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Telehealth Behavior Therapy for the Management of Type 1 Diabetes in Adolescents

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Abstract

Background:

Poor management of type 1 diabetes mellitus (T1DM) may result in serious medical complications. Psychological intervention may improve adherence to medical regimens; however, access to trained professionals is limited, particularly in rural communities. Telehealth interventions may address this by allowing families to access services at home; however, little is known about the efficacy of such services.

Method:

This study presents results from a pilot trial of a randomized waitlist controlled trial of Telehealth Behavioral Therapy (TBT) for youths with T1DM. Primary outcome measures were adherence to the diabetes regimen, glycemic control, and level of family discord. Thirty-two youths (23 female) with T1DM (aged 9 to 17 years) and one parent or caregiver participated. Telehealth Behavioral Therapy sessions were conducted thrice weekly for 12 weeks by phone and lasted an average of 15 min each.

Results:

Results indicated that youths in treatment decreased their hemoglobin A1c by 0.74 compared to 0.09 in the waitlist, though this was not statistically significant. Youths in treatment reported increased unsupportive and decreased caring parental behaviors.

Conclusion:

Telehealth Behavioral Therapy improves access to knowledgeable providers and results in a clinically significant improvement in glycemic control. Despite some youths experiencing an increase in unsupportive parental behaviors, TBT is a promising method of service delivery that warrants further investigation.

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Abbreviations: (BFST) Behavior Family Systems Therapy, (CGI) clinical global improvement, (CGIS) clinical global impression scale, (DFBC) diabetes family behavior checklist, (DFBS) diabetes family behavior scale, (DFRQ) diabetes family responsibility questionnaire, (DSMP) diabetes self-management profile, (DKA) diabetic ketoacidosis, (HbA1c) hemoglobin A1c, (ITT) intent to treat, (SD) standard deviation, (SES) socioeconomic status, (T1DM) type 1 diabetes mellitus, (TBT) Telehealth Behavioral Therapy

Keywords: adherence, glycemic control, type 1 diabetes mellitus

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Introduction

Type 1 diabetes mellitus (T1DM) is a complex and challenging disease due to the necessary integration of daily medical tasks (e.g., blood glucose monitoring) and lifestyle modifications. A substantial percentage of youths are nonadherent to these demands.[1–3] Although some nonadherent youths experience few negative consequences, most are at risk for medical complications, including diabetic ketoacidosis (DKA), neuropathy, nephropathy, and others.[4,5] Currently, DKA represents the most acute common cause of hospitalization and death in children with diabetes,[6,7] with estimates of fatality rates at 1% to 2% for youths who experience a DKA episode.

Approximately 30–50% of youths with T1DM are in poor control.[2] Indirectly, nonadherence may impact clinical decisions made by health care providers, such as prescribing incorrect insulin doses and excessive use of health care services.[8,9] Improving adherence to the complex routine may result in improved glycemic control,[10] which in turn would translate to decreased personal distress and societal cost.

Four primary barriers to adherence to the regimen have been identified.[11] One of these barriers is membership in certain groups such as the underinsured, low socioeconomic status (SES), and ethnic minorities. The other barriers are conflict between typical developmental and regimen tasks, family challenges to providing appropriate supervision and transference of responsibility for tasks, and demands of the regimen overwhelming the capacity of the family.

Certain demographic factors have been implicated in regimen nonadherence and poor glycemic control. For example, belonging to a lower SES group has been associated with more hospital admissions for youths with T1DM.[12] Other researchers have also found that youths from lower SES groups are in poorer glycemic control when compared with higher SES peers with diabetes.[13,14] It has also been reported that the number of life changes was inversely related to adherence and glycemic control in youths.[15]

Youths with diabetes must manage the increasing demands of adolescence (i.e., becoming independent and separating from parents) with diabetes regimen tasks. Several researchers have demonstrated that, as family relationships change,[16] adherence declines in this age group.[3] It may be that adherence declines in this age group, as youths place a higher priority on social development rather than health, which is typical during this stage of development.[16,17]

Supervision and transfer of responsibility for regimen tasks has been shown to be related to poor metabolic control.[18,19] Specifically, research has shown that, when adolescents are more responsible for diabetes management and parents are less involved, glycemic control suffers. Further, other research has demonstrated that perceived support is also related to health outcome in youths with diabetes. For example, perceived parental negativity was associated with a higher likelihood of experiencing an episode of DKA, just as perceived warmth was associated with less risk of DKA.[20] If parents are less emotionally supportive and provide less supervision, youths are likely to make more mistakes in their care,[21,22] which can lead to serious health outcomes.

Addressing the aforementioned barriers in order to reduce nonadherence and improve glycemic control through effective psychological treatments is critical. One treatment program that has shown efficacy is Behavior Family Systems Therapy (BFST),[23,24] an intensive, diabetes-specific psychotherapeutic intervention, which has shown improvements in family conflict, adherence, and hemoglobin A1c (HbA1c). Interventions with nonadherent youths and families are most successful when they directly targeted maladaptive parent-and-child interactions around the diabetes regimen.[25,26] Unfortunately, numerous barriers exist that preclude intensive face-to-face intervention (e.g., economics and geography).

One innovative approach that addresses access barriers is Telehealth Behavioral Therapy (TBT). Telehealth interventions permit providers to assist patients in their home environment without contending with logistical challenges of scheduling in-person contact.[27–29] Additionally, telehealth allows providers to increase availability over a wider geographical area, because patients no longer have to travel to receive services.[30] Likewise, it is a low-cost intervention that can be used in conjunction with usual diabetes care in order to improve glycemic control.[11]

Preliminary data suggest that TBT may be effective in increasing adherence to medical regimens and improving

health status. For example, in adults, several examples demonstrate that receiving treatment via telehealth is associated with improved glycemic control,[31] reduced diabetes-related consequences, and increased self-efficacy related to the regimen.[32] Studies demonstrate the effectiveness of TBT for youths with T1DM. A case study[33] and series[34] documented improved HbA1c and family dynamics. In an open trial of 27 adolescents,[35] youths decreased their HbA1c by 0.7% and had no diabetes-related hospitalizations. These studies illustrate that TBT has promise in improving adherence to the medical regimen, glycemic control, and family dynamics by addressing barriers to obtaining treatment and to the medical regimen. Conversely, two randomized controlled trials did not find improvement on HbA1c following telehealth intervention.[36,37] Furthermore, a program providing bimonthly telephone contacts to youths with T1DM did not result in improvement in glycemic control.[37] They posit that more frequent contact with a focus on individual problems may improve outcome for these youths. Similarly, one research group[36] provided an average of 16 phone contacts over a year with a median interval of 3 weeks between calls. They reported improvements in self-efficacy, but not in HbA1c for any group. Further, they noted that barriers to insulin usage were associated with HbA1c, suggesting this as a possible point for intervention.

The present study expands the literature in this area by presenting results from a pilot trial of the first randomized waitlist controlled trial of TBT for youths in very poor glycemic control. The specific TBT protocol[38] used in this study utilized some of the principles of BFST.[23] Areas addressed in the protocol include problem solving, behavioral contracting, communication skills, cognitive restructuring, and family structuring (detailed session content discussed later). Youths were in very poor glycemic control prior to study entry. Participants were provided with thrice weekly phone contacts. We chose to deliver services via telephone to ensure that all participants would have easy access to treatment. Previous attempts in our clinic have used videoconferencing with little success, as many of our participants did not have the phone lines in their area to support the technology. Contacting families three times per week allowed therapists to monitor progress more closely and assist families with problem solving for specific issues. We hypothesized that youths participating in active treatment would experience an increase in adherence to the diabetes regimen, a decrease in family discord, and a decrease in HbA1c.

Method

Participants

Participants were recruited via provider-initiated referrals from a university-affiliated pediatric endocrinology clinic. Thirty-two youths (23 female) between the ages of 9 and 17 years [mean = 13.66, standard deviation (SD) = 2.43 years] participated. The majority used state-funded insurance as their primary insurance. Participants self-identified as Caucasian (81.2%), African American (12%), Hispanic (3.1%), and one as "other." Average HbA1c was 10.66% (SD = 1.94), which is representative of the clinic population from which this sample was drawn. Parents participating in treatment were primarily mothers (84.4%, n = 27), although grandparents/guardians (9.3%, n = 3) and fathers (6.3%, n = 2) also participated. Average age for parents at study entry was 41.53 (SD = 8.14). Additional descriptive information for parents is presented in **Table 1**. Inclusion criteria were diagnosis of T1DM for at least six months, an HbA1c greater than 9%, and the availability of a caregiver to accompany a participant to assessments. Approximately 80% of participants who were approached consented for the study. Those who did not consent reported that they were not interested in services at this time or did not want to come to visits to complete measures. All participants were offered other psychological services if they did not want to participate.

Table 1.
Parental Demographic Information

Variable	Percent	Number
Marriage Status		
Married	81.3	26
Divorced	9.4	3
Single	6.3	2
Widowed	3.1	1
Education Completed		
Some college	59.4	19
High school graduate	21.9	7
College graduate	9.4	3
Post-graduate work	6.3	2
Some high school	3.1	1
Income		
$20,000–39,999	29.0	9
>$80,000	19.4	6
$10,000–19,999	19.4	6
$40,000–59,999	16.1	5
$60,000–79,999	16.1	5

Measures

Diabetes Self-Management Profile-Child and Parent Versions

The diabetes self-management profile (DSMP), child and parent versions,[39] are structured interviews for children

with T1DM and their parent(s). Items assess diabetes management behaviors over the past 3 months (insulin administration, blood glucose monitoring, exercise, diet, and management of hypoglycemia). A total adherence score was obtained and used for analyses. Higher scores indicate better adherence strategies. Reliability was adequate (parents $\alpha = 0.69$ at baseline; children $\alpha = 0.77$ at baseline).[39] The DSMP has been shown to have adequate predictive validity with HbA1c.[39]

Diabetes Family Behavior Scale, Abbreviated

The diabetes family behavior scale (DFBS)[40] includes 60 items measuring children's perceptions of family support related to T1DM management. Only the warmth/caring and guidance/control subscales were used in this study. These scales were chosen because previous research has demonstrated them to be the most reliable.[41] Overall, the DFBS has good internal consistency ($\alpha = 0.82$) and test–retest reliability (0.79 and 0.83, warmth/caring and guidance/control, respectively).[40] Cronbach's alpha for the present sample ranged from 0.48 to 0.70.

Diabetes Family Behavior Checklist

The diabetes family behavior checklist (DFBC)[42] assesses supportive and unsupportive parental behaviors related to T1DM management. The seven-item negative/unsupportive scale was used. Children and parents completed parallel forms. At baseline, Cronbach's alpha was 0.65 for parents and 0.50 for children. The DFBC has also been shown to have adequate predictive validity when looking at diabetes management behaviors.[43]

Diabetes Family Responsibility Questionnaire

The diabetes family responsibility questionnaire (DFRQ)[18] assesses which family member is responsible for completing 17 diabetes-related tasks (e.g., telling teachers about diabetes). A "no responsibility" score is calculated by comparing the responses of parent and youths dyads. When dyads do not agree (e.g., parent reports child is responsible and child reports parent responsible), this item is scored on the no-responsibility scale, indicating that no one monitors the activity. Internal consistencies were adequate for the child ($\alpha = 0.72$) and parent ($\alpha = 0.72$) versions.

A1c Now

A1cNow is a single-use, disposable monitor for the quantitative measurement of percentage of HbA1c in finger stick whole blood samples. Data analysis performed by Metrika demonstrated negligible bias between A1cNow and the National Glycohemoglobin Standardization Program lab.

Clinical Global Impression Scale

The clinical global impression scale (CGIS)[44] is a seven-point clinician (independent assessor) rating of severity of illness, with ratings ranging from 0 (no illness) to 6 (extremely severe). It is based on the degree of nonadherence (e.g., parent or child report of omitting insulin doses or neglecting other regimen tasks) and related pathology (e.g., degree of negative family interactions related to T1DM, not severity of medical condition). The independent assessor made this rating.

Clinical Global Improvement

The clinical global improvement (CGI)[45] is a one-item, seven-point rating of treatment response (1 = very much improved to 7 = very much worse). The independent assessor completed this at the end of treatment or waitlist based on interactions with the participant and review of records.

Procedures

Assessments

Participants were recruited through normal patient flow at a university-affiliated pediatric endocrinology clinic. After referral, the research coordinator contacted the family to schedule the baseline visit. During this visit, parents and youths provided written informed consent/assent for study procedures and completed study measures (including an A1cNow test). All assessments were conducted by an independent rater. The independent rater was a full-time research assistant trained by Eric A. Storch and Gary Geffken to complete assessments. This rater completed all assessments for this research project. Participants were then randomly assigned to the immediate treatment group or to a 1 month waitlist using a random numbers table. For immediate treatment participants, phone calls with the therapist began within 1 week. Waitlist participants returned after 1 month to complete an end of waitlist assessment similar to the baseline assessment; waitlist participants had no contact with study therapists during the interim. A 1 month waitlist period was chosen to reduce the number of youths lost to follow-up. Our clinical experience has demonstrated that this is a difficult group to capture for research purposes, thus the waitlist was reduced. Thereafter, they participated in telehealth treatment. All participants completed an assessment following treatment conclusion.

Telehealth Behavioral Therapy

Telehealth Behavioral Therapy sessions were conducted by Heather D. Lehmkuhl, Christina Cammarata, Kara Meyer, and three predoctoral clinical psychology

interns. At study entry, each family was assigned to one therapist who provided all treatment sessions. Sessions were conducted according to the manualized protocol[38] using some principles from BFST.[23] The TBT protocol involves thrice weekly phone contacts over 12 weeks (total of 36 sessions), lasting approximately 15 to 20 min each. Therapists spoke with both the child and the parent during each phone call. Typically, calls followed a similar pattern of discussing self-care activities and reinforcing adaptive self-care (diabetes goals) and identifying potential barriers to management and education (BFST goals). **Table 2** presents topics covered by session. Therapists ended calls by scheduling the next phone session. All therapists participated in weekly supervision with Heather D. Lehmkuhl. Participants were provided with incentives (gift certificates for a national retail chain) following each assessment.

Data Analyses

Preliminary Analyses

Descriptive statistics were computed for each group (immediate treatment and waitlist) for demographic and pretreatment variables. Differences between groups on pretreatment variables were examined using independent samples *t* tests or chi-square tests. Preliminary analyses revealed no pretreatment differences on variables of interest for the groups.

Table 2.
Goals and Intervention Strategies by Week of Treatment

Week	BFST Goal	BFST Intervention	Diabetes goal	Diabetes intervention examples
1 to 2	Engage in therapy	1. Self-monitoring of family conflict 2. Family discussion of goals for treatment	1. Injection strategies, ketone management 2. Increase positive parent–child interactions	1. Introduce site rotation schedule, concrete reminders, acquire ketone strips 2. Discuss positive parenting principles, institute daily meeting with focus on identifying positive skills
3 to 4	Problem-solving training	1. Review problem-solving educational material 2. Conduct problem-solving discussion regarding diabetes-related concern and implement solution	1. Blood glucose monitoring 2. Encouraging positive behavior	1. Assist in establishing routine for checking and having supplies 2. Instruction on setting reasonable goals and using positive reinforcement
5 to 6	Behavioral contracting	1. Review problem solving 2. Introduce behavioral contract educational material 3. Negotiate behavioral contract with a chosen self-management task and implement	1. Meals and snacks 2. Encouraging positive behavior in the long term	1. Have child monitor eating habits, discuss healthy alternatives for snacks, low carbohydrate snacks, and measuring portions 2. Discuss how to break down large tasks, rewarding successive approximations and using token economy
7 to 8	Communication skills	1. Review behavioral contracting 2. Discuss communication skills educational material 3. Have family self-monitor communication patterns and identify areas of improvement and implement	1. Communication with medical team	1. Assess family use of medical team and discuss appropriate uses 2. Implement a plan for contacting medical team (e.g., have questions ready, meter available, decision rules—if blood glucose is *x*, then call)
9 to 10	Cognitive restructuring	1. Review communication skills 2. Introduce cognitive restructuring educational materials 3. Identify strong belief for adolescent and implement restructuring techniques	1. Handling low blood glucose 2. Decreasing unwanted behaviors	1. Assist child in determining signs/signals of low blood glucose, how to talk with friends about low blood glucose, and having snacks available 2. Discuss effective use of appropriate discipline strategies and identify one behavior and contingency to use
11 to 12	Family Structuring	1. Review cognitive restructuring 2. Discuss appropriate roles and tasks for family members 3. Assign roles and implement	Changing home environment	1. Discuss effect of environment on child's management 2. Identify reasonable changes to facilitate positive change and implement

Primary Analyses

The primary outcome variables for the present study include parent and child scores on the DSMP, DFRQ, DFBS, DFBC, CGIS, and HbA1c values. Data were analyzed using a mixed model repeated measures analyses of variance, with time measurement (time one or time two) as the repeated measure and group membership (immediate versus waitlist) as the between-subjects variable. Separate analyses were conducted for parent and child measures. Results are reported using the entire sample and in intent-to-treat (ITT) analyses. Analyses for the ITT were identical to the completer analyses. All participants completed the study sessions (36 telephone sessions), but some did not complete the final assessment. For participants who did not complete the last assessment, missing scores were replaced with the last scores carried forward. Thus, comparison groups were based on initial randomization.

Results

Preliminary Analyses

Eighteen youths (11 female) were assigned to immediate treatment and 14 youths (12 female) to waitlist. The proportion of males to females was not significant between groups. Groups did not differ on intake HbA1c, clinician-rated severity, other demographics, or parental characteristics. Descriptive statistics for the sample are presented in **Table 3**.

Table 3.
Baseline Descriptive Statistics by Group

Variable	*N*	Mean	SD	*t* value
Age				
Immediate treatment	18	13.72	2.67	0.33
Waitlist	14	13.43	2.17	
Baseline A1c				
Immediate treatment	18	10.81	2.05	0.62
Waitlist	14	10.37	1.88	
Baseline DSMP-parent				
Immediate treatment	17	42.65	8.97	0.29
Waitlist	14	41.64	10.42	
Baseline DSMP-child				
Immediate treatment	18	42.67	10.41	-0.31
Waitlist	13	43.92	11.97	
Baseline CGIS				
Immediate treatment	18	4.0	1.14	0.74
Waitlist	14	3.71	.99	
Parent age				
Immediate treatment	18	40.11	8.27	-1.12
Waitlist	14	43.36	7.88	
Parental marital status				X^2 (3) = 3.50
Parental education				X^2 (4) = 5.64
Parental income				X^2 (1) = 4.01 $p < .05$[a]

[a] Significantly more youths in the immediate treatment group had incomes below $40,000 than in waitlist.

Only 11 (61%) of the 18 immediate treatment participants completed the post-treatment assessment, and all participants completed treatment. Eleven (78.5%) waitlist participants entered treatment after the waitlist. Thus we present two sets of analyses, one includes only participants who completed treatment/waitlist and the second represents ITT analyses.

Completer Analyses

There was a main effect of time on HbA1c: mean HbA1c scores reduced from 10.2% to 9.8%, $F(1, 21) = 5.8$, $p = .03$. However, there was no effect of group membership, and the time *x* group interaction was nonsignificant. Inspection of means revealed that participants who completed active treatment had a reduction in HbA1c of 0.74, while the HbA1c for the waitlist decreased 0.09 during the waitlist.

Analyses of the DSMP (child and parent versions) indicated that, from baseline to time, two mean scores for the overall sample increased from 41.7 to 49.2, $F(1, 20) = 17.1$, $p < .01$, as reported by parents, and from 42.2 to 51.1, $F(1, 18) = 22.8$, $p < .01$, as reported by children. However, there was no effect of group membership, and the interaction was not significant.

For the DFBC parent, the time *x* group interaction was significant, $F(1, 18) = 4.3$, $p = .05$. For the treatment arm, the mean increased from 17.2 to 18.5, and for the waitlist, the DFBC decreased from 17.9 to 15.3. Thus, for the immediate group, unsupportive parental behaviors increased, but decreased for the waitlist group. Analysis of the DBFC child was not significant.

For the DFBS warmth/caring, the time *x* group interaction was significant, $F(1, 17) = 6.1$, $p = .03$. For the treatment arm, the mean decreased from 44.2 to 41.2, whereas the mean for the waitlist increased from 38.0 to 39.8. Analysis of the DFBS guidance/control was not significant. Thus warmth/caring decreased for the immediate group and increased for the waitlist group, while there was no change in guidance.

For the DFRQ no-responsibility scores, the main effect for time was significant. The mean for the overall sample decreased from 7.0 to 4.7, $F(1, 30) = 8.1$, $p < .01$. However, there was no effect of group membership, and the interaction was not significant.

Data were also analyzed for overall improvement as rated on the CGI at the end of treatment or waitlist. Participants whose CGI rating had improved from baseline to time two by any amount were considered to be improved, whereas those whose rating was unchanged or deteriorated were considered as having no improvement. In the treatment arm, nine subjects improved (82%) and two did not (18%). In the waitlist group, the pattern was opposite, with two subjects considered improved (18%) and nine rated as having no improvement (82%). This difference was significant, $X^2(1, 22) = 8.9$, $p < .01$.

Intent-to-Treat Analyses

Overall, the results of the ITT analyses were similar to the completer results. As with the completers, the HbA1c change from baseline to time two was significant for the entire sample (10.6 to 10.3, $F(1, 30) = 4.2$, $p = .05$), but the time x group interaction and the effect of group interaction were not significant. Changes in DSMP from baseline to time two were significantly different, with DSMP scores increasing for the overall sample as reported by parents (42.2 to 47.5; $F(1, 29) = 13.5$, $p < .01$) and children (42.3 to 48.4; $F(1, 27) = 16.3$, $p < .01$). However, there was no effect of group membership, and the interaction was not significant. For the DFBC parent version, the time x group interaction was significant [$F(1, 28) = 4.5$, $p = .04$] but was not significant for the child report. For the DFBS warmth/caring subscale, the time x group interaction was significant, $F(1, 26) = 5.2$, $p = .03$. The pattern of means was similar to the completers, decreasing for the immediate group and increasing for the waitlist group. Analyses of the DFBS guidance/control and DFRQ no responsibility were not significant.

Discussion

Telehealth Behavioral Therapy was developed to address the number of access barriers to in-person treatment. It is based on a model of diabetes-specific family therapy and addresses a number of concerns associated with poor glycemic control in children with T1DM.[11,31–33] Telehealth Behavioral Therapy focuses on family communication and problem solving, with the goal of improving the parent–child relationship and decreasing familial conflict, and addresses the four primary barriers to adherence.[11] This study presents preliminary results of a randomized, waitlist controlled trial of TBT for youths with T1DM and their families.

While the results of this study did not statistically support the hypothesis that TBT treatment was superior to waitlist in terms of adherence behaviors, responsibility, or metabolic control outcomes, treatment participants evidenced clinically significant improvement. For example, participants in the treatment arm reduced their HbA1c an average of 0.74. This represents a medium effect size at time two (Cohen's $d = 0.54$[32]).[46] A decrease of approximately one percentage point may reduce the risk of developing diabetes-related complications in the future.[5] Considering the numerous benefits of TBT as a delivery method for treating health-related issues, these results suggest that this is a promising area for future research. In the future, researchers may want to examine the relative contributions of content of intervention (i.e., communication and family structure) and modality (telehealth versus in-person treatment) to find the most effective combination.

Both the treatment and waitlist groups demonstrated improvements in adherence to the regimen as measured by the DSMP. Thus participants engaged in more diabetes-related tasks (e.g., blood glucose monitoring and administering insulin). However, results were not statistically significant between groups. It may have been that participants in the waitlist changed some of their management behaviors in anticipation of entering a treatment study. As measured by the CGI, an overall rating of improvement during study participation revealed that significantly more youths in the treatment arm made improvements relative to the waitlist. In fact, 82% of youths in the treatment arm improved compared to 18% of youths in the waitlist arm. This provides additional evidence that TBT is effective in helping children adhere to diabetes-related tasks.

An additional goal of TBT is to improve parent–child interactions. Results of parent report measures revealed an interesting pattern of findings. For example, parents in the treatment arm reported an increase in unsupportive behaviors, while parents in the waitlist reported a small decrease in these behaviors. Perhaps parents in the treatment arm increased more "task-focused" behaviors such as reminding youths to check blood glucose or administer insulin but believed that these tasks were unsupportive. From our clinical experience, many parents perceive providing reminders as "nagging" and that youths should be able to manage independently, thus increasing reminders may seem unsupportive. However, this is merely speculative and warrants further investigation. Perhaps having parents identify "supportive" behaviors or discussing supportiveness directly would improve their perception.

Children's perceptions of the parents' warmth and caring behaviors were also examined. Youths in the treatment arm reported decreased warmth and caring parenting behaviors, while the waitlist group reported the opposite effect. Again, this may reflect that youths and parents perceive the parent being more active in management activities as unsupportive, uncaring, or "nagging." Thus it may be useful to have youths, as suggested for parents, describe supportive and unsupportive behaviors so that this may be addressed directly.

Some limitations to the present study should be noted. First, only participants who were in poor control of their diabetes (HbA1c greater than 9%) were recruited. Further, many of our participants faced all four barriers to treatment adherence, in that they were underinsured, of low SES, or minority families.[11] Thus our participants may not be representative of all youths with T1DM, and this type of intervention may be better suited for youths in better control or with fewer barriers. Youths recruited for this study were from a large age range. This was done in part to ensure that all youths seen in the clinic would have the opportunity to participate in the pilot trial for this intervention. While it may be beneficial in the future to restrict the age range of participants, the current study had the advantage of an individualized intervention based on the needs of the family within the content areas. Thus, we were able to account for different developmental needs of each participant and overall results should not be affected. Additionally, such an approach has more translational validity than one designed for a narrow age band. Second, several participants in the treatment arm did not complete the end of treatment assessment, though they completed treatment. Therefore, we were not able to directly assess improvement. The pattern of findings may have been different with end-of-treatment data completed. This represents a challenge to assessing the effectiveness of telehealth procedures. One advantage of telehealth is that it allows participants access to otherwise inaccessible care. For many participants, being involved in telehealth was the only way to get treatment for their child, but they were not able to come to assessments. One way to address this would be to complete assessments by phone, during regular clinic visits, or to provide transportation.

The small sample size limits the ability to generalize the findings and detect significant differences. Results of a *post hoc* power analysis suggest that the sample size needed to detect our desired difference would be 27 participants completing treatment; thus it can be assumed that, although power in the present study was low, adding a few additional participants would improve our ability to detect differences. Another potential limitation is the reliability of the measures. We had lower than ideal reliability statistics for the DFBS and DFBC; however, these measures are most commonly used. Future research should continue to examine psychometric properties of these measures. The length of the waitlist period was less than the period of active treatment. This was chosen to reduce the risk of dropout as well as provide youths with treatment sooner so they may benefit from it more quickly. Future studies should ensure that the waitlist period is equivalent to the active treatment phase. Finally, the preponderance of female participants may limit our ability to extend findings to males. It will be important to over-recruit male participants in the future.

In summary, while the results of this study did not support the hypothesis that telehealth therapy is superior to waitlist, there was a trend toward greater glycemic control, adherence-related behaviors, and overall improvement for the treatment group. This study provides preliminary evidence suggesting TBT may be a useful and cost-effective method of treatment. In terms of feasibility, the intervention is easy to implement, uses relatively low manpower, and is cost-effective in terms of clinician time. However, there are some issues that emerged or should be considered in the future. At this time, we are not aware of insurance companies that reimburse for time; thus, although a clinician may be able to provide services to more individuals, he/she may not be reimbursed for time. Additional support for this intervention as effective may help to change billing difficulties in this area. Another issue that emerged was that participants were not always willing to come in for follow-up assessment. It will be important to continue to develop assessment measures that can be completed over the phone or during regular clinic visits to reduce the burden on the family. Overall, adolescents were receptive to the intervention and benefited from it. Additional research in this area will continue to improve service delivery and effectiveness.

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