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Effectiveness of 'Tackle Your Tics', a brief, intensive group-based exposure therapy programme for children with tic disorders: study protocol of a randomised controlled trial

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ABSTRACT

Introduction This paper outlines the study protocol for the Dutch Tackle Your Tics study in youth with tic disorders. Tourette syndrome and chronic tic disorders are prevalent neurodevelopmental disorders, placing considerable burden on youth and their families. Behavioural treatment is the first-line, evidence-based intervention for tic disorders, but tic reduction and availability remain relatively low. Patient associations stress the need for more accessible high-quality treatments, also focusing on improving quality of life. Therefore, the brief, intensive group-based treatment Tackle Your Tics was developed.

Methods and analysis Tackle Your Tics is a 4-day intensive and comprehensive group-based intervention for children and adolescents (9–17 years) with Tourette syndrome or a chronic tic disorder. The programme encompasses exposure and response prevention treatment and additional supporting components (coping strategies, relaxation exercises and parent support). To study the effectiveness of Tackle Your Tics and identify predictors/moderators at baseline, a single-blinded randomised controlled trial (n=104) is conducted, comparing Tackle Your Tics (n=52) with a waiting list condition lasting 3 months (n=52). Assessments are performed at similar time points for both groups: at baseline, after 4 weeks, and at 3 and 6 months of follow-up, on tic severity, quality of life and other psychosocial variables.

Ethics and dissemination Ethics approval has been obtained from the medical ethical committee of the Amsterdam Medical Centre (METC nr NL66340.018.18, v3 June 2020). Findings will be presented on national and international conferences, peer-reviewed scientific journals, patient organisation meetings and public media. Patient representatives are fully integrated as part of the research team. If Tackle Your Tics proves to be effective, it can expand evidence-based treatment possibilities for children and adolescents with tic disorders. Identifying the psychosocial predictors/moderators for the effectiveness of this intervention can provide personalised treatment advice in the future.

Trial registration number NL8052.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This study uses a randomised controlled design, with a large sample size, in which workshops given by trained 'experts by experience' are an integral part of the treatment protocol.
⇒ Longitudinal assessments are performed at pretreatment and post-treatment, but also at longer-term follow-up (after 6 months), using a multi-informant approach (children, parents and therapists) and psychometrically sound assessment instruments, also studying possible predictors and moderators of treatment outcomes.
⇒ In this study, no active control condition is being compared, which limits interpretation of the results.
⇒ Programme adjustments and family stress as a result of the COVID-19 pandemic may influence treatment results.

INTRODUCTION

Tic disorders, including Tourette syndrome, can seriously impact the quality of life[1–5] of children and their families. Tics are sudden, repetitive motor movements or vocalisations which may affect different areas of daily functioning.[3] Many children with tics suffer from poor school functioning[6] and emotional/behavioural and social problems[7 8] (eg, bullying[9] or stigmatisation[10]). Tics are also associated with family stress and costs for society.[11 12] However, tic severity alone does not determine individual impairment or quality of life.[5 13] In most children, tics co-occur with various comorbid disorders and problems, such as attention deficit and hyperactivity,[14] compulsions[15] and rage attacks,[16] which can be more troublesome than the tics. Although tics disorders are prevalent (0.77%–1.0% for Tourette syndrome[17 18]), they are still poorly recognised and understood in society.

Efficacy of behavioural treatment for tic reduction is well established, and behavioural treatment is considered a first-line intervention for tic disorders.[18] Most research has been done into habit reversal training (HRT) and comprehensive behavioural intervention for tics (CBIT), where the main element is HRT, but exposure and response prevention (ERP) seems promising as well. One comparative study showed no significant difference in tic reduction between ERP and HRT.[19] Research into behavioural treatments for tics has shown moderate to high effect sizes (0.57–1.5), but tic reductions remain relatively low (on average 30% on the Yale Global Tic Severity Scale (YGTSS)).[20]

There are several treatment barriers that bother the use of evidence-based behavioural therapies.[21 22] Lack of trained therapists may be a barrier for local face-to-face treatment. Consequently, children and their parents must travel to a specialised therapist, which is potentially time-consuming, might cause financial barriers for families with low socioeconomic status and can have an impact on the time spent on work, school and family life. Moreover, the individual therapy and daily ERP home exercises require a lot of motivation and discipline. Strategies to improve homework adherence could optimise treatment outcomes.[23] Online treatments may be a solution for the lack of local specialised practitioners or limited options for face-to-face contact,[24 25] especially during the recent COVID-19 pandemic. Patient associations stress the need for more accessible treatments that focus not only on tic reduction but also on peer and family support on a broader level (daily living issues and problems other than tics), to enhance quality of life of both patients and their families.[26] Positive results have been found for a comprehensive CBIT programme, Living with Tics, that reduced tic-related impairment and improved quality of life in children with tic disorders.[5]

Case studies have suggested that brief, intensive treatment with CBIT[27] and ERP[28] are comparably effective as longer time-frame therapies with weekly 1-hour sessions. In other patient populations (eg, adolescents with post-traumatic stress disorder[29]), obsessive–compulsive disorder (OCD)[30–32] and anxiety disorders[33]), short intensive forms of behavioural treatment have been successful.

In addition, group formats have been shown to be feasible and equally successful as individual therapies for children with tics. Group therapy can offer many benefits such as peer support, reduced waiting lists and increased cost-effectiveness. Outpatient group therapy for children, based on HRT[34 35] or CBIT[36] showed improvements of tic severity and quality of life. Nissen and colleagues found no significant difference in total tic scores of children and adolescents in combined HRT and ERP in a group setting versus in an individual setting.[37] The study of Himle and colleagues[38] indicated a possible improvement of comorbid symptoms in adolescents after group therapy. Group cognitive–behavioural therapy for OCD, including ERP, reduced symptoms in participants with tic-related OCD as well as those with non-tic-related OCD.[38]

In our previous pilot study (n=14), we demonstrated the feasibility of a brief, intensive and comprehensive group-based exposure therapy programme for children with tic disorders called Tackle Your Tics.[39] Drop-out rates were low (7%), 1 out of a total of 14 participants dropped out due to poor group functioning, which was not identified during intake. The other participants completed the full therapy programme. Parents stated the programme was very helpful. Most parents mentioned their children experienced more control over their tics (85%) or the social contact with other children with tics was helpful (39%). Furthermore, indications of improvements in tic severity as well as quality of life and co-occurring emotional and behavioural problems were found. The mean total tic score (as measured by the YGTSS) decreased with 16% from baseline to follow-up with a medium effect size (p=0.013, effect size=0.412). Quality of life scores improved with 20% from baseline to follow-up (p=0.002, effect size=0.584). The group format, making use of (co) therapists, offered opportunities to train more behavioural therapists. These pilot findings underlined the urgent need for a larger randomised controlled trial (RCT) to determine the effectiveness of our brief, intensive group-based programme for children with tic disorders. Based on feedback of parents from this pilot study, the following adaptations were applied to the programme: (1) we have added parent sessions, in which parents can learn how to support their child's home exercises, and (2) an extra meeting after the fourth day, to motivate the children to continue doing their ERP exercises at home.

The aim of this RCT is to test the effects of Tackle Your Tics on tic severity, quality of life, premonitory urges, beliefs about tics, daily functioning, family functioning, treatment adherence and satisfaction, and treatment costs from a societal perspective. We will compare results on these outcomes in our intervention group with those in a waiting list control group (WLCG). Furthermore, we aim to identify baseline psychosocial and medical predictors/moderators for the effectiveness of Tackle Your Tics. Exploring which children benefit most from this brief intensive treatment will offer opportunities to improve personalised treatment advice.

Several baseline characteristics possibly influence differential response to Tackle Your Tics based on studies on predictors and moderators of behavioural interventions for tic disorders and other neurodevelopmental disorders. In tic disorders, greater tic severity and positive participant expectancy predict greater tic improvement, whereas anxiety disorders and premonitory urge severity predict lower tic reduction.[40] In a meta-analysis of behaviour therapy for Tourette syndrome, co-occurring attention deficit hyperactivity disorder (ADHD), a smaller number of therapy sessions and a mean younger age were predictors of poorer outcome.[20] Homework adherence has been shown to predict tic severity reduction.[18] In a study on predictors and moderators of behavioural intervention for anxiety disorders, higher caregiver strain predicted lower improvement.[41]

METHODS AND ANALYSIS

Design

A multicentre, single-blinded RCT comparing the efficacy of the Tackle Your Tics intervention (TyT, n=52) with a WLCG (n=52) in children and adolescents with tic disorders.

Participants

Inclusion criteria

Children and adolescents must meet all of the following criteria: (1) age 9–17 years; (2) being diagnosed with Tourette syndrome or persistent (motor/vocal) tic disorder, using diagnostic criteria of the *Diagnostic and Statistical Manual of Mental Disorders*, Fifth edition[42]; (3) with at least moderate severity as indicated by a YGTSS total tic score of >13 (>9 for children with motor or vocal tics only).

Exclusion criteria

Exclusion criteria include (1) behavioural treatment for tics in the past 12 months; (2) pharmacological treatment for tics or another diagnosed psychiatric disorder that has not been stable the past 6 weeks or with planned changes during study participation; (3) poor mastery of the Dutch language; (4) IQ of <75; (5) serious physical disease; (6) substance abuse; (7) suicidality; (8) psychotic disorder; and (9) poor group functioning and/or low motivation (as reported by child, parents or local therapist). Since Tourette syndrome is seldom seen without comorbidities,[15] co-occurring ADHD, OCD, anxiety disorders or mood disorders are allowed, unless the disorder requires immediate treatment or change in current treatment.

Recruitment and randomisation

From July 2020 to end of 2022, children and adolescents are recruited by the Dutch Tourette Association and the participating expert centres on tic disorders in youth: Levvel, Accare and Yulius. After being informed by the therapist and researcher about this study, eligible participants and their parents are asked to sign informed consent forms.

Participants are randomly allocated, using block randomisation, and stratified by gender, by an independent researcher to either the brief, intensive TyT condition or the WLCG condition. The size of the blocks (two to four patients) is randomly selected and is unknown to the researchers to avoid allocation predictability. For each block, 50% the patients will be allocated to Tackle Your Tics and 50% to the waiting list group. The randomisation process is performed using a computerised data management system (Castor EDC). Patients and families are specifically instructed not to tell their condition to the researcher performing the assessments.

Patients in the TyT condition (n=52) will receive the Tackle Your Tics intervention 1 month after randomisation, in groups of approximately four to eight patients per group, while patients in the WLCG condition (n=52) receive this same intervention after a waiting period of 3 months (total sample: n=104). Treatment for all participants takes place at Levvel, Amsterdam.

Therapists and patient representatives

The Tackle Your Tics programme is provided by experienced therapists from three participating centres with expertise on tic disorders in the Netherlands: Levvel (Amsterdam), Accare (Groningen) and Yulius (Dordrecht), together with patient representatives from the national patient organisation (Stichting Gilles de la Tourette). Therapists are academically trained (clinical) psychologists or cognitive behavioural therapists with 3–15 years of experience in treating tic disorders. Cotherapists from these sites are trained during the treatment and have the same academical background, with less (0–3 years of) experience in treating tic disorders. Depending on group size (four to eight participants), a team of tow to three experienced therapists, one to two cotherapists, and one to two trained patient representatives will provide the treatment programme. All team members are blinded for treatment allocation of the participants.

Intervention

Behavioural therapy intervenes in the sequence of negative reinforcement between premonitory sensations or 'tic alarms', the subsequent tics and decrease of the sensation. In ERP, patients with tic disorders learn to suppress their tics for a prolonged time (response prevention), while the focus remains on these sensations (exposure). This allows the patient to learn to tolerate these sensations or tic alarms, resulting in a reduction of tics.[19 43] The therapist coaches and encourages the patient to improve time records, and provokes the tic alarms to optimise exposure, for example, by attending the sensations, playing exciting games or talking about tics.

Tackle Your Tics offers the same number of ERP therapy hours as regular, 12 weekly individual ERP sessions but in a shorter period. The brief, intensive group programme covers three consecutive days and one booster day 1 week later, followed by a 'get-together afternoon' after 1 month. The programme days consist of ERP sessions and several supporting, relaxing and motivating components to enhance motivation and homework adherence and reduce dropout (see table 1). Based on our previous feasibility study and the intensive, group-based format, we expect poor group functioning to be the main reason for possible dropouts.

ERP sessions

One-hour treatment sessions with ERP are offered in small subgroups of two or three children. Participants assist each other by timing and registering their tics and encouraging each other to enhance motivation and peer support. When needed, participants can train a specific tic reduction individually with a therapist in one of the sessions. To generalise learnt skills, from about day 3, the therapist can expand the exercises to outdoors or other

Table 1 Tackle Your Tics therapy programme for children and adolescents

	Day 1	Day 2	Day 3	Day 4 booster day (after 1 week)	Get-together afternoon (after 1 month)	
9:30–10:00	Welcome and acquaintance game (all participants and parents)					
10:00–11:00	Psychoeducation or therapy session (subgroups)	Psychoeducation or therapy session (subgroups)	Psychoeducation or therapy session (subgroups)	Psychoeducation or therapy session (subgroups)		
11:00–11:10	Short break (all participants)	Short break (all participants)	Short break (all participants)	Short break (all participants)		
11:10–12:10	Psychoeducation or therapy session (subgroups)	Psychoeducation or therapy session (subgroups)	Psychoeducation or therapy session (subgroups)	Psychoeducation or therapy session (subgroups)		
12:10–12:40	Lunch break (all participants)	Lunch break (all participants)	Lunch break (all participants)	Lunch break (all participants)		
12:40–13:40	Workshop coping strategies or therapy session (subgroups)	Workshop coping strategies or therapy session (subgroups)	Workshop coping strategies or therapy session (subgroups)	Workshop coping strategies or therapy session (subgroups)		
13:40–14:10	Playtime (all participants)	Playtime (all participants)	Playtime (all participants)	Playtime (all participants)		
14:10–15:10	Workshop coping strategies or therapy session (subgroups)	Workshop coping strategies or therapy session (subgroups)	Workshop coping strategies or therapy session (subgroups)	Workshop coping strategies or therapy session (subgroups)	14:00–14:30	Get together (participants and parents): welcome
15:10–15:25	Relaxation therapy (all participants)	Relaxation therapy (all participants)	Relaxation therapy (all participants)	Relaxation therapy (all participants)	14:30–15:30	Evaluation (participants and parents)
15:25–15:40	Group therapy session (all participants)	Group therapy session (all participants)	Group therapy session (all participants)	Group therapy session (all participants)	15:30–15:45	Break/playtime
15:40–15:55	Short evaluation (all participants)	Short evaluation (all participants)	Short evaluation (all participants)	Short evaluation (all participants)	15:45–16:45	Workshop (all participants)
15:55–16:30	Feedback: therapist with parents and participant	Feedback: therapist with parents and participant	Feedback: therapist with parents and participant	Feedback: therapist with parents and participant	16:45–17:00	Get together (participants and parents): closing

Three parallel parent meetings are organised on day 1 and day 4 (10:00–12:00) and on the 'get together afternoon' (15:45–16:45). Psychoeducation and workshops are offered in subgroups of three to five children, parallel to the ERP sessions of the other participants (except for small groups that consist of four or five children).
ERP, exposure and response prevention.

situations (eg, playing an exciting game or riding a bike), depending on the individual progress of the participants.

Coping strategy workshops

According to a large European patient survey,[26] patients need support that does not focus on tics only but also on other symptoms and problems related to tic disorders and daily living issues (dealing with Tourette syndrome at home, work and school). Therefore, as advised by the Dutch national patient association, young adult patients offer 1-hour coping strategy workshops each programme day. They teach the children how to cope with their symptoms in a positive, creative way. In the workshops, three themes are discussed and visualised (by writing, painting and mind mapping): self-acceptance, solution-oriented thinking, and positive characteristics and strengths.

BT-Coach

A training app, *BT-Coach*, is introduced on the third and fourth programme days to motivate and support the children to continue with the exercises at home. The app may also be used as part of the relapse prevention plan to enhance homework adherence after the Tackle Your Tics programme has finished.[44] In the absence of a therapist, the app takes over the coaching role during homework exercises. During exposure to the premonitory urges or tic alarms, the participant records urge severity ratings. After having a tic, the participant clicks on a button, 'Tap for a Tic', to register non-suppressed tics. The app provides visual and auditory feedback, which encourages the participant to extend his or her capacity to suppress the tics and to set new time records. If the urge to tic

increases, the audio-voice encourages the participant to keep suppressing the tic. If the premonitory urge to tic diminishes or is absent, it encourages exposure to the premonitory urges.

Parent involvement

Parents are involved in the treatment by (1) parent meetings, (2) attending one therapy session to learn to coach their child during exercises and (3) participating in feedback sessions at the end of all treatment days, to evaluate and answer questions. In three parent meetings of 60 or 120 min (see table 1), therapists offer psychoeducation to parents, and discuss expectations and how parents can help their child at home during and after treatment. Trained patient representatives accompany the meetings to exchange experiences in the parent group and offer emotional support.

Psychoeducation

A small workbook, partly based on *Tics - Workbook for Children* by Verdellen *et al*,[45] has been developed specifically for this programme to teach children and adolescents about premonitory sensations (tic alarms), tic triggers, difficult moments and practising at home. Daily psychoeducation classes of 60 min are given jointly by therapists and patient representatives in which clinical and experiential knowledge complement each other.

Relaxation

The programme contains short (15 min) commonly used relaxation exercises focusing on breathing and muscle relaxation techniques.

COVID-19 adjustments

Due to COVID-19 regulations, the first treatment groups were postponed to September 2020. The treatment programme had to be adapted according to the national pandemic regulations. We distinguish four variants of the programme: (1) the original face-to-face programme; (2) a slightly modified programme with online parent meetings and some basic safety measures (eg, health check); (3) a 'blended' programme, a mix of face-to-face and online participation, in case some participants or team members cannot complete the programme face-to-face (eg, due to quarantine); and (4) a completely online programme, if face-to-face treatment is not possible at all due to national policies (see table 2).

Training and treatment integrity

Therapists of participating centres are trained in intensive ERP for tic disorders by a leading Dutch expert. Two adult experts by experience developed the coping strategy workshops and will train other patient representatives. A standardised training programme for therapists and patient representatives is used. Before the start of each treatment group, the therapists and patient representatives will be trained by experts by (1) following a 3-hour online training, specially developed for this study, to gain more in-depth knowledge about tics and premonitory urges, ERP, details about the Tackle Your Tics programme and research; (2) studying the protocol of the Tackle Your Tics programme (time schedule, instructions for the programme elements and points of attention); and (3) attend an intervision meeting with the team of therapists and patient representatives before the start of each treatment group (to ensure treatment integrity, answer

Table 2 Adjustments to COVID-19 measures on the Tackle Your Tics programme

	Original programme (see table 1)	Adapted programme	Blended programme	Online programme
Indications	If no COVID-19 regulations are applicable	In case of applicable COVID-19 regulations	If some participants or team members cannot continue participation after a face-to-face start, for example, due to quarantine or positive test	If face-to-face group treatment is impossible from the start due to policy changes
Programme elements for participants	Face-to-face	Face-to-face, with adjustments based on national COVID-19 regulations, for example, health check, protective equipment, larger spaces and ventilation	Mix of face-to-face with COVID-19 adjustments and online participation	Completely online, in shortened form
Programme elements for parents	Face-to-face parent meetings in parallel during the children's programme, face-to-face parent sessions and feedback sessions with the therapist	Online parent meetings in the evenings, face-to-face parent sessions and feedback sessions with the therapist	Online parent meetings in the evenings, face-to-face or online parent sessions and feedback sessions with the therapist	Online parent meetings in the evenings, online parent sessions and feedback sessions with the therapist

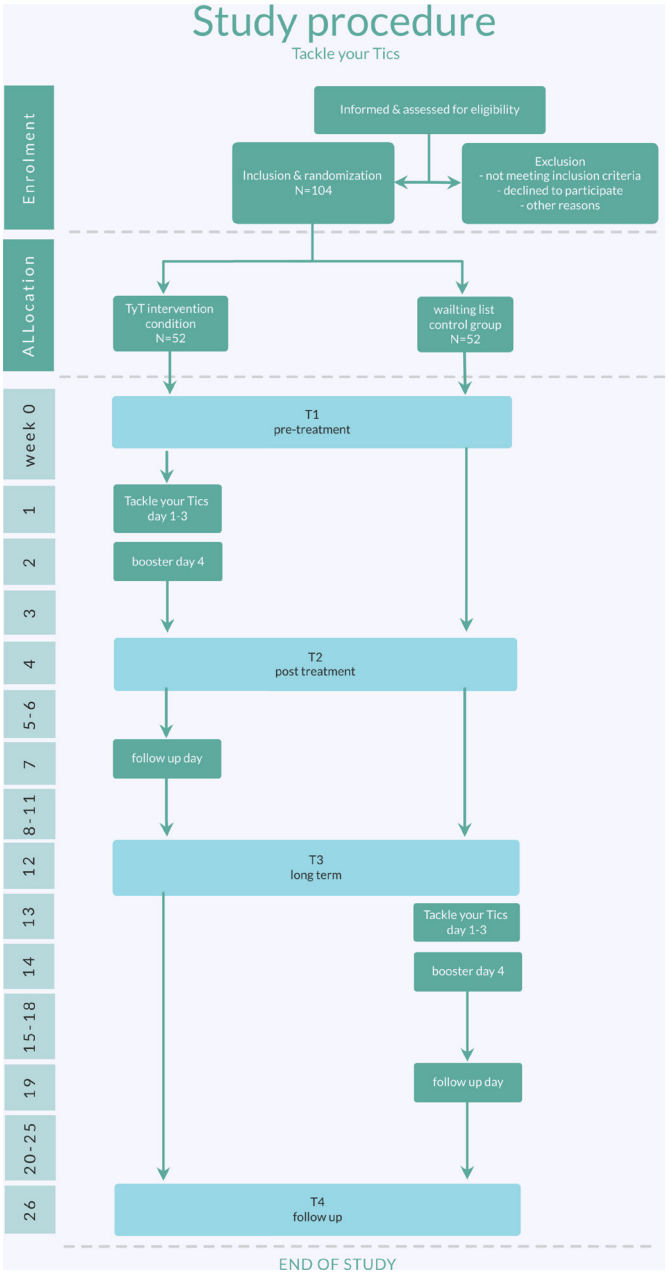

Figure 1 Flowchart study procedure, Tackle Your Tics.

questions and share points of attention). During the treatment days, cotherapists with less experience in tic treatment will assist an experienced colleague.

To enhance treatment integrity, team intervision meetings for every new treatment group are conducted. Treatment integrity is assessed by two independent, trained raters, rating a random 20% of all programme sessions (10% TyT and 10% WLCG condition). Sessions will be audiotaped, after having received consent from patients and parents.

Outcome measures

At four moments, at similar time intervals for both the TyT and WLCG condition, assessments will be done pretreatment and post treatment, and at 3 and 6 months of follow-up using validated, psychometrically sound instruments, with both patients, parents and teachers as informants. See figure 1 for the study procedure. For data management, a computerised data management system (Castor EDC) is used and monitored.

The researcher psychologist (AH-H) performing the assessments will be blinded to the group conditions. Parents and patients are explicitly instructed not to communicate their group condition to the researcher. Self-report questionnaires are completed online by patients and parents. One questionnaire (Outcome Rating Scales and Session Rating Scales[46]) is completed by the participants during the treatment days.

Primary outcome

Tic severity (key outcome) will be measured by the YGTSS,[47] a commonly used, reliable and valid semi-structured interview for the assessment of tic severity.[48] The global tic severity score (response range 0–100) is composed of an impairment score (0–50) and a total tic score (0–50). The total tic score, the summation of the motor tic score (0–25) and the total vocal tic score (0–25), is the primary outcome measure. A high score indicates a high severity of the tics regarding number, frequency, intensity, complexity and/or interference. At T2, directly post intervention as our primary end point, we define a 25% reduction of this score as a positive response.[49]

Secondary outcomes

Quality of life is measured by the Gilles de la Tourette Syndrome Quality of Life Scale for Children and Adolescents,[50] a 27-item patient-reported scale for the measurement of health-related quality of life in patients with Tourette syndrome (range 27–135), with high internal consistency and test–retest reliability. A high score indicates more problems in daily life and a lower quality of life.

Other secondary outcome measures are tic-related cognitions, emotional and behavioural functionings, social competence, school functioning, self-esteem, family functioning, treatment satisfaction, quality of life related to cost effectivity, and cost-effectiveness/medical consumption. For the instruments used and their psychometric characteristics, see table 3.

Moderators and predictors

To identify possible baseline psychosocial moderators and predictors for the effectiveness of Tackle Your Tics, the following variables are studied for moderation and prediction: tic severity, premonitory urge severity, age, gender, family functioning, homework adherence and comorbidity (for the instruments used, see table 3).

Patient characteristics

Demographic data are derived by the researcher from the medical files and a semistructured interview about possible comorbid problems (Anxiety Disorder Interview Schedule, both parent and child version (>12 years).[51] Demographical data encompass, for example, sex, gender, age in years/months, school class of child, cultural

Table 3 Assessment plan for the Tackle Your Tics study (n=104) at four assessment moments (n=104)

Variable	Questionnaire	Items	Score range	Score indication	Assessment moments			
					T1	T2	T3	T4
Primary outcome								
Tic severity*	Yale Global Tic Severity Scale[47]	11	0–100	Low–high tic severity	R	R	R	R
Secondary outcomes								
Quality of life	Gilles de la Tourette Syndrome Quality of Life Scale for Children and Adolescents[50]	27	27–135, scale scores	Low–high degree of problems in daily life (=high–low quality of life)	C	C	C	C
Tic-related cognitions	Beliefs about Tics Scale[55] (Dutch translation)	20	20–80	Low–high degree of tic-related cognitions	C	C		C
Emotional/behavioural functioning	Child Behaviour Checklist[56 57]	112	0–220	Low–high degree of emotional and behavioural problems	P		P	P
	Youth-Self Report (11 years and older)[57]	112	0–220	Low–high degree of emotional and behavioural problems	C			C
School functioning	Teacher Report Form[57]	112	0–220	Low–high degree of emotional and behavioural problems	T			T
Self-esteem	Self-Perception Profile for Children[58] (Dutch versions for children or adolescents: CBSK and CBSA)[59]	36	Scale scores	Low–high experience of competence and self esteem	C			C
Quality of life related to health	EQ-5D/EQ-5D-Y[60–62]	5	1–5 per item	Low–high health related quality of life	C, P	C, P		C, P
Stress of parenting	Stress of Parenting Questionnaire[63]	34	34–136	Low–high stress of parenting	P	P		P
Care-related quality of life in informal caregivers (parents)	Care-Related Quality of Life[64]	7	0–100	Low–high burden of providing informal care	P	P		P
Cost-effectiveness/medical consumption	Treatment Inventory of Costs in Patients with Psychiatric Disorders, adult/child version[65]	57		Low–high medical costs and productivity losses	C, P			C, P
Treatment satisfaction/ burden/homework adherence	Treatment satisfaction forms, developed for this study (child/ parent version)	17 (C) 28 (P)	11–55 22–110 (5-point-scale items)	Low–high treatment satisfaction		C, P	C, P	
Therapeutic alliance, patient functioning	Outcome Rating Scales and Session Rating Scales[46] (during treatment, child/youth version)	8	0–40 per scale	Low–high				
Moderator/predictor variables								
Demographic data	Sex, gender, age				R			P

Continued

Table 3 Continued

Variable	Questionnaire	Items	Score range	Score indication	Assessment moments	
Family functioning	Family Assessment Device[66] (general functioning subscale)	12	12–48	Low–high degree of problems in family (high–low family functioning)	P	P
Psychiatric comorbidities	Anxiety Disorders Interview Schedule[51]		0–8 severity score per comorbidity	Comorbidities and low–high severity	C, P	
Premonitory urges	Premonitory Urges for Tics Scale[67]	9	9–36	Low–high tic-related feelings and sensations (premonitory urges)	C*	

*Tic severity at baseline and homework adherence will also be included in the moderator/predictor analyses (see the Methods and Analysis section).
C, child report; CBSA, Competentie-Belevingsschaal voor Adolescenten; CBSK, Competentie-Belevingsschaal voor Kinderen; P, parent report; R, researcher/clinician report; T, teacher report; TIC-P, Treatment Inventory of Costs in Patients with psychiatric disorders; TIC-P-Y, Treatment Inventory of Costs in Patients with psychiatric disorders - child version.

background, parental age, and their marital, educational and socioeconomic status, according to the International Standard Classification of Occupations-08,[52] psychiatric comorbidities, previous treatment of tics (behavioural therapy or medication) and outcomes thereof, family history of tics, and autoimmune diseases in first and second family relatives.

Sample size calculation

To determine the effects on the primary outcome (total tic score as measured by the YGTSS), at the primary end point (T2), at an effect size of Cohen's d=0.5 (according to Cohen, 1988), with a power of 0.8, a sample size of 52 patients per group (n=104) is needed to detect univariate differences ($p<0.05$) between the TYT and WLCG groups. In addition, we will test the background characteristics of participants versus patients who refused to participate to determine whether there is selection bias. Based on this sample size calculation, the intervention group will encompass approximately seven to eight groups of approximately four to eight patients with tic disorders.

Based on our clinical experiences and the percentage of dropouts in the feasibility study (7%), we aim to include and randomise at least 112 patients to achieve the total sample size of 104, necessary to answer our research questions.

Statistical analysis

To check for selection bias, differences in patient characteristics between participants and non-participants (no informed consent) will be tested by independent t-tests, χ^2 tests and Fisher's exact tests, where appropriate. In the same way, differences in baseline characteristics will be tested between the TyT and WLCG condition.

To test the effectiveness of Tackle Your Tics, group differences between the TyT brief intensive therapy versus WLCG at our primary outcome (T2) will be analysed using the intention-to-treat-principle, by weighted generalised estimating equations (GEEs) to handle missing data.[53] In case of treatment dropouts, the clinical measures obtained at the time of dropout will be used for our analyses. Changes on the key outcome tic severity will be corrected for group effect and analysed with GEEs.

Based on the pilot study results, changes in tic severity are expected between pretreatment (T1) and post-treatment (T2), as well as further improvement at 12 weeks (T3) and 6 months (T4) of follow-up. Group mean differences at the four measurements (T1–T2–T3–T4) will be tested as a secondary analysis using GEE to show outcomes on tic severity, quality of life, premonitory urges, beliefs about tics, daily functioning (emotional/behavioural, social and school functioning), self-esteem, family functioning (including caregiver strain), treatment alliance/satisfaction and cost effectivity.

To check for possible effects of the programme adjustments to COVID-19 measures (see table 2),

the differences in outcomes between the (original or slightly adapted) face-to-face groups and the blended/online groups will be analysed with GEE, as well as the differences between the results of the total study population and the study population without the participants of blended or online groups, to see if there are differences in the effects.

ETHICS AND DISSEMINATION

Ethics approval

This study is performed in accordance with the Declaration of Helsinki and approved by the medical ethical committee of the Amsterdam Medical Centre (METC nr NL66340.018.18). Representatives of the Dutch patient organisation are active members of the research team and continuously review the research process from the patients' perspective.

Informed consent

Oral and written information is given to parents and patients, and written consent from patients over 12 years and parents is received.

Patient and public involvement

Patient representatives are 'experts by experience' and play a unique and important role in this project and are equal partners in the research team from start to finish. Next to the programme contributions already mentioned, their contributions include codesigning the study, obtaining grants, recruitment, collection and interpretation of the data, cowriting publications and giving congress presentations. This active involvement from the patient's perspective ensures that the research process matches the needs and wishes of patients and families.

Dissemination

Results of the study will be presented on national and international conferences, peer-reviewed scientific journals, patient organisation meetings and public media. If Tackle Your Tics proves to be effective, the programme will be implemented in centres for youth mental healthcare.

DISCUSSION

This study is, to our knowledge, the first RCT studying the effectiveness of a brief, intensive group-based exposure therapy for children and adolescents with chronic tic disorders. If this brief, intensive ERP treatment is shown to be effective, it can offer several benefits. Programmes like Tackle Your Tics can expand the access to behavioural treatment for youth living in different areas, where specialised therapists trained in treatment of tics are unavailable. Families may find it more feasible to follow a brief, compromised treatment in 4 days with earlier benefit of possible treatment results and additional support. The programme also offers opportunities to educate behavioural therapists in behavioural (group) therapy for tics. This study will show which children benefit most from an intensive group-based format, which will make it easier for practitioners to give personalised treatment advice.

This study design also encompasses several limitations. First, the active treatment condition is compared with a waiting list condition, in which the participants receive the same treatment after 3 months. No active control condition is being compared. As a consequence, no conclusions can be drawn about the value of the specific components of the programme.

Second, the results of this trial may not be directly generalisable to all patients in clinical practice, since the parents and children in this sample were motivated to participate in research, preferred an intensive group-based treatment and were able to invest time and effort to travel to the treatment centre. Furthermore, it is unclear what the effectiveness will be on the longer term, since the last follow-up measurement is conducted 6 months after treatment. Lastly, effects of programme adjustments and family stress as a result of the COVID-19 pandemic may influence treatment results but will also provide new insights into the feasibility to adjust group programmes during changing situations.

Few studies have investigated the neural changes that are associated with behavioural treatment for tics. A study of Deckersbach *et al*[54] indicated that behavioural therapy leads to a normalisation of activation in the putamen.[54] Future studies could provide more insight into the mechanisms of behavioural therapy and its components.

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Competing interests CV and JMTMG developed and published the manual 'Tics' and the training app BT-Coach (BT-Tics Foundation), which are both being used in the programme. On behalf of all authors, the corresponding author states that there are no other conflicts of interest.

Patient and public involvement Patients and/or the public were involved in the design, conduct, reporting or dissemination plans of this research. Refer to the Methods and analysis section for further details.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants and was approved by medical ethical committee of the Amsterdam Medical Centre (METC nr NL66340.018.18). The participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. Considering the fact that for this project we have gathered highly sensitive and privacy protected data (protection legislated by Dutch law), we can share the following: relevant supporting documents will be made publicly available after an embargo period (ie, after publication of our results/the intended PhD thesis on this project and in accordance with informed consents), in case of relevant research questions. For this study, the following study information will be published in a public repository: metadata about the study: the study protocol, statistical analysis plan, data management plan, metadata schema and a global description of the intervention protocols (as described in our trial design paper by Heijerman-Holtgrefe *et al*, to be published); metadata about the data: documentation on study procedures, a data dictionary and syntaxes.

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