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Clinical Characteristics of Children With Tourette Syndrome With and Without Sleep Disorder

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Abstract

Background: Sleep problems are common in children with Tourette Syndrome (TS). However, research regarding their demographic and clinical profile is limited.

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Methods: We examined characteristics of 114 children aged five to 17 years with a lifetime diagnosis of TS and compared children with sleep disorder (n = 32) and without sleep disorder (n = 82). Parent report from the 2014 National Survey of the Diagnosis and Treatment of ADHD and Tourette Syndrome provided demographics and clinical information, other diagnosed disorders, medication use, TS severity, and impairment.

Results: More children with TS with sleep disorder were from households with lower parental education ($P < 0.01$) and poverty ($P = 0.04$); had other diagnoses ($P = 0.03$), including obsessive-compulsive disorder ($P < 0.01$), oppositional defiant disorder or conduct disorder ($P < 0.01$), attention-deficit/hyperactivity disorder (ADHD) ($P = 0.02$), and autism ($P = 0.03$); and had ever used TS medication ($P = 0.01$) than children with TS without sleep disorder. More children with TS with sleep disorder had severe TS symptoms ($P < 0.01$), tic-related impairment ($P < 0.01$), and severe ADHD symptoms ($P < 0.01$) compared with children with TS without sleep disorder.

Conclusions: Findings suggest greater parent-reported impact and tic-related interference in children with TS with sleep disorder compared with TS without sleep disorder. Results underscore the importance of monitoring and intervention for TS exacerbations, other diagnosed disorders, and medication use, and consideration of socioeconomic context in sleep disorder management and prevention in children with TS.

Keywords

Tourette syndrome; Tics; Sleep disorder; Comorbidity; Impairment

Tourette syndrome (TS) is a neurodevelopmental disorder characterized by multiple repetitive, stereotyped movements and one or more vocalizations persisting for longer than one year.[1] TS is more common in males, with a ratio of 3:1.[2] Symptoms typically first present between ages four and eight years,[3] and follow a waxing and waning course, with a rise in severity between ages 10 and 12 years and decline during later adolescence in the majority of cases.[3] TS commonly co-occurs with other disorders such as anxiety (61%) attention-deficit/hyperactivity disorder (ADHD; 52%), behavioral problems (34%), learning disabilities (34%), and developmental delays (26%) in children.[2] Overall prevalence estimates of sleep disorders in children with TS are not well established; in a prior study involving in-person prospective interview of clinic-referred children with TS (n = 123), 65% of children with TS also had a sleep disorder.[4] Common sleep disorders and sleep problems among children with TS include insomnia, parasomnias such as night terrors and sleep walking, and involuntary movements during sleep.[5,6]

Limited research exists examining the clinical characteristics and functional impairment associated with sleep disorder in children with TS. However, available studies suggest some patterns. For example, prior studies have shown that sleep problems in children with TS are associated with the presence of other mental disorders, particularly ADHD,[4,7,8] anxiety disorders,[6,9,10] and obsessive-compulsive and depressive symptoms.[6] In addition, sleep problems in children with TS have been linked to older age,[11] being female,[10,12] and increased tic severity.[6,13] Furthermore, sleep problems are associated with having ADHD and with the use of stimulant medication as treatment for ADHD symptoms,[4,7] potentially affecting children with TS who also have ADHD. Among children with TS, increased sleep

problems have been associated with poorer quality of life.[10] In addition to the limited information, the majority of prior studies have utilized samples of children with TS from specialty clinics, which often contain children with more severe TS symptoms and may be limited to a single geographic area or region.[14,15]

Understanding the factors associated with sleep disorders in children with TS may inform the clinical management of TS. The National Survey of the Diagnosis and Treatment of ADHD and Tourette Syndrome (NS-DATA), designed to improve knowledge related to service use, treatment utilization, and functional health status in families of children with TS and ADHD[16] includes children from geographically diverse, nonclinically drawn samples and provides an opportunity to expand evidence for sleep disorders and TS. Information about associated characteristics and risks may help to identify children with TS who may benefit from clinical intervention and prevention of sleep disorders. Therefore, the present study compared demographic factors, clinical characteristics, and impairment among children with diagnosis of TS with and without a diagnosis of sleep disorder.

Methods

Data were from NS-DATA and included a nationally drawn sample of children with TS, with and without ADHD. It was conducted in 2014 by the US Centers for Disease Control and Prevention's (CDC) National Center for Health Statistics, with support from the National Center on Birth Defects and Developmental Disabilities, as a follow-back survey of selected households that were part of the 2011–2012 National Survey of Children's Health (NSCH). The NSCH used random digit-dialed sampling of households with landline and cell phones and represents noninstitutionalized children aged zero to 17 years in the United States.[17] On the NSCH, one child per household was randomly selected as the target child; parents or primary caretakers (herein referred to as *parents*) were asked to report on that child's physical health, emotional health, and overall well-being.[17]

NS-DATA actively enrolled participants from January 2014 through June 2014. A child was initially eligible for NS-DATA if their parent reported on the 2011–2012 NSCH that they had ever been diagnosed with TS or ADHD by a health care provider.[18] Furthermore, to be eligible for NS-DATA (1) children needed to be younger than 18 years at the time of NS-DATA, (2) children needed to live in the same household as the parent respondent, (3) and their parent needed to confirm that their child ever had a diagnosis of TS or ADHD at the time of NS-DATA.[18] Current diagnosis of TS or ADHD at the time of NS-DATA was not a requirement for NS-DATA eligibility. Parents provided consent over the phone after an interviewer reviewed a consent statement approved by the National Center for Health Statistics Research Ethics Review Board. For additional detail about 2011–2012 NSCH or 2014 NS-DATA see Bramlett et al.,[19] Zablotsky et al.,[16] and Wolicki et al.[20]

NS-DATA included a module for TS and a module for ADHD. At the start of the NS-DATA interview, parents were asked whether their child had ever been diagnosed with ADHD or TS and were then asked to complete the relevant modules depending on their answer. In the TS module of NS-DATA, parents were asked questions about the diagnosis and treatment of their child's TS. The ADHD module of NS-DATA contains similar questions specific to

the diagnosis and treatment of their child's ADHD.[16] The present paper focuses only on children whose parents reported during the NS-DATA interview that their child ever had TS, heretofore described as a lifetime diagnosis of TS, some of whom also ever had a diagnosis of ADHD (lifetime diagnosis of ADHD). All parents of children with TS were asked to complete the TS module; parents who endorsed their child had a lifetime diagnosis of both TS and ADHD were asked to complete both modules. Children with ADHD, but not TS, were not included in this study.

Demographics

The majority of demographic information was collected at the time of the 2011–2012 NSCH including the child's age (updated to reflect age at the time of NS-DATA, dichotomized to 5 to 12 years and 13 to 17 years), sex, racial/ethnic minority status (i.e., black, Hispanic, or other race and ethnicity were included in the minority group), parent education (i.e., highest education level attained by either parent), and household income expressed as a percent of the federal poverty level (FPL). FPL was based on household income and size reported on the 2011–2012 NSCH, calculated by NCHS, and provided in the NS-DATA dataset.[17] Household income for observations with missing income and/or household size was estimated using multiple imputation (affecting less than 10% of the NS-DATA, TS module sample).

Survey items for TS and sleep disorder

Parents were asked "*Has a doctor or other health care provider ever told you that your child had Tourette syndrome?* and "*Has a doctor or health care provider ever told you that your child had a sleep disorder? (Sleep apnea, insomnia, and narcolepsy are examples of sleep disorders).*"

Other mental, behavioral, or developmental disorders

In addition to TS and sleep disorder, parents were asked whether their child was ever diagnosed with any of the following disorders: ADHD, anxiety disorders (such as generalized anxiety disorder, panic disorder, or a phobia), autism spectrum disorder or pervasive developmental disorder, bipolar disorder, conduct disorder, eating disorders (such as anorexia or bulimia), intellectual disability, intermittent explosive disorder, language disorder, learning disorder, mood disorders (such as depression or major depressive disorder), obsessive-compulsive disorder, oppositional defiant disorder, post-traumatic stress disorder, and substance use disorder. An aggregate variable for any mental, behavioral, or developmental disorder was generated from a "*yes*" response to ever having one or more of the disorders listed above.

Medication

Parents of children with TS were asked if their child had ever taken medication for TS. In addition, parents of children with TS and ADHD were also asked if their child had ever taken ADHD medication.

Medication side effects

Parents who endorsed any use of TS medication for their child were asked whether their child had ever experienced TS medication-related side effects, including sleep problems or insomnia, mental slowness or sluggishness, and physical slowness or sluggishness. Parents of children with TS and ADHD who endorsed any use of ADHD medication for their child were asked if their child had ever experienced sleep problems or insomnia due to ADHD medication.

TS Course

To describe TS course, parents were asked about their child's age in years at which someone first noticed tics, help for tics was first sought from a doctor or health care provider, and TS was at its worst.

Severity

In addition, as part of the TS and ADHD modules, respectively, parents were also asked, "*When the symptoms were at their worst, how would you describe [child]'s TS/ADHD?*" Response options (mild, moderate, severe) were dichotomized into "*mild/moderate*" and "*severe.*"

Impairment

Impairment was evaluated using responses to the question, "*When the symptoms were at their worst, did the tics interfere with [child]'s ability to do things other children could do?*" Parents were also asked to describe their child's overall school performance. Response options were "problematic" and "somewhat problematic" (combined as "problematic) and "average," "above average," and "excellent," (combined as "not problematic").

Statistical methodology

The NS-DATA TS module sample was drawn from across the United States, including children from 44 states, but cannot be assumed to be nationally representative or generalizable to all children with TS in the United States.[16] Therefore, unweighted analyses were conducted on this convenience sample using SAS version 9.4 (RTI International; Cary, NC, USA). If a parent refused to answer a question or responded "don't know," their response for that question was considered missing.

Descriptive statistics, including unweighted frequencies, percentages, and means, are presented. Groups were compared using independent samples *t* test and Fisher exact test (two-tailed). Differences with *P* values less than 0.05 were considered significant.

Results

The overall analytical sample included 114[a] children aged five to 17 years with a lifetime diagnosis of TS; among children with TS, 32 also had a lifetime diagnosis of a sleep

[a]The NS-DATA, TS module sample consists of 78 children who had ever been diagnosed with TS at the time of the NSCH 2011–2012 and 37 children who had ever been diagnosed with ADHD at the time of the NSCH 2011–2012 and at the time of the 2014 NS-DATA

disorder (henceforth referred to as TS with sleep disorder) and 82 were without a lifetime diagnosis of sleep disorders (TS without sleep disorder).

Demographics

Among the overall sample (n = 114), 60.5% of children were aged five to 12 years at the time of NS-DATA. Among the sample 82.5% were identified as male and 30.7% were identified as belonging to a racial or ethnic minority group (i.e., Hispanic, non-Hispanic black, or other race or ethnicity, see Table). There were no differences by age, sex, or race and ethnicity for children with versus without sleep disorder (see Table). A significantly higher proportion of children with TS with sleep disorder had no parents who had attained more than a high school degree relative to children with TS without sleep disorder (46.9% vs 17.1%; $P < 0.01$). Similarly, a significantly higher proportion of children with TS with sleep disorder, about half, were residing in households at less than or equal to 200% of the FPL compared with only one-third of children with TS without sleep disorder (56.3% vs 33.4%; $P = 0.04$). All demographic information, except child age at the time of NS-DATA, reflects information collected at the time of the 2011–2012 NSCH.

Other mental, behavioral, or developmental disorders

A significantly higher proportion of children with TS with sleep disorder had another mental, behavioral, and/or developmental disorder relative to children with TS without sleep disorder (100.0% vs 86.6%; $P = 0.03$; see Table). In terms of specific disorders, a significantly higher proportion of children with TS with sleep disorder had a lifetime diagnosis of ADHD compared with children with TS without sleep disorder (90.6% vs 68.3%; $P = 0.02$). Similarly, a significantly higher proportion of children with TS with sleep disorder had lifetime oppositional defiant disorder or conduct disorder, obsessive-compulsive disorder, and autism spectrum disorder relative to children with TS without sleep disorder (see Table). The proportions of children with TS with sleep disorder who had lifetime anxiety or depression were not significantly higher relative to children with TS without sleep disorder (anxiety: 59.4% vs 39.0%; $P = 0.06$; depression: 50.0% vs 31.7%; $P = 0.09$).

Medication

Table also presents medication use among children with TS with and without sleep disorder. A significantly higher proportion of children with TS with sleep disorder had ever taken TS medication relative to children with TS without sleep disorder (77.4% vs 48.8%; $P = 0.01$). In contrast, children with TS with and without sleep disorder did not significantly differ in ever having taken ADHD medication (see Table).

Medication side effects

There were no significant group differences in the proportion of children who ever had sleep problems or were ever mentally or physically slowed down or sluggish as a side effect due

had ever been diagnosed with TS, according to parent report (see Figure 1 in Wolicki et al.[24] for participant flow). In the present analysis, one observation was excluded due to endorsing “don’t know” to the question regarding lifetime sleep disorder, yielding a sample of 114.

to TS medications (see Table). However, among children with lifetime TS and ADHD who took ADHD medication, a significantly higher proportion of children with TS with sleep disorder (86.4%) ever had sleep problems due to ADHD medication relative to children with TS without sleep disorder (53.7%; $P = 0.01$).

TS course

The mean age at which tics were first noticed in children with TS with sleep disorder (M = 6.1, S.D. = 3.2) compared with children with TS without sleep disorder (M = 6.5, S.D. = 2.4; $t = 0.63$, $P = 0.53$) did not differ significantly. The mean age at which help for tics was first requested did not significantly differ between children with TS with sleep disorder (M = 6.9, S.D. = 3.1) and children with TS without sleep disorder (M = 7.2, S.D. = 2.6; $t = 0.51$, $P = 0.61$). Finally, there were no significant differences in the age when they were first diagnosed with TS between children with TS with sleep disorder (M = 7.4, S.D. = 3.1) and children with TS without sleep disorder (M = 7.9, S.D. = 2.5; $t = 0.79$, $P = 0.43$).

Severity

More children with TS with sleep disorder (46.9%) had severe TS when TS was at its worst, relative to children with TS without sleep disorder (18.3%; $P < 0.01$). Similarly, more children who had TS and ADHD with sleep disorder (84.6%) had severe ADHD when ADHD was at its worst when compared with those with TS and ADHD without sleep disorder (50.0%; $P < 0.01$) (see Table).

Impairment

A significantly higher proportion of children with TS with sleep disorder (77.4%) had tic-related interference in their ability to do things their peers could do when symptoms were at their worst, relative to children with TS without sleep disorder (46.9%, $P < 0.01$). There were no significant group differences found in overall school performance (see Table).

Discussion

The present study evaluated the demographic and clinical features and impairment in children with lifetime TS with and without lifetime sleep disorder. A number of risk-related characteristics, including socioeconomic status, presence of other disorders, and impairment in children with TS, were associated with the presence of sleep disorder.

Children with TS with sleep disorder more often experienced socioeconomic disadvantage than children with TS without sleep disorder; they were more likely to have parents whose highest level of education was high school graduate or less and more likely to reside in households with reduced financial resources. The current findings are consistent with research indicating sleep problems among children are associated with markers of socioeconomic disadvantage, including lower parental education levels and increased poverty.[21,22] This relationship between socioeconomic disadvantage and sleep problems has been attributed to a number of contextual influences related to socioeconomic status, including household (e.g., crowding, bed sharing, family conflict, reduced parental

involvement, screen time) and neighborhood-level factors (safety, cohesion, light levels, noise).[23]

All children with lifetime TS with sleep disorder had at least one other lifetime diagnosis of a mental, behavioral, or developmental disorder; this is a significantly higher proportion relative to children with TS without sleep disorder (100% with vs 86.6% without). Lifetime diagnosis of ADHD, autism spectrum disorder, obsessive-compulsive disorder, and oppositional defiant disorder or conduct disorder occurred at significantly higher rates in children with sleep disorder relative to children without sleep disorder. These findings draw attention to the contributions of other psychiatric disorders to the presence of sleep disorders, as prior studies have shown,[4,11] and/or the potential exacerbation of psychological symptoms associated with sleep deprivation.[24,25] Rates of anxiety and depression trended higher in children with TS with sleep disorder than in children with TS without sleep disorder, although these differences did not reach statistical significance. In contrast to our findings, several prior studies have shown a relationship between co-occurring anxiety and co-occurring sleep problems in children with TS.[6,9,10] Although co-occurring psychiatric disorders generally contribute to the co-occurrence of sleep disorders in children with TS,[7,8] a prior study showed that after controlling for co-occurring psychiatric disorders, TS was still significantly and independently associated with higher risk for sleep disorders.[9] Thus, other disorders may not fully account for the presence of sleep disorders.

A higher proportion of children with TS with sleep disorder had used TS medication relative to children without sleep disorder. Previous research has noted side effects of TS medication related to sleep (e.g., sedation or insomnia).[26] However, there were no significant group differences in ever having TS medication-related sleep problems or insomnia, mental sluggishness, or physical sluggishness. Thus, the higher rates of TS medication use in children with sleep disorder may be driven by greater TS symptom severity in that group, as children with a lifetime diagnosis of TS with sleep disorder were more likely to have TS rated as severe by their parents when symptoms were at their worst than children with TS without sleep disorder.

For ADHD medication use, there were no significant group differences among children with TS and ADHD. In contrast, rates of ever having ADHD medication-related sleep problems or insomnia were significantly higher in children with TS and ADHD with sleep disorder than in children with TS and ADHD without sleep disorder. This finding is consistent with a prior study showing that rates of insomnia presenting secondary to medication were higher among children with co-occurring TS and ADHD relative to children with TS without ADHD.[4] In addition, common medications, including stimulants and antidepressants to treat co-occurring disorders in children with TS, have been associated with enuresis and nightmares among males, respectively.[7] Stimulant medications for ADHD are frequently associated with difficulties falling and staying asleep, particularly when taken over shorter durations of time or administered three times a day using immediate release.[27] Of note, a higher proportion of children with TS with sleep disorder have lifetime ADHD than children without sleep disorder, but relatively fewer use ADHD medication. The potential for sleep-related side effects may prevent families from using ADHD medication, which may leave these children with untreated or undertreated ADHD symptoms.

Children with TS with or without sleep disorder did not differ with respect to the average age at which tics were first observed, help for tics was first sought from a health care provider, or TS had reached a peak in severity as reported by their parents. This finding suggests that lifetime sleep disorder may not be associated with timing of symptom onset or peak, or seeking health care in the present sample. However, the survey is cross-sectional as well as retrospective, and thus presence or absence of causal pathways cannot be inferred. Nevertheless, the waxing and waning nature of tics may still have implications for the emergence of sleep disorders in children with TS; future longitudinal studies would be helpful to explore this issue.[5] For example, research involving long-term structured diagnostic assessment of tic severity and sleep disorders beginning at or soon after tic onset and scheduled at stable intervals (e.g., every six months) over several years may inform understanding of directionality between TS and sleep disorders in children.

Children with TS with sleep disorder were significantly more likely to have ever had severe TS and tic-related interference in the ability to do things their peers could do when TS symptoms were at their worst, as reported by their parents, than children without sleep disorder. Collectively, these findings suggest increased peak TS severity among children with TS with sleep disorder relative to those without. Children were also more likely to have had severe ADHD when ADHD symptoms were at their worst than children with TS without sleep disorder. There were no significant group differences in current moderate/severe TS or current or lifetime ADHD severity. Prior research has shown a positive relationship between both TS[5,13] and ADHD severity[28] and sleep problems. A number of factors may contribute to these relationships. For one, increased tic and ADHD symptom severity may directly interfere with sleep. For example, tics occurring at bedtime may make it challenging to fall and remain asleep,[6,29] and ADHD may be associated with bedtime resistance.[30,31] Of note, an inverse relationship, with poor sleep influencing daytime tic and ADHD severity, is also possible.[4] Second, greater TS and ADHD symptom severity may be indicative of increased psychiatric medication use, which is frequently linked to adverse sleep effects, as described above. Third, both TS and ADHD may overlap with sleep problems in terms of neural etiology,[5,32] so the relationship between them may reflect a common underlying mechanism.

Despite finding differences between children with TS with or without sleep disorder in tic-related interference, they did not significantly differ in overall parent-reported school performance, suggesting that lifetime sleep disorder may not be significantly associated with overall school functioning or that this survey methodology lacks sensitivity to detect this association. A more in-depth assessment of sleep duration may shed further light on this issue, given that sleep duration can impact functioning,[33] and a significant proportion of children do not get the recommended sleep.[34] Although not examined in detail in the present analysis, sleep problems can have a number of health consequences for children, including deficits in cognitive, behavioral, and emotional functioning and implications for physical development (e.g., obesity and overweight).[35,36]

The present study has several limitations. First, although data are from a national sample, the dataset is not nationally representative and was treated as a convenience sample for the analyses.[16] Second, the data lack details about the nature of the sleep disorder or

sleep-related problems that parents may not report as a sleep disorder (e.g., difficulty rising, daytime sleepiness, bedtime resistance, irregular bedtime, insufficient sleep).[37] Third, the survey is according to parent report and may be affected by recall bias and observer bias. The questions used for parents to report on tic severity and impairment were general in nature rather than being specific to settings and circumstances or using standardized assessment tools. Parents may be limited in their ability to estimate impact on school functioning. Similar to a study of children with autism spectrum disorder, parent's perception of the child's experience may reflect the impact of the disorder on the family more than the impact felt by the child.[38] In addition, due to the nature of the survey design, we lack child self-report. Children's self-report of sleep may be especially informative when working with older-aged children (i.e., adolescents), as their self-ratings of sleep may significantly diverge from that of their parents due to lower parental monitoring of bedtime and the increased autonomy that emerges with advancing age.[39] Also, it is possible that the higher rates of co-occurring disorders (e.g., obsessive-compulsive disorder, oppositional defiant disorder, or conduct disorder) reported for children with TS with sleep disorder relative to children with TS without sleep disorder contributed to group differences in medication side effects, symptom severity, and symptom-related impairment. In addition, due to multiple statistical comparisons, there is a risk for spurious findings. Some of the data about the child's living situation, such as poverty level, were from the earlier NSCH collected in 2011–2012 rather than the 2014 NS-DATA, which represents a gap between steps of data collection. Moreover, as the study is focused on children with lifetime diagnoses of TS and/or sleep disorder, findings may not generalize to children with current diagnoses of TS and sleep disorder. Additionally, we lack confirmation of mental, behavioral, or developmental diagnoses by a health professional. Prevalence based on parent report of a diagnosis by a health care provider may differ from those in clinical studies. For example, the rate of autism spectrum disorder reported in the present study was higher than that (8.9%) previously reported using gold-standard assessment (i.e., Autism Diagnostic Observation Schedule) in a large (n = 975) clinical sample of children aged five to 18 years with TS.[40,41] Finally, analyses relied upon comparisons of varying sample sizes and unequal variances; readers should interpret *P* values alongside the relative differences in estimates across groups.

Findings suggest increased parent-reported severity and tic-related interference among children with TS with sleep disorder relative to children with TS without sleep disorder. Results may have clinical implications for assessment and management of sleep disorders in children with TS and could guide health care providers toward key clinical characteristics to monitor when addressing sleep problems in children with TS. Assessing sleep problems in children with TS may help health care providers identify those with additional risk; this includes other diagnosed disorders and psychiatric medications, as specified in clinical assessment guidelines,[42] in addition to tic exacerbations. With the potentially increased risk of sleep disorders among children with TS, clinical management of TS may include preventive sleep education and intervention if needed.[42] Future work could explore the potential utility of sleep disorder intervention to improve symptoms of TS and associated disorders.[19] Furthermore, health care providers can also consider the role of socioeconomic status in the development and persistence of sleep problems when administering

interventions.[23] Future research can seek to understand the unique relationships between specific sleep disorders/problems and particular clinical characteristics.

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TABLE.

Demographic and Clinical Characteristics of Children Aged 5 to 17 years With TS, by Sleep Disorder Status

Demographic and Clinical Characteristics	Lifetime TS with Sleep Disorder		Lifetime TS without Sleep Disorder†		Full Sample		*P*
	With Indicator n (%)	TOTAL n	With Indicator n (%)	TOTAL n	With Indicator n (%)	TOTAL n*	
Demographics							
Age (≤12 years)	12 (37.5)	32	32 (39.0)	82	44 (38.6)	114	>0.99
Sex (male)	24 (75.0)	32	70 (85.4)	82	94 (82.5)	114	0.27
Racial or ethnic minority status (minority)‡,§	11 (34.4)	32	22 (26.8)	82	33 (28.9)	114	0.49
Parent education (no parent with more than a high school degree)	15 (46.9)	32	14 (17.1)	82	29 (25.4)	114	<0.01
Federal poverty level (≤200%)‡,‖	1 (56.3)		− (33.4)		− (39.8)		0.04
Other mental, behavioral, or developmental disorders							
One or more lifetime mental, behavioral, or developmental disorder¶	32 (100.0)	32	71 (86.6)	82	103 (90.4)	114	0.03
ADHD	29 (90.6)	32	56 (68.3)	82	85 (74.6)	114	0.02
Anxiety	19 (59.4)	32	32 (39.0)	82	51 (44.7)	114	0.06
Autism spectrum disorder	17 (53.1)	32	24 (29.3)	82	41 (35.9)	114	0.03
Depression	16 (50.0)	32	26 (31.7)	82	42 (36.8)	114	0.09
OCD	21 (65.6)	32	30 (36.6)	82	51 (44.7)	114	<0.01
ODD or conduct disorder	19(61.3)	31	23 (28.1)	82	42 (37.2)	113	<0.01
Medication							
Ever TS medication	24 (77.4)	31	40 (48.8)	82	64 (56.6)	113	0.01
Ever ADHD medication#	22 (81.5)	27	41 (89.1)	46	63 (86.3)	73	0.48
Medication side effects**							
Ever sleep problems or insomnia due to TS medication	13 (54.2)	24	13 (34.2)	38	26 (41.9)	62	0.19
Ever sleep problems or insomnia due to ADHD medication	19 (86.4)	22	22 (53.7)	41	41 (65.1)	63	0.01
Ever mentally slowed down or sluggish due to TS medication	17 (70.8)	24	19 (50.0)	38	36 (58.1)	62	0.12
Ever physically slowed down or sluggish due to TS medication	15 (62.5)	24	15 (39.5)	38	30 (48.4)	62	0.12
Severity							
Worst TS severity (severe)	15 (46.9)	32	15 (18.3)	82	30 (26.3)	114	<0.01
Worst ADHD severity (severe)††	22 (84.6)	26	23 (50.0)	46	45 (62.5)	72	<0.01

Demographic and Clinical Characteristics	Lifetime TS with Sleep Disorder		Lifetime TS without Sleep Disorder†		Full Sample		*P*
	With Indicator n (%)	TOTAL n	With Indicator n (%)	TOTAL n	With Indicator n (%)	TOTAL n*	
Impairment							
At their worst, tics interfered with ability to do things other children could do	24 (77.4)	31	38 (46.9)	81	62 (55.4)	112	<0.01
Overall school performance (problematic)‡‡	17 (53.1)	32	33 (40.7)	81	50 (44.3)	113	0.29

Abbreviations:

ADHD = Attention-deficit/hyperactivity disorder

OCD = Obsessive-compulsive disorder

ODD = Oppositional defiant disorder

TS = Tourette syndrome

Data from the 2014 National Survey of the Diagnosis and Treatment of ADHD and Tourette Syndrome (NS-DATA) and 2011–2012 National Survey of Children's Health (NSCH).

*Proportions reflect unweighted values. The original NS-DATA sample had 115 participants. One observation was excluded from the analysis due to endorsing "don't know" to ever diagnosed with sleep disorder.

†*P* values are listed for group comparisons between lifetime TS without sleep disorder and lifetime TS with sleep disorder.

‡Data for these indicators are from the 2011—2012 NSCH; all other values are from NS-DATA.

§Youth were categorized as minority status if identified as black, Hispanic, or other (i.e., not non-Hispanic white).

‖Federal poverty level reflects the proportion of household incomes that were less than or equal to 200% federal poverty level, using multiply imputed data for less than 5% of the overall sample (n = 114). Because of the imputation procedure, no sample n's were available.

¶Represents an aggregate variable generated from a "yes" response to ever being diagnosed with one or more co-occurring disorders each rated separately: ADHD, anxiety disorders (such as generalized anxiety disorder, panic disorder, or a phobia), autism spectrum disorder or pervasive developmental disorder, bipolar disorder, conduct disorder, eating disorders (such as anorexia or bulimia), intellectual disability, intermittent explosive disorder, language disorder, learning disorder, mood disorders (such as depression or major depressive disorder), OCD, ODD, post-traumatic stress disorder, and substance use disorder.

#Only parents who reported that their child was ever diagnosed with ADHD and were administered the ADHD module were asked to report on ADHD medication.

**Only parents who reported that their child was taking TS or ADHD medication were asked to report on side effects.

††Only parents who reported that their child was ever diagnosed with ADHD and were administered the ADHD module were asked to report on ADHD severity.

‡‡"Problematic" performance was derived from answer options of "problematic" and "somewhat problematic."

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