible ASD, a careful clinical examination of symptom patterns that are specific to ASD is essential, with a particular focus on social communication deficits, as measured by the SCI component of the SRS, for example, rather than repetitive behaviors, as measured by the RRB component, as an indication of ASD. Supplementary measures such as the Social Communication Questionnaire (SCQ) may also be useful in screening for ASD in children affected by TD.[45] In addition, even in the absence of ASD, the SRS may be a very useful tool for identifying children with TD who have such social communication deficits, potentially placing them at increased risk for bullying and other negative sequelae among their peers. &

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FIGURE S1 Distributions of Social Responsiveness Scale *DSM-5* subscale T scores. Note: RRB = restricted interests and repetitive behaviors; SCI = social communication and interaction deficits; TD = Tourette's disorder.