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Effects of Group Comprehensive Behavioral Intervention for Tics in Children With Tourette's Disorder and Chronic Tic Disorder

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Objectives: Comprehensive behavioral intervention for tics (CBIT) is effective in children with chronic tic disorders. This study aimed to assess the effect of group-based CBIT (group-CBIT) on tic severity and comorbid symptoms. We compared the efficacy of group CBIT with that of a control.

Methods: Thirty children with chronic tic disorder or Tourette's disorder were enrolled in this study. Eighteen were assigned to the group-CBIT for eight sessions, and 12 were assigned to the control group. Tics and comorbid symptoms were assessed pre- and post-intervention using the Yale Global Tic Severity Scale (YGTSS), Premonitory Urge for Tics Scale, attention-deficit hyperactivity disorder Rating Scale-IV, Children's Yale-Brown Obsessive-Compulsive Scale, and the Korean-Children Behavioral Checklist. We compared the pre- and post-intervention results of each group and determined the difference in the pre- and post-intervention results between intervention and the control group.

Results: The YGTSS motor and vocal tic interference, global impairment, and global severity scores decreased in the intervention group only. Group CBIT was superior in reducing the motor tic interference, impairment score, and global severity score to the control group.

Conclusion: The group-CBIT showed an improvement in tic symptoms, especially in reducing the level of interference and impairment of tics.

Keywords: Comprehensive behavioral intervention for tics; Habit reversal training; Chronic tic disorder; Tourette disorder.

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INTRODUCTION

Tourette's disorder (TD) and chronic motor or vocal tic disorder (CTD) are neurodevelopmental disorders accompanied by motor or vocal tic disorders for more than one year [1], which lead to various functional impairments and deterioration of the quality of life [2,3].

Comprehensive behavioral intervention for tics (CBIT) is a multi-component and individualized intervention for tic symptoms. The first component of CBIT is habit reversal training (HRT). HRT consists of awareness training and competing response training for tics; elements of self-monitoring, motivational procedures, and generalization training are also utilized. The second component is the functional intervention. Antecedent factors associated with tic aggravation, such as stress, anxiety, boredom, and intense arousal, are addressed by functional analysis related to tics. Coping strategies for interpersonal situations that inadvertently result in the worsening of tic disorders are also addressed by this component. The third component provides parents with psychoeducation on tics. The fourth category included relaxation training.

HRT and CBIT showed a strong effect size in a meta-analysis [4]. The American and European Child and Adolescent Psychiatric Associations recommend behavioral treatments with strong evidence for tic disorders [5,6]. In a recent study of group-CBIT, it was reported that vocal and motor tics improved, and the treatment effect was maintained even after 3 months [7]. However, despite the strong evidence, it is difficult to implement individual CBIT in clinical practice. There are studies on the effect of HRT in Korea [8], but the number of participants was within 10, and individualized treatment was conducted without a control group. In this study, we aimed

to administer group-CBIT in children with TD/CTD and examine its effects on tic-related symptoms relative to a control.

METHODS

Participants and procedures

The participants of the study were pediatric patients aged 18 years or younger who were diagnosed with TD/CTD using the DSM-5 criteria. All participants were recruited through the Child and Adolescent Clinic at the Department of Psychiatry at Jeju National University Hospital. There were 18 and 12 participants in the experimental and control groups, respectively. The experimental group received group CBIT in members 3 and 4 between 2015 and 2019. The control group included children and adolescents who were being treated at the outpatient clinic for TD/CTD, and supportive psychotherapy and parental education were provided according to the symptoms. For all participants who were on medication, there was no change in the dose of tics from 6 weeks before starting the treatment throughout the study period. Participants with attention-deficit hyperactivity disorder (ADHD) were included in the study, but those who started psychosocial therapy, such as social skills training, during the study period or changed their medications were excluded. For those who were receiving medication for ADHD, the dose was stable during the study. The exclusion criteria were intellectual disability, autism spectrum disorder, organic mental disorder, and the presence of a neurologic condition. The experimental group received pre- and post-assessments administered by a clinical psychologist immediately before and after the treatment, while the control group participated in the pre- and post-assessments with an 8-week study period. Written informed consent was obtained from all participants, and the study was approved by the Institutional Review Board of Jeju National University Hospital (2013-08-004).

Program composition and progress

The experimental group participated in group-CBIT once a week for a total of eight sessions conducted by clinical psychologists for 8 weeks. CBIT was constructed based on the guidelines for therapists to control Tourette's syndrome [9], and each session took an average of 90 minutes (Table 1). During the first session, the rationale for CBIT treatment and psychoeducation for tic disorders were introduced, a symptom hierarchy was prepared, and education on tic was provided. During sessions 2 to 6, individual target tics and symptoms of the premonitory urge were identified while conducting competing response training. During each session, a functional intervention that evaluated the situational factors related to the exacerbation of tics and the intervention was provided. Parent education was provided by a child and adolescent psychiatrist during the second session, and relaxation training was provided during the third session. Once sufficient education was provided for the target tics, competing response training was repeated for the next target tic. During sessions 7 and 8, the competing response and relaxation training for each tic symptom were reviewed, and plans were established for the remaining tic symptoms. During each session, self-monitoring and competing responses to practice were assigned as homework, and tic symptoms and homework from the previous session were reviewed at the beginning of the next session. All participants participated in the 8-session

Table 1. Group comprehensive behavioral intervention for tics program content

Session number	Subjects of program
1	Psychoeducation on tics
	Introduction of evidence of behavioral therapy
	Develop a hierarchy of tics
	Awareness training
2	Review tic hierarchy and premornitory urge
	Develop function-based interventions for tics
	Awareness training and develop a competing response for tics
	Parent education for tics and support
3	Review tic hierarchy
	Develop function-based interventions for tics
	Awareness training and develop a competing response for tics
	Introduce and practice deep breathing and progressive muscle relaxation
4	Review tic hierarchy
	Develop function-based interventions for tics
	Awareness training and develop a competing response for tics
5	Review tic hierarchy
	Develop function-based interventions for tics
	Awareness training and develop a competing response for tics
6	Review tic hierarchy
	Develop function-based interventions for tics
	Awareness training and develop a competing response for tics
7	Review tic hierarchy
	Develop function-based interventions for tics
	Review relaxation techniques
	Introduce relapse prevention and discuss strategies for relapse prevention
8	Review tic hierarchy
	Review previous treatment content
	Plan competing response for residual tics

program without dropping out, and a clinical scale evaluation was conducted for the children and parents before and after the program.

Measures

Korean form of Yale Global Tic Severity Scale (YGTSS)

The YGTSS is a clinician-rated scale that includes an inventory of tic severity [10]. The severity of motor and vocal tics is scored on a 6-point scale (0−5 points) for five dimensions, including the number, frequency, intensity, complexity, and interference. The global impairment rating evaluates the impact of tic-related disability experienced during the past week on self-esteem, family relationships, interpersonal relationships, and school life. The global severity score is the sum of the scores for motor tics, vocal tics, and global impairments. In this study, the Korean version of the YGTSS was used, and it showed high internal consistency (Cronbach's alpha=0.69) and reliability (0.75 to 0.98) [11].

Korean form of the Premonitory Urge for Tics Scale (PUTS)

The PUTS is a self-report measure used to assess the severity of premonitory urges in patients with TD/CTD. It evaluates nine items on a 4-point scale [12], and a higher total score indicates more severe premonitory urges. The Korean version of the PUTS was evaluated as having good internal consistency (Cronbach's alpha=0.79) and reliability (0.60) [13].

Children's Yale-Brown Obsessive-Compulsive Scale (CY-BOCS)

The CY-BOCS is a children's version of the Y-BOCS, an obsessive-compulsive scale for adults, which is a semi-structured scale designed to evaluate the severity of obsessive-compulsive symptoms within the past week according to 10 items, similar to those for adults [14]. The symptoms were evaluated across five areas, including the time to experience symptoms, interference, distressing nature, resistance, and control associated with obsessions and compulsions. Each item was scored on a 5-point ranking scale. Higher scores indicated higher severity ratings [15].

ADHD Rating Scale-IV (ARS-IV)

The ARS, developed by DuPaul [16], was designed to evaluate ADHD symptoms in school-aged children. The scale consists of 18 items based on DSM-IV criteria. Each item is rated on a scale of 0 to 3, depending on the severity of the child's behavior. In Korea, the reliability of the parental evaluation scale was reported as 0.94 [17].

Korean-Children Behavioral Checklist (K-CBCL)

The CBCL developed by Achenbach [18] was used to evaluate mental health problems in children. In Korea, reliability and validity have been reported for the version standardized by Lee et al. [19]. It consists of 12 subscales, including anxiety/depression, somatic complaints, withdrawal/ depression, social problems, thought problems, attentional problems, delinquent behaviors, aggressive behaviors, internalizing problems, externalizing problems, and total score. Having more emotional and behavioral problems resulted in a higher score, which was converted into raw and T scores, respectively. In this study, the T scores for internalizing and externalizing problems and the total score were used to evaluate the comorbid mental health problems of the participants.

State-Trait Anxiety Inventory for Children (STAI)

The state-trait anxiety scale developed by Spielberger [20] and a standardized version for Korea were used [21]. It evaluates state and trait anxiety, each of which is designated 20 items. Each item was rated on a scale of 1 to 3, with higher scores indicating higher anxiety.

Statistical analyses

The data were analyzed using nonparametric statistics. The Mann-Whitney U test was used to compare pre-scores and investigate the differences in the pre-post scores between the experimental and control groups, while the Wilcoxon signed ranks test was used to assess the difference between the pre- and post-scores in each group. SPSS 18 for Windows (SPSS Inc., Chicago, IL, USA) was used for all the analyses, and the significance level was set at $p<0.05$.

RESULTS

The mean ages of the experimental and control group were 11.50 years and 11.06 years, respectively (p=0.628). There were 14 males and 4 females in the experimental group, while the control group had 12 males (p=0.079), and there was no significant difference between the two groups. The number of participants with TD and CTD was 15 (83.3%) and 3 (16.7%), respectively, in the experimental group, and 8 (66.7%) and 4 (33.3%), respectively, in the control group; there was no significant difference between the groups (p=0.290). Ten participants (55.6%) in the experimental group and 7 (58.3%) in the control group had both ADHD and tic disorders (p=0.880). Sixteen participants (88.9%) in the experimental group and 9 (75%) in the control group were receiving antipsychotic drugs (risperidone and aripiprazole) (p=0.556). Six participants (33.3%) in the experimental group and 6 (50%) in the control group were being treated for ADHD with medi-

cations, and there was no significant difference between the groups (p=0.528). In the experimental group, six participants took atomoxetine; in the control group, five subjects took atomoxetine, and one participant took methylpentidate (Table 2).

The difference in the pre-intervention score between the intervention and control group

Regarding the pre-intervention score comparison between the experimental and control groups, the scores for internal-

Table 2. Demographic and clinical characteristics of participants

Characteristics	Intervention group (n=18)	Control group (n=12)	p-value
Sex, male	14 (77.8)	12 (100)	0.079
Age (year)	11.06 (1.43)	11.50 (3.45)	0.628
Diagnosis			0.290
Chronic motor tic disorder	3 (16.7)	4 (33.3)	
Tourette disorder	15 (83.3)	8 (66.7)	
ADHD diagnosis	10 (55.6)	7 (58.3)	0.880
Medication history			0.556
None	2 (11.1)	2 (16.7)	
Antipsychotics monotherapy	9 (50.0)	3 (25.0)	
Two antipsycohtics combination	1 (5.6)	1 (8.3)	
Antipsychotics+ADHD medication	6 (33.3)	5 (41.7)	
ADHD medication monotherapy	0 (0)	1 (3.3)	
Combined antidepressant	4 (22.2)	1 (8.3)	

Data are presented as mean (SD) or n (%)

Table 3. Baseline score difference between intervention and control groups

	Intervention group (n=18)	Control group (n=12)	Mann-Whitney U	p-value
PUTS	16.61 (5.30)	15.58 (5.62)	88.50	0.406
YGTSS_motor				
Number	2.00 (0.77)	1.75 (1.36)	94.00	0.492
Frequency	3.11 (0.90)	2.08 (1.44)	64.00	0.051
Intensity	2.61 (0.92)	1.92 (1.31)	76.00	0.156
Complexity	0.67 (1.19)	0.33 (0.89)	90.00	0.327
Interference	1.78 (1.27)	1.00 (1.04)	70.00	0.097
Total motor tic score	10.17 (3.85)	7.08 (5.27)	69.00	0.097
YGTSS_vocal				
Number	0.78 (0.81)	0.42 (0.67)	81.00	0.206
Frequency	1.56 (1.72)	1.00 (1.71)	85.00	0.289
Intensity	1.33 (1.41)	0.75 (1.29)	81.50	0.218
Complexity	0.33 (0.77)	0.50 (1.45)	103.50	0.785
Interference	0.67 (0.84)	0.58 (1.17)	88.00	0.333
Total vocal tic score	4.67 (4.70)	3.25 (5.85)	82.50	0.241
YGTSS_global impairment score	17.22 (8.95)	10.83 (11.65)	63.00	0.047*
YGTSS_global severity score	32.06 (14.51)	21.17 (20.92)	55.00	0.025*
CBCL				
Total problem	59.94 (8.38)	57.17 (8.57)	81.50	0.363
Internalizing problem	60.35 (11.77)	51.83 (8.78)	57.00	0.046*
Externalizing problem	54.59 (7.78)	54.92 (11.10)	99.50	0.913
C-YBOCS	0.89 (1.97)	0.25 (0.87)	93.00	0.328
STAI-trait anxiety	40.35 (13.00)	33.92 (8.59)	69.50	0.152
STAI-state anxiety	36.83 (12.93)	32.83 (9.97)	97.00	0.662
ADHDRS	11.47 (8.07)	13.25 (10.10)	88.00	0.533

*p<0.05. PUTS, Premonitory Urge for Tics Scale; YGTSS, Yale Global Tic Severity Scale; CBCL, Children Behavioral Checklist; C-YBOCS, Children's Yale-Brown Obsessive-Compulsive Scale; STAT, State-Trait Anxiety Inventory for Children; ADHDRS, attention-deficit hyperactivity disorder rating scale

Table 4. Comparison between pre- and post- intervention score after group habit reversal training program

	Intervention group			Control group		
	Pre	Post	p-value	Pre	Post	p-value
PUTS	16.61 (5.30)	17.50 (5.22)	0.254	15.58 (5.62)	16.75 (9.05)	0.959
YGTSS_motor						
Number	2.00 (0.77)	2.00 (0.84)	>0.999	1.75 (1.36)	1.67 (1.16)	0.480
Frequency	3.11 (0.90)	2.83 (1.10)	0.248	2.08 (1.44)	1.83 (1.40)	0.366
Intensity	2.61 (0.92)	2.28 (0.90)	0.130	1.92 (1.31)	1.67 (1.16)	0.206
Complexity	0.67 (1.19)	0.33 (0.77)	0.319	0.33 (0.89)	0.33 (0.65)	>0.999
Interference	1.78 (1.27)	1.11 (1.13)	0.023*	1.00 (1.04)	1.00 (1.04)	>0.999
Total motor tic score	10.17 (3.85)	8.56 (3.42)	0.071	7.08 (5.27)	6.50 (4.32)	0.198
YGTSS_vocal						
Number	0.78 (0.81)	0.67 (0.59)	0.480	0.42 (0.67)	0.42 (0.52)	>0.999
Frequency	1.56 (1.72)	1.33 (1.41)	0.811	1.00 (1.71)	1.17 (1.64)	0.414
Intensity	1.33 (1.41)	1.06 (1.06)	0.290	0.75 (1.29)	0.83 (1.12)	0.564
Complexity	0.33 (0.77)	0.00 (0)	0.059	0.50 (1.45)	0.00 (0)	0.180
Interference	0.67 (0.84)	0.33 (0.59)	0.034*	0.58 (1.17)	0.42 (0.90)	0.414
Total vocal tic score	4.67 (4.70)	3.33 (3.65)	0.098	3.25 (5.85)	2.83 (3.83)	0.854
YGTSS_global impairment score	17.22 (8.95)	8.33 (7.07)	0.005*	10.83 (11.65)	10.83 (9.00)	>0.999
YGTSS_global severity score	32.06 (14.51)	20.22 (11.65)	0.004*	21.17 (20.92)	21.17 (14.23)	0.430
CBCL (T scores)						
Total	60.06 (8.14)	56.67 (7.78)	0.024*	57.17 (8.57)	51.75 (14.11)	0.181
Internalizing	60.50 (11.44)	57.00 (9.19)	0.072	51.83 (8.78)	50.33 (11.48)	0.623
Externalizing	54.72 (7.57)	53.06 (9.17)	0.236	54.92 (11.10)	51.42 (12.72)	0.327
CY-BOCS	0.89 (1.97)	1.33 (3.90)	0.498	0.25 (0.87)	0.25 (0.87)	>0.999
STAI-trait anxiety	40.35 (12.95)	38.58 (12.95)	0.422	33.92 (8.59)	35.92 (15.97)	0.721
STAI-state anxiety	36.83 (12.93)	40.35 (13.00)	0.831	32.83 (9.97)	34.75 (16.70)	0.838
ADHDRS	11.78 (7.94)	11.00 (6.93)	0.328	13.25 (10.10)	6.56 (1.89)	0.182

Data are presented as mean (SD). *p<0.05. PUTS, Premonitory Urge for Tics Scale; YGTSS, Yale Global Tic Severity Scale; CBCL, Children Behavioral Checklist; C-YBOCS, Children's Yale-Brown Obsessive-Compulsive Scale; STAT, State-Trait Anxiety Inventory for Children; ADHDRS, attention-deficit hyperactivity disorder rating scale

izing problems of the K-CBCL (p=0.046), the YGTSS global impairment score (p=0.047), and the global severity score were significantly higher (p=0.025) in the experimental group (Table 3).

Differences in the pre- and post-intervention scores

In the experimental group, there was a significant improvement in the YGTSS motor and vocal tic interference scores (p=0.023, p=0.034), as well as a significant reduction in the scores for global impairment and global severity by 8.89 points and 11.84 points, respectively (p=0.005, p=0.004). In the experimental group, a significant improvement in the total K-CBCL problem score was observed (p=0.024). However, in the control group, there was no significant difference between the pre- and post-intervention scores for all scales (Table 4).

Pre- and post-intervention score difference between the intervention and control group

In the YGTSS, the changes in the pre- and post-intervention scores for motor tic interference in the experimental group were significantly lower than those in the control group (p=0.031). The global severity score lso showed a significant improvement post-intervention from before the intervention compared with those of the control group (p=0.013, p=0.022) (Table 5).

DISCUSSION

This study aimed to examine the changes in the pre- and post-intervention scores for the tic-related symptom scale with those of the control group to identify the effects of group-CBIT. It was confirmed that group CBIT was associated with a significant improvement in the interference of motor tics, impairment due to tics, and global severity score relative to the control group.

Table 5. Comparison pre- and post-intervention score difference between intervention and control groups

	Intervention group	Control group	Mann-Whitney U	p-value
PUTS	-0.89 (4.86)	-1.17 (6.46)	88.50	0.415
YGTSS_motor				
Number	0.00 (0.84)	0.08 (1.08)	94.50	0.573
Frequency	0.28 (0.96)	0.25 (0.97)	106.50	0.950
Intensity	0.33 (0.91)	0.25 (1.14)	100.00	0.755
Complexity	0.33 (1.24)	0 (0.43)	85.50	0.346
Interference	0.67 (1.03)	0 (0.74)	57.50	0.031*
Total motor tic score	1.61 (3.37)	0.58 (3.53)	88.00	0.415
YGTSS_vocal				
Number	0.11 (0.68)	0 (0.43)	97.00	0.662
Frequency	0.06 (1.66)	-1.67 (0.72)	91.00	0.491
Intensity	0.28 (1.13)	-0.83 (0.51)	85.00	0.346
Complexity	0.33 (0.77)	0.50 (1.45)	103.50	0.851
Interference	0.33 (0.59)	0.17 (0.72)	87.00	0.391
Total vocal tic score	1.33 (3.50)	0.42 (3.37)	79.00	0.232
YGTSS_global impairment score	8.89 (10.23)	0 (4.26)	50.50	0.013*
YGTSS_global severity score	11.83 (14.15)	1.00 (9.71)	54.00	0.022*
CBCL (T scores)				
Total	3.39 (6.37)	5.42 (10.77)	106.50	0.950
Internalizing	3.50 (9.73)	1.50 (8.71)	94.00	0.573
Externalizing	1.67 (6.97)	3.50 (8.92)	105.50	0.917
CY-BOCS	-0.44 (3.99)	0 (0)	90.00	0.465
STAI-trait anxiety	1.76 (7.62)	-2.00 (12.70)	100.50	0.948
STAI-state anxiety	0.44 (9.76)	-1.92 (10.91)	107.50	0.983
ADHDRS	0.78 (4.91)	3.08 (6.30)	93.50	0.545

*$p<0.05$. PUTS, Premonitory Urge for Tics Scale; YGTSS, Yale Global Tic Severity Scale; CBCL, Children Behavioral Checklist; C-YBOCS, Children's Yale-Brown Obsessive-Compulsive Scale; STAT, State-Trait Anxiety Inventory for Children; ADHDRS, attention-deficit hyperactivity disorder rating scale

Compared with the control group, the intervention group showed improvements in the interference due to motor tics and the overall score for tics, which was similar to the findings of a previous study showing an improvement in motor tic severity [22] and another study on the efficacy of CBIT involving 126 adolescents aged 9 to 17 years showing a significant reduction in overall YGTSS score and 51% improvement in the clinical global impression [23]. In addition, the significant reduction in the global impairment score was also similar to the results of a recent study that administered group-CBIT to 28 participants aged 8 to 15 years [7]. In contrast, there was a significant improvement in the interference score for vocal tics in the experimental group after the CBIT intervention, the difference was not significant when compared with that of the control group. The reports on the effects of behavioral therapy on vocal tics are inconsistent, but previous studies on group-CBIT have shown no significant improvement [7,22]. The participants receiving behavioral therapy such as HRT or CBIT usually had 3 to 4 tics, and the target tics to be modified were determined according to the severity of the tics and the interruption of daily life activities. Since most of the tics are motor, it is rare to target vocal tics as the treatment goal of behavioral modification [22,24], and this may be the reason for the inconsistent effects of CBIT on vocal tics.

In this study, the experimental group showed a high internalizing problem score and higher severity of tic symptoms. A previous study reported that the effects of behavioral therapy on tics were effective in minimizing functional impairment when the severity of tics was higher, while the effects were small for TD/CTD patients with high anxiety [25]. In contrast, the results suggest that anxiety, depression, obsessive-compulsive symptoms, and attention problems are not significantly associated with treatment effects, although the behavioral problem score in the CBCL is a significant determinant of CBIT effects [7]. This indicates that the effects of internalizing problems on the treatment effects of CBIT are inconsistent. In this study, there was a limitation in interpreting the effects of the severity of tics and internalizing problems on treatment effects. Thus, there is a need for research on emotional problems and tic severity in tic disorders as predictors of the treatment effects of CBIT.

In this study, there was no significant difference between the two groups in the proportion and types of drug treatment received and the incidence of comorbidity with ADHD. Previous studies have reported that the presence of co-morbidities such as ADHD and obsessive-compulsive disorder had no significant effect on the response to CBIT treatment [26] and the type of drug treatment does not affect the response to CBIT treatment [23]. The presence of ADHD and drug treatment may not have affected the CBIT response. Nevertheless, it is necessary to research the effect of comorbidities such as ADHD and drug treatment on the treatment response to CBIT in the future.

The limitations of this study include the difficulty of including a large number of participants and follow-up on the durability of treatment response after treatment termination. In addition, it was difficult to verify the therapeutic effects of CBIT alone, as most of the participants received CBIT in combination with drug therapy.

This is the first study conducted in Korea to examine the effects of group-CBIT. The clinical significance of this study is that behavioral intervention for tics is an effective treatment, which could be particularly useful when performed in groups. Although there was no significant change in the frequency or severity of motor tics with CBIT treatment, the motor tics interference and global impairment scores showed a significant reduction, suggesting that the ability to minimize the negative effects of tics in daily life improved. This may be because the participants actively received treatment, including HRT, which is a component of CBIT, as well as functional intervention and relaxation training, thereby enhancing awareness and coping ability according to the exacerbation of tics or antecedent factors. In addition, it served as an opportunity to actively participate in the treatment by providing families with psychoeducation and parental education about tics and by helping the generalization of competing responses at home. However, considering that weekly face-to-face behavioral therapy with a specialist is a limitation in a clinical setting, a recent study was conducted on the effect of internet-based CBIT and reported a significant therapeutic effect on tic symptoms [27]. Taking this into account, further research on the treatment duration of behavioral therapy and the factors affecting the treatment effect is needed through the development of a structured manual for behavioral treatment of tics and the dissemination and implementation of various methods in the future.

CONCLUSION

This study examined the therapeutic effects of group CBIT on tic-related symptoms. Group CBIT reduces the interference caused by motor tics and reduces the impairment score and global severity of tics, leading to reduced inconveniences in daily life due to tics. The components and progress of CBIT treatment conducted in this study were suitable for reducing tics, and it is expected that CBIT can be applied to TD/CTD patients and their families in the future as a non-pharmacological treatment for tics.

Availability of Data and Material

All data generated or analyzed during the study are included in this published article (and its supplementary information files).

Conflicts of Interest

The authors have no potential conflicts of interest to disclose.

Author Contributions

Conceptualization: Young Sook Kwack. Data curation: Hui-Jeong Kim. Formal analysis: Na Ri Kang, Duk Soo Moon. Methodology: Young Sook Kwack. Writing—original draft: Na Ri Kang. Writing—review & editing: Na Ri Kang, Duk Soo Moon.

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REFERENCES

1) **American Psychiatric Association.** Diagnostic and statistical manual of mental disorders. 5th ed. Arlington, VA: American Psychiatric Association;2013.
2) **Eapen V, Cavanna AE, Robertson MM.** Comorbidities, social impact, and quality of life in Tourette syndrome. Front Psychiatry 2016;7:97.
3) **Pérez-Vigil A, Fernández de la Cruz L, Brander G, Isomura K, Jangmo A, Kuja-Halkola R, et al.** Association of Tourette syndrome and chronic tic disorders with objective indicators of educational attainment: a population-based sibling comparison study. JAMA Neurol 2018;75:1098-1105.
4) **McGuire JF, Piacentini J, Brennan EA, Lewin AB, Murphy TK, Small BJ, et al.** A meta-analysis of behavior therapy for Tourette syndrome. J Psychiatr Res 2014;50:106-112.
5) **Murphy TK, Lewin AB, Storch EA, Stock S; American Academy of Child and Adolescent Psychiatry (AACAP) Committee on Quality Issues (CQI).** Practice parameter for the assessment and treatment of children and adolescents with tic disorders. J Am Acad Child Adolesc Psychiatry 2013;52:1341-1359.
6) **Andrén P, Jakubovski E, Murphy TL, Woitecki K, Tarnok Z, Zimmerman-Brenner S, et al.** European clinical guidelines for Tourette syndrome and other tic disorders-version 2.0. Part II: psychological interventions. Eur Child Adolesc Psychiatry 2022;31:403-423.
7) **Zimmerman-Brenner S, Pilowsky-Peleg T, Rachamim L, Ben-Zvi A, Gur N, Murphy T, et al.** Group behavioral interventions for tics and comorbid symptoms in children with chronic tic disorders. Eur Child Adolesc Psychiatry 2022;31:637-648.
8) **Hong JW, Doh JA, Kim HW, Lim MH.** Habit reversal training in tic disorder. Anxiety and Mood 2010;6:24-30.
9) **Woods DW, Piacentin JC, Chang SW, Deckersbach T, Ginsburg**

GS, Perterson AL, et al. Managing Tourette syndrome - A behavioral intervention for children and adults; therapist guide. Lim MH, Doh JA, Lee HJ, Park TW, Kim YS, Cho SC, trans. Seoul: Hakjisa;2010.
10) **Leckman JF, Riddle MA, Hardin MT, Ort SI, Swartz KL, Stevenson J, et al.** The Yale Global Tic Severity Scale: initial testing of a clinician-rated scale of tic severity. J Am Acad Child Adolesc Psychiatry 1989;28:566-573.
11) **Chung SJ, Lee JS, Yoo TI, Koo YJ, Jeon SI, Kim BS, et al.** Development of the Korean form of Yale Global Tic Severity Scale: a validity and reliability study. J Korean Neuropsychiatr Assoc 1998; 37:942-951.
12) **Woods DW, Piacentini J, Himle MB, Chang S.** Premonitory urge for tics scale (PUTS): initial psychometric results and examination of the premonitory urge phenomenon in youths with tic disorders. J Dev Behav Pediatr 2005;26:397-403.
13) **Kim M, Chung SK, Yang JC, Park JI, Nam SH, Park TW.** Development of the Korean form of the premonitory urge for tics scale: a reliability and validity study. J Korean Acad Child Adolesc Psychiatry 2020;31:146-153.
14) **Goodman W, Price L, Rasmussen S, Riddle M, Rapoport J.** Children's Yale-Brown obsessive compulsive scale (CY-BOCS). New Haven, CT: Clinical Neuroscience Unit;1991. p.31-51.
15) **Chung SJ, Lee JS, Kang YH, Cho SJ, Suh DH, Hong KE.** Development of Korean form of Children's Yale-Brown Obsessive-Compulsive Scale (CY-BOCS): a reliability and validity study. J Korean Acad Child Adolesc Psychiatry 2000;11:60-69.
16) **DuPaul GJ.** Parent and teacher ratings of ADHD symptoms: psychometric properties in a community-based sample. J Clin Child Adolesc Psychol 1991;20:245-253.
17) **So YK, Noh JS, Kim YS, Ko SG, Koh YJ.** The reliability and validity of Korean parent and teacher ADHD rating scale. J Korean Neuropsychiatr Assoc 2002;41:283-289.
18) **Achenbach TM.** Manual for the Child Behavior Checklist/4-18 and 1991 profile. Burlington, VT: University of Vermont;1991.
19) **Lee HL, Oh KJ, Hong KE, Ha EH.** Clinical validity study of Korean CBCL through item analysis. J Korean Acad Child Adolesc Psychiatry 1991;2:138-149.
20) **Spielberger CD.** Manual for the state trait anxiety inventory for children. Palo Alto, CA: Consulting Psychologists Press;1973.
21) **Cho SC, Choi JS.** Development of the Korean form of the state-trait anxiety inventory for children. Seoul J Psychiatry 1989;14:150-157.
22) **Yates R, Edwards K, King J, Luzon O, Evangeli M, Stark D, et al.** Habit reversal training and educational group treatments for children with Tourette syndrome: a preliminary randomised controlled trial. Behav Res Ther 2016;80:43-50.
23) **Piacentini J, Woods DW, Scahill L, Wilhelm S, Peterson AL, Chang S, et al.** Behavior therapy for children with Tourette disorder: a randomized controlled trial. JAMA 2010;303:1929-1937.
24) **Dabrowski J, King J, Edwards K, Yates R, Heyman I, Zimmerman-Brenner S, et al.** The long-term effects of group-based psychological interventions for children with Tourette syndrome: a randomized controlled trial. Behav Ther 2018;49:331-343.
25) **Nissen JB, Parner ET, Thomsen PH.** Predictors of therapeutic treatment outcome in adolescent chronic tic disorders. BJPsych Open 2019;5:e74.
26) **Sukhodolsky DG, Woods DW, Piacentini J, Wilhelm S, Peterson AL, Katsovich L, et al.** Moderators and predictors of response to behavior therapy for tics in Tourette syndrome. Neurology 2017;88: 1029-1036.
27) **Rachamim L, Zimmerman-Brenner S, Rachamim O, Mualem H, Zingboim N, Rotstein M.** Internet-based guided self-help comprehensive behavioral intervention for tics (ICBIT) for youth with tic disorders: a feasibility and effectiveness study with 6 month-follow-up. Eur Child Adolesc Psychiatry 2022:31:275-287.