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Original article

# Blood Glucose Monitoring and Glycemic Control in Adolescence: Contribution of Diabetes-Specific Responsibility and Family Conflict

Lisa M. Ingerski, Ph.D.<sup>a</sup>, Barbara J. Anderson, Ph.D.<sup>b</sup>, Lawrence M. Dolan, M.D.<sup>c,d</sup>,  
and Korey K. Hood, Ph.D.<sup>a,d,\*</sup>

<sup>a</sup>Division of Behavioral Medicine and Clinical Psychology, Center for Treatment Adherence, Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio

<sup>b</sup>Texas Children's Hospital, Houston, Texas

<sup>c</sup>Division of Endocrinology, Diabetes Center, Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio

<sup>d</sup>Department of Pediatrics, University of Cincinnati College of Medicine, Cincinnati, Ohio

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## Abstract

**Purpose:** To examine age and time trends in responsibility for diabetes management tasks and diabetes-specific family conflict and their relationship to blood glucose monitoring (BGM) frequency and blood glucose control (HbA1c).

**Methods:** A sample of 147 adolescents (mean = 15.5 ± .4 years) with type 1 diabetes and their caregivers completed measures of diabetes-specific responsibility and family conflict at baseline and 6 months. BGM frequency and HbA1c were measured during outpatient clinic appointments.

**Results:** Responsibility for diabetes management tasks shifted from caregivers to adolescents with increasing age by adolescent and caregiver report. Diabetes-specific conflict was stable. Similar trends in responsibility and conflict were seen over the 6-month follow-up period. Less frequent BGM and higher HbA1c were also observed with increasing adolescent age. Multivariate analyses demonstrated adolescents taking greater responsibility for management tasks and experiencing greater family conflict at baseline reported lower BGM at 6 months. Family, demographic, psychosocial, and disease-specific variables accounted for 26% of the variance in BGM frequency by both adolescent and caregiver report. Adolescents reporting greater diabetes-specific family conflict at baseline experienced higher HbA1c values at 6 months. Variables accounted for 23% and 28% of the variance in HbA1c by adolescent and caregiver report respectively.

**Conclusions:** Diabetes-specific responsibility and conflict have important implications for improving disease outcomes. Interventions targeting responsibility and conflict (i.e., reducing conflict while keeping caregivers involved in diabetes management) may help prevent the deterioration in BGM and HbA1c frequently seen during adolescence. © 2010 Society for Adolescent Medicine. All rights reserved.

## Keywords:

Family; Adherence; Glycemic control; Responsibility; Conflict

Adolescence is a critical period of growth accompanied by changes in interpersonal roles, responsibilities, and identity development [1]. Not surprising, these years are more complex for adolescents diagnosed with type 1 diabetes. A common chronic illness of childhood, data suggest current rates of type 1 diabetes are increasing and affect approxi-

mately every 1 in 500 youth aged 10–19 years in the United States [2,3]. In addition to experiencing the same challenges as their peers, adolescents with diabetes must contend with intensive medical regimens, regular clinic appointments, complicated carbohydrate calculations, and frequent monitoring of blood glucose levels [4].

Although tools are currently available to facilitate more optimal glycemic control [5] and decrease the risk of long-term, negative health consequences [6], many adolescents with type 1 diabetes achieve suboptimal glycemic control. The literature documents decreased blood glucose monitoring (BGM) frequency [7] and deterioration in blood glucose

\*Address correspondence to: Korey Hood, Ph.D., Division of Behavioral Medicine and Clinical Psychology, Center for the Promotion of Treatment Adherence and Self-Management, Cincinnati Children's Hospital Medical Center, 3333 Burnet Ave., MLC 7039, Cincinnati, OH 45229-3039.

E-mail address: [Korey.Hood@cchmc.org](mailto:Korey.Hood@cchmc.org)

control or hemoglobin A1c (HbA1c) [8,9], with few adolescents achieving optimal HbA1c values (<7.5%) [4].

These poor health outcomes have prompted investigation into possible explanations for this deterioration in glycemic control. Research has demonstrated that several demographic (e.g., family composition, ethnicity), disease (e.g., mode of insulin delivery), individual, and family factors contribute to poor control [10]. In addition to individual psychosocial factors, such as child depression [11] and anxiety [12], a number of family factors [13] affect the frequency of BGM frequency, a commonly cited indicator of adherence [7] and blood glucose control. Of note, diabetes-specific supervision and/or responsibility (e.g., the extent to which the parent and/or the adolescent are responsible for managing diabetes management tasks) and family conflict have emerged as important correlates of both BGM and blood glucose control. Less parental involvement, greater adolescent responsibility [13–17], and greater family conflict surrounding diabetes management [18–22] are frequently related to less frequent BGM and decreased blood glucose control. Furthermore, responsibility for daily diabetes care often shifts from the parent to the adolescent [23,24] and family conflict increases [25].

While it seems that responsibility and conflict have important implications for BGM frequency and blood glucose control, previous research has not investigated how these important family variables are related to BGM frequency and blood glucose control across time. Most of the earlier data [13,15,16,18–21] derive from cross-sectional studies. In fact, only three of the above studies (i.e., [14,17,22]) completed longitudinal data collection across multiple time points. Additionally, even these studies [14,17,22] used a wide age-range of children and adolescents and/or used varying methodologies (e.g., parent vs. child-report of functioning, measured only one aspect of family functioning). No research currently exists that examines both age and time trends in family responsibility and family conflict and how they relate to BGM frequency and blood glucose control in an exclusively adolescent sample. Given the well-documented deterioration in blood glucose control that occurs in this age group [8,9], such new information on this age cohort may have important implications for providers working to identify treatment targets and to plan targeted interventions to assist adolescents in achieving more optimal control.

The current study examined trends in responsibility for diabetes management tasks and diabetes-specific family conflict across adolescent age groups and changes in these variables across time from baseline to 6 months. In addition, the study examined the relationship of these variables at baseline to BGM frequency and blood glucose control at 6 months. We hypothesized that [1] responsibility would shift from parent to adolescent and family conflict would increase across age groups and across time from baseline to 6 months and [2] greater family conflict and greater adolescent responsibility for diabetes management at baseline would be related

to less frequent BGM and worse blood glucose control at 6 months.

## Method

### *Participants and procedures*

Data for this report are part of a larger longitudinal study examining the psychosocial functioning of adolescents with type 1 diabetes. A total of 147 adolescents (age 13–18 years) with type 1 diabetes and their primary caregivers participated in the current study. All adolescents had a diagnosis of type 1 diabetes according to the practice guidelines of the American Diabetes Association [26] and were receiving care from a multidisciplinary team at a pediatric diabetes center in the Midwest. Exclusion criteria included [1] the presence of a major psychiatric or neurocognitive disorder that would inhibit their ability to participate; [2] a significant medical disease other than type 1 diabetes, treated thyroid disorders, or celiac disease; or [3] the inability to read or understand English. Participants completed measures at baseline (time 1) and again 6 months later (time 2). A total of 150 adolescents participated from the 166 eligible adolescents approached (participation rate of 90%). Of those 150 adolescents participating at time 1, about 147 adolescents participated at time 2 (98% retention rate). Only participants with data at both time points were included in analyses. Data for eligible families that declined participation were removed from the database, precluding additional analyses to determine whether participants differed significantly from those who declined. All study procedures were approved by the local Institutional Review Board. After obtaining written informed consent from caregivers and assent from adolescents (consent if aged 18 years), a research assistant administered questionnaires. All questionnaires were completed in the pediatric diabetes clinic before or after the adolescent's scheduled clinic visit.

### *Measures*

Diabetes-specific family conflict was evaluated with the revised Diabetes Family Conflict Scale (DFCS) [27]. This version of the original DFCS [28] contains updated language and additional items related to contemporary diabetes management (e.g., new technologies). Caregivers and youth completed this scale independently. The level of diabetes-specific family conflict was rated on a 3-point scale (1 = never argue, 2 = sometimes argue, 3 = always argue) across 19 diabetes management tasks such as insulin administration, checking blood glucose values, and telling others about diabetes. A total score, ranging from 19 to 57, was calculated for each youth and caregiver with higher scores indicating more conflict. Internal consistency for the DFCS in this study sample was high for both youth and caregivers (adolescent coefficient  $\alpha = .86$ ; caregiver coefficient  $\alpha = 0.87$ ).

The 17-item Diabetes Family Responsibility Questionnaire was used to assess caregiver-child teamwork in daily

diabetes management tasks. This measure has strong psychometric properties [23] and both caregivers and youth completed equivalent forms and assigned a value ranging from 1 to 3 to each item (1 = child taking or initiating responsibility for this task almost all the time; 2 = caregiver and child sharing responsibility for this task almost equally, and 3 = caregiver taking or initiating responsibility for this task almost all of the time). Scores could range from 17 (child has complete responsibility) to 51 (caregiver has complete responsibility). In this sample, internal consistency was high for both youth and caregivers (adolescent coefficient  $\alpha = .72$ ; caregiver coefficient  $\alpha = .85$ ).

The 27-item Children's Depression Inventory [29] assessed adolescent depressive symptoms at baseline. Items are rated from 0 (no symptom) to 2 (distinct symptom). Possible scores range from 0 to 54 with a clinical cutoff score of 13 or higher indicative of elevated depressive symptoms and suggestive of further evaluation [29]. Youth responses on the Children's Depression Inventory demonstrated a high degree of internal consistency (coefficient  $\alpha = .90$ ).

The 40-item State-Trait Anxiety Inventory [30] measured adolescent anxiety symptoms at baseline. The State-Trait Anxiety Inventory includes items related to present feelings (state scale) and feelings in general (trait scale). On both scales, there was a high degree of internal consistency (state coefficient  $\alpha = .87$ ; trait coefficient  $\alpha = .87$ ).

Adherence was measured as the frequency of blood glucose monitoring (BGM frequency). BGM frequency was calculated based on available data from clinic visits. Participants' meters were downloaded and daily frequency calculated across the past 2 weeks. If meters were not available, the value reported in the medical chart (i.e., patient-report) or adolescent self-report was used. If self-report was used, we adjusted this value. For example, at time 2, self-report was used for 21 adolescents and 126 adolescents had both meter and self-report values. Meter values were 84% of the self-report values, so this served as the adjustment. The self-report value was multiplied by .84 to obtain the value used in analyses. At time 1, self-report was used for 32 adolescents and the self-report value was multiplied by .89. We have reported previously on using this methodology to calculate BGM frequency [11]. Adolescent blood glucose control (HbA1c values) was measured by the DCA 2,000+ (reference range 4.3%–5.7%, Bayer Inc, Tarrytown, NY). Duration of diabetes and mode of insulin administration were obtained from chart review. Family demographic data were obtained from a self-report questionnaire completed by the adolescent's primary caregiver during the study visit.

### Statistical analyses

Prior to analysis, data were double entered and cross-checked for accuracy. Descriptive statistics and frequencies were calculated across variables of interest as appropriate. To examine baseline age trends in responsibility and conflict, analysis of variance models tested for differences between age

groups. Given the small number of adolescents aged 18 years ( $n = 11$ ), these youth were added to the 17-year-old age group. The analysis of variance models also examined trends in responsibility and conflict from baseline to 6 months. Hierarchical regression analyses examined the relationship between responsibility and conflict at baseline to BGM and HbA1c at 6 months. Demographic and disease-specific variables (age, disease duration, gender [male/female], minority status [white, minority], insulin mode [injection/CSII], health insurance [private/public], caregiver marital status [married/other], and caregiver education [college degree/other]) were entered into the first block. Psychosocial covariates (child depression, state anxiety, trait anxiety) were entered into the second block and responsibility and conflict entered into the third block. This method allowed researchers to examine the unique contribution of family factors beyond that accounted for by demographic/disease-specific and individual psychosocial variables. Interaction effects between responsibility and conflict with time were also entered into regression models. Analyses were conducted in SAS 9.1 for Windows (SAS Institute Inc., 2002–2003).

## Results

### Demographic and disease characteristics

At baseline, the majority of adolescents (mean = 15.5  $\pm$  1.4 years old, 52% female) were white, not of Hispanic origin (86%), used subcutaneous insulin infusion (CSII) pumps (63%), and had private insurance (85%). Duration of type 1 diabetes ranged from 6 months to 16.75 years (mean = 6.0  $\pm$  3.8 years;  $n = 10$  duration less than 1 year). Caregivers of adolescents were mostly mothers (86%), married (76%), and had a college degree (47%; Table 1).

No significant differences across gender (male vs. female), ethnicity (white vs. minority), health insurance (private vs. public), caregiver marital status (married vs. other), or caregiver education (college degree vs. other) were found between age groups.

### Age trends in responsibility and conflict

Across adolescent age groups, diabetes-specific responsibility shifted from parent to adolescent with increasing age according to adolescents ( $F[4,146] = 6.13, p < .001$ ) and caregivers ( $F[4,146] = 4.84, p < .01$ ). Age was not associated with diabetes-specific family conflict; conflict remained stable according to both adolescents ( $F[4,146] = .78, p = .54$ ) and caregivers ( $F[4,146] = .71, p = .59$ ). BGM frequency decreased ( $F[14,146] = 7.78, p < .001$ ), while HbA1c showed a higher trend ( $F[4,146] = 2.31, p = .06$ ) across age groups.

### Time trends in responsibility and conflict

Diabetes-specific responsibility shifted from parent to adolescent by both adolescent ( $t[146] = 3.04, p < .01$ ) and caregiver report ( $t[144] = 2.88, p < .01$ ) from baseline to 6

Table 1  
Demographic and disease-specific characteristics of participants

	<i>M</i> ± <i>SD</i> or <i>n</i> (%)	
	Time 1 (baseline)	Time 2 (6 mon)
Adolescent characteristics		
Age (yr)	15.5 ± 1.4	16.0 ± 1.4
Female gender	76 (51.7%)	–
Race		
African American	16 (10.9%)	–
Caucasian	127 (86.4%)	–
Hispanic/Latino	2 (1.4%)	–
Other/multiracial	2 (1.4%)	–
A1c (%)	8.8 ± 1.9	9.1 ± 2.1
BGM frequency	3.5 ± 1.5	3.0 ± 1.7
Disease duration (yr)	6.0 ± 3.8	6.5 ± 3.8
Mode of insulin delivery: CSII	93 (63.3%)	91 (61.9%)
Private insurance	125 (85.0%)	121 (82.3%)
Caregiver characteristics		
Relation to child		
Mother	127 (86.4%)	–
Father	15 (10.2%)	–
Other	5 (3.4%)	–
Currently married	111 (75.5%)	–
College degree or higher	69 (46.9%)	–

months. Diabetes-specific family conflict remained stable by both adolescent ( $t[146] = 1.92, p = .06$ ) and caregiver report ( $t[144] = 1.96, p = .05$ ) over 6 months. Additional analyses revealed that BGM frequency decreased ( $t[146] = 4.43, p < .001$ ) and HbA1c increased ( $t[146] = -2.89, p < .01$ ) over 6 months (Table 2).

**Relationship to BGM and HbA1c by adolescent report.** After controlling for demographic variables and psychosocial covariates, hierarchical regression analyses revealed significant main effects for adolescent report of family responsibility ( $\beta = .18, p < .05$ ) and conflict ( $\beta = -.19, p < .05$ ) in the model predicting BGM frequency at 6 months ( $F[13,146] = 3.55, p < .001, R^2 = .26$ ). Analyses also revealed a significant main effect for adolescent report of family conflict ( $\beta = .19, p < .05$ ), but not responsibility ( $\beta = -.02, p = .78$ ), in the model predicting HbA1c at 6 months ( $F[13,146] = 3.13, p < .001, R^2 = .23$ ; Table 3). Interaction effects with time were not significant and excluded from the model.

**Relationship to BGM and HbA1c by caregiver report.** Hierarchical regression analyses revealed significant main effects for caregiver report of family responsibility ( $\beta = .21, p < .05$ ) and conflict ( $\beta = -.21, p < .05$ ) in the model predicting BGM frequency at 6 months ( $F[13,146] = 3.60, p < .001, R^2 = .26$ ) after controlling for demographic variables and psychosocial covariates. Analyses also revealed a significant main effect for caregiver report of family conflict ( $\beta = .31, p < .001$ ), but not responsibility ( $\beta = -.05, p = .61$ ), in the model predicting HbA1c at 6 months ( $F[13,146] = 4.05, p < .001, R^2 = .28$ ; Table 4). Interaction effects with time were not significant and were excluded from the model.

## Discussion

This study demonstrated that diabetes management tasks shifted from caregivers to adolescents with increasing adolescent age, and family conflict related to diabetes management remained stable across time. During this shift in responsibility for care, BGM frequency declined and the concentration of HbA1c increased. Younger adolescents taking greater responsibility for care and experiencing greater family conflict at baseline reported less frequent BGM 6 months later. In addition, for adolescents and caregivers reporting greater diabetes-specific family conflict at baseline, adolescents obtained higher HbA1c values at 6 months. These findings suggest that improving the transition of responsibility from caregivers to adolescents in daily diabetes care and decreasing family conflict may reduce the deterioration in diabetes outcomes for adolescents with type 1 diabetes.

Current findings support previous studies that have also described a similar shift in responsibility for diabetes management tasks from parents to adolescents with increasing age [23,24]. While parents of 13-year-olds in the current sample were sharing fairly equal responsibility for management tasks, responsibility for disease management tasks had clearly shifted to greater responsibility on the part of the adolescent by age 17. Some of this shift to greater responsibility by adolescents is developmentally appropriate as they attain greater independence and prepare to transition away from the home and their pediatric healthcare providers [31]. However, this shift in responsibility for disease management tasks adversely affects the frequency of BGM measurement. In contrast, families sharing greater responsibility for management tasks reported more frequent BGM. This finding supports the need for continued involvement of parents and caregivers in their adolescent's care. Given that some adolescents were already taking greater responsibility for disease management as early as age 13, the promotion of continued involvement by caregivers in disease management needs to begin in the pre-adolescent years.

A growing body of literature now exists documenting the significant difficulties associated with the transition from pediatric to adult healthcare settings [32–35] and a number of interventions and programs to help ease the transition process to adult healthcare have been described or are currently underway [36–38]. While it may seem that more extensive interventions regarding responsibility and self-management are needed during this period, current data suggest that difficulties related to self-management may begin long before this transition takes place. It may be that prevention efforts targeting both family conflict and division of responsibility in the adolescent age group may be especially beneficial earlier in adolescence. Discussions surrounding disease management, sustained parental involvement, and family conflict should then be an integral component of prevention efforts throughout the adolescent years. For example, Anderson and colleagues [17] have previously described a four-session, clinic-based, parent-adolescent

Table 2  
Differences and correlations in variables of interest between baseline and 6-month time points

	Baseline (Time 1)		6 mon (Time 2)		<i>r</i>	<i>t</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Adolescent responsibility	29.61	4.28	28.57	3.76	.48*	3.04**
Caregiver responsibility	33.10	4.37	32.18	5.08	.68*	2.88**
Adolescent conflict	25.99	4.81	25.15	5.75	.51*	1.92
Caregiver conflict	25.85	5.46	25.11	5.30	.65*	1.96
HbA1c	8.79	1.94	9.14	2.13	.75*	−2.89**
BGM frequency	3.52	1.54	3.04	1.74	.68*	4.43*

\*  $p < .001$ .

\*\*  $p < .01$ .

teamwork intervention that includes a focus on both responsibility and conflict reduction within the family. Demonstrating positive effects on both HbA1c and family conflict, this intervention provides promising evidence regarding possible strategies to decrease the difficulties documented in our current data. Future, longitudinal research will determine whether prevention efforts during this time may subsequently serve as a foundation for the family as they finally transition to adult healthcare providers.

We also found that greater diabetes-specific family conflict at baseline was related to less frequent BGM and higher HbA1c values at 6 months. In contrast to previous literature [25], family conflict remained relatively stable across both age and time through adolescence. While conflict related to management tasks remains an important factor in understanding adolescents' overall disease functioning, it may be that patterns of conflict are fairly established by the adolescent years. Family conflict is perhaps one of the more widely studied family variables known to affect adherence and glycemic control in pediatric diabetes samples [18–22], and current data certainly support its continued consideration in explaining the health outcomes of adolescents in future studies. A number of interventions targeting family conflict in type 1 diabetes populations are described in the literature (e.g., [39]) and have had some success in improving disease-related outcomes. Given our results regarding the stability of conflict over time, it seems such intervention may be especially beneficial early in adolescence to address those difficulties related to conflict found to affect BGM and HbA1c.

Similar to other studies [12], we found that child anxiety was related to BGM frequency in the model using caregiver report of responsibility and conflict, supporting continued consideration of child anxiety symptoms in understanding disease-related care. That family characteristics remained significant even after individual child psychosocial variables were added to the model, speaks to the importance of family factors to diabetes outcomes. Also consistent with existing literature, we found deterioration in BGM frequency and glycemic control with advancing age [7–9]. Specifically, 17-year-olds were monitoring their blood glucose levels almost two times less frequently each day than 13-year-olds. This finding was associated with a concomitant

increase in HbA1c. Interestingly, these changes were observed in a sample where the majority of adolescent participants were white, enrolled in private insurance, living with a married caregiver, and where two-thirds of the adolescents used CSII. This decline in glycemic control over only 6 months further justifies the need to understand those factors affecting this important health outcome.

Table 3  
Regression models examining time trends in BGM and HbA1c by adolescent report

	$\beta$	T	$\Delta R^2$	$R^2$
Dependent variable: BGM				
Block 1				.18
Age	−.21	−2.46*		
Gender	.14	1.81		
Duration	−.15	−1.92		
Minority status	−.02	−.20		
Insurance	.04	.44		
Insulin mode	.16	1.85		
Parent marital status	−.01	−.13		
Parent education	.14	1.71		
Block 2			.03	.21
Depression	.09	.76		
State anxiety	.06	.64		
Trait anxiety	−.17	−1.40		
Block 3			.05	.26
Responsibility	.18	2.12*		
Conflict	−.19	−2.09*		
Dependent variable: HbA1c				
Block 1				.19
Age	.13	1.44		
Gender	−.08	−.97		
Duration	.17	2.12*		
Minority status	.07	.83		
Insurance	−.02	−.18		
Insulin mode	−.21	−2.45*		
Parent marital status	−.14	−1.55		
Parent education	−.07	−.84		
Block 2			.02	.21
Depression	−.02	−.20		
State anxiety	.12	1.15		
Trait anxiety	−.08	−.62		
Block 3			.02	.23
Responsibility	−.02	−.27		
Conflict	.19	2.06*		

\*  $p < .05$ .

Table 4  
Regression models examining time trends in BGM and HbA1c by caregiver report

	$\beta$	$T$	$\Delta R^2$	$R^2$
Dependent variable: BGM				
Block 1				.18
Age	-.22	-2.55*		
Gender	.14	1.83		
Duration	-.14	-1.73		
Minority status	-.06	-.76		
Insurance	.08	.92		
Insulin mode	.12	1.41		
Parent marital status	.03	.34		
Parent education	.13	1.66		
Block 2			.03	.21
Depression	.10	.81		
State anxiety	.06	.62		
Trait anxiety	-.24	-2.00*		
Block 3			.05	.26
Responsibility	.21	2.38*		
Conflict	-.21	-2.49*		
Dependent variable: HbA1c				
Block 1				.19
Age	.14	1.62		
Gender	-.06	-.76		
Duration	.15	1.92		
Minority status	.08	.94		
Insurance	-.04	-.51		
Insulin mode	-.16	-1.82		
Parent marital status	-.17	-1.97		
Parent education	-.07	-.87		
Block 2			.02	.21
Depression	-.09	-.71		
State anxiety	.12	1.23		
Trait anxiety	.00	-.04		
Block 3			.07	.28
Responsibility	-.05	-.52		
Conflict	.31	3.69**		

\*  $p < .05$ .

\*\*  $p < .001$ .

This study has several limitations. First, despite efforts to document family conflict and responsibility by both adolescent and caregiver report, families may not have accurately disclosed current conflict and/or patterns of responsibility due to social desirability. Second, the data were collected from a single diabetes center where adolescents were predominantly white and from relatively high functioning families, limiting general applicability. However, current findings regarding BGM frequency and HbA1c are similar to those published elsewhere [8,9] and provide support for its relevance to other adolescent samples. Third, only two diabetes-specific family factors were examined in the current study. While demographic, disease-specific, and child psychological factors known to influence BGM and A1c in previous literature were considered in analyses, there are likely other family or individual psychosocial variables influencing BGM and HbA1c in this population.

In summary, this study suggests that targeting responsibility and family conflict may benefit both BGM and HbA1c. Certainly, the current data have important implications for

adolescents followed up in multidisciplinary specialty clinics and for healthcare professionals providing care to this high-risk age group. Differences in models by reporter are consistent with the current literature (e.g., [40]), suggesting important differences in how parents and adolescents view the family environment and confirming the needed for multiple informants. Psychosocial assessment is needed to identify those family factors that may be affecting type 1 diabetes management. In addition to strategies related to transitional care (i.e., sustained parental involvement with increasing adolescent age) these data also provide additional support for the use of family-based interventions in working with adolescents to address challenges related to care. Furthermore, a focus on modifiable family factors, such as responsibility and conflict, may help to improve overall outcomes. Finally, interventions that focus on reducing conflict within the family around diabetes-related tasks while promoting sustained parental involvement in diabetes management tasks may prove to be the most effective in preventing or reducing the deterioration in glycemic control frequently seen during adolescence.

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### References

- [1] Spear HJ, Kulbok P. Autonomy and adolescence: A concept analysis. *Public Health Nurs* 2004;21:144–52.
- [2] Liese A, D'Agostino R, Hamman RF, et al. SEARCH for Diabetes in Youth Study Group. The burden of diabetes mellitus among US youth: Prevalence estimates from the SEARCH for diabetes in youth study. *Pediatrics* 2006;118:1510–8.
- [3] Dabelea D, Bell R, D'Agostino RB, et al. The Writing Group for the SEARCH for Diabetes in Youth Study Group. Incidence of diabetes in youth in the United States. *JAMA* 2007;297:2716–24.
- [4] Silverstein J, Klingensmith G, Copeland K, et al. Care of children and adolescents with type 1 diabetes: A statement of the American Diabetes Association. *Diabetes Care* 2005;28:186–212.
- [5] White N, Cleary P, Dahms W, et al. Beneficial effects of intensive therapy of diabetes during adolescence: Outcomes after the conclusion of the Diabetes Control and Complications Trial (DCCT). *J Pediatr* 2001;139:804–12.
- [6] Nathan DM, Zinman B, et al., Diabetes Control Complications Trial/Epidemiology of Diabetes Interventions and Complications (DCCT/EDIC) Research Group. Modern-day clinical course of type 1 diabetes mellitus after 30 years' duration: The diabetes control and complications trial/epidemiology of diabetes interventions and complications and Pittsburgh epidemiology of diabetes complications experience (1983–2005). *Arch of Intern Med* 2009;(169):1307–16.
- [7] Johnson SB, Kelly M, Henretta JC, et al. A longitudinal analysis of adherence and health status in childhood diabetes. *J Pediatr Psychol* 1992;17:537–53.
- [8] Bryden K, Peveler R, Stein A, et al. Clinical and psychological course of diabetes from adolescence to young adulthood: A longitudinal cohort study. *Diabetes Care* 2001;24:1536–40.
- [9] Mortensen HB, Robertson KJ, Aanstoop HJ, et al. Insulin management and metabolic control of Type 1 diabetes mellitus in childhood and adolescence in 18 countries. *Diabet Med* 1998;15:752–9.

- 660 [10] Nansel TR, Hood KK. Diabetes in childhood: Promoting emotional  
661 health. In: Gullotta T, Blau G, eds. Handbook of Child Behavioral  
662 Issues: Evidence-Based Approaches. New York, NY: Routledge  
663 Publishers, 2007.
- 664 [11] McGrady ME, Laffel L, Drotar D, et al. Depressive symptoms and gly-  
665 cemic control in adolescents with type 1 diabetes. *Diabetes Care* 2009;  
666 32:804–6.
- 667 [12] Herzer M, Hood KK. Anxiety symptoms in adolescents with type 1 dia-  
668 betes: Association with blood glucose monitoring and glycemic  
669 control. *J Pediatr Psychol*, in press.
- 670 [13] Cameron FJ, Skinner TC, de Beaufort CE, et al. Are family factors  
671 universally related to metabolic outcomes in adolescents with type 1  
672 diabetes? *Diabet Med* 2008;25:463–8.
- 673 [14] Helgeson VS, Reynolds KA, Siminerio L, et al. Parent and adolescent  
674 distribution of responsibility for diabetes self-care: Links to health  
675 outcomes. *J Pediatr Psychol* 2008;33:497–508.
- 676 [15] Ellis D, Podolski C, Frey M, et al. The role of parental monitoring in  
677 adolescent health outcomes: Impact on regimen adherence in youth  
678 with type 1 diabetes. *J Pediatr Psychol* 2007;32:907–17.
- 679 [16] Anderson BJ, Ho J, Brackett J, et al. Parental involvement in diabetes  
680 management tasks: Relationships to blood glucose monitoring adher-  
681 ence and metabolic control in young adolescents with insulin-  
682 dependent diabetes mellitus. *J Pediatr* 1997;130:257–65.
- 683 [17] Anderson B, Brackett J, Ho J, et al. An office-based intervention to  
684 maintain parent-adolescent teamwork in diabetes management. Impact  
685 on parent involvement, family conflict, and subsequent glycemic  
686 control. *Diabetes Care* 1999;22:713–21.
- 687 [18] Lewandowski A, Drotar D. The relationship between parent-reported  
688 social support and adherence to medical treatment in families of adoles-  
689 cents with type 1 diabetes. *J Pediatr Psychol* 2007;32:427–36.
- 690 [19] Anderson BJ, Vangsness L, Connell A, et al. Family conflict, adher-  
691 ence, and glycaemic control in youth with short duration Type 1 dia-  
692 betes. *Diabet Med* 2002;19:635–42.
- 693 [20] Miller-Johnson S, Emery RE, Marvin RS, et al. Parent-child relation-  
694 ships and the management of insulin-dependent diabetes mellitus.  
695 *J Consult Clin Psychol* 1994;62:603–10.
- 696 [21] Wysocki T. Associations among teen-parent relationships, metabolic  
697 control, and adjustment to diabetes in adolescents. *J Pediatr Psychol*  
698 1993;18:441–52.
- 699 [22] Hauser ST, Jacobson AM, Lavori P, et al. Adherence among children  
700 and adolescents with insulin-dependent diabetes mellitus over a four-  
701 year longitudinal follow-up. II. Immediate and long-term linkages  
702 with the family milieu. *J Pediatr Psychol* 1990;15:527–42.
- 703 [23] Anderson BJ, Auslander WF, Jung KC, et al. Assessing family sharing  
704 of diabetes responsibilities. *J Pediatr Psychol* 1990;15:477–92.
- 705 [24] Drotar D, Ievers C. Age differences in parent and child responsibilities  
706 for management of cystic fibrosis and insulin-dependent diabetes mel-  
707 litus. *J Dev Behav Pediatr* 1994;15:265–72.
- 708 [25] Schilling LS, Knafel KA, Grey M. Changing patterns of self-management  
709 in youth with type 1 diabetes. *J Pediatr Nurs* 2006;21:412–24.
- 710 [26] The Diabetes Control Complications Trial Research Group. The effect  
711 of intensive treatment of diabetes on the development and progression  
712 of long-term complications in insulin-dependent diabetes mellitus.  
713 *N Engl J Med* 1993;329:977–86.
- 714 [27] Hood KK, Butler DA, Anderson BJ, et al. Updated and revised diabetes  
715 family conflict scale. *Diabetes Care* 2007;30:1764–9.
- 716 [28] Rubin RR, Young-Hyman D, Peyrot M. Parent-child responsibility and  
717 conflict in diabetes care [Abstract]. *Diabetes* 1989;38:28.
- 718 [29] Kovacs M. Children's Depression Inventory. North Tonawanda, NY:  
719 Multi-Health Systems Inc, 1992.
- 720 [30] Spielberger CD. State-Trait Anxiety Inventory for Adults. Redwood  
721 City, CA: Mind Garden, 1983.
- 722 [31] Weissberg-Benchell J, Wolpert H, Anderson BJ. Transitioning from  
723 pediatric to adult care: A new approach to the post-adolescent young  
724 person with type 1 diabetes. *Diabetes Care* 2007;30:2441–6.
- 725 [32] Cooke E. Transitional care for young people with diabetes: Policy and  
726 practice. *Paediatr Nurs* 2007;19:19–22.
- 727 [33] Court J. Issues of transition to adult care. *J Paediatr Child Health* 1993;  
728 29(suppl 1):53–5.
- 729 [34] Kipps S, Bahu T, Ong K, et al. Current methods of transfer of young  
730 people with type 1 diabetes to adult services. *Diabet Med* 2002;19:649–54.
- 731 [35] Reisse JG, et al. Health care transition: Youth, family and provider  
732 perspectives. *Pediatrics* 2005;115:112–20.
- 733 [36] Vanelli M, et al. Effectiveness of an uninterrupted procedure to transfer  
734 adolescents with Type 1 diabetes from the pediatric to the adult clinic  
735 held in the same hospital: Eight year experience with the Parma  
736 protocol. *Diabetes Nutr Metab* 2004;17:304–8.
- 737 [37] Van Walleghem N, MacDonald CA, Dean HJ. Evaluation of a systems  
738 navigator model for transition from pediatric to adult care for young  
739 adults with type 1 diabetes. *Diabetes Care* 2008;31:1529–30.
- 740 [38] Holmes-Walker DJ, Llewellyn AC, Farrell K. A transition care pro-  
741 gramme which improves diabetes control and reduces hospital admis-  
742 sion rates in young adults with Type 1 diabetes aged 15–25 years.  
743 *Diabet Med* 2007;24:764–9.
- 744 [39] Wysocki T, Harris MA, Buckloh LM, et al. Effects of behavioral family  
745 systems therapy for diabetes on adolescents' family relationships, treat-  
746 ment adherence, and metabolic control. *J Pediatr Psychol* 2006;31:928–  
747 38.
- 748 [40] Eiser C, Morse R. Can parents rate their child's health-related quality of  
749 life? Results of a systematic review. *Qual Life Res* 2001;10:347–57.