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ORIGINAL ARTICLE

Neurodevelopmental and Mental Health Diagnoses Among Pediatric Patients With Turner Syndrome: A PEDSnet Study

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ABSTRACT

Individuals with Turner syndrome (TS) are known to be at increased risk for neurodevelopmental disorders (NDD) and mental health (MH) conditions, but data from large, population-based pediatric samples remain limited. We examined the prevalence of NDD and MH diagnoses among youth with TS ($N = 2145$) compared to matched female controls ($N = 8580$) across six US pediatric health systems. Odds ratios (OR) and 95% confidence intervals (CI) were calculated using generalized estimating equations. Youth with TS had significantly higher odds of an NDD diagnosis (24.2% vs. 11.9%; OR 2.37, 95% CI 2.11–2.67), particularly for speech-language, motor, learning, and attentional disorders. Increased odds were also observed for autism spectrum disorder (ASD) and intellectual developmental disorder (IDD), though these remained relatively uncommon. In contrast, MH diagnoses, such as anxiety and mood disorders, were not more prevalent in TS compared to controls (17.3% vs. 18.5%; OR 0.92, 95% CI 0.81–1.05). These findings support the need for proactive neurodevelopmental screening in TS and raise important questions about the recognition and documentation of MH conditions in this population. Additional research is warranted to understand whether MH symptoms are underdiagnosed, present differently, or emerge later in development in youth with TS.

1 | Introduction

Turner syndrome (TS) is a genetic disorder that occurs in 1:2000–2500 females due to a partial or complete absence of the second sex chromosome (Berglund et al. 2019; Martin-Giacalone et al. 2023). Karyotypes vary, with approximately half of individuals presenting with non-mosaic 45, X (Cui et al. 2018). Phenotypic heterogeneity in TS is influenced by the specific karyotype as well as other genetic and environmental factors. Classically, TS is associated with short stature, congenital and acquired cardiac conditions (Bondy 2008; Yoon et al. 2023), primary ovarian insufficiency, and sensorineural hearing loss (Kubba et al. 2017). Standard treatments often include growth hormone and estrogen replacement therapy. In addition to these

physical manifestations, neurodevelopmental disorders (NDD) and mental health (MH) conditions are also common among individuals with TS.

Existing research characterizing the neurocognitive profile in TS reveals an increased likelihood of developmental and cognitive challenges. Developmental delays across fine motor, gross motor, and language domains are commonly reported in TS (Robinson et al. 1990). A recent multi-site study found that 40.9% of 631 children with TS had documented developmental concerns in their medical records (Kremen et al. 2023). Most individuals with TS have overall intellectual abilities within the average range, although significant discrepancies between domains are often present (Pennington et al. 1985). Verbal reasoning is often a relative strength, while visual–spatial deficits are frequently noted—previously characterized as the verbal IQ-performance IQ (VIQ-PIQ) split (Pennington et al. 1985). Attention-related challenges are also prevalent, with increased rates of Attention-Deficit/Hyperactivity Disorder (ADHD) reported. Studies estimate that 14%–25% of individuals with TS have ADHD (Kremen et al. 2023; Russell et al. 2006; Björlin Avdic et al. 2021). However, there is high variability among studies, with a large population-based study from Sweden finding only 1.6% of individuals with TS had ADHD compared to 1.2% of controls (Björlin Avdic et al. 2021). Additionally, specific learning disabilities, particularly in mathematics, affect 43%–55% of individuals with TS (Rovet 1993; Mazzocco 2006). Social communication deficits, especially understanding facial expressions or nonliteral/figurative language (e.g., sarcasm, idioms), are also frequently reported (McCauley et al. 2001). Previous research has also indicated increased concerns regarding social competence and social cognition (Hong et al. 2011). In one large population study, individuals with TS were four times more likely to have an autism spectrum disorder (ASD; 2% vs. $<1\%$ in the general population) (Björlin Avdic et al. 2021). Another study found that 3% of individuals with TS met the diagnostic criteria for ASD, approximately twice the incidence observed in the general female population (Björlin Avdic et al. 2021). Some neurodevelopmental outcomes may be directly or indirectly impacted by medical comorbidities. For example, children with congenital heart disease requiring surgery or prolonged hospitalization are at increased risk for NDDs due to a variety of risk factors that can impact the developing brain, including the potential for chronic hypoxia (Marino et al. 2012). Similarly, hearing impairment can place a child at increased risk for delays in speech-language and literacy development (Alzahrani et al. 2015). Despite well-documented NDD comorbidities in TS, population-based data on the relative odds of these conditions compared to peers remain limited.

MH conditions including mood or affective are also commonly associated with TS. Reported prevalence rates vary by population and study design, ranging from 22% to 70%, with depression and anxiety being most frequently observed (McCauley et al. 2001; Downey et al. 1989; Cardoso et al. 2004). Most studies suggest the prevalence of MH conditions is higher in TS than typical female peers; however, disparities diminish when compared to females with short stature (Kiliç et al. 2005) or premature ovarian insufficiency (Schmidt et al. 2006). Thus, as with NDDs, MH concerns may be more closely related to the medical phenotype of TS than to intrinsic genetic risk. The impact of MH disorders across development in TS remains unclear. A recent systematic review noted increased risk for depression in adolescents and adults with TS, but not in children (Morris et al. 2020). A recent chart review spanning three large pediatric centers found that 20.4% of youth with TS had documented MH concerns; however, the study lacked a direct comparison group (Kremen et al. 2023). In contrast, (Björlin Avdic et al. 2021) found only 7% of individuals with TS were diagnosed with an anxiety disorder compared to 8% of the control group (Björlin Avdic et al. 2021). Taken together, these findings highlight the need for further research into the association between MH disorders and TS, particularly in pediatric populations.

To date, much of the literature on NDD and MH outcomes in TS is derived from small, clinic-based samples. The current study aimed to expand on those findings using data from a large, diverse US pediatric cohort, with diagnostic and treatment information reflective of US-based clinical practice. We hypothesized that youth with TS would have increased odds of receiving NDD and MH diagnoses compared to matched peers.

2 | Materials and Methods

2.1 | Data Source

PEDSnet is a pediatric clinical research network facilitating collaborative, patient-centered pediatric research in the US Six children's health systems—Children's Hospital Colorado, Children's Hospital of Philadelphia, Nemours Children's Health System, Nationwide Children's Hospital, St. Louis Children's Hospital, and Seattle Children's Hospital—participated in this project, collectively representing over 6 million children. A limited dataset including individual-level data for patient demographics, clinical encounter types, diagnoses (from billing codes and/or problem list), and prescription medications from electronic health records (EHR) was obtained from the PEDSnet Data Coordinating Center.

2.2 | Analytic Sample

Patients within participating PEDSnet institutions with a diagnosis code mapping to TS (see Table S1 for codes previously validated), with at least one visit before the age of 21 years, and at least one outpatient visit in a 10-year period (from 2009 to 2019) were included as TS Cases ($n=2145$) as per our prior TS computable phenotype analysis (Huang et al. 2024). A random sample of 113,725 females with at least one outpatient visit and no diagnosis of TS or any other genetic condition were used as a pool of controls. Because demographic variables were dissimilar between TS cases and controls, we proceeded with propensity score matching. Propensity scores were generated via multivariable logistic regression based on year of birth, age at last encounter, PEDSnet site, race, ethnicity, health insurance payer status (public/private/none), and duration in the PEDSnet database (time between first and last encounter). Missing data were handled by the widely accepted approach of including missing as a separate category for the variable. Each TS case was matched to four controls on the logit of the propensity score using a greedy match algorithm and a caliper

of width 0.1. Covariate balance was evaluated using standardized mean differences, with values less than 0.2 indicative of acceptable balance.

2.3 | Outcomes

The PEDSnet Common Data Model directly maps to SNOMED-CT concept codes, an international system for clinical terminology. Investigators refined composites to encompass the diagnoses of interest (Table S1). The NDD Composite included diagnoses related to developmental delays, autism spectrum disorders, learning disorders, and behavioral disorders. The MH Composite included all conditions falling under the SNOMED parent code "Mental Disorder" except for the concept "developmental mental disorder," "developmental delay in feeding," "feeding disorder of infancy," and "non-organic infant feeding disturbance". Additional composites were also developed to assess related outcomes of interest including sleep disorders, failure to thrive, and self-harm. In addition to diagnoses, RxNorm codes were used to query prescriptions for any stimulant medications, selective serotonin uptake inhibitors (SSRIs) and antipsychotic medications. All outcomes were treated as binary variables; if there was no documentation of the condition within the record it was determined to not be present.

2.4 | Statistical Analyses

Descriptive statistics (frequencies and percent, means and standard deviations and/or median with interquartile ranges) were used to summarize sample demographics and outcomes. Generalized estimating equations (GEE) were used to compare TS cases to controls, and the odds ratio (OR) and 95% confidence intervals were reported. In accordance with PEDSnet policy, cells with fewer than 11 individuals were not reported. In addition to the GEE models, logistic regression models including covariates of growth hormone prescription (yes/no) and estrogen prescription (yes/no) were conducted for the TS cases. Given the large dataset and multiple comparisons, a conservative significance threshold of $p < 0.0025$ was applied. All statistical analyses were conducted in SAS version 9.4 (SAS Institute Inc., Cary, NC).

3 | Results

There were 2145 individuals within PEDSnet with a diagnosis of TS. The median age at first TS diagnosis was 8 years; 42.3% had a documented prescription for growth hormone, and 32.2% had a prescription for estrogen. Demographics were similar between TS and their matched controls, although patients with TS had more total outpatient visits (Table 1). Significantly more patients with TS had encounters with a behavioral health provider (37.6% for TS vs. 24.2% for controls, $p < 0.0001$).

3.1 | NDD Outcomes

Nearly one quarter (24.2%) of individuals with TS had a diagnosis encompassed by the NDD Composite, representing significantly higher odds compared to controls (OR 2.4 [95% CI 2.11–2.67]) (Figure 1). The TS group had a higher prevalence of all diagnoses falling under the NDD Composite, with the exception of disruptive behavior disorders (Table 2). Longer duration in the PEDSnet system and younger age at diagnosis were associated with higher odds of diagnoses within the NDD Composite; however, inclusion of these variables in the model did not change the results. Within the TS group, treatment with growth hormone was positively associated with diagnoses within the NDD Composite, including learning disabilities and ADHD. In addition, use of estrogen was positively associated with a learning disorder diagnosis (Table S2). Although individuals with TS were at a higher risk for being diagnosed with ADHD, prescriptions for stimulant medication were not significantly different across the two groups (5.3% vs. 4.1%).

3.2 | MH Outcomes

In contrast to the NDD Composite, youth with TS had a similar prevalence of MH diagnosis to matched controls (17.3% vs. 18.5%, $p = 0.21$) (Figure 1). Longer study duration and older age at the last follow-up appointment were associated with higher odds of diagnoses within the MH composite; however, adding these variables to the model did not change results. Compared with controls, individuals with TS had a *lower* prevalence of both anxiety (6.4% vs. 7.9%, OR 0.80 [0.66, 0.96]) and mood disorders (3.6% vs. 7.5%, OR 0.46 [0.36, 0.59]). Similarly, self-harm diagnoses were less common among youth with TS (OR 0.29 [95% CI 0.17–0.50]) compared to controls. Congruent with diagnostic findings, there was no increased use of SSRIs (4.1% vs. 5.3%) or antipsychotic medications (2.0% vs. 3.0%) in patients with TS compared to controls. Within the TS cohort, neither growth hormone nor estrogen prescriptions were associated with any MH diagnoses (Table S2). Although not strictly classified as an MH condition, sleep disorders were more prevalent among youth with TS (13.0% vs. 8.1%, OR 1.69 [95% CI 1.46–1.95]) and were positively associated with growth hormone treatment.

4 | Discussion

This large, multicenter US study of pediatric patients with TS demonstrates that youth with TS are at significantly increased risk for NDDs compared with matched peers, but not for MH diagnoses. One in four individuals with TS had an NDD diagnosis, with particularly elevated odds for speech-language, motor, learning, and attention disorders. In contrast, the prevalence of MH diagnoses, such as anxiety and mood disorders, was comparable or even lower than in matched controls. These findings suggest that while NDDs are more consistently recognized and diagnosed in TS, MH diagnoses may not be fully captured in EHR data. If youth with TS are at higher risk for MH conditions, as clinical experience would suggest, there is a need for improved screening and diagnostic practices to ensure these concerns are identified and addressed in clinical care.

Our findings regarding NDDs are consistent with previous literature describing increased neurodevelopmental risk in TS. Diagnoses of learning disabilities and ADHD were significantly more common among individuals with TS in this study,

TABLE 1 | Cohort demographics.

	TS (%) $N = 2145$	Controls (%) $N = 8580$	p
Site			0.93
Site 1	252 (11.7)	1043 (12.2)	
Site 2	423 (19.7)	1612 (18.8)	
Site 3	290 (13.5)	1135 (13.2)	
Site 4	552 (25.7)	2230 (26.0)	
Site 5	426 (19.9)	1745 (20.3)	
Site 6	202 (9.4)	815 (9.5)	
Race			> 0.99
White	1458 (68.0)	5823 (67.9)	
Black	179 (8.3)	696 (8.1)	
Asian	54 (2.5)	215 (2.5)	
Other	284 (13.2)	1158 (13.5)	
Unknown	170 (7.9)	688 (8.0)	
Ethnicity			0.68
Hispanic	311 (14.5)	1240 (14.5)	
Non-Hispanic	1704 (79.4)	6775 (79.0)	
Unknown	130 (6.1)	565 (6.6)	
Health insurance status			0.04
Public	820 (38.2)	3317 (38.7)	
Private	1119 (52.2)	4433 (51.7)	
Other	156 (7.3)	543 (6.3)	
Unknown	50 (2.3)	287 (3.3)	
Age at first visit (years)	4.4 [0.3, 10.2]	4.3 [0.7, 9.9]	0.05
Age at last visit (years)	14.3 [8.5, 18.5]	14.6 [10.0, 17.2]	0.08
Duration in PEDSnet (years)	7.1 [2.8, 11.5]	7.3 [2.2, 12.2]	0.48
Total # of outpatient visits	17.0 [8.0, 38.0]	7.0 [3.0, 20.0]	< 0.01
Age at first TS diagnosis (years)	8.0 [2.0, 13.0]	n/a	n/a
Age at last TS diagnosis (years)	13.0 [7.0, 17.0]	n/a	n/a
# of encounters with a TS diagnosis	10.0 [4.0, 22.0]	n/a	n/a

Note: Data are presented as *N* (%) or median [IQR].

supporting prior studies that document these difficulties as part of the TS neurocognitive phenotype (Björlin Avdic et al. 2021). Intellectual developmental disorder was more prevalent in TS compared to controls, although overall rates remained relatively low, consistent with the broader consensus that intellectual functioning in TS is generally within the average range (Hong et al. 2009; Mazzocco 2006). ASD was similarly more prevalent in TS, although rates remain low. The observed ADHD prevalence (9%) was higher than in the Swedish registry study (1.6%) but lower than in smaller US clinic-based cohorts reporting rates as high as 25% (Russell et al. 2006; Björlin Avdic et al. 2021). This suggests that while increased attentional difficulties are recognized in some individuals with TS, they may still be underdiagnosed, particularly if symptoms are attributed to the TS phenotype rather than conceptualized as a separate disorder.

Despite the elevated rate of ADHD diagnoses, stimulant prescriptions were not more common in the TS group than in controls. This may reflect under-treatment or under-recognition of functionally impairing attention difficulties, a phenomenon observed in other pediatric populations with chronic health conditions. For example, research among cancer survivors has shown that many children experience attentional impairments without meeting formal diagnostic criteria for ADHD (Kahalley et al. 2011). The emerging use of "neurodevelopmental disorder

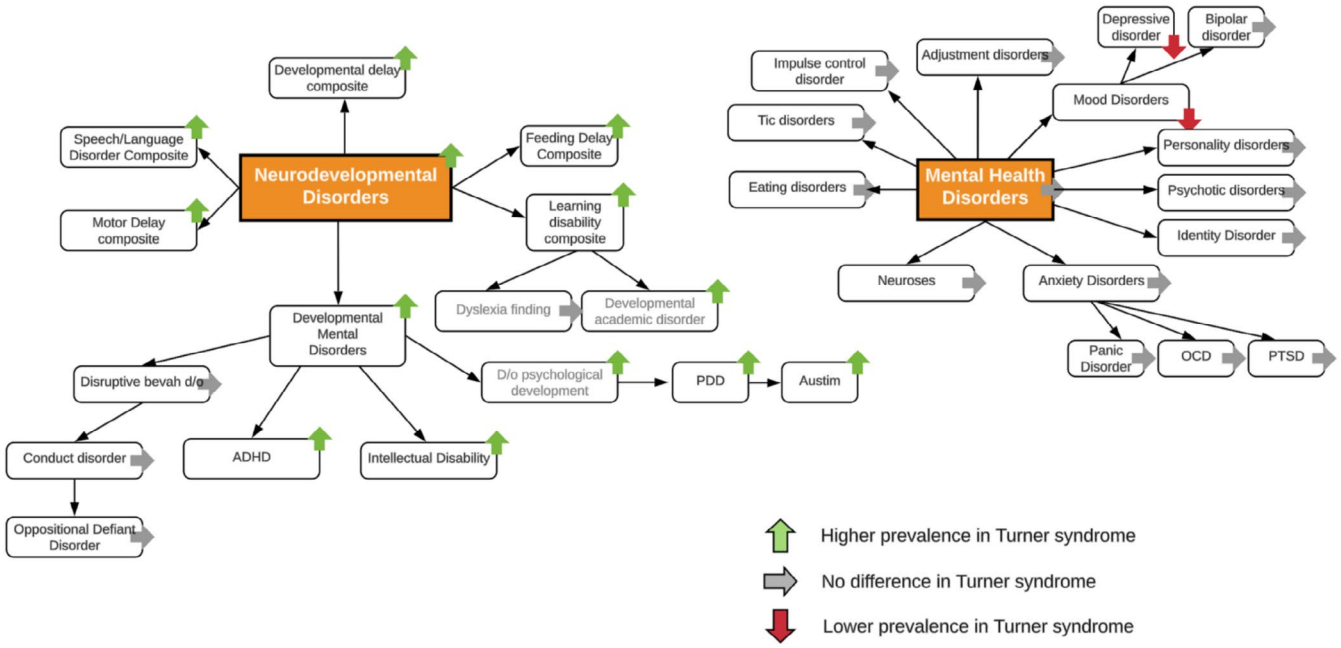

FIGURE 1 | Neurodevelopmental disorder (NDD) diagnoses are diffusely increased in youth with TS compared to age- and sex-matched peers; however, mental health (MH) diagnoses are not.

associated with a medical condition" as a diagnostic label highlights the need for greater diagnostic nuance in medically complex populations. Our findings emphasize the importance of systematic screening and referral to neuropsychological services for youth with TS, as recommended by the TS Clinical Practice Guidelines, to ensure that cognitive and behavioral symptoms are appropriately evaluated and supported (Gravholt et al. 2024).

In contrast to expectations and clinical experience, we did not find an increased prevalence of MH diagnoses, such as anxiety or mood disorders, among individuals with TS. Rates of self-harm diagnoses and prescriptions for SSRIs and antipsychotics were also similar or lower than in controls. While this pattern was surprising, it mirrors findings from another large population-based study by Björlin Avdic et al. (2021), which also found no increased risk of anxiety or related disorders among individuals with TS compared to the general population. One potential explanation is that MH conditions are under-recognized or under-documented in pediatric medical settings. Many youth with TS are followed primarily by specialists such as endocrinologists or cardiologists, who may not routinely screen for emotional or behavioral concerns. A recent survey of pediatric endocrinologists reported low confidence in identifying and addressing MH concerns among patients with TS (Davis et al. 2021). In addition, behavioral health providers may bill for psychosocial concerns using Health and Behavior codes, which would not appear as psychiatric diagnoses in the EHR (McAuliffe Lines et al. 2012). It is also possible that the expression of MH symptoms in TS differs from typical presentations, complicating recognition using standard diagnostic frameworks. Prior studies have suggested that anxiety in TS may present with somatic or internalized features that are less likely to trigger formal diagnosis (Carl et al. 2024). Another important consideration is the nature of our control group, which was limited to pediatric patients seen at tertiary care institutions. Many of these children likely have chronic medical conditions, which may also be associated with elevated MH risk. This may have attenuated differences between groups and contributed to the relatively high rate of MH diagnoses in controls. Indeed, both groups had MH diagnosis rates below the 25% prevalence estimated for adolescent anxiety in the US (Merikangas et al. 2010) which may reflect underdiagnosis or limited documentation of MH conditions in subspecialty care.

In addition to group-level differences, we examined individual-level factors associated with diagnostic patterns in TS. Longer duration in the PEDSnet system was associated with higher odds of both NDD and MH diagnoses, which was also observed in a similar study among youth with differences of sex development suggesting that increased time in care provides more opportunities for symptom recognition and documentation (Sewell et al. 2021). Age patterns also aligned with clinical expectations: younger age was associated with greater odds of NDD diagnoses, reflecting the early developmental onset of many of these conditions, while older age was associated with increased likelihood of MH diagnoses, which may emerge, or be more readily identified, during adolescence (Steinhausen and Jakobsen 2019). We also found that treatment with growth hormone and estrogen was associated with higher odds of NDD diagnoses. These associations likely reflect phenotype severity rather than causal effects of treatment, as individuals requiring these therapies may represent a more medically complex subset of the TS population. Taken together, these findings highlight how developmental stage, medical complexity, and duration of clinical follow-up may influence the likelihood of receiving a documented NDD or MH diagnosis in TS.

4.1 | Limitations

Several limitations should be considered. First, the use of deidentified EHR data limited our ability to stratify results by

TABLE 2 | NDD and MH Diagnoses.

	TS $N = 2145$	Controls $N = 8580$	OR (95% CI)	p
NDD composite	520 (24.2)	1020 (11.9)	2.37 (2.11, 2.67)	**<0.0001**
Development delay composite	188 (8.8)	231 (2.7)	3.47 (2.86, 4.22)	**<0.0001**
Motor delay disorder composite	245 (11.4)	511 (6.0)	2.04 (1.73, 2.39)	**<0.0001**
Feeding delay disorder composite	138 (6.4)	149 (1.7)	3.89 (3.07, 4.94)	**<0.0001**
Speech and language disorder composite	241 (11.2)	408 (4.8)	2.54 (2.15, 2.99)	**<0.0001**
Learning disorder composite	95 (4.4)	129 (1.5)	3.04 (2.34, 3.95)	**<0.0001**
Disruptive behavior disorder	101 (4.7)	345 (4.0)	1.18 (0.94, 1.48)	0.15
Attention deficit hyperactivity disorder	190 (8.9)	453 (5.3)	1.74 (1.46, 2.08)	**<0.0001**
Intellectual developmental disorder	51 (2.4)	118 (1.4)	1.75 (1.26, 2.41)	**0.0007**
Autism spectrum disorder	72 (3.4)	122 (1.4)	2.41 (1.79, 3.23)	**<0.0001**
MH composite	371 (17.3)	1586 (18.5)	0.92 (0.81, 1.05)	0.21
Adjustment disorder	32 (1.5)	162 (1.9)	0.79 (0.54, 1.15)	0.22
Anxiety disorder	138 (6.4)	680 (7.9)	0.80 (0.66, 0.96)	0.02
Obsessive-compulsive disorder	13 (0.6)	57 (0.7)	0.91 (0.51, 1.64)	0.76
Eating disorder	32 (1.5)	143 (1.7)	0.89 (0.61, 1.32)	0.57
Mood disorder	78 (3.6)	647 (7.5)	0.46 (0.36, 0.59)	**<0.0001**
Depressive disorder	67 (3.1)	578 (6.7)	0.45 (0.34, 0.58)	**<0.0001**
Tic disorder	17 (0.8)	67 (0.8)	1.02 (0.59, 1.74)	0.96
Other related diagnoses				
Sleep disorder	279 (13.0)	698 (8.1)	1.69 (1.46, 1.95)	**<0.0001**
Self-harm composite	14 (0.7)	192 (2.2)	0.29 (0.17, 0.50)	**<0.0001**
Encounters and prescriptions				
Behavioral health encounter	806 (37.6)	2072 (24.2)	1.89 (1.71–2.09)	**<0.0001**
SSRI prescription	87 (4.1)	455 (5.3)	0.75 (0.60–0.95)	0.018
Antipsychotic prescription	42 (2.0)	259 (3.0)	0.64 (0.46–0.89)	0.007
Stimulant prescription	113 (5.3)	353 (4.1)	1.30 (1.04–1.61)	0.029

Note: Data are presented as N (%). NDD = neurodevelopmental disorder; MH = mental health; SSRI = selective serotonin reuptake inhibitor.

karyotype or mosaicism status, which may impact neurodevelopmental risk. Although prior studies suggest strong diagnostic validity of TS in PEDSnet,[24] we could not confirm specific genetic findings or differentiate more complex presentations (e.g., ring X chromosome). Second, reliance on billing codes may have resulted in misclassification or missed diagnoses, especially for conditions that are less consistently documented or diagnosed in specialty care. Third, care delivered outside of PEDSnet institutions, including community or school-based evaluations, was not captured, likely leading to underestimates of NDD and MH prevalence. We were also unable to control for important risk factors such as prematurity, anesthesia exposure, or medical complexity, which are known to affect neurodevelopmental outcomes. Finally, PEDSnet policy on small cell sizes (< 11 individuals) restricted reporting on rare conditions.

5 | Conclusion

In this large, population-based study of youth with TS, we found significantly increased odds of NDD diagnoses, especially in the areas of speech-language, learning, motor, and attention, compared to matched controls. However, we did not observe increased rates of documented MH diagnoses, raising the possibility that these concerns are under-recognized or underreported in pediatric specialty care. These findings support the need for routine, proactive screening for both NDD and MH concerns in youth with TS. As research continues to clarify the neurocognitive and social–emotional phenotype associated with TS, it will be important to identify modifiable risk factors and develop targeted interventions to improve long-term outcomes.

Author Contributions

Christa Hutaff-Lee: conceptualization, methodology, data curation, and writing – original draft. **Holly Wakeman:** data curation and writing – original draft, review and editing. **Deanna Swain:** data curation and writing – review and editing. **Morgan Jolliffe:** data curation and writing – original draft. **Karli S. Swenson:** data curation and writing – original draft. **Anna Furniss:** formal analysis and writing – review and editing. **Natalie Nokoff:** methodology, data curation, writing – review and editing. **Jen Hansen-Moore**, **Chijioke Ikomi**, **Vaneeta Bamba**, **Rachel E. Lean**, and **Skyler Leonard:** data curation and writing – review and editing. **Shanlee M. Davis:** conceptualization, methodology, funding acquisition, data curation, and writing – review and editing. All authors critically reviewed and edited the final version of the manuscript and approve it for publication.

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Ethics Statement

This project was approved by the PEDSnet Research Committee and was determined by the local Institutional Review Boards to be non-human subject research, as research activities were limited to receipt and analysis of deidentified data.

Conflicts of Interest

S.D. has received research funding unrelated to this study from Turner Syndrome Global Alliance and Turner Syndrome Colorado and has consulted for Ascendis Pharma. N.N. is a consultant for Neurocrine Biosciences and on an expert panel for World Athletics. The all other authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from PEDSnet. Restrictions apply to the availability of these data, which were used under license for this study.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Table S1:** Definitions. **Table S2:** Associations between estrogen or growth hormone prescriptions and outcomes, TS only.