

CASE REPORT

# A comprehensive cognitive behavioral intervention in a 12-year-old girl with Tourette Syndrome Plus: A case report

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## Abstract

**BACKGROUND:** Tourette syndrome (TS), a neurodevelopmental disorder marked by tics, affects the quality of life due to associated social and emotional challenges. Approximately 86% of TS patients also suffer from psychiatric comorbidities, termed TS Plus. Cognitive behavioral therapy (CBT) is a recommended non-invasive initial treatment option. This case report outlines the successful CBT treatment of a 12-year-old girl, S.G., diagnosed with TS Plus, without the need for pharmacological intervention.

**CASE PRESENTATION:** S.G. exhibited motor and vocal tics, severe phobia, social anxiety, and obsessive-compulsive behavior (OCB), severely impacting her self-esteem and daily functioning. Treatment began with Comprehensive Behavioral Intervention for Tics (CBIT) to address tics. Social anxiety was managed using assertive training, exposure therapy, cognitive restructuring, and relaxation techniques. Phobia treatment integrated relaxation, exposure therapy, and Virtual Reality Exposure Therapy (VRET), while third-generation techniques enhanced self-esteem and self-efficacy.

**RESULTS:** Post-treatment, significant improvements were observed in S.G.'s symptoms: tics (YGTSS: 86 to 15/100), phobia (Severity Measure for Specific Phobia: 38 to 6/40), social anxiety (LSAS: anxiety from 30 to 11, avoidance from 40 to 2), and OCB (CY-BOCS: 15 to 2/40). Enhanced self-esteem was also noted, with therapeutic benefits maintained at 1, 3, 6, and 10-month follow-ups.

**DISCUSSION:** This case supports CBT's efficacy in treating TS Plus symptoms without pharmacological methods. However, factors like patient motivation, comorbidity profiles, gender, and therapist expertise can influence treatment outcomes, necessitating careful consideration when prescribing CBT for TS patients.

## BACKGROUND

Tourette syndrome (TS) is a neurodevelopmental disorder characterized by motor and vocal tics that are recurrent and uncontrollable, with a fluctuating pattern over time and onset before age 18 (APA, 2013). Although tics remain the main feature in the diagnosis of TS (Robertson, Mary M. & Eapen, 2014), the presence of tics in the absence of other associated disorders occurs in only about 13% of cases ("pure-TS"); while in the remaining cases there is co-presence of other psychiatric disorders and clinical features ("TS-plus") (Eapen & Robertson, 2015). The most common comorbid disorder include attention deficit hyperactivity disorder (ADHD), obsessive-compulsive disorder (OCD) or obsessive-compulsive behaviors, and autism spectrum disorders (ASD). Some common co-occurring issues include anxiety, depression, substance abuse, conduct disorder, and personality disorders in adults (Robertson, Mary M., 2015). Having TS can therefore result in numerous social and emotional sequelae that negatively affect quality of life (QoL). Tic disorders are far from being rare, with a reported prevalence ranging from 0.3 to 0.9% (Scharf *et al.* 2015) and occurs more frequently in males than in females, with a ratio of 3-4:1 (Lichter & Finnegan, 2015). Some gender differences exist in the phenomenology of the disorder, since female patients may start later and are more likely to worsen with age, may have more complex tics, are less prone to develop ADHD, but anxiety and mood disorders are common (Garris & Quigg, 2021). Some studies report an increased lifetime prevalence of OCD, mood disorders, anxiety and eating disorders among female TS patients (Hirschtritt *et al.* 2015). Also, female sex was found predictive of future emotional disorders in a longitudinal study on TS (Groth, Skov, Lange, & Debes, 2019).

The European Clinical Guidelines for Tourette Syndrome and other tic disorders provide an evidence-based practical algorithm for the treatment of patients with TS, in which behavioral therapy is recommended as a non-invasive initial treatment (Müller-Vahl *et al.* 2022). The primary type of behavioral therapy used in TS is comprehensive behavioral intervention for tics (CBIT), which comprises habit reversal training, relaxation therapy and awareness training. Cognitive behavioral therapy (CBT) may also be applied for the treatment of TS comorbidities and related disorders (Seideman & Seideman, 2020). Non-pharmacologic treatments have been emphasized over the last decade since they offer non-invasive procedures, the avoidance of systemic drug side effects and potential alternatives for patients failing drug therapy. Nevertheless, CBIT is an understudied treatment for TS (Seideman & Seideman, 2020). In this case report, we describe the case of a 12-year-old girl diagnosed with TS plus successfully treated with CBIT and CBT, without pharmacological therapy.

## CASE PRESENTATION

The patient, S.G., a 12-year-old girl, was sent by her neuropsychiatrist, who diagnosed her with Tourette syndrome. The neuropsychiatrist suggested a cognitive behavioral therapy and did not prescribe any pharmacological therapy.

S.G. presented with motor and vocal tics, phobia, social anxiety and obsessive-compulsive behavior. Specifically, her motor tics consisted of eye twitching, lateral gaze and head turning, which was a malignant tic, causing S.G. neck pain. Vocal tics were the repetition of short words (e.g. "si", meaning "yes" in Italian) or sounds, like "shhh". Tics started at the age of 5 with stuttering and blocking tics, especially when walking. Patient's tics changed in body location and over time, with a typical fluctuating pattern. She did not report feeling any premonitory urge (Premonitory urge for tics scale, PUTS (Gulisano, Cali, Palermo, Robertson, & Rizzo, 2015): 10/36) and she never manifested coprolalia, copraxia, echolalia, echopraxia or self-injury behavior (SIB). S.G. defined herself exhausted by the tics and was very tired at the end of the day due to the symptoms. She reported a subjective unit of discomfort (SUD) of 9/10 related to tics.

S.G. also presented with phobia for wind and atmospheric phenomena, such as rain and storm. The phobia caused her to lock herself in a windowless room during rainy days, crying and shouting. S.G.'s insistent phobic requests, that generalized to a number of situations, significantly affected family life. Phobic symptoms began when S.G. was 8 years old.

The patient also manifested social anxiety related to performance, which caused her to freeze in scholastic evaluation occasions and negatively influenced her academic performance and her self-esteem.

S.G. also showed some obsessive-compulsive behaviors (OCB), especially checking behaviors and obsessive doubt at bedtime, with involvement of the caregivers and negative influence of the quality of her sleep. However, these symptoms did not meet diagnostic criteria for OCD and were not reported as disturbing by S.G. and her family.

The psychodiagnostic assessment is reported in Table 1 (pre-treatment).

In conclusion, S.G. symptomatology met DSM 5 diagnostic criteria for Tourette Syndrome Plus, comorbid with specific phobia, social anxiety disorder related to performance and OCB.

### Functional analysis and conceptualization

Functional analysis and conceptualization play a pivotal role in cognitive-behavioral assessment as a scientific approach to the individual case. They guide the therapist to effective interventions from observations of possible causal or maintaining factors in the patient's problems and goals, providing the link between assessment and intervention (Yoman, 2008).

**Tab. 1.** Pre-treatment, post-treatment and follow-ups score of S.G. psychodiagnostic assessment. Clinically significant scores are highlighted in bold.

Test	Subscale	Pre-treatment		Post-treatment		Follow-up (months)		
		score	percentile (%)	score	percentile (%)	1	3	6
CBCL	Anxious/depressed	<b>12</b>	<b>&gt; 98</b>	5	69-84			
	Withdrawn/depressed	5	84-93	1	50-69			
	Somatic complaints	1	50-69	1	50-69			
	Social problems	<b>6</b>	<b>93-98</b>	1	50-69			
	Thought problems	4	84-93	4	84-93			
	Attention problems	3	50-69	4	69-84			
	Rule-breaking behavior	0	≤ 50	2	50-69			
	Aggressive behavior	5	50-69	3	50-69			
	Other problems	2	≤ 50	1	≤ 50			
	DMS-oriented	Affective problems	5	84-93	1	50-69		
Anxiety problems		<b>10</b>	<b>&gt; 98</b>	3	69-84			
Somatic problems		1	50-69	1	50-69			
Attention deficit/hyperactivity problems		2	50-69	1	50-69			
Oppositional defiant problems		2	50-69	2	50-69			
Conduct problems		0	≤ 50	1	50-69			
Internalizing		<b>18</b>	<b>93-98</b>	7	50-69			
Externalizing	5	50-69	5	50-69				
DCI		65						
YGTSS	Tic severity score (max. 50)	<b>36</b>		5		17	16	8
	Disability (max. 50)	<b>50</b>		10		10	0	0
	Total (max. 100)	<b>86</b>		15		27	16	8
PUTS	(Max. 36)	10		9		9	9	9
CY-BOCS	Obsession (max. 20)	9		2		1	1	2
	Compulsion (max. 20)	4		0		0	0	0
	Total (max. 40)	15		2		1	1	2
Phobia	Mean item score	<b>3,8</b>		0,6		0,5	0,6	0,7
	Total score (max. 40)	<b>38</b>		6		5	6	7
LSAS	Anxiety	<b>30</b>		11		16	14	17
	Avoidance	24		2		2	1	5

Abbreviations: CBCL = Child Behavior Checklist (Achenbach & Edelbrock, 1991); DCI = Diagnostic Confidence Index (Robertson, M. M. et al. 1999); YGTSS = Yale Global Tic Severity Scale (Leckman, Riddle, Hardin, Ort, & Swartz, 1989); PUTS = Premonitory Urge for Tics Scale (Gulisano et al. 2015); CY-BOCS = Children Yale-Brown Obsessive Compulsive Scale (Goodman et al. 1989); Phobia = Severity Measure for Specific Phobia - Child Age 11-17 (APA, 2013); LSAS = Liebowitz Social Anxiety Scale (Baroni et al. 2019).

In the case of S.G., the fear for others' judgment, both linked to her performance and to tics, was evident and recurrent. S.G. had the tendency to dichotomous thinking ("everyone"; "never"; "terrible") and to catastrophization, which fueled her negative emotions and discomfort. This also applied to phobic situations, in which her preferred coping strategy was escape or, if possible, avoidance.

S.G. had genetic familiarity with tic disorders (tics and stuttering on the paternal side). She has always been a shy and fearful child, and showed excessive worries and emotional hypersensitivity. Her mother was a very anxious person, and S.G. may have learned her mother's cognitive style through modeling (Bandura, 1971). Also, as said in the introduction, females with TS are more predisposed than males to develop anxiety disorder.

ders (Garris & Quigg, 2021). As a child, and for a long period, S.G. stuttered, a problem that is often associated with tic disorders (Maguire, Yeh, & Ito, 2012).

Tics and previous episodes of mockery may have favored the development of social anxiety and weakened S.G.'s self-esteem. Furthermore, Tourette Syndrome predisposes to the development of other mental disorders, with a comorbidity rate reported in the literature of approximately 86% (Kumar, Trescher, & Byler, 2016).

The influence of specific events linked to the onset of tic symptoms is not scientifically demonstrated in the literature (Zanaboni Dina & Porta, 2019). S.G. disorder debuted at 5 years of age, in line with the age of onset reported in the literature, i.e.  $7 \pm 6$  years (Leckman, 2002).

It was also difficult to identify a particular event that contributed to the onset of social performance anxiety; more likely, the symptomatology derived from an accumulation of negative experiences, both at home and at school, during which S.G. learned failure and helplessness (Seligman, 1972).

The onset of phobic symptoms at 8 years of age was in line with the data reported in the literature (Merckelbach, de Jong, Muris, & van De Hout, Marcel A., 1996) and could not be traced back to any precipitating event.

Obsessive-compulsive symptoms were also present since childhood, but subsequent, in temporal terms, to the onset of tics, in line with the timeline of comorbidities in Tourette's syndromes (Jankovic, 2001). Even in this case, no specific precipitating episode was reported.

Both for the phobic and obsessive-compulsive symptoms, it is more likely that the interaction of biological, psychological and social factors (TS, tics, predisposition to anxiety, learned helplessness, negative life experiences) contributed to S.G.'s belief of being vulnerable towards others and the world, and supported her selective attention bias to threats (Pile, Robinson, Topor, Hedderly, & Lau, 2019).

S.G.'s clinical picture was complex, and manifested in a phenomenology in which the typical symptoms of the various disorders predisposed and maintained each other. Tics and the embarrassment resulting from them certainly maintained S.G.'s social anxiety, making her fear the judgment of others. The strong anxiety that made her freeze in evaluative situations further weakened her self-esteem and reinforced her belief to be inadequate and incapable. This made her feel vulnerable and defenseless even towards the world, maintaining her fear that atmospheric events or leaving the house when it was dark could cause her dramatic consequences. Obsessive doubts and checking behaviors maintained insecurity. Furthermore, S.G.'s avoidance behaviors, in particular of some phobic situations, maintained the symptoms of anxiety and fear. The ambiguous behavior of family members and some teachers, sometimes colluding with symptoms sometimes impatient, also contributes to the perpetuation of symptoms.

S.G.'s negative cognitive patterns, highlighted in the functional analysis, maintained and strengthened her experiences of fear, inadequacy and anxiety, and therefore also her tics.

Considering S.G.'s protective factors and resources, she was a smart and very introspective girl. She was very motivated and compliant. Beyond social situations of evaluation, the patient was relationally skilled and competent. She had a good social and emotional support from some friends and family. Also, S.G. was creative, like the majority of TS patients (Colautti *et al.* 2021) and cultivated her interests both at school and with extracurricular activities.

#### Treatment

Based on the clinical assessment and the patient's and family requests, the following objectives, in order of priority, and methods were followed:

- Decrease the frequency and intensity of tics and of the perceived personal discomfort, through Comprehensive Behavioral Intervention for Tics (CBIT) (Piacentini *et al.* 2010). The Comprehensive Behavioral Intervention for Tics (CBIT) is a non-pharmacological treatment developed to help individuals manage tics and is therefore particularly relevant for individuals with Tourette Syndrome or Persistent (Chronic) Motor or Vocal Tic Disorder. The foundational study by Piacentini *et al.* (2010) demonstrated the efficacy of CBIT in reducing tic severity and associated impairment in children and adolescents. CBIT encompasses several components, including Habit Reversal Training (HRT) (Azrin & Nunn, 1973), relaxation training, and functional interventions. HRT is a critical element of CBIT and involves several steps: bringing awareness to the tics, identifying the premonitory urge, and practicing a competing response (a behavior incompatible with the tic). The competing response is practiced when the individual feels the premonitory urge, helping to prevent the tic from occurring. However, in some cases, individuals might find it challenging to identify a clear premonitory urge, or tic substitution strategies might not be as effective. In our case, the full HRT could not be delivered, since S.G. could not identify any valid premonitory urge and tic substitution was inefficient. In such cases, other components of CBIT, such as relaxation training and functional interventions, gain prominence. Relaxation training in CBIT aims to reduce the overall level of arousal and stress, which can contribute to the exacerbation of tics. Techniques might include deep breathing, progressive muscle relaxation, or guided imagery. Functional interventions address the environmental factors that might sustain or worsen tics. These interventions involve identifying and modifying the situations, events, thoughts or feelings that trigger or exacerbate tics. It might also involve working on strategies to increase positive social reinforcement when tics are absent or less severe.

• The management of **social anxiety**, particularly in school settings, was a crucial aspect of the treatment. The combination of assertive training, exposure therapy, cognitive restructuring, and relaxation techniques forms a comprehensive approach to alleviate her social anxiety symptoms, ultimately aiming to improve her overall quality of life and ability to cope with challenging situations.

Assertive training (Duckworth & Mercer, 2006) involved teaching S.G. how to express her thoughts, feelings, and needs in a clear, direct, and respectful manner. This skill was particularly important in a school setting where she might need to advocate for herself, communicate with teachers and peers, and navigate social interactions. The goal was to empower S.G. and help her build confidence in her ability to interact with others, reducing feelings of anxiety and helplessness.

The importance of exposure therapy in the treatment of social anxiety is well known (Radtke, Strege, & Ollendick, 2020). This technique involved gradually and systematically exposing S.G. to social situations that elicited anxiety, with the goal of reducing her fear and avoidance over time. By confronting these situations, rather than avoiding them, S.G. could learn that her feared outcomes were unlikely to occur, or that she could cope with them if they do.

Originating from the work of Ellis (Ellis, 1962), cognitive restructuring is a cognitive-behavioral technique aimed at identifying and challenging irrational or maladaptive thoughts that contribute to social anxiety. For S.G., this involved addressing negative self-talk, unrealistic expectations, or catastrophic thinking patterns that exacerbated her anxiety in social and academic settings. Finally, techniques such as deep breathing, progressive muscle relaxation, and guided imagery (Goldwurm & Scarlato, 2003), were employed to help S.G. manage the physiological symptoms of anxiety. These techniques could serve as valuable tools for S.G., providing her with practical strategies to calm her body and mind in stressful situations.

The intersection of these techniques with the CBIT was significant for S.G., as social and academic occasions were often triggers for her tics. The concurrent treatment of social anxiety and tics was essential, as reducing anxiety could lead to a decrease in tic frequency and severity, and vice versa. For example, assertive training can not only improve one's social interactions but also enhance one's ability to advocate for accommodations or support in managing her tics. Similarly, relaxation techniques can be beneficial for both alleviating anxiety and managing tic urges.

By integrating these diverse therapeutic strategies, the treatment plan for S.G. addressed both her social anxiety and tic symptoms in a holistic manner, aiming to improve her functioning and wellbeing in social, academic, and personal domains.

• In addressing the **phobic symptoms** presented by S.G., the treatment plan incorporated a combination of relaxation techniques, traditional exposure therapy, and innovative Virtual Reality Exposure Therapy (VRET).

Relaxation techniques were utilized to help S.G. manage her physiological responses to phobic stimuli (Goldwurm & Scarlato, 2003). These strategies aim to induce a state of calmness and reduce the anxiety associated with phobia, making it easier for the patient to confront and eventually overcome the phobic situations.

Exposure therapy was employed to systematically desensitize S.G. to the objects or situations that trigger her phobia (Choy, Fyer, & Lipsitz, 2007). This was achieved by gradually and repeatedly directly (i.e. in vivo) exposing her to the feared stimulus, allowing her to experience and learn to manage her anxiety in a controlled and safe environment. Over time, this repeated exposure helps to reduce her fear and avoidance behaviors. Recognizing the limitations of in-vivo exposure, particularly when it is not consistently possible, the treatment plan incorporated Virtual Reality exposure therapy (VRET) as an innovative and effective alternative. VRET provides a safe and controlled virtual environment in which a patient can be exposed to the phobic stimuli. The systematic review by Freitas and colleagues (Freitas *et al.* 2021) highlights the growing body of evidence supporting the efficacy of VRET in the treatment of various phobias. In S.G.'s case, 360° videos were played on an Oculus Quest 2, both during the therapy sessions and as homework assignments. This approach allowed for a flexible and accessible means of exposure, ensuring that S.G. could consistently practice confronting her phobia, regardless of the limitations posed by the real-world environment.

The combination of relaxation techniques, traditional exposure, and VRET provided a comprehensive and adaptable approach, ensuring that S.G. had the tools and support necessary to overcome her phobia. Through consistent practice and the gradual challenging of her fears, the goal was for S.G. to experience a significant reduction in her phobic symptoms and an improvement in her overall quality of life.

• The enhancement of **self-esteem** and **self-efficacy** in S.G., was crucial, given that individuals with TS often face social stigma, misunderstanding, and bullying, all of which can significantly impact their self-perception and confidence (Eapen, Cavanna, & Robertson, 2016). To address this, the treatment plan employed a comprehensive approach.

Success in earlier treatment goals, such as reducing tic severity and managing social anxiety, directly contributed to improved self-esteem and self-efficacy. These accomplishments are particularly meaningful for individuals with TS, as they often experience a sense of helplessness due to the involuntary nature of tics

(Pringsheim *et al.* 2019). Demonstrating control over these symptoms can, therefore, be incredibly empowering.

Cognitive restructuring was used, since it is tailored to challenge and modify the negative thought patterns often observed in TS patients, who may internalize societal stigma and develop a skewed self-image (Cuenca *et al.* 2015). By fostering a more accurate and positive self-perception, S.G. was better equipped to navigate the psychological challenges associated with TS. Also third generation techniques were included (Kabat-Zinn, 2015). Mindfulness practices are particularly beneficial for TS patients, as they promote acceptance and reduce reactivity to tics, which can be a source of embarrassment and low self-esteem (Specht *et al.* 2011). Mindfulness-based stress reduction (MBSR) program, in particular, has been shown to be effective in reducing tic severity and improving quality of life in individuals with TS (Reese *et al.* 2015).

OCB was not included in the treatment plan since it was not perceived as disabling by S.G. and her family. An improvement in these symptoms as an indirect effect of achieving the therapeutic objectives was hypothesized, and a post-treatment evaluation of OCB was contemplated.

Treatment began in November 2021 and had a total duration of approximately 13 months, with weekly sessions. Due to S.G.'s periods of isolation due to SARS-CoV-2 infection, sessions were occasionally held online.

Treatment also included 8 sessions of parent training (Evans, Wittkowski, Butler, Hedderly, & Bunton, 2016) and one session of psychoeducation and case presentation to the teaching staff of S.G.'s school.

## RESULTS

The therapeutic outcome was very good. S.G. achieved excellent management of her tics, with a post-treatment SUD of 1/10. No more episodes of freezing occurred at school and she did not report disabling levels of anxiety in social evaluative situations. The patient acquired coping strategies, such as relaxation techniques, and techniques for managing negative automatic thoughts, such as cognitive restructuring, that she autonomously applied in daily life. The phobic symptoms ameliorated and the improvement also generalized to situations that were not directly addressed during the therapy. Specifically, some situations still activated S.G., but avoidance behaviors vanished. Likewise, obsessive-compulsive symptoms benefited from treatment. Finally, S.G.'s self-esteem, sense of self-efficacy and optimism increased and became a protective factor. Clinical improvement was supported by the psychodiagnostic assessment (Table 1). Importantly, S.G. motivation to therapy and compliance was high and constant throughout the treatment, as she always attended her sessions, unless ill, and

she always completed her therapeutic homework. The therapeutic alliance was strong and trustful.

Follow-ups at 1, 3 and 6 months confirmed the stability of the therapeutic benefits, both in clinical observation and in test assessment (Table 1). CBCL and DCI were not re-tested for lack of clinical indication. Although tics severity (see Table 1, YGTSS scores) fluctuated over time, as typical in tic disorders (Robertson, Mary M. & Eapen, 2014), S.G. could manage her symptoms when necessary and, most important, did not suffer from a significant discomfort (disability score of the YGTSS ranged from 0/50 to 10/50).

A non-structured follow-up at 10 months with S.G.'s parents confirmed the long term stability of the results, since the patient began high school with good socialization and academic performance; two episodes of intense fear for climatic events occurred since the previous follow-up, but without escape or avoidance behaviors, and objectively justified by the extraordinary severity of the storms that afflicted northern Italy during summer 2023. OCB was not reported, and S.G. was then described as confident, determined and positive.

## DISCUSSION

In this case report, we describe the successful cognitive-behavioral treatment of a female girl with Tourette Syndrome Plus, presenting with motor and vocal tics, social anxiety, phobia and OCB. Pharmacological treatment was not prescribed.

The therapy was complex, since different aspects and symptoms had to be considered and as explained in the conceptualization, they predisposed and maintained each other in a vicious circle. Therefore, the priority of the objectives described in the treatment plan was respected in principle, but the treatment of social anxiety partially overlapped with CBIT, since socially arousing situations also triggered tics. It was possible to address the treatment of phobia only once the first two therapeutic objectives were achieved. Nevertheless, the therapeutic benefits appeared stable over time, since structured and non-structured follow-ups at up to 10 months indicated a good management of tics, anxiety and fear, and a satisfying self-esteem and quality of life.

These outcomes parallel findings which accentuate the potential of CBT in engendering discernible improvements in tic management and associated emotional regulations (Verdellen, van de Griendt, Hartmann, Murphy, & ESSTS Guidelines Group, 2011). In fact, to date several randomized controlled trials (RCT) on HRT/CBIT in children and adults with tic disorders have been conducted, showing significant improvements in tic severity with treatment (Fründt, Woods, & Ganos, 2017). Cognitive behavioral interventions have been included as first-line treatments in international guidelines for the management of TS patients

(Müller-Vahl *et al.* 2022). The effect size of CBIT in the reduction of tic severity is similar to that of medications (Rizzo, Pellico, Silvestri, Chiarotti, & Cardona, 2018) and efficacy is maintained for at least 6 months (Pringsheim *et al.* 2019). CBT as an intervention also reconciles the ethical and medical apprehensions apropos of deploying pharmacotherapeutic modalities in pediatric populations, given the conceivable side effects and the multifaceted nature of TS Plus, which encompasses an array of co-occurring psychological conditions.

Age, patient motivation and comorbidity profile need to be considered when recommending a cognitive behavioral treatment. Specifically, younger age, scarce motivation and comorbidity with ADHD increase the risk of unsuccessful psychological intervention (Pringsheim *et al.* 2019).

Several factors may have contributed to the success of the treatment herein described. First, S.G.'s motivation and compliance were constantly optimal, with a good adherence to homework and a high commitment to therapy. The practice of therapeutic skills between session is a key component for therapeutic improvement. A study by Essoe and colleagues (Essoe *et al.* 2021) on a sample of youths and adults with TS found that greater overall homework adherence predicted tic severity reductions and treatment response to behavior therapy. Also, lower baseline hyperactivity/impulsivity predicted better compliance in youth. Therefore, the absence of hyperactivity and impulsivity also favored therapeutic success in the case of S.G.

Gender-specific disparities in the manifestation and management of TS and its comorbidities also warrant consideration. Several studies now demonstrate the predominance of male sex in Tourette syndrome. However, whilst they represent the clinical TS population, they may not provide the best indications to counsel a female TS patients. Studies intimate a potentially divergent symptomatic expression and comorbidity prevalence between genders, with females ostensibly exhibiting a higher predilection for anxiety disorders, possibly due to sex differences and neuroendocrine aspects (Conelea *et al.* 2011; Garris & Quigg, 2021). Also, even if only very few studies provide enough data to assess these differences, treatment response may also differ between sexes (Schwabe & Konkol, 1992; Sukhodolsky *et al.* 2017). Thus, is it possible that a gender-tailored CBT approach accentuate therapeutic efficacy? While the present case report underpins the potential of generalized CBT in assuaging a spectrum of symptoms in females with TS Plus, future research necessitates a deeper exploration into the interaction between gender, TS, and therapeutic modalities, ensuring that treatment is optimally tailored to the nuanced needs of diverse demographic subsets.

Within the ambit of employing CBT for managing Tourette Plus, especially in pediatric populations, the expertise and specialization of therapists emerge as

pivotal considerations in comprehending and replicating therapeutic successes. The proficiency of the therapist plays a nontrivial role in the delivery, adaptation, and efficacy of CBT, particularly when managing multifaceted pathologies that necessitate a nuanced and integrative approach.

Indeed, the literature underscores the salience of therapists' expertise in treating pediatric TS, wherein their capability to establish rapport, navigate the child's cognitive and emotional domains, and adapt techniques to align with the child's developmental stage critically influences therapeutic outcomes (Sukhodolsky *et al.* 2017). Hence, while the current case underscores the potential merits of CBT, it concurrently highlights the indispensability of expert practitioners in ensuring efficacious and safe therapeutic journeys, particularly in complex cases involving diverse symptomatology. Future research and practice may seek to not only explore and standardize efficacious CBT interventions for TS Plus but also to delineate the requisite therapist competencies and training paradigms that underpin therapeutic success, thereby elevating the caliber and consistency of care provided to this vulnerable demographic.

While the exemplary outcomes delineated in this case report advocate for the potential utility of CBT in treating adolescents with Tourette Plus, particularly those with intersecting psychopathologies, it is imperative to acknowledge the intrinsic methodological limitations inherent to case reports. Foremost, the uncontrolled, non-randomized design restricts our capacity to generalize findings and assert causality unequivocally. As such, though marked progress was noted, it remains indeterminate whether similar successes would ubiquitously transpire across a broader demographic spectrum or if specific, unrecounted variables contributed to the favorable outcome. Additionally, the single-subject framework precludes the control for possible placebo effects, which, given the psychological basis of CBT, could potentially catalyze perceived improvements. Further confounding variables, such as concurrent life events or evolving psychosocial environments, remain unaccounted for, yet feasibly could have wielded influential roles in symptom modulation. Moreover, the relatively brief post-therapy follow-up duration incorporated herein curtails our ability to conclusively remark on the longevity and stability of the therapeutic effects. Subsequent, robustly-designed research endeavors, employing randomized controlled trials with larger sample sizes, gender-specific groupings, and extended follow-up durations, are imperative to substantiate the preliminary insights gleaned from this singular case.

In conclusion, this case report converges with the existing literature on the potential for CBT to ameliorate symptoms comprehensively and without pharmacological intervention in patients with Tourette Plus. Specific factors should be taken into consideration

when prescribing CBT to a patient with TS Plus, such as the patients' motivation and compliance, the comorbidity profile, patient's gender and the therapist expertise in CBIT.

Further rigorous examination is warranted to validate, optimize, and possibly gender-tailor this therapeutic approach within wider clinical applications.

## FINANCIAL DISCLOSURE

The Authors have no financial interest in this manuscript and no affiliations (relationships) to disclose.

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