

Assessing the Effectiveness of Real-Time Online Parent Training for Parents of Children with Diverse Neurodevelopmental Disorders Residing in the Community

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ABSTRACT

Background Parents residing in the community have children with diverse neurodevelopmental disorders. Thus, developing online parent training that is effective for various types of neurodevelopmental disorders, not just for a single one, is essential. This study investigated the effects of real-time online group parent training developed for parents of children with various neurodevelopmental disorders.

Methods Twenty-two parents (two males and 20 females) of children with diagnosed or suspected neurodevelopmental disorders participated. We developed real-time online group parent training based on the Tottori University parent training (TUPT-ON), which can be implemented online as a pilot study. Parenting stress, parenting attitudes, mental health, and children's inappropriate behavior scores were measured before and after the intervention and analyzed using paired *t*-test.

Results The average participation rate was 75.5%, and the average homework submission rate was 66.6%. The intervention significantly improved parents' quality of life and negative parenting. Moreover, significant improvements were found in the total problems age-standardized scores (T-scores) of the Child Behavior Checklist in participants' children. In response to five questions about the acceptability of our online group parent training, participants rated most items as four or higher out of five.

Conclusion The implementation of TUPT-ON showed some improvements in children's outcomes and brought about positive changes in parental outcomes across various neurodevelopmental disorders. This result suggests the potential effectiveness of this intervention for different types of neurodevelopmental disorders. TUPT-ON could provide parent training and support for parents dealing with their children's various neurodevelopmental disorders, regardless of location, as long as they have a stable internet connection. However, the lack of a control group and the small sample size of certain diseases warrant caution in interpreting these findings, and a rigorous validation design should be employed and revalidated in the future.

Key words Internet-based intervention; neurodevelopmental disorders; parent

The prevalence of neurodevelopmental disorders (NDs) is increasing globally.¹ In Japan, an increasing number of children are diagnosed with NDs such as autism spectrum disorder (ASD), attention deficit hyperactivity disorder (ADHD), and specific learning disorder (SLD).² Parents of children with NDs have been shown to be at risk for high stress, anxiety, and depression.^{3,4}

Parent training (PT) is a training program designed to equip parents with techniques to increase appropriate behaviors in their children while preventing or reducing inappropriate behaviors.^{5,6} Numerous studies have demonstrated that PT is an effective intervention for improving the mental health of parents of children with NDs and the behavior of children with NDs.^{7,8} Therefore, PT for parents of children with NDs has recently been recommended in many countries worldwide,⁹ and the Japanese government is also promoting the dissemination and implementation of PT in the community.¹⁰

There are two forms of PT: individual and group. PT for individuals has the advantage of flexibility regarding the content, pace, and mode of implementation

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Abbreviations: ADHD, Attention Deficit Hyperactivity Disorder; ASD, Autism Spectrum Disorder; BDI-II, Beck Depression Inventory Second Edition Japanese Version (BDI-II); CBCL, Child Behavior Check List 4-18 Japanese Version; DCD, developmental coordination disorder; ECBI, Eyberg Children Behavior Inventory Japanese Version; G-PT, Group-PT; ID, Intellectual Disability; ND, Neurodevelopmental Disorders; PNPS, Positive and Negative Parenting Scale; PSI, Parent Stress Index Japanese version; QOL, quality of life; SLD, Specific Learning Disorder; PT, Parent training; SM, selective mutism; TUPT -ON, TUPT was modified into a form that can be implemented online; TUPT; Tottori University parent training; WHO-QOL, WHO-QOL26 Japanese Version; on-demand PT, PT in person using on-demand materials posted on the Web; real-time online PT, PT is conducted in real-time using remote technology

with parents.¹¹ Group-PT (G-PT) has advantages concerning efficiency¹² and can reduce isolation through group interaction.¹¹ Review studies have discovered that in the context of ASD, ADHD, and intellectual disability (ID), both individually delivered PT and G-PT can improve parenting stress,¹³ inappropriate child behavior,⁸ and children's communication skills,¹⁴ while also promoting development. Tottori University parent training (TUPT) is a G-PT for various NDs based on applied behavior analysis, created to help children adjust their environment to minimize inappropriate behavior and learn appropriate alternative behaviors.¹⁵ Haraguchi & Inoue retrospectively assessed the impact of TUPT on 128 parents with children aged 2–17 years with a wide range of NDs, including ASD, ID, and other NDs.¹⁵ The results showed that parents improved their mental health significantly after completing PT, irrespective of their child's ND type. During the PT period, almost all parents were able to implement several instructional tasks targeted toward their children, some children with NDs acquired several adaptive skills.

Online PT can be divided into two forms: one in which parents facilitate PT in person using on-demand materials posted on the Web (on-demand PT)¹⁶ and the other in which PT is conducted in real-time using internet video communication technology (real-time online PT).¹⁷ Previous studies comparing self-directed (on-demand) and therapist-assisted (real-time online through Web conference systems) types reported no difference in program effectiveness, however, the therapist-assisted type reported higher levels of parent fidelity and positive perceptions of their children.¹⁸

Online PT is highly important in promoting PT in the community as it can overcome barriers, such as geographical distance between professionals.^{19, 20} However, most studies currently examining the effectiveness of online PT for NDs are focused on on-demand PT.^{21, 22} Although several studies have also focused on real-time online PT for parents of children with NDs, few involve group work among PT participants, and the PT targets are limited to a single ND (e.g., only parents of children with ASD,^{23, 24} only parents of children with ADHD,²⁵ and so on). However, peer support programs for parents of children with NDs have been proven to promote parental well-being.²⁶ Therefore, as in traditional PT, incorporating group work is an essential component in online PT for parents of children with NDs. Additionally, the range of ND types covered by online PT must be broadened, as parents of children with diverse NDs may reside in a community with a lack of professionals who can provide support.²⁷

Thus, developing therapist-assisted online PT that

is effective for various types of NDs would be meaningful rather than limiting the target to a single ND type, as Haraguchi and Inoue¹⁵ did to spread online PT in the community.

In this study, TUPT, which is effective for various ND types in a face-to-face format, was modified into a format that can be implemented online (TUPT-ON), and an online real-time G-PT was conducted with parents of children with NDs of various types as a pilot study. We then examined whether changes in parents' mental health, parenting stress, parenting attitudes, and children's inappropriate behavior occurred in the pre-post design. Subsequently, we considered the dissemination of TUPT-ON in the community.

SUBJECTS AND METHODS

Subjects

Participants were recruited for the study through a flier posted on the last author's website. Eligibility criteria included parents aged 20 or above, with a child aged 3–9 years with an ND, and participants were required to have a suitable internet environment for attending TUPT-ON. As a result, 23 people expressed their willingness to participate in the study, but one participant withdrew due to work commitments, resulting in 22 participants (two males and 20 females). Participants completed a Google Form to provide information on household income, special service agency use, and their children's diagnosis. Informed consent was obtained via Zoom, and anonymity was preserved through the use of nicknames during TUPT-ON.

The participants' and children's profiles are presented in Tables 1 and 2. The mean age of the participants' children was 5.27 ± 1.88 years, ranging from three to eight years. There were sixteen boys (72.7%) and six girls (27.2%). Fourteen had a diagnosis of ASD (63.6%), and six were suspected of having ASD (27.2%). One was diagnosed with ADHD (4.54%), and two were suspected of having ADHD (9.09%). Two were diagnosed with ID (2.54%), and two were suspected of having ID (9.09%). One had a diagnosis of selective mutism (SM) (4.54%), and one was suspected of having SM (4.54%). One had a diagnosis of stuttering (4.54%). Finally, one was diagnosed with developmental coordination disorder (DCD) (4.54%).

The mean age of the participants was 39.77 ± 4.46 years, with a range of 28–51 years. There were two males (9.09%) and 20 females (90.9%). Sixteen were employed (72.7%). Two of the participants' last education level was high school (9.09%), twelve university (54.5%), and five graduate school (22.7%). Four of the participants had annual household incomes between

Table 1. Profile of the participants

ID	Age	Sex	Last educational background	Employment situation	Number of attendance	Number of home-work submissions	Type of issue set
1	39	F	University	Employed	8/8 (100.0%)	7/7 (100.0%)	S
2	40	F	Graduate school	Employed	7/8 (87.5%)	4/7 (57.1%)	S
3	34	F	High school	Employed	7/8 (87.5%)	4/7 (57.1%)	S
4	35	F	University	Employed	6/8 (75.0%)	5/7 (71.4%)	S
5	51	F	Graduate school	Not employed	6/8 (75.0%)	6/7 (85.7%)	S
6	44	F	University	Not employed	8/8 (100.0%)	7/7 (100.0%)	S
7	41	M	Graduate school	Employed	8/8 (100.0%)	7/7 (100.0%)	a) L b) L
8	42	F	University	Employed	8/8 (100.0%)	7/7 (100.0%)	S
9	35	F	University	Employed	7/8 (87.5%)	5/7 (71.4%)	a) S b) S
10	40	F	University	Employed	6/8 (75.0%)	1/7 (14.3%)	S
11	41	F	Graduate school	Not employed	6/8 (75.0%)	3/7 (42.9%)	S
12	47	F	University	Employed	8/8 (100.0%)	6/7 (85.7%)	a) S b) C
13	39	F	University	Employed	6/8 (75.0%)	3/7 (42.9%)	a) S b) C
14	41	F	University	Employed	8/8 (100.0%)	7/7 (100.0%)	a) S b) S
15*	42	F	University	Employed	8/8 (100.0%)	0/7 (0.0%)	S
16*	40	F	University	Employed	6/8 (75.0%)	1/7 (14.3%)	S
17*	40	F	High school	Employed	5/8 (62.5%)	7/7 (100.0%)	a) S b) S
18*	38	F	University	Not employed	5/8 (62.5%)	3/7 (42.9%)	S
19*	39	F	Junior college	Not employed	5/8 (62.5%)	0/7 (0.0%)	S
20†	41	F	Specialized training college	Employed	0/8 (0.0%)	0/7 (0.0%)	—
21†	38	M	Graduate school	Employed	3/8 (37.5%)	0/7 (0.0%)	—
22†	28	F	Specialized training college	Not employed	2/8 (25.0%)	0/7 (0.0%)	—

C, Communication, F, Female, L, Learning, M, Male S, Self-help skills, *Participants excluded from analysis, †Dropout.

JPY 3 and 3.99 million (18.1%), two between 4 and 4.99 million (9.09%), one between 5 and 5.99 million (4.54%), three between 6 and 6.99 million (13.6%), four between 7 and 7.99 million (18.1%), three between 8 and 8.99 million (13.6%), two between 9 and 9.99 million (9.09%), and 3 with 10 million or higher (13.6%).

Training staff

TUPT-ON consisted of a “main facilitator” in the lecture, a “group facilitator” in the group work of each group, a “network manager” to monitor and support the internet and other connections, and a “supervisor” to oversee the whole process (last author). The staff included graduate students in clinical psychology, research students in special needs education, and an experienced ND parenting mentors.

Tottori University Online Parent Training

TUPT-ON was manualized, and a revised eight-session version of the Haraguchi & Inoue¹⁵ program was

implemented in this study. TUPT-ON consisted of eight 120-minute group sessions every two weeks using a Web conferencing tool (Zoom). The sessions took place from 1 pm to 3 pm.

The lecture sessions included five topics: how to praise children’s behavior, how to conduct a functional analysis of inappropriate behavior, how to adjust the environment to minimize inappropriate behavior, how to communicate with a child who is behaving inappropriately, and how to conduct task analysis and prompt when teaching adaptive behavior.¹⁵ Table 3 presents the TUPT-ON structure. Group work was conducted using the “Breakout Room” feature on Zoom, with small groups consisting of three to four participants and staff members. Each group discussed session issues and themes, with group work conducted two to three times per session for 10–20 minutes. Afterward, the staff shared small group opinions and questions with the whole group. Participants were reminded via email before homework submission. Mindfulness was

Table 2. Profile of the participants' children

ID	Age of the child (in months)	Sex of the child	Diagnostic name of the child	Child's school attendance
1	5 (68)	M	ASD	Preschool
2	4 (53)	M	Suspected ASD	Elementary school (Normal class)
3	4 (55)	M	ASD	Preschool
4	5 (71)	M	ASD, DCD	Preschool
5	8 (99)	F	ASD	Elementary school (Special support education class)
6	8 (97)	F	Suspected ASD	Elementary school (Normal class)
7	7 (90)	M	ASD	Elementary school (Normal class)
8	6 (78)	M	Suspected ASD	Elementary school (Normal class)
9	8 (105)	M	Suspected ASD	Elementary school (Normal class)
10	5 (68)	F	Suspected ADHD	Elementary school (Normal class)
11	4 (57)	M	ASD Suspected ADHD	Elementary school (Normal class)
12	9 (109)	F	ASD, SM	Elementary school (Special support education class)
13	5 (66)	F	Suspected ASD Suspected SM	Preschool
14	4 (58)	M	ASD, stuttering	Elementary school (Normal class)
15*	6 (76)	F	ASD, ADHD	Preschool
16*	3 (47)	M	ASD Suspected ID	Preschool
17*	3 (45)	M	ASD	Preschool
18*	8 (104)	M	ASD	Elementary school (Truancy)
19*	4 (50)	M	ASD, ID	Preschool
20†	4 (54)	M	ASD, ID	Preschool
21†	3 (43)	M	Suspected ASD	Preschool
22†	3 (41)	M	Suspected ASD Suspected ID	Preschool

F, Female, M, Male, *Children excluded from analysis, †Dropout participants' children.

introduced as a stress-management strategy, emphasizing its usefulness in dealing with negative emotions and thoughts during parenting. The second author explained mindfulness in all sessions.

In the study, the participants underwent a series of sessions as part of the TUPT-ON intervention. Session one focused on teaching participants how to effectively praise children after an orientation and self-introduction session. In Session two, participants shared and discussed their homework on praising their children. Session three focused on role-playing fictional cases to practice praising techniques. Group work sessions allowed participants to report homework results and practice functional assessment using fictional cases. Session four introduced materials for environmental

adjustment, while Session five involved discussions on environmental adjustments and proper levels of instruction. Sessions six and seven focused on setting and implementing instructional tasks, with facilitator assistance. In Session eight, participants presented the results of homework assignments they had practiced, followed by a lecture from the TUPT-ON implementer on how to make promises to children. A completion ceremony was held at the end of the program, where participants were asked to reflect on what they had learned and practiced so far. Missed sessions were supplemented with video lectures.

Study design

This study employed a pre-post design without a control

Table 3. Contents of Tottori University Online Parent Training

Session	Content	Group work	Homework
1	<ul style="list-style-type: none"> · Orientation · Points on how to praise well · Mindfulness 	<ul style="list-style-type: none"> · Sharing of everyday praise · Thinking about the praise words that children enjoy 	<ol style="list-style-type: none"> 1. Practice praise for children. 2. Record the circumstances when you praise the child, how you praise the child, and the child's response to the praise.
2	<ul style="list-style-type: none"> · Reframing · Functional analysis · Mindfulness 	<ul style="list-style-type: none"> · Homework sharing · Reframing 	<ol style="list-style-type: none"> 1. Practice praise in a way that makes children happy. 2. Record children's responses to praise.
3	<ul style="list-style-type: none"> · Token economy · Functional analysis · Mindfulness 	<ul style="list-style-type: none"> · Homework sharing · The practice of praise using a fictional case · Practice functional analysis using a fictional case 	<ol style="list-style-type: none"> 1. Conduct and record the instructing task.
4	<ul style="list-style-type: none"> · Environmental adjustments to elicit adaptive behavior · Mindfulness 	<ul style="list-style-type: none"> · Homework sharing · Practice in environmental adjustment using a fictional case. 	<ol style="list-style-type: none"> 1. Consider effective environmental adjustments to the instructing tasks.
5	<ul style="list-style-type: none"> · Communication methods to elicit adaptive behavior · Mindfulness 	<ul style="list-style-type: none"> · Homework sharing · Preparation of the task sheet 	<ol style="list-style-type: none"> 1. Practice communicating to elicit adaptive behavior. 2. Record the situations in which you have practiced the communication, the method, and the children's reactions to the communication.
6	<ul style="list-style-type: none"> · Task analysis · Prompting · Mindfulness 	<ul style="list-style-type: none"> · Homework sharing · Preparation of the task sheet 	<ol style="list-style-type: none"> 1. Practice set instructing tasks 2. Record the results of the practice.
7	<ul style="list-style-type: none"> · Prompting · Mindfulness 	<ul style="list-style-type: none"> · Homework sharing · Preparation of the task sheet 	<ol style="list-style-type: none"> 1. Practice set instructing tasks 2. Record the results of the practice.
8	<ul style="list-style-type: none"> · Completion ceremony · How to make promises to children · Mindfulness 	<ul style="list-style-type: none"> · Homework sharing 	

group. Participants completed a measure before and after the intervention.

Measures

Parent Stress Index Japanese Version (PSI)

The PSI is a 101-item scale designed by Abidin et al.²⁸ to assess parenting stress and parent-child and family problems. It has two sub-items measuring stress on the parent domain (e.g., role restriction, competence) and the child domain (e.g., distractibility/hyperactivity, reinforces parent). Each question is scored on a five-point scale ranging from 1 to 5. Higher PSI scores indicate higher parenting stress. This study used the Japanese version of the PSI, which has been confirmed to have high internal consistency and reliability.^{29, 30}

Positive and Negative Parenting Scale (PNPS)

The PNPS development team developed a 35-item scale

to evaluate positive and negative parenting behaviors.³¹ Responses are scored on a four-point scale ranging from 1 to 4. The higher the positive parenting score, the more desirable it is. The PNPS has been confirmed to have high internal consistency and reliability.³¹

WHO-QOL26 Japanese Version (WHO-QOL)

The WHO-QOL is a 26-item scale designed to assess quality of life (QOL).³² Twenty-four items measure the four QOL domains: physical domain, psychological domain, social relationship, and environmental domain, and the other two items measure overall QOL and general health. The score for each question ranges from 1 to 5, with higher scores reflecting a higher QOL. This study used the Japanese version of the WHO-QOL, validated by Tazaki & Nakane³³ for reliability and construct validity.

Beck Depression Inventory Second Edition Japanese Version (BDI-II)

The BDI-II is a 21-item measure created by Beck et al.³⁴ to measure the severity of depressive symptoms over the past two weeks. The score for each question is measured using a four-point scale from 0 to 3. Higher BDI-II scores indicate a severe depressive state. We used the Japanese version of the BDI-II, shown to have both internal consistency and concurrent validity.³⁵

Child Behavior Check List 4-18 Japanese Version (CBCL)

The CBCL is a 120-item measure developed by Achenbach³⁶ to comprehensively assess children's behavior and emotions. The CBCL can be divided into three scales: internalizing, externalizing, and total problems. Each question is scored on a three-point scale from 0 to 2. Higher CBCL scores indicate a higher likelihood of behavioral and emotional problems in children. The raw CBCL scores can be converted to age-standardized scores (T-scores; mean = 50, *SD* = 10) that can be compared with scores from normative samples of children within the same broad age range.³⁶ According to Achenbach,³⁶ a T-Score of 60–63 is the borderline range, and a score of 63 or higher is the clinical range. We used the Japanese version of the CBCL in this study, which Itani et al.³⁷ found to have high reliability and validity.

Eyberg Children Behavior Inventory Japanese Version (ECBI)

The ECBI is a 36-item measure developed by Eyberg and Pincus³⁸ to assess children's inappropriate daily behavior and caregivers' difficulties in raising their children. It consists of two scales: the intensity scale, which quantitatively captures the child's inappropriate behavior, and the problem scale, which captures the caregiver's sense of parenting difficulty. The intensity scale is measured using a seven-point scale ranging from 1 to 7. The problem scale is measured using a two-factorial method ranging from "yes" (1 point) to "no" (0 points). We used the Japanese ECBI,^{38, 39} which Ito et al.⁴⁰ confirmed to be reliable.

Acceptability

We asked five questions to assess participants' acceptability of TUPT-ON. Participants were asked to score each of the five questions on a scale from 1 (strongly disagree) to 5 (strongly agree) following each session. Answering these questions was not compulsory. The questions were: "Q1 I found the right time for the conversation in TUPT.", "Q2 I got to talk about what I wanted to talk about.", "Q3 The audio during TUPT-ON

was easy to hear.", "Q4 The screen during TUPT-ON was easy to view.", and "Q5 The content of TUPT-ON's lecture was easy to understand."

Statistical analysis

The Shapiro–Wilk test assessed the normality of questionnaire data. For normally distributed data, *t*-test were conducted, while the Wilcoxon signed–rank test was conducted for non-normally distributed data. Statistical significance was set at $P < 0.05$ indicating a significant trend. In the case of missing response data, only the scale containing the missing data was excluded from the analysis. As a result, one participant was excluded due to missing CBCL, and two had to miss ECBI problem scores. Acceptability ratings were averaged per session, excluding non-respondents. SPSS Ver. 25 for Windows was used for all statistical analyses.

Ethical considerations

This study was approved by the research ethics committee of the authors' institution (approval number 21B001) and conducted in accordance with the ethical standards established by the 1964 Declaration of Helsinki. All participants completed an online informed consent and agreement form.

RESULTS

Participation rate

The participation rate of TUPT-ON was 90.9% for one session, 81.8% for two sessions, 72.7% for three sessions, 68.1% for four sessions, 59.0% for five sessions, 81.8% for six sessions, 68.1% for seven sessions, and 81.8% for eight sessions. The average participation rate for all sessions was 75.5%. Of the participants, seven attended all sessions, three missed one, six missed two, and three missed three. Reasons for absence included parental ill health (16%), childcare commitments (25%), a pre-determined schedule prior to participation in TUPT-ON (16%), and other reasons (12%).

Participants analyzed

Three participants (13.6%) withdrew from TUPT-ON. Two of the three participants could not attend the lectures because of childcare commitments and declined to participate. Another was withdrawn because the number of tasks involved in TUPT-ON. Excluding these dropouts, 19 participants were included in the analyses of attendance and task completion rates.

Percentage of the instructional task completion rate

The instructional task completion rate was calculated

Table 4. Statistical analysis results

Measurement	<i>n</i>	Mean		Effect <i>t</i> (<i>r</i>)
		Pre (<i>SD</i>)	Post (<i>SD</i>)	
PSI	14	234.42 (41.68)	222.42 (41.68)	2.01 (0.49)
BDI-II	14	14.14 (9.72)	11.42 (9.68)	2.00 (0.49)
WHO-QOL	14	76.14 (9.53)	6.28 (1.48)	-2.24 (0.53)*
PNPS	14			
Positive Parenting		38.07 (5.51)	38.42 (4.38)	-0.25 (0.07)
Negative Parenting		38.42 (4.38)	20.42 (3.05)	11.49 (0.95)*
CBCL (Total Problems T-scores)	13	56.46 (7.79)	51.84 (8.32)	2.50 (0.57)*
ECBI				
Intensity Scale	14	127.00 (24.66)	118.64 (24.96)	1.66 (0.42)
Problem Scale	13	11.84 (6.98)	10.61 (6.04)	0.89 (0.24)

* $P < 0.05$.

using the self-reports of the 19 participants, excluding dropouts. First, the number of instructional tasks for which participants self-reported completion was calculated (instructional task completion rate), taking the total number of instructional tasks set in sessions seven and eight. Next, we divided the participants' instructional tasks into "self-help skills," "learning," and "communication" and calculated the completion rate for each type of instructional task. The results showed that of the 25 instructional tasks set by the participants, 21 (84.0%) were related to self-help skills, two (8.0%) to learning, and two (8.0%) to communication. Twenty-one (84.0%) instructional tasks were completed through self-reporting. Eighteen (85.7%) instructional tasks related to self-help skills were completed. Two instructional tasks (100%) related to learning were completed. One instructional task (50.0%) related to communication was also completed.

Results of the normality test

The results of the Shapiro–Wilk test confirmed normality for all variables in both the Parent Rating Scales and the Children Rating Scales.

Parent rating scales

In this study, 14 participants who attended at least six sessions of TUPT-ON without dropping out and returned the post-evaluation scale by the due date were included in the analysis. To analyze participants' changes, we evaluated the scores of BDI-II, PSI, PNPS, and WHO-QOL before and after implementing TUPT-ON (Table 4). The paired *t*-tests showed a significant difference in the total WHO-QOL scores of the analyzed participants [$t(13) = -4.08$, $P = 0.04$, $r = 0.53$].

The analyzed participants' parenting attitudes showed no significant difference in positive parenting [$t(13) = -0.25$, $P = 0.80$, $r = 0.07$] but a significant difference in negative parenting [$t(13) = 11.49$, $P = 0.00$, $r = 0.95$]. There were no significant differences in the total score of parenting stress [$t(13) = 2.01$, $P = 0.06$, $r = 0.49$] and the total score of depression [$t(13) = 2.00$, $P = 0.06$, $r = 0.49$].

Children rating scales

To analyze the changes that occurred in the children of the analyzed participants, we conducted a paired *t*-test using the CBCL and ECBI scores of the analyzed children assessed before and after the completion of TUPT-ON (Table 3). The results showed significant differences in the total problems T-score of the CBCL [$t(13) = 2.50$, $P = 0.02$, $r = 0.57$]. The ECBI intensity scale [$t(13) = 1.66$, $P = 0.12$, $r = 0.42$] and the problem scale [$t(13) = 0.89$, $P = 0.38$, $r = 0.24$] showed no significant difference.

Assessing acceptability

The average scores for four question items, Q1, Q3, Q4, and Q5, were above four in all sessions (Table 5). The average scores for Q2 were above three for sessions one and three and above four for the other sessions.

DISCUSSION

In this study, we used a pre-post design to examine the effectiveness of online real-time G-PT for parents of children with various types of ND. The results indicated that the intervention significantly improved the QOL and negative parenting of parents. Moreover, participants' children benefited, with significant improvements found in the total problems scores on the CBCL.

Table 5. Results of program acceptability

Question items	Session 1. (n = 20)	Session 2. (n = 15)	Session 3. (n = 14)	Session 4. (n = 11)	Session 5. (n = 9)	Session 6. (n = 11)	Session 7. (n = 13)	Session 8. (n = 11)
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Q1 I found the right time for the conversation in TUPT.	4.24 (0.81)	4.33 (0.47)	4.21 (0.56)	4.55 (0.50)	4.67 (0.47)	4.36 (0.98)	4.54 (0.84)	4.64 (0.48)
Q2 I got to talk about what I wanted to talk about.	3.85 (0.79)	4.27 (0.57)	3.93 (0.80)	4.45 (0.50)	4.44 (0.68)	4.27 (1.14)	4.46 (0.84)	4.36 (0.64)
Q3 The audio during TUPT-ON was easy to hear.	4.65 (0.73)	4.53 (0.88)	4.57 (0.73)	4.73 (0.86)	4.89 (0.31)	4.55 (0.66)	4.69 (0.46)	4.91 (0.29)
Q4 The screen during TUPT-ON was easy to view.	4.80 (0.51)	4.67 (0.60)	4.71 (0.70)	4.82 (0.39)	4.89 (0.31)	4.73 (0.62)	4.85 (0.36)	4.91 (0.29)
Q5 The content of TUPT-ON's lecture was easy to understand.	4.71 (0.46)	4.31 (0.57)	4.79 (0.41)	4.82 (0.39)	4.78 (0.42)	4.83 (0.39)	4.77 (0.58)	4.91 (0.29)

The average participation rate in this study was 75.5%, which was similar to face-to-face G-PT.⁴¹ However, the dropout rate in this study was 13.6%, which was lower than the average dropout rate (27.0%) for face-to-face G-PT.⁴¹

In online PT, as in face-to-face PT, decreasing participation rates due to various reasons, such as absences caused by health problems or sudden scheduling conflicts, is unavoidable. However, unlike face-to-face PT, online PT eliminates geographical barriers, potentially reducing dropout rates. Furthermore, real-time online PT sessions, such as those conducted in this study, are presumed to have a higher likelihood of maintaining participant motivation than self-directed PT sessions because they facilitate participant interactions.^{42, 43} This increased interaction might help reduce dropout rates. Nonetheless, further investigations must be conducted to compare these aspects among different forms of online PT.

Parents' QOL and negative parenting were significant. Many other indicators also recognized a medium effect size, and the score improved in all parent rating scales. In this study, it is possible that the communication between participants through group work created a peer support effect,⁴⁴ and the QOL of the participants might have led to improvement. However, since this study did not measure objective indicators related to communication, the relationship between communication in the program and improvement in parent rating scales remains to be determined.

Mindfulness in the program might also have affected the results. PTs involving mindfulness might improve parenting stress compared with standard PTs.⁴⁵ By learning mindfulness, the participants might have been able to distance themselves from negative thoughts

and emotions related to parenting,⁴⁶ which, in turn, improved their parenting stress and QOL. However, as this study did not use a mindfulness scale, the extent to which mindfulness contributed to the results obtained needs to be clarified, and further investigation related to this is required in the future.

The instructional task completion rate was higher than that of face-to-face TUPT,¹⁵ and such a high instructional task completion rate and the resulting improvement in children's behavior might have contributed to improvements in QOL and parenting stress. However, no significant improvement was observed in parents' positive parenting. Thus, modifying the program content to further improve positive parenting will be necessary. For the children's indicators, TUPT-ON produced significant improvements in the CBCL total problems scores. In TUPT-ON, participants learned how to adjust the environment to elicit adaptive behavior in children and practiced these methods through homework and other means. The environmental adjustment methods learned by the participants might have prevented the children's problem behavior from occurring.^{47, 48}

Practitioners delivering online programs are recommended to resolve technical issues and prepare the implementation environment.⁴⁹ All items related to the acceptability of TUPT-ON had a mean rating higher than 3 in all sessions. The results indicated that the participants in this study were accepting of TUPT-ON's technical aspects, communication, and lecture content.

Despite the diverse range of NDs (ASD, ADHD, ID, SM, stuttering, and DCD), the implementation of TUPT-ON resulted in partial improvements in child outcomes without deterioration, and all parental outcome scores improved. Therefore, the effectiveness of this intervention for different ND types might have been

shown. In addition, these effects have also been recognized in face-to-face PT for ND.¹⁵ Therefore, it can be said that TUPT-ON has the potential to provide PT and alleviate parenting difficulties for parents of children with various NDs, regardless of their geographical location, as long as the online PT participants have access to a stable network environment. However, caution is necessary when interpreting the effectiveness of TUPT-ON due to the absence of a control group and small sample sizes for specific disorders. Nonetheless, this study contributes to the development of an online PT platform for local communities.

This study had some limitations. The educational background and household income of the participants in this study were higher than the average Japanese data,⁵⁰ and the living standards of the participants may have been biased. This bias may have been caused by the recruitment method employed in this study (via the author's website). Therefore, in future verification, various recruitment methods, such as recruiting at parent associations and having leaflets regarding participant recruitment posted in local government offices, must be considered to reduce recruitment bias as much as possible. Furthermore, since this study employed a pre-post design without setting a control group, it could not control for confounding factors. This made it challenging to rigorously assess the effectiveness of TUPT-ON. Although the results obtained are similar to those of previous studies, a type I error may have occurred due to the repeated statistical analysis in this study. Therefore, future research must adopt a randomized controlled trial design and present results by conducting tests and analyses without repetition, such as multivariate variance analysis. In addition, in the future, it will be necessary to introduce objective indicators related to communication, mindfulness, and teaching tasks into online G-PT under the test conditions described above and to verify the relationships and causal relationships with other indicators.

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