Diabetes-Specific Family Conflict and Blood Glucose Monitoring in Adolescents With Type 1 Diabetes: Mediational Role of Diabetes Self-Efficacy

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Abstract

Purpose. To determine whether the association between diabetes-specific family conflict and self-monitoring of blood glucose (SMBG) frequency is mediated by diabetes self-efficacy.

Methods. A total of 276 adolescents with type 1 diabetes (aged 15.6 ± 1.4 years; duration of diabetes 6.6 ± 1.8 years; A1C 8.9 ± 1.8%) completed measures of diabetes-specific family conflict and self-efficacy. Sociodemographic, family, and disease characteristics (including SMBG frequency and glycemic control) were obtained at the clinic visit.

Results. Multivariate analyses were used to test the mediational role of self-efficacy. The first model established that family conflict was associated with lower levels of self-efficacy. The second model established that increased family conflict was associated with lower SMBG frequency. In the third model, self-efficacy was added, and the effect of family conflict on SMBG frequency became less significant ($P = 0.001$ to $P = 0.03$). The indirect effect of family conflict on SMBG frequency through diabetes self-efficacy was significant (Sobel = 2.10, $P = 0.035$) and explained 22% of the association between family conflict and SMBG frequency.

Conclusions. Results confirm a partial mediational role of diabetes self-efficacy and suggest that a family environment characterized by conflict may also contain poorer self-efficacy in the adolescent. In these cross-sectional analyses, both variables contributed to less frequent SMBG. Future longitudinal research to confirm these relationships and potential avenues for intervention are discussed.

Type 1 diabetes is an autoimmune disease that affects 1 in 500 children and adolescents, and recent estimates show increasing incidence in the United States.[1] Treatment of pediatric type 1 diabetes involves coordinating the timing and administration of insulin with results of self-monitoring of blood glucose (SMBG), dietary intake, and physical activity.[2] Effective management of this complex regimen is associated with better glycemic control (i.e., primary indicator of overall diabetes control); however, effective management is hard to achieve for adolescents.[3–6]

Although a number of individual factors contribute to poor diabetes management in this age-group,[7–9] family variables are contributors, as well.[10,11] Unfortunately, little is known about the interaction among individual and family variables, particularly in adolescents with type 1 diabetes. The purpose of this study was to further elucidate relationships among these variables.

During adolescence, there is often a shift in responsibility for diabetes management, with the adolescent assuming more responsibility.[12,13] Factors such as the degree to which the family effectively negotiates this process and whether communication is negative or positive will play a role in the level of conflict within the family. Not surprisingly, less diabetes-specific family conflict is associated with better management.[14–16]

The level of conflict involved in the interactions between family

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members is thought to affect management in a variety of ways. For example, in the presence of high levels of diabetes-specific family conflict, there may be less caregiver involvement and ineffective problem-solving around diabetes management.[17,18] Likewise, youth who identify caregivers as critical regarding diabetes management may be more resistant to parental demands about diabetes care.[19,20] Although there is preliminary evidence of mechanisms that link diabetes-specific family conflict to poor diabetes management, few investigations have focused on adolescent psychosocial variables that may be links between family conflict and adolescents' diabetes management.

A potential factor that may be involved in the link between diabetes-specific family conflict and diabetes management is diabetes self-efficacy. This concept has been applied increasingly to diabetes self-management research in recent years. Several studies have identified a mediational relationship, in which self-efficacy leads to improved adherence to diabetes regimens, which in turn leads to improved glycemic control.[21,22]

One reason for the link between low self-efficacy and poor diabetes management may be that adolescents with low self-efficacy disengage from diabetes management because of their belief that they are incapable of achieving the outcome. Further, that belief may be linked to the family context; individuals' judgments regarding their own self-efficacy are connected to the efficacy of other individuals involved in the task and their enabling or impeding activities.[23] For example, adolescents experiencing conflict in the family around diabetes may doubt their ability to effectively carry out management tasks. When this occurs, adolescents may engage in the tasks less frequently, thus demonstrating poorer diabetes management.

Given the lack of clinical investigation of this potential link between diabetes-specific family conflict and diabetes self-efficacy, the purpose of this study was to examine their association with each other and a specific measure of diabetes management, namely, SMBG frequency. We hypothesized that an environment characterized by diabetes-specific family conflict will be associated with lower self-efficacy in the adolescent, which would be associated with lower SMBG frequency. Further, we hypothesized that diabetes self-efficacy would mediate the relationship between diabetes-specific family conflict and SMBG frequency.

Research Design and Methods

Participants and procedures

The study included 276 adolescents with type 1 diabetes (aged 13–18 years) and their primary caregivers. All participants were receiving care from a multidisciplinary team at one of two pediatric diabetes centers (Northeastern and Midwestern clinical sites). Each of the adolescents had a diagnosis of type 1 diabetes according to the clinical practice guidelines of the American Diabetes Association (ADA).[2] Exclusion criteria included the presence of a major psychiatric or neurocognitive disorder that would inhibit the ability to participate; a significant medical disease other than type 1 diabetes, treated thyroid disorders, or celiac disease; and the inability to read or understand English.

At the Northeastern site, participants were drawn from a sample of 173 eligible adolescents who were approached as a convenience sample about participation; 126 adolescents participated (agreement rate of 73%). At the Midwestern site, 150 participants were gathered from the 166 eligible adolescents who were similarly approached (agreement rate of 90%).

All study procedures were approved by the institutional review board at each clinical site. A research assistant administered questionnaires after obtaining written informed consent from caregivers and consent/assent from adolescents. All questionnaires were completed in the pediatric diabetes clinic before or after adolescents' clinic visits.

Measures

Diabetes self-efficacy was measured using a 10-item scale developed at the National Institute of Child Health and Human Development.[21] On this questionnaire, adolescents rate 10 diabetes management tasks (e.g., "Adjust your insulin correctly . . .") on a scale ranging from 1 = "Not at All Sure" to 5 = "Completely Sure" that they can complete each task. This measure has strong psychometric properties, and total scores can range from 10 to 50, with higher scores indicating greater self-efficacy for diabetes management.

Diabetes-specific family conflict was evaluated using the revised Diabetes Family Conflict Scale (DFCS).[14] This new version of the DFCS contains updated language and additional items that relate to current diabetes management practices and tools (e.g., new technologies). Adolescents rate diabetes-specific family conflict on a 3-point scale (1 = never argue, 2 = sometimes argue, 3 = always argue) across 19 diabetes management tasks. Total scores range from 19 to 57, with higher scores indicating greater levels of family conflict.

SMBG frequency was measured by meter download (if available) and self-report. In this sample, 158 adolescents provided meters for downloading. For these 158 adolescents, meter-downloaded daily frequency was highly correlated with ($r = 0.66$, $P < 0.0001$) and very similar to their self-report (meter mean = 4.15 times per day; self-report mean = 4.26 times per day). To adjust for this self-report inflation, each of the remaining 118 adolescents without meter downloads had their self-report value adjusted by multiplying it by 0.97 (4.15 ÷ 4.26). Notably, the 118 adolescents with only self-report data had a mean value of 3.97 before adjustment, which was not significantly different from the mean value with meter download. No differences between adolescents with and without meter downloads were observed on sociodemographic variables, family conflict, or self-efficacy.

At the Northeastern clinical site, high-performance liquid chromatography was used to determine participants' glycemic control (A1C value; reference range 4.0–6.0%, Tosoh 2.2 (Somagen Diagnostics Inc.,

Foster City, Calif.). Alternatively, at the Midwestern clinical site, A1C values were measured by the DCA 2000+ (Bayer Inc., Tarrytown, N.Y.). Previous studies have shown that A1C values obtained from the laboratory and DCA 2000 + measurements show high agreement.[24]

Family demographic data were obtained from a self-report questionnaire completed by the participants' caregivers during the study visit, and chart reviews were used to obtain data on duration of diabetes and mode of insulin administration.

Statistical analyses

Before analysis, data were double entered and cross-checked for accuracy. Descriptive statistics, frequencies, and univariate comparisons were calculated for the total sample as well as for each site. Bivariate correlations were carried out for the variables of primary interest: diabetes-specific family conflict, diabetes self-efficacy, and SMBG frequency.

Next, we conducted a series of multivariate analyses in the general linear model framework to test the hypothesis that diabetes self-efficacy would mediate the relationship between diabetes-specific family conflict and SMBG frequency, in accordance with the guidelines for testing mediation as highlighted by Baron and Kenny.[25] Specifically, the first model tested the effect of diabetes-specific family conflict on diabetes self-efficacy. The second model tested the effect of diabetes-specific family conflict on SMBG frequency.

The final model tested the effect of both family conflict and self-efficacy on SMBG frequency. Full mediation occurred if the addition of self-efficacy to the third model eliminated the statistically significant effect of family conflict on SMBG frequency. Partial mediation occurred if the magnitude of the effect was reduced, but was still significant. The Sobel test was used to test for the magnitude of the mediation effect. In other words, the Sobel test was used to measure how much of the family conflict-SMBG relationship was explained by self-efficacy.

In all models, the following covariates were included: adolescent age, sex, ethnicity, type 1 diabetes duration, and mode of insulin delivery; caregiver education level, insurance status, and marital status; and clinical site. Analyses were conducted in SAS v9.1 software (SAS Institute, Cary, N.C.).

Results

Participant characteristics

Table 1 displays characteristics of the adolescents and caregivers for both the total sample and for each clinical site. The mean age of the sample was 15.6 ± 1.4 years, with a near-equal split of males (52%) and females (48%). The sample was predominantly white, not of Hispanic origin (87%) and living in two-caregiver families (80%), and 54% of caregivers had achieved at least a college degree. Duration of type 1 diabetes ranged from 3 months to 16.8 years (mean duration 6.6 ± 1.8 years). The mean A1C for this sample was 8.9 ± 1.8%, with 55% of the sample on continuous subcutaneous insulin infusion (CSII).

Analyses between the two clinical sites revealed that the participants at the Northeastern site were slightly older ($P = 0.03$), had a longer diabe-

Table 1. Participant Characteristics

Characteristic	Total Sample (*n* = 276)	Northeast (*n* = 126)	Midwest (*n* = 150)
Age (years)	15.6 ± 1.4	15.8 ± 1.4	15.5 ± 1.4
Sex (% female)	47.5	42.9	51.3
Ethnicity (% white, not of Hispanic origin)	87.3	88.9	86.0
Caregiver marital status (% married)	80.4	84.1	77.3
Primary caregiver (% mother)	82.6	77.8	86.7
Education level of primary caregiver (% with at least a college degree)	54.0	62.7	46.7
Insurance status (% private)	84.4	85.7	83.3
Type 1 diabetes duration (years)	6.6 ± 1.81	7.3 ± 4.0	6.0 ± 3.9
A1C (%)	8.9 ± 1.8	9.0 ± 1.7	8.8 ± 1.9
SMBG frequency (times daily)	4.0 ± 1.8	4.3 ± 1.8	3.8 ±1.7
Method of insulin delivery			
Multiple daily injections (%)	44.9	54.8	36.7
CSII (%)	55.1	45.2	63.3
Diabetes self-efficacy (range = 10–50)	37.3 ± 7.5	36.6 ± 8.2	37.8 ± 6.8
Diabetes-specific family conflict (range = 19–57)	25.5 ± 5.2	24.8 ± 5.5	26.0 ± 4.8

Scores are shown as mean ± SD.

Table 2. Mediation Analyses

Model	Dependent Variable	Independent Variables	R^2	F	b	P
1	Diabetes self-efficacy	(Overall model)	0.15	4.75		< 0.0001
		Diabetes-specific family conflict			−0.50	< 0.0001
		Female sex			1.75	0.04
2	SMBG frequency	(Overall model)	0.25	9.01		< 0.0001
		Diabetes-specific family conflict			−0.06	0.001
		Insulin delivery via injections			0.82	0.0001
		Longer duration of diabetes			−0.05	0.05
		Older age			−0.33	< 0.0001
		Participation at Northeastern site			0.67	0.001
		Parental education less than college			0.57	0.005
3	SMBG frequency	(Overall model)	0.27	8.95		< 0.0001
		Diabetes-specific family conflict			−0.04	0.03
		Diabetes self-efficacy (lower level)			0.03	0.01
		Insulin delivery via injections			0.79	0.0002
		Older age			0.34	< 0.0001
		Parental education less than college			0.57	0.005

tes duration ($P = 0.01$), were more likely to use injections ($P = 0.002$), had caregivers with higher educational attainment ($P = 0.02$), engaged in more frequent SMBG ($P = 0.02$), and had slightly less diabetes-specific family conflict ($P = 0.05$) than those at the Midwestern clinical site. There were no significant differences on any other covariates or self-efficacy scores. Bivariate correlations showed that higher levels of diabetes-specific family conflict were associated with lower diabetes self-efficacy ($r = -0.34$, $P < 0.001$) and lower SMBG frequency ($r = -0.23$, $P < 0.001$). Diabetes self-efficacy was positively correlated with SMBG frequency ($r = 0.21$, $P < 0.001$).

Tests of Mediation

Results for the three steps in the mediation analyses are presented in Table 2.

Model 1: Diabetes-specific family conflict → diabetes self-efficacy. The first model included family conflict and covariates as independent variables and self-efficacy as the dependent variable. The overall model was significant: F (10, 265) = 4.75, $P < 0.001$, $R^2 = 0.15$. Higher levels of diabetes self-efficacy were associated with female sex ($P = 0.04$) and lower levels of diabetes-specific family conflict ($P < 0.001$).

Model 2: Diabetes-specific family conflict → SMBG frequency. The second model included family conflict and covariates as independent variables and SMBG frequency as the dependent variable. The model was significant: F (10, 265) = 9.01, $P < 0.001$, $R^2 = 0.25$. Lower SMBG frequency was associated with longer diabetes duration ($P = 0.05$), older age ($P < 0.001$), insulin delivery via injections versus CSII ($P < 0.001$), lower caregiver education level ($P = 0.005$), participation at the Northeastern site ($P = 0.001$), and higher levels of diabetes-specific family conflict ($P = 0.001$).

Model 3: Diabetes-specific family conflict and self-efficacy → SMBG frequency. The third model contained both family conflict and self-efficacy, along with the covariates, as the independent variables; SMBG frequency was the dependent variable. The overall model was significant: F (11, 264) = 8.95, $P < 0.001$, $R^2 = 0.27$. The same covariates from Model 2 were significant; however, with the addition of diabetes self-efficacy, the significance level of diabetes-specific family conflict dropped from $P = 0.001$ to $P = 0.03$. Diabetes self-efficacy was a significant correlate of SMBG frequency in this final model ($P = 0.01$). The Sobel test of mediation effects indicated that diabetes self-efficacy was a partial mediator between diabetes-specific family conflict and SMBG frequency (Sobel = 2.10, $P = 0.04$; Figure 1). Examination of the indirect and direct effects[26] showed that 21.6% of the link between diabetes-specific family conflict and SMBG frequency could be explained by diabetes self-efficacy.

Discussion

The aim of this study was to gain a greater understanding of the potential role that diabetes self-efficacy plays in mediating between diabetes-specific family conflict and SMBG frequency, a primary indicator of diabetes management. Results of this cross-sectional analysis provide support for the mediational role of diabetes self-efficacy. Specifically, higher levels of diabetes-specific family conflict were associated with lower levels of diabetes self-efficacy, which was subsequently associated with lower frequency of SMBG. This study establishes support for an individual pathway between a diabetes-specific family variable—conflict—and diabetes management in adolescents with type 1 diabetes.

In this study, self-efficacy was used to characterize adolescents' beliefs in their capabilities of carrying out diabetes management tasks.

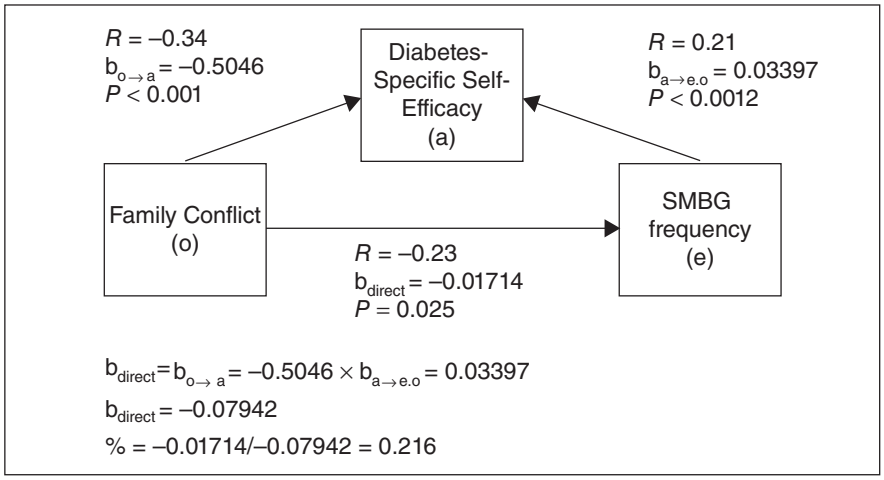

Figure 1. Mediational role of adherence. b, multivariate model estimate; P, *multivariate model significance level;* R, *bivariate correlation*

The results show that in the context of heightened diabetes-specific family conflict, adolescents are likely to perceive themselves as less efficacious. A possible explanation for this is that adolescents become discouraged in diabetes management because of the critical behaviors of caregivers and no longer feel capable of carrying out management tasks.

This is consistent with past findings on critical parenting behaviors around diabetes[19,20] and miscarried helping.[27,28] In these cases, caregivers intend to help with diabetes management, but because of the negative and unsupportive way they do so, they actually serve to cause management difficulties.

Likewise, diabetes-specific family conflict may be the result of management difficulties already being observed, so adolescents may perceive that they have tried harder in the past to manage diabetes, but it was not effective and only led to more conflict. This negatively reinforcing cycle would likely lead to adolescents feeling less capable of managing diabetes. Future studies should examine family precursors to the low diabetes self-efficacy and ongoing management difficulties many of these adolescents may be facing.

Although the focus of this study was the mediational role of diabetes self-efficacy within the context of the family, the R^2 values of the multivariate models showed that there is an independent and additive effect of diabetes self-efficacy on SMBG frequency. In other words, beyond the potential "roots" of diabetes self-efficacy in the family, developing adolescents with type 1 diabetes have their own beliefs about their capability to manage diabetes. Although it is not surprising that this occurs, it is an important finding given that it demonstrates that adolescents are beginning to develop their own ideas about diabetes and its management.

Furthermore, it provides a target for clinic visits or clinic-based interventions in that the promotion of diabetes self-efficacy in adolescents may help with the transition they experience in taking primary responsibility for diabetes management. Although there is an emerging evidence base for individual programs for adolescents with type 1 diabetes,[29] a greater focus on diabetes self-efficacy may have lasting effects on diabetes management. Ultimately, the integration of family and individual approaches may prove the most beneficial.

The results of this study yield contributions to the existing literature; however, several limitations should be considered. First, because these data were cross-sectional, it is not possible to show causal relationships. We are examining these variables over time to gain a better appreciation of their associations. This appears particularly important given the likelihood of cyclical relationships that may serve to reinforce diabetes management in different ways. For example, an adolescent's self-efficacy may be perceived by the family as detrimental to management and cause conflict. Another limitation is that the level of family conflict was determined solely from adolescents' self-report. Although the levels are similar to previous reports of adolescents with type 1 diabetes,[14,30] results may have differed if we evaluated caregivers' perceptions of family conflict. Finally, our sample may not be representative of the larger population of adolescents with type 1 diabetes. Although the overall management and glycemic control levels appear similar, our sample was predominantly white and living in two-caregiver homes. Examination of these findings in more diverse samples may yield different results; however, we would expect that similar relationships would be found but the magnitude of the associations may differ.

In sum, adolescents with type 1 diabetes who experience elevated diabetes-specific family conflict are also likely to experience lower self-efficacy. When this occurs, diabetes management is likely to suffer. An implication of these findings is that more comprehensive clinic-based interventions that include family and individual components may serve to promote better diabetes management because both factors appear key to the best outcomes.

These interventions should include educational components to promote the understanding and knowledge of management tasks because adolescents may exhibit lower self-efficacy out of misinformation or poor understanding. These factors could also contribute to family conflict, especially if caregivers perceive adolescents as having the requisite diabetes management skills when in fact they do not.

Furthermore, existing family-based interventions may benefit from a greater focus on diabetes self-efficacy in adolescents and linking this with both family processes and the behavioral tasks that are part of management. Attention to these areas should promote better individual and family functioning around diabetes, ultimately resulting in better behavioral and health outcomes.

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