



Depressive Symptoms in a Trial Behavioral Family Systems Therapy for Diabetes: A Post Hoc Analysis of Change

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OBJECTIVE

The objective was to test whether Behavioral Family Systems Therapy for Diabetes (BFST-D), an evidence-based family therapy, produces individual changes in depressive symptoms for adolescents with type 1 diabetes in suboptimal glycemic control ($HbA_{1c} \geq 9.0\%$ [≥ 74.9 mmol/mol]).

RESEARCH DESIGN AND METHODS

Data were from a randomized controlled trial (RCT) comparing two modes of BFST-D delivery: in clinic versus Internet videoconferencing. There were no significant differences between groups in the RCT, so groups were collapsed into a within-group prepost design for secondary analyses. A multiple regression analysis was performed to test for mediation of treatment outcomes by changes in family processes.

RESULTS

Significant improvements in glycemic control, depressive symptoms, and family functioning were found from pre- to posttreatment. A multiple regression analysis for within-subject mediation indicated that improvements in depressive symptoms were partially mediated by improvements in parent-youth conflict; however, family process changes did not mediate diabetes health outcomes.

CONCLUSIONS

In addition to improving treatment adherence and glycemic control, BFST-D has collateral benefits on depressive symptoms.

Risk for depressive symptoms is especially high for adolescents with type 1 diabetes, with prevalence estimates ranging from two to three times that of the general population (1). Depression may be particularly damaging for adolescents with diabetes, as it is adversely associated with a number of outcomes including poor glycemic control (1–3), increased risk for hospitalization (4,5), treatment adherence (6,7), quality of life (8), and suicidality (8). Despite the evidence that depressive symptoms are related to diabetes outcomes in adolescence, few studies have reported intervention outcomes for both.

Family processes have been implicated in the development and maintenance of both diabetes health and youth depression. In the general population, risk of youth depression is associated with caregiver depression, familial conflict, and other family characteristics such as health, stress, and education (9). For adolescents with

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diabetes, parental depressive symptoms and parenting stress are associated with depressive symptoms and other internalizing problems (10–12). A substantial body of research indicates that family processes such as family conflict, parent-youth communication, parenting style, and problem-solving are associated with youth diabetes health outcomes (10,13,14).

Behavioral Family Systems Therapy (BFST) for Diabetes (BFST-D), a flexible, multicomponent intervention designed to improve diabetes-specific family communication and problem-solving processes, has been found to significantly improve glycemic control, treatment adherence, and diabetes-related family conflict (15–17). While the effects of BFST-D on family processes and diabetes outcomes have been evaluated, no trial has examined its impact on depressive symptoms. BFST-D may also affect depressive symptoms, as it targets family processes that are implicated in the development and maintenance of youth depressive symptoms. Further, iterations of BFST (18) and other family-based interventions (19) have yielded positive outcomes in the broader youth depression literature.

The goal of the current study was to examine changes in depressive symptoms in a trial of BFST-D, as well as to examine a potential pathway for change in depressive symptoms: change in family processes.

RESEARCH DESIGN AND METHODS

This study used data from a randomized controlled trial (RCT) that compared BFST-D delivered in person with BFST-D delivered via Skype (20). The methods presented here are those deemed essential for describing secondary findings pertinent to depressive symptoms.

Design

Results from the RCT found that both the Skype and in-person BFST-D groups showed significant improvement in treatment adherence and glycemic control. Further, there were no differences between groups (20). Subsequent between-group analyses have found no differences between groups on measures of depressive symptoms and family processes. While the finding that adherence and glycemic control outcomes of BFST-D delivered in person and via

Skype produced equivalent results is compelling, we were additionally interested in whether significant changes in depressive symptoms occurred and whether any changes were consistent with the theoretical underpinning of BFST. Our primary question for this analysis was whether within-subject changes in depressive symptoms can be partially or wholly explained by changes in family processes targeted by the BFST-D intervention. In other words, does a change in family processes serve as a mediator for change in depressive symptoms? Given this goal for secondary analysis, both the Skype and in-person groups were combined for analysis as a within-subjects open trial using a before-and-after design.

Participants

Participants were recruited from two multidisciplinary, comprehensive, hospital-based diabetes care centers located in an urban Pacific Northwest city via referral by medical provider, identification by study staff through chart review, or self-referral. Participants in the RCT were 90 youth with type 1 diabetes for duration of at least 1 year, age 12–19 years, who were in suboptimal glycemic control as indicated by HbA_{1c} values $\geq 9.0\%$ (≥ 74.9 mmol/mol) at the time of enrollment and at least one caregiver. The youth must have been living with the primary caregiver at the time of the study in order to participate. Exclusion criteria included a history of mental retardation or other mental health condition that would preclude completion of study measures, as well as uncontrolled medical conditions (e.g., cystic fibrosis) that would confound assessment of adherence to diabetes care recommendations. Parents and adolescents signed institutionally approved informed consent and assent forms prior to study participation. For inclusion in the analyses reported here, an additional criterion of at least one Children's Depression Inventory (CDI) completed during participation was necessary. Of the 90 participants in the RCT, 82 met this criterion. Five of those excluded were at least 18 years old at baseline and as such outside the age range for which the CDI has been psychometrically evaluated. Three were enrolled in the study but

never completed the CDI at baseline or subsequent assessments due to near-immediate dropout.

Treatment

BFST consisted of four therapy components: problem-solving training, communication skills training, cognitive restructuring, and altering family roles. Problem-solving provided families with a structured, evidence-based method of addressing problems consisting of problem definition, goal setting, brainstorming solutions, evaluating potential solutions, enacting a plan, and reassessment/revision. Communication skills training focused on increasing positive communication strategies such as expression of feelings, reflective listening, and confirming understanding. Cognitive restructuring consisted of helping parents and youths identify and alter problematic strong beliefs (e.g., "My parents don't trust me.") to improve functioning. Altering family roles involved identifying and improving maladaptive familial interaction patterns such as triangulation, in which a third family member gets "pulled in" to a dispute between two others rather than solving the problem directly. All components of BFST were used flexibly to address problems related to the adolescent's diabetes health and more general issues. Participants completed up to 10 therapy sessions within a 12-week period. The youth with diabetes and at least one parent attended each session together. Sessions were 60–90 min in duration. Nineteen of 82 families (23.2%) completed the maximum 10 sessions with a mean (SD) of 6.3 (3.4) sessions completed. Depressive symptoms were not explicitly targeted, but may have been discussed if relevant for a given family.

Measures and Assessment Schedule

Dependent Measures

Outcome measures were collected at baseline, posttreatment, and at 3-month follow-up. All assessments were completed during clinic visits.

Depressive Symptoms. The CDI consists of 27 items completed by the youth that assessed for the presence and severity of depressive symptoms in the prior 2 weeks (21). The CDI possesses strong psychometric properties. A score of ≥ 13 is indicative of elevated depressive

symptoms (1,2). The CDI was completed by 82 (100%), 72 (88%), and 60 (73%) of participants at baseline, posttreatment, and at 3-month follow-up, respectively. Missing CDI data at follow-up were accounted for by dropout ($n = 21$) and researcher error ($n = 3$). There were no specific procedures with regards to assessing suicidality. Had suicidal intent been identified through examination of the CDI or as part of clinical assessment, the therapist would have evaluated risk and responded in accordance with normal clinical procedures. This issue did not arise.

Glycemic Control. Glycemic control was evaluated via a glycosylated HbA_{1c} assay using a Siemens/Bayer DCA 2000 analyzer, which provided an estimate of blood glucose levels over the preceding 2–3 months (22).

Measures of Family Process

Measures of hypothesized mediators evaluated changes in family processes targeted by BFST-D.

Parent-Youth Conflict. Parent and youth versions of the Conflict Behavior Questionnaire-20 (CBQ) (23) were used to assess general conflict in the relationship. The CBQ consists of 20 items that discriminate between distressed and non-distressed families by asking respondents to indicate whether statements are true or false over the previous 2 weeks. For example, “My child and I have big arguments about little things.” Higher scores indicate greater conflict. The CBQ showed acceptable internal consistency for youth ($\alpha = 0.79$) and parent ($\alpha = 0.88$) versions.

Diabetes Family Conflict. Family conflict specific to diabetes care was assessed using the Diabetes Family Conflict Scale (DFCS). The DFCS is a 19-item rating scale available in both youth and parent versions. It has good psychometric properties and is predictive of glycemic control (24). Internal consistency with the current sample was good for both the youth ($\alpha = 0.84$) and parent ($\alpha = 0.82$) versions.

Miscarried Helping. The Helping for Health Inventory (25) is a 15-item scale that measures miscarried helping or negative social support, a process through which caregivers’ increased efforts to ensure adequate diabetes care lead to frustration and conflict. On a 5-point scale, parents and youth rate the frequency with which parents engage

in certain behaviors or feel certain ways pertaining to their child’s health. Both youth ($\alpha = 0.82$) and parent ($\alpha = 0.82$) versions demonstrated good internal consistency.

Analyses

All analyses were conducted using an intent-to-treat approach. Two methods of handling missing data were conducted: last observation carried forward (LOCF) and multiple imputations via a multivariate normal distribution model. Results of LOCF were compared with the pooled results of five imputed data sets. No differences with regards to statistically significant effects were found between the two methods, and LOCF produced more conservative outcomes, likely due to less within-subject variance. Given the post hoc nature of this analysis, a conservative approach was indicated, so results presented hereafter were derived from the LOCF data set. Ten cases (12.2%) were replaced posttreatment, and 22 cases (27.0%) were replaced at 3-month follow-up. Repeated-measures ANOVAs and related-samples *t* tests were used to compare means across time points. Analysis of mediation was performed via multiple regression analysis consistent with the least squares approach to within-subject mediation described by Judd et al. (26). Briefly, this involves calculating within-subject difference scores between repeated measures and regressing the dependent variable (e.g., depressive symptoms) difference scores on the hypothesized mediating variables (e.g., family processes) difference scores. In this way, a regression coefficient is produced that estimates the variance in the outcome variable change accounted for by mediating variable change (i.e., the

indirect effect). All predictor variables were entered into the regression model simultaneously, as there were no specific a priori hypotheses regarding hierarchical relationships between variables of interest. Imputations of missing data were created using NORM, version 2.0 (27). All other analyses were carried out with IBM SPSS Statistics, version 22.0 (28).

RESULTS

Baseline characteristics of the sample are reported in Table 1. A total of 82 participants averaging 14.1 years of age were included in the sample. Youths were largely Caucasian ($n = 72$); others were biracial/multiethnic ($n = 4$), Hispanic ($n = 4$), Native American ($n = 1$), and Hawaiian/Pacific Islander ($n = 1$). Mean (SD) diabetes duration was 6.4 (3.5) years (range 1.1–14.4). Mean (SD) HbA_{1c} at baseline was 11.1 (1.7)% (98 [18.6] mmol/mol). Nineteen youths (23.2%) reported elevated depressive symptoms, consistent with previous findings. Those with elevated depressive symptoms had higher baseline HbA_{1c} values and were older on average than the remainder of the sample.

Table 2 summarizes the results of repeated-measures ANOVAs. A statistically significant time effect in the desired direction was observed on the CDI for the entire sample ($F[1.87, 151.73] = 14.57, P = 0.001$). Both the posttreatment ($t[81] = 2.53, P = 0.01, d = 0.39$) and follow-up ($t[81] = 3.88, P < 0.001, d = 0.61$) mean CDI scores were significantly different than pretreatment but did not differ from each other ($t[81] = 1.00, P = 0.32$). These effects were replicated for those with elevated depressive symptoms at baseline ($F[1.84, 33.27] = 11.43, P < 0.001$). Of the 19

Table 1—Baseline characteristics

	Elevated CDI	Nonelevated CDI	Total
Female, <i>n</i> (%)	9 (47.4)	25 (39.7)	34 (41.5)
Male, <i>n</i> (%)	10 (52.6)	38 (60.3)	48 (58.5)
Age (years)	15.5 (1.2)*	14.6 (1.7)	14.8 (1.6)
Diabetes duration (years)	5.5 (3.1)	6.7 (3.6)	6.4 (3.5)
HbA _{1c} , % [mmol/mol]	11.8 (1.7) [105 (18.6)]*	10.9 (1.7) [96 (18.6)]	11.1 (1.7) [98 (18.6)]
Hollingshead index	36.8 (9.9)	36.5 (9.8)	36.6 (9.8)
CDI	16.4 (4.1)**	5.9 (3.6)	8.3 (5.8)

Data are mean (SD) unless otherwise indicated. Elevated = raw score of 13 or higher.

*Statistically significant mean difference from the nonelevated group at $P \leq 0.05$; ** $P \leq 0.001$.

Table 2—Means, SDs, and P values for repeated-measures ANOVAs

	Pretreatment	Posttreatment	Follow-up	P
HbA _{1c} , % [mmol/mol]	11.1 (1.7) [98 (18.6)]	10.7 (1.8) [93 (19.7)]*	10.6 (1.9) [92 (20.8)]*	0.002
CDI	8.3 (5.8)	6.7 (5.9)*	6.2 (5.3)**	0.001
CBQ				
Youth	4.9 (3.6)	3.6 (3.7)**	3.2 (3.5)	0.001
Parent	7.1 (4.7)	6.1 (5.0)*	5.4 (4.8)**†	0.001
DFCS				
Youth	29.0 (6.0)	27.3 (6.1)*	27.0 (6.2)	0.006
Parent	30.4 (5.4)	27.8 (6.1)**	27.5 (5.1)**	0.001
HHI				
Youth	42.9 (8.8)	40.9 (9.0)*	39.8 (9.1)*	0.006
Parent	49.4 (9.8)	42.4 (9.9)**	42.0 (9.3)**	0.001

HHI, Helping for Health Inventory. *Statistically significant mean difference from the pretreatment score at $P \leq 0.05$; ** $P \leq 0.001$. †Statistically significant mean difference from the posttreatment score at $P < 0.05$.

youth reporting elevated symptoms at baseline, 7 continued to exceed the cutoff at posttreatment, as did an additional 6 youth who did not meet the cutoff at pretreatment. Improvements on the CDI were significantly and positively correlated with baseline CDI scores for both the entire sample ($r[80] = 0.49$, $P < 0.001$) and those with elevated scores at baseline ($r[17] = 0.49$, $P = 0.03$).

Statistically significant changes in the desired directions were also observed on HbA_{1c} ($F[1.80, 145.41] = 7.13$, $P = 0.001$) and parent and youth versions of the CBQ (youth, $F[1.76, 142.26] = 12.23$, $P < 0.001$; parent, $F[1.80, 146.14] = 9.98$, $P < 0.001$), DFCS (youth, $F[1.95, 157.76] = 5.42$, $P = 0.006$; parent, $F[1.89, 153.03] = 13.56$, $P < 0.001$), and HHI (youth, $F[1.880, 152.31] = 5.45$, $P = 0.006$; parent, $F[1.91, 154.43] = 27.52$, $P < 0.001$). Overall, there was a substantial positive response to BFST-D. Gains on the CBQ improved significantly from posttreatment to follow-up. All

other dependent measures showed no differences between posttreatment and follow-up.

Given the statistically significant changes in in outcome and family process measures, a multiple regression analysis was performed to evaluate whether changes in family functioning mediated changes in depressive symptoms. Given the high level of missing data at follow-up, immediate posttreatment data were used in the regression model. The correlations of all variables are shown in Table 3. Improvements on the CDI were positively correlated with improvements in youth- and parent-reported conflict and youth-reported miscarried helping, as well as youth and parent report of BFST skills use. Table 4 displays the results of the multiple regression test for mediation. The prediction model was statistically significant ($F[6, 75] = 7.45$, $P < 0.001$, $R^2 = 0.37$) and accounted for ~37% of the variance in depressive symptoms from pre- to posttreatment. Change in depressive

symptoms was primarily predicted by changes in youth- and parent-reported conflict, such that greater reduction in conflict was predictive of improvements in depressive symptoms. This is notable, as reducing family conflict is a primary goal of BFST.

A second regression analysis was conducted to determine whether changes in family processes similarly mediated HbA_{1c} outcomes. The resulting model was not statistically significant ($F[7, 74] = 7.45$, $P = 0.89$, $R^2 = 0.04$), suggesting that changes in HbA_{1c} were not driven by alterations of family processes (Table 4).

CONCLUSIONS

Improvements in both depressive symptoms and glycemic control were observed after a course of BFST-D. Interestingly, evidence for mediation by changes in family processes was found for depressive symptoms but not glycemic control. The depressive symptom findings are particularly notable given that 1) the treatment as implemented did not specifically target depressive symptoms and 2) youths with elevated depressive symptoms were not targeted in recruitment. This is an important finding given the higher rates of elevated depressive symptoms in youths with diabetes and the undesirable health outcomes associated with those symptoms. If BFST-D not only improves diabetes functioning but also has collateral effects on depressive symptoms, it may be a particularly useful intervention to use with this population.

That BFST-D affects both adolescent diabetes health and depressive symptoms is consistent with prominent theoretical models and suggests relationships between outcomes in both domains. For example, the diathesis stress model of depression posits that depressive symptoms are the result of personal characteristics interacting with stressful life events (30), such as family conflict associated with diabetes care. At the same time, negative cognitive and behavioral patterns associated with depression likely contribute to less effective illness management, which in turn amplifies family conflict, as concerned parents use maladaptive strategies (i.e., miscarried helping). In this way, it is apparent that diabetes health, family conflict, and depressive symptoms may interact. Such a model has

Table 3—Correlations between change on the CDI and changes on the predictor variables for pre- to posttreatment

Variable	CDI	CBQ-Y	CBQ-P	DFCS-Y	DFCS-P	HHI-Y	HHI-P
CDI		0.42**	0.25*	0.24*	0.03	0.38**	0.16
CBQ-Y			0.13	0.22*	0.07	0.27*	-0.01
CBQ-P				-0.02	0.17	0.05	0.29**
DFCS-Y					0.16	0.27*	0.06
DFCS-P						0.14	0.23*
HHI-Y							0.50**
HHI-P							

HHI, Helping for Health Inventory. "Y" and "P" designate youth and parent versions, respectively. * $P \leq 0.05$; ** $P \leq 0.01$.

Table 4—Results of multiple regression test of mediation

Model	<i>b</i>	SE- <i>b</i>	β	Pearson <i>r</i>	<i>sr</i> ²
Constant	0.41	0.69			
CBQ-Y*	0.66	0.16	0.40	0.42**	0.13
CBQ-P*	0.61	0.17	0.36	0.25*	0.11
DFCS-Y	0.09	0.10	0.09	0.24*	0.01
DFCS-P	−0.02	0.09	−0.02	−0.03	0.00
HHI-Y	0.13	0.08	0.19	0.38**	0.02
HHI-P	0.09	0.06	0.16	0.16	0.02

Change on the CDI was the dependent variable. $R^2 = 0.37$. Adjusted $R^2 = 0.32$. sr^2 is squared semipartial correlation. HHI, Helping for Health Inventory. “Y” and “P” designate youth and parent versions, respectively. * $P \leq 0.05$; ** $P \leq 0.001$.

important practical implications and underscores the need for dissemination of family-based interventions for adolescents with diabetes such as BFST-D. The formats of these interventions may be clinic based (15,16,31–33) or online (20,34,35).

Additionally important is identifying adolescents with diabetes who are at risk for depression. The American Academy of Pediatrics now endorses depression screening for all adolescents (34), and this is especially important for youth with diabetes given the impact on physical health. With earlier and better identification, psychosocial interventions like BFST-D hold potential to prevent undesirable health outcomes. Enhanced skills, such as those taught through BFST-D, may better prepare families to handle illness-related stress and subsequently buffer against undesirable outcomes.

Surprisingly, the findings do not support change in family processes as a mechanism of improving glycemic control. This suggests that BFST-D exerts change on diabetes health through some other pathway, possibly through alteration of maladaptive cognitions or improved problem-solving skills. Future trials of BFST-D should include measures of hypothesized mediators in order to better explicate mechanisms of change.

It should be noted that these findings are preliminary. The primary purpose of this trial was not examination of changes in depressive symptoms or mediational processes, and conclusions are tentative. While changes in depressive symptoms were statistically significant and effect sizes compared favorably with those found in the youth depression literature, use of a sufficient control condition is needed to merit stronger

conclusions. The current study suggests that the family processes targeted in BFST-D are important in depressive symptom improvement, but it does not experimentally evaluate whether the intervention components or some other factor (e.g., passage of time or nonspecific factors) caused those changes. However, that the findings were theoretically consistent lends some credence to the conclusion that BFST-D promoted the change. The participant sample in this study was ethnically homogenous and included only 19 youths with elevated depressive symptoms. Recruitment of larger and more diverse samples of youth with suboptimal glycemic control and elevated depressive symptoms would allow for more robust analysis with regard to efficacy. Further analyses of mediation as well as moderation would be additionally useful in identifying for whom and in what ways BFST-D is most likely to produce benefits.

In sum, the current findings extend the evidence in support of BFST-D, highlight the importance of family processes in depressive symptom change, and suggest that future trials are merited to examine the efficacy of BFST-D to address depression in the context of suboptimal glycemic control.

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