



Internet-based cognitive behavioral therapy intervention for youth with type 1 diabetes and depressive symptoms: a pilot and feasibility study

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Abstract: Depression is more common in youth with type 1 diabetes (T1D) compared to youth without diabetes. This study aims to assess the efficacy of Competent Adulthood Transition with Cognitive Humanistic and Interpersonal Teaching (CATCH-IT), an internet-based cognitive behavioral therapy (CBT) intervention, in adolescents with T1D and depressive symptoms. Adolescents (13 to 17 years old) with T1D and mild (score 5–9) or moderate (score 10–14) depressive symptoms on Patient Health Questionnaire-Adolescent (PHQ-A) screening assessment were recruited to participate and received online access to the CATCH-IT modules for 6 months (requested to complete in 12 weeks). Statistical analyses included paired *t*-test for changes in Center for Epidemiologic Studies Depression Scale (CES-D), PHQ-A, Problem Areas in Diabetes-Teen version (PAID-T), and hemoglobin A1c (HbA1c). Nineteen patients were consented, 15 met inclusion criteria and received the intervention. In the seven participants that completed the modules, there was a trend towards improvements in PHQ-A, CES-D and HbA1c. Participants provided robust qualitative feedback on the modules and areas for improvement in subsequent iterations, such as inclusion of diabetes-related content. Given the prevalence of depression in diabetes, feasible, low resource interventions are needed. Internet programs such as CATCH-IT can serve as an effective first line intervention in this high-risk population. A modified version of CATCH-IT tailored for adolescents with T1D may be beneficial in this patient population.

Keywords: Type 1 diabetes (T1D); depression; cognitive behavioral therapy (CBT)

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Introduction

The prevalence of moderate to severe depressed mood is higher in youth with diabetes [type 1 (T1D) or type 2 (T2D)] compared to those without diabetes, with estimates as high as 22% (1-3). This prevalence is likely an

underestimation, as universal screening for depression is not standard of care (4). Depression in youth with T1D or T2D has been associated with decreased quality of life and overall functioning, poor adherence to medical regimen, poor glycemic control, and increased emergency department

visits (3,4). Adolescents with T1D and depression had an 87% increased risk for diabetic ketoacidosis (DKA) (5) and were twice as likely to be hospitalized for hypoglycemia or hyperglycemia (2,4,6).

In adolescents with diabetes, behavioral activation (BA), cognitive behavioral therapy (CBT), and individual psychotherapy (IPT) can reduce risk of depression (7). An integrative review of CBT in adolescents with T1D found improvements in anxiety, coping, quality of life, and depressive symptoms in several studies (8). However, in-person CBT may be burdensome to patients and may not be cost effective (9). A recent systematic review assessing the effectiveness of digital interventions in youth with T1D showed modest but inconsistent improvements in patients' self-efficacy, adherence to diabetes self-management tasks and glycemic control (10). Computerized interventions can be an efficacious and cost-effective first line intervention and offers flexibility with time and location (11). One study in adults with T1D using a diabetes-focused online CBT showed improvements in glycemic control (12). The Competent Adulthood Transition with Cognitive Humanistic and Interpersonal Teaching (CATCH-IT) is an internet program focused on BA, CBT, and IPT that has shown declines in depressive episodes, reduced symptoms of depression and anxiety, as well as moderate reduction in suicidal ideation, and improved functional status and self-esteem in adolescents (ages 14–21 years) without diabetes who were at risk for depression in primary care setting (13–17).

Given the risk and burden of comorbid depression in youth with T1D, we conducted a pilot and feasibility study to assess outcomes of CATCH-IT in adolescents with T1D and depressive symptoms.

Materials and methods

Setting and participants

Adolescents 13 to 17 years old with mild (score 5–9) or moderate (score 10–14) depressive symptoms on a Patient Health Questionnaire-Adolescent (PHQ-A) (18) assessment administered during their clinic visit were recruited from Children's Medical Center Dallas Diabetes Clinic, a university-affiliated healthcare facility. Current practice for all adolescent patients in diabetes clinic is for annual completion of PHQ-A. If the provider has concerns, the clinic social worker meets with the patient. If clinical assessment is concerning for a psychiatric disorder, a referral is placed to Psychiatric Department for appropriate clinical

management. For those with sub-threshold symptoms of depression, counseling resources are provided, but not necessarily any ongoing psychosocial treatment. As such, participants enrolled in the study did not receive below standard of care. Since Center for Epidemiologic Studies Depression Scale (CES-D) is not standard of care in the clinic workflow, patients had to consent to be in the study prior to completing CES-D survey. Inclusion criteria were diagnosis of T1D for at least 12 months, English-speaking, internet access, and experiencing at least sub-threshold depression (CES-D score >15), and PHQ-A ≥ 5 but <20. Exclusion criteria included patients who were medically unstable (i.e., current episode of DKA, symptomatic hypoglycemia), PHQ-A ≥ 20 so too severely depressed for this form of intervention, diagnosis of schizophrenia or bipolar disorder, prior psychiatric hospitalization, prior self-harm attempt, participating in ongoing counseling or therapy services in the last year by a licensed professional (counselor, psychologist, or psychiatrist), or currently taking psychotropic medications. At the time of enrollment, 220 patients in our clinic were eligible based on age and PHQ-A scores. However, many were on psychotropic medications or receiving ongoing therapy. Of the 24 patients who were approached, nineteen provided assent to participate. Fifteen met inclusion criteria and received access to CATCH-IT. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Institutional Review Board of the University of Texas Southwestern Medical Center (No. STU-2020-023) and informed consent was obtained from all the patients' parents/legal guardians.

Study design and intervention

The pilot and feasibility study was a single group pre-post design assessing the within group effect of the CATCH-IT intervention on improving depressive symptoms, diabetes distress, and glycemic control in adolescents. At time of enrollment, the research staff completed a brief motivational interview to encourage their use of the self-directed CATCH-IT program. Participants were given access to the CATCH-IT program, which includes a brief practitioner-provided motivation enhancement component (in-person at time of enrollment and through phone calls), 14 online self-directed modules, and information for parents to support the adolescent (five printed modules that described the CATCH-IT modules). The content of the modules targets multiple etiological elements by teaching skills from

empirically supported, face-to-face interventions including BA, CBT, and Interpersonal Psychotherapy. CATCH-IT targets mechanisms that are associated with increased risk for depression in adolescents. The modules are grouped into six sections: introduction, how do you act, how do you think, how do you socialize, how resilient are you, and wrap up. There are one to four modules in each section, and teens spend approximately 15 to 20 minutes per module (13,19). Information is presented as slides and videos showing adolescent stories (13,19). Additionally in this pilot study, participants were given a journal with activities based on best practices of depression prevention. Participants had clinic visits at screening (baseline) and 3 months later (exit), and safety phone calls or text messages from the research team to monitor for adverse events (weeks 1–6) as well as reminders to complete modules. Hemoglobin A1c (HbA1c), CES-D, Problem Areas in Diabetes-Teen version (PAID-T) and PHQ-A were assessed at baseline and 3 months. Patient's age, gender, race/ethnicity, and age at diabetes diagnosis was collected.

Measures

The primary outcome was change in CES-D, a 20-item measure of depressive symptoms with items rated on a four-point Likert scale where higher scores reflect greater severity (20). Secondary outcome measures were changes in PAID-T, a 14-item measure of diabetes-specific emotional distress scored on a six-point Likert scale (21), PHQ-A a 9-item self-report questionnaire assessing depression, and HbA1c (18). Participants provided verbal feedback during each safety call (weeks 1–6) on how they were experiencing the modules, skills they were using and recommendations for tailoring the CATCH-IT program to support and benefit adolescents with diabetes. Participants were compensated with a ClinCard, a reloadable debit card used as a method to reimburse research participation. Participants received \$10 per task (baseline questionnaires, weekly safety phone calls, 12-week follow-up questionnaires) completed up to a maximum of \$80.

Statistical analysis

Repeated-measures analysis of variance was used to examine change in CES-D, PHQ-A, PAID-T and HbA1c data over time from baseline to exit visit in participants who completed CATCH-IT. A sample size calculation indicated that 16 participants would provide 80% power

to detect a pre-post Δ CES-D of 4.7 [consistent with previously reported efficacy of CBT in reducing depressive symptoms (22)] using paired *t*-tests assuming a standard deviation of 5.7 and $\alpha=0.05$. Data were analyzed using Microsoft Excel (Microsoft Corporation, Redmond, Washington, USA). Three independent researchers (P.S., C.H. and O.T.G.) reviewed field notes from participant verbal feedback to identify themes.

Results

Nineteen patients were consented in this pilot study. Fifteen met inclusion criteria (four excluded as CES-D score did not meet threshold) and received access to the intervention. Five participants were lost to follow-up, and three discontinued the intervention (one participant was enrolled in a therapeutic program, and two participants withdrew due to time constraints). Subsequent data analysis was conducted using responses from the remaining seven participants (*Table 1*). Six (86%) were female and the mean age was 15.1 ± 1.2 years. Most identified as non-Hispanic White, used insulin pump therapy (57%), and continuous glucose monitors (71%). Compared to those who completed CATCH-IT intervention, the eight participants who did not had higher baseline HbA1c (10.2% *vs.* 8.2%, $P < 0.05$, *Table 2*). There was no significant difference between the two groups for baseline CES-D, PAID-T, or PHQ-A. At the exit visit, the participants who completed CATCH-IT showed a trend towards improvements in PHQ-A, CES-D and HbA1c (*Table 3*).

Feedback shared by the participants showed promising results through completion of the CATCH-IT program and some universal themes. Twelve common themes were identified within the field notes, eight related to having diabetes and four unrelated to diabetes (*Table 4*). There were mixed views on inclusion of diabetes-related goals in the module content. Most participants reported that they would be able to connect to the content better if patients with diabetes were depicted in the videos. Participants supported inclusion of diabetes-related relationships into their relationship circle, such as diabetes camps or Juvenile Diabetes Research Foundation (JDRF). Other themes included recognition of diabetes-related examples as stressful events, and diabetes management in new situations. All participants shared that diabetes has led to them having negative thoughts. Some examples included persistent hyperglycemia, out of range blood glucoses, feeling one is “*not good enough, smart, or strong enough to take*

Table 1 Baseline characteristics of adolescents with T1D and depressive symptoms

Characteristics	Values (n=7 participants)
Baseline HbA1c (%)	8.2±1.8
Age (years)	15.1±1.2
Female (%)	86
Race (%)	
Caucasian	71
African American	29
Hispanic	0
Time since T1D diagnosis (years)	6.0±3.4
Insulin pump (%)	57
Continuous glucose monitor (%)	71
Patient Health Questionnaire-Adolescent	8.3±2.7
Center for Epidemiologic Studies Depression Scale	27.6±9.4
Problem Areas in Diabetes-Teen version	89.9±28.7

Data are shown as mean ± standard deviation if not otherwise specified. T1D, type 1 diabetes; HbA1c, hemoglobin A1c.

care of diabetes”, and how “*diabetes holds [one] back from being a normal teenager*”.

After completing the modules, participants acknowledged how some of the skills could help with stress and anxiety, and how to counter negative thoughts. They recognized that being proactive about diabetes management could help avoid a preventable outcome, such as checking blood glucoses and timely insulin pump site changes to prevent ketones. Other universal coping strategies that emerged and were utilized involved feelings of normality, steering from negative to positive thought patterns, trying new coping skills, and setting realistic and personal goals.

Discussion

The aim of this study was to assess the feasibility and within group effect of an innovative mental health intervention on depressive symptoms in adolescents with T1D. Given the prevalence of depressive symptoms in chronic illness, it is important to have accessible first line interventions, such as CATCH-IT. The results from this study were difficult to interpret given limitation of small sample size. Of note, strong effect size was seen in adolescents without chronic

Table 2 Comparison of participants who did not complete CATCH-IT to those that completed modules

Measured value	Completed modules (n=7 participants)	Did not complete modules (n=8 participants)
Hemoglobin A1c (%)	8.2	10.2*
Patient Health Questionnaire-Adolescent	8.3	10.3
Center for Epidemiologic Studies Depression Scale	27.6	26.0
Problem Areas in Diabetes-Teen version	89.9	90.9

*, P<0.05. CATCH-IT, Competent Adulthood Transition with Cognitive Humanistic and Interpersonal Teaching.

Table 3 Changes in pre/post measures of depression risk factors, diabetes distress and HbA1c

Measured value	Baseline (n=7 participants)	Follow-up (n=7 participants)	P value
Patient Health Questionnaire-Adolescent	8.3±2.7	7.6±3.6	0.2
Center for Epidemiologic Studies Depression Scale	27.6±9.4	26.3±11.8	0.8
Problem Areas in Diabetes-Teen version	89.9±28.7	88.1±35.4	0.8
HbA1c (%)	8.2±1.8	7.8±1.6	0.3

Data are shown as mean ± standard deviation. HbA1c, hemoglobin A1c.

Table 4 Qualitative feedback from participants

Discussed element	Description	Example quotation
Diabetes-related		
Negative thoughts	Strategies to apply the concept of “negative thoughts” and “counter thoughts” to diabetes management and feelings about having diabetes (n=7)	<p>“Negative thought: why is my blood sugar always high, I’m trying everything; counter thought: I know how to bring my blood sugar down and it will come down”</p> <p>“Negative thoughts: the ‘regulars’—I’m not good enough to take care of my diabetes, it’s going wrong or I’m not smart or strong enough to take care of my diabetes”</p> <p>“Negative thought: how diabetes holds you back from being a normal teenager; counter-thought: there are ways to stay on top of it so you can still be you and not hold yourself back”</p>
Video content	Encourages inclusion of adolescents with diabetes (n=5)	“(I) would like to see someone with diabetes in the videos because I know they relate”
Social network	Supports inclusion of diabetes-related entities in the relationship circle (n=3)	<p>“... it would be useful to add something about diabetes relationships like diabetes connections, camp, Type 1 Diabetes Nation (T1DNation), Juvenile Diabetes Research Foundation (JDRF)”</p> <p>“...would definitely add diabetes world to the social network ... I have gotten a lot out of connecting with other kids”</p>
	Opposes inclusion of diabetes-related entities in the relationship circle (n=1)	“No need to add people with diabetes in network”
Time givers and breakers	Supports the notion that being proactive about diabetes management could prevent later “time breakers” (n=4)	<p>“... hate sitting for 5 min for the Personal Diabetes Manager (PDM) when changing pod. On the other hand, if (I) don’t just do it, (it) would be a big time breaker to fix things especially if I got ketones”</p> <p>“Hadn’t thought about diabetes as a time giver or time breaker—checking blood glucose and pump changes could be time givers”</p>
Goal setting	Supports inclusion of diabetes-related goals (n=2)	“Think could add in a goal about diabetes or goals that you might think diabetes could get in the way of”
	Opposes inclusion of diabetes-related goals (n=1)	“Diabetes goals are drilled in from the doctors (MDs), parents, basically anyone that knows that you have diabetes”
Diabetes and depression	Supports inclusion of a link between diabetes and depression (n=2)	“Include diabetes as a risk for depression”
Stressful events	Supports inclusion of how to manage stressful events (n=1)	“For stressful event examples could include fighting with parents about blood glucose or changing pump site or managing high or low blood glucose, hospitalization or going into Diabetic Ketoacidosis (DKA)”
New situations	Supports inclusion of how to manage new situations (n=1)	“Going to school with diabetes, learning and taking care of diabetes, 504 plans, get with your nurse”
		“Really anything new—new job, club, sports team ... how to work in how to take care of diabetes as you take on new roles”

Table 4 (continued)

Table 4 (continued)

Discussed element	Description	Example quotation
Not diabetes-related		
Steering from negative to positive thought patterns	n=5	<i>"I can list them now, then I can stop negative thoughts with stop, snap tap"</i>
Trying coping skills	n=5	<i>"I am using the walk away and to stay calm ... Have been doing the calm thing because yelling is the go-to thing in my family has freaked out my parents when I am calmly telling them that I am upset"</i>
Setting goals (general)	n=5	<i>"I learned that I set unrealistic goals that make me fail, the module taught me how to be more realistic"</i>
Normality	n=4	<i>"I didn't know other teenagers thought like me"</i>

health conditions (14,16).

The minimal improvement in depressive symptoms is not consistent with results from previous studies utilizing CATCH-IT which demonstrated significant reductions in depressed mood (13,16,23). This lack of robust improvement may be due to the presence of diabetes-related distress as evidenced by elevated scores on PAID-T scale. More attention to diabetes-related topics within the CATCH-IT modules may improve both the diabetes-distress and depressive symptoms. Participation in other diabetes-focused web-delivered systems yielded improvements in self-efficacy, quality of life, improved self-monitoring of blood glucoses, and other behavioral outcomes highlighting the potential beneficial utility of online modules in adolescents with T1D (24,25). Similar themes were seen in the qualitative feedback from participants in this study, such as participants learning coping skills to help with stress and anxiety, recognizing proactive diabetes management can prevent negative outcomes, and countering negative thoughts. There are promising results regarding feasibility and high satisfaction with an internet-based CBT model in adolescents with chronic health conditions (cystic fibrosis, juvenile idiopathic arthritis, and T1D) and comorbid depression, though research is ongoing to assess effectiveness (26). Implementation of CATCH-IT in other diverse populations has shown the need for adaptation and inclusion of cultural nuances and community practices (27,28).

This study had limitations including small sample size, lack of diversity in sex and race/ethnicity and high attrition rate which is typical for these types of studies

(7,13,24). Thus, the study was underpowered for its primary outcome. Additionally, there was a marked attrition bias; compared to those who completed CATCH-IT, the eight participants who did not complete CATCH-IT had higher baseline HbA1c. Research efforts are ongoing to identify the most and least effective components of CATCH-IT. The strengths of the study are the inclusion of qualitative feedback and use of a novel web-based approach to address adolescent depression.

These data suggest that engagement in a computer-based CBT program can lead to improved depressive symptoms in adolescents with T1D. To better determine benefit of such an intervention, a randomized control trial with a control group would be important. A modified intervention with fewer modules tailored to adolescents with diabetes could be beneficial and may have higher retention.

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Footnote

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Conflicts of Interest: All authors have completed the ICMJE

uniform disclosure form (available at <https://mhealth.amegroups.com/article/view/10.21037/mhealth-23-33/coif>). B.W.V.V. has a contract to assist in the translation of CATCH-IT (\$5,000). The University of Hong Kong and a Chinese start-up company have developmental licenses for CATCH-IT. Several developmental licenses pending. There are no current or projected payments related to these licenses. The other authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Institutional Review Board of the University of Texas Southwestern Medical Center (No. STU-2020-023) and informed consent was obtained from all the patients' parents/legal guardians.

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