

# The Role of Parental Monitoring in Adolescent Health Outcomes: Impact on Regimen Adherence in Youth with Type 1 Diabetes

Deborah A. Ellis,<sup>1</sup> PhD, Cheryl-Lynn Podolski,<sup>2</sup> PhD, Maureen Frey,<sup>1</sup> PhD, Sylvie Naar-King,<sup>1</sup> PhD, Bo Wang,<sup>1</sup> PhD, and Kathleen Moltz,<sup>1</sup> MD

<sup>1</sup>Carman and Ann Adams Department of Pediatrics and <sup>2</sup>Department of Psychiatry and Behavioral Neurosciences, Wayne State University

**Objective** To determine if parental monitoring of adolescent behavior was related to regimen adherence and metabolic control among adolescents with type 1 diabetes. An additional objective was to compare the relative importance of instrumental parenting behaviors such as monitoring to affective behaviors such as parental support as predictors of regimen adherence. **Method** Ninety-nine adolescents aged 12–18 years and their primary caregiver completed self-report questionnaires. Path analysis was used to test a model where diabetes-specific parental monitoring and support were predicted to have direct effects on regimen adherence and indirect effects on metabolic control via regimen adherence and an alternative model where parental support moderated the effects of monitoring on adherence. **Results** Diabetes-specific, but not general, monitoring was found to be associated with regimen adherence based on both parent and youth report. Monitoring had an indirect effect on metabolic control through regimen adherence. Although adolescent-reported parental support was significantly associated with regimen adherence in bivariate analyses, multivariate analyses indicated that parental support was not a significant independent predictor of health outcomes when parental monitoring was considered simultaneously. Modest support was also found for parental support as a moderator of the relationship between monitoring and adherence.

**Conclusions** Close parental monitoring of care completion can contribute to better adherence in adolescents with diabetes. General warmth and support in the absence of careful parental supervision may be insufficient to help youth achieve adequate levels of adherence.

**Key words** adolescents; diabetes; parental monitoring.

Parental monitoring of adolescent behavior has been repeatedly identified as an important predictor of risky behaviors in youth (Chilcoat, Breslau, & Anthony, 1996). Monitoring refers to those aspects of parenting behavior that involve information-seeking about the youth's daily activities as well as direct supervision and oversight of those activities. Low levels of parental monitoring have been linked to early sexual initiation (French & Dishion, 2003), poor academic outcomes (Rodgers & Rose, 2001), use of alcohol and drugs (Chilcoat & Anthony, 1996; Dishion & McMahon, 1998; Li, Stanton, & Feigelman, 2000) and involvement in

antisocial activities (Griffin, Botvin, Scheier, Diaz, & Miller, 2000; Pettit, Bates, Dodge, & Meece, 1999).

Poor adherence to the diabetes regimen is a risk behavior that has been linked to adverse health consequences such as poor metabolic control (Levine et al., 2001; Morris et al., 1997) and hospitalizations for diabetic ketoacidosis (Musey et al., 1995; Smith, Firth, Bennett, Howard, & Chisholm, 1998). Poor metabolic control in turn leads to long-term diabetes complications [Diabetes Control and Complications Trial (DCCT)/Epidemiology of Diabetes Interventions and Complications (EDIC) Research Group, 2001].

All correspondence concerning this article should be addressed to Deborah A. Ellis, Ph.D., Pediatric Prevention Research Center, 6D-UHC, 4201 St. Antoine, Detroit MI 48201. E-mail: dellis@med.wayne.edu.

*Journal of Pediatric Psychology* 32(8) pp. 907–917, 2007  
doi:10.1093/jpepsy/jsm009

Advance Access publication April 9, 2007

*Journal of Pediatric Psychology* vol. 32 no. 8 © The Author 2007. Published by Oxford University Press on behalf of the Society of Pediatric Psychology. All rights reserved. For permissions, please e-mail: journals.permissions@oxfordjournals.org

In the diabetes literature, there has been extensive investigation of the relationship between general family functioning (e.g., conflict, cohesion, communication) and adolescent adherence to medical regimen and metabolic control (Cohen, Lumley, Naar-King, Partridge, & Cakan, 2004; Hanson, Henggeler, & Burghen, 1987; Hauser et al., 1990; Jacobson et al., 1994; Wysocki, 1993). Fewer studies, however, have investigated the role of specific parenting behaviors, and those that have done so have focused primarily upon the affective dimension of parenting such as support. For example, higher levels of parental support for diabetes care have been found to be related to better adherence (Hanson, DeGuire, Schinkel, Henggeler, & Burghen, 1992; La Greca et al., 1995; Skinner, John, & Hampson, 2000). However, instrumental components of parenting, such as parental monitoring, have not been well evaluated in empirical studies of adolescents with diabetes.

Items evaluating parental monitoring have sometimes been included in measures of parental support for diabetes care (La Greca & Bearman, 2002), suggesting that at times, parental monitoring has been subsumed in the construct of parental support. Parental involvement in the diabetes regimen, a variable that has conceptual similarities to parental monitoring, has also been investigated (Anderson, Auslander, Jung, Miller, & Santiago, 1990; La Greca, Follansbee, & Skyler, 1990; Wysocki et al., 1996); such studies have found that higher levels of parental involvement are related to better regimen adherence. However, in these studies, parental involvement was operationalized by measuring whether the parent or the adolescent reported being responsible for various diabetes care tasks, not by determining whether the parents of adolescents who held partial or primary responsibility for their own care monitored their child's diabetes care completion. Clear assignment of family responsibility for tasks to the adolescent (e.g., completing homework, checking blood sugar) does not preclude the parent from checking to ensure that the task was in fact completed; therefore, assessing how the family assigns responsibility for completion of diabetes care tasks is not synonymous with assessing parental monitoring.

In one of the few studies that directly evaluated parental monitoring of diabetes care, Johnson, Perwien, and Silverstein (2000) used semistructured interviews to investigate the effect of parental presence during blood glucose testing on adolescent management of episodes of hypo- and hyperglycemia. No relationship was found between monitoring as measured by parental observation

of blood glucose testing and appropriateness of youth response to hypoglycemia. Contrary to prediction, episodes of inadequate response to hyperglycemia were associated with higher levels of parental supervision. However, this study evaluated the relationship between adherence behavior and monitoring only in difficult diabetes management situations, where adolescent might have solicited parental presence in order to decide how to respond to the blood glucose reading. In addition, parental monitoring of other aspects of diabetes care such as insulin injections or dietary management was not evaluated.

The purpose of the current study was to assess the relationship between parental monitoring of adolescent diabetes care, and adherence to regimen and metabolic control. It was predicted that higher levels of parental monitoring would be related to better regimen adherence and metabolic control. Because measures of monitoring have been underutilized in the chronic illness literature, it was also important to evaluate the relative utility of general measures of parental monitoring versus measures specific to monitoring of diabetes care.

In light of the lack of previous comparisons of the relative importance of affective versus instrumental parenting behaviors in predicting adherence in this population, an additional purpose of the study was to determine whether parental monitoring of adolescent diabetes care and parental support for diabetes care would be equally important in promoting adolescent adherence. In the literature on the development of adolescent risk behaviors, many studies have investigated the relative importance of affective components of parenting behavior such as parental warmth, support, and positive communication as compared with instrumental behaviors such as supervision, monitoring and/or discipline in predicting youth substance abuse and antisocial behavior. Findings have been mixed, with some studies supporting the importance of affective components of parenting, some instrumental components, and some both (Parker & Benson, 2004; Sullivan, Kung, & Farrell, 2004; Wasserman, Miller, Pinner, & Jaramillo, 1996). In fact, Dishion and McMahon (1998) have argued that given the high degree of relatedness between these two facets of parenting behavior, they should not be considered to be orthogonal constructs. Given lack of consensus in earlier studies regarding whether monitoring or support is primary, and how their relationship should be best represented, we chose to test two alternative hypotheses regarding of the impact of

parental monitoring and support on regimen adherence. The first hypothesis was that monitoring and support would each have direct effects upon youth adherence. The second hypothesis was that parental support would function as a moderator of the effect of monitoring on regimen adherence; this hypothesis is also consistent with prior conceptualizations of the role of parental support as a moderator of other risk variables such as life stress (Wills & Cleary, 1996).

## Methods

### Participants

Participants for this cross-sectional study were recruited from a university-affiliated pediatric diabetes clinic located in a tertiary care facility in a large Midwestern metropolitan area. Participants were seen clinically for medical visits by a multidisciplinary diabetes treatment team at 3–4 month intervals. Recruitment was conducted by approaching potential participants in person at the time of a regularly scheduled clinic visit. The research was approved by the Human Investigation Committee of the university affiliated with the hospital where the adolescents were seen for medical care. All participants and their primary caregiver provided informed consent and assent to participate.

In order to be eligible for the study, adolescents had to be between 12 and 18 years of age, residing with their parent or legal guardian, accompanied by their primary caregiver, diagnosed for at least a year with type 1 diabetes, have no known developmental delay or other chronic medical conditions, and be English speaking. Of the 128 potential subjects who were approached, 103, or 80%, of those eligible, agreed to participate. The most frequent reason for nonparticipation was the extra time required during the clinic appointment to complete the research measures. Four of the consented subjects were later found to be ineligible and were subsequently excluded. The final sample consisted of 99 adolescents and their primary caregiver.

Demographic characteristics of the participants are shown in Table I. The average age of adolescents participating in the study was 14.8 years. The majority were male (52%). Forty-seven percent were White, 36% were African-American and the rest were of other race/ethnicity. Mean family income was \$50,706 and the majority of adolescents resided in two-parent homes (65%). Overall, the demographics of the sample were representative of the diverse, urban population served by the clinic where subjects were recruited.

**Table I.** Demographic Characteristics of Adolescents and Their Families ( $N = 99$ )

	%	<i>M (SD)</i>
Child age		14.8 (1.7)
Parent age		44.2 (6.9)
Annual family income (dollars)		\$50,706 (34,130)
Child gender		
Male	52	
Female	48	
Number of parents in home		
Two parents <sup>a</sup>	65	
Single parent	35	
Child ethnicity		
Caucasian	47	
African-American	36	
Other	10	
Missing	7	
Duration of diabetes in years		5.7 (4.2)
HbA1c		9.1 (2.2)
Insulin regimen		
2–3 injections/day	24	
≥4 injections/day	52	
Insulin pump	24	

<sup>a</sup>Two parents included two biological parents, a biological parent and a step-parent or a biological parent living with a partner.

### Procedure

All measures were collected by a trained research assistant at the time of a scheduled visit to the diabetes clinic. The adolescent's primary caregiver completed the parent questionnaires; in 78% of cases, this was a female. Adolescents were provided with a \$5 gift certificate to compensate them for participating in the study.

### Measures

Support for diabetes care was measured by the supportive subscale of the Diabetes Family Behavior Checklist (DFBC; Schafer, McCaul, & Glasgow, 1986). Unlike some other measures of parent support, the DFBC evaluates affective support (e.g., "I congratulated my child for sticking to his diabetes care schedule") and practical support (e.g., "I bought things that contained sugar for my child to carry in case of an insulin reaction") but does not include items assessing monitoring or supervision of diabetes care completion. Parents were asked to rate their supportive behaviors toward the youth. Youths were asked to rate the same behaviors by the parent. Higher scores on the instrument indicate more support. Internal consistency in the current sample was .79 for parents and .82 for adolescents.

Parental monitoring of diabetes care completion was measured by an 18-item investigator-developed measure of supervision and monitoring of diabetes regimen tasks, the Parental Monitoring of Diabetes Care scale (PMDC). Sample items include “How often were you present at home when your child gave themselves insulin?” “How often were you present in the room when your child tested their blood glucose?” and “When your child’s blood glucose meter breaks, gets lost, or misplaced, how quickly do you know?” (Appendix A). Adolescents were asked to rate the same items regarding their primary caregiver’s monitoring of their diabetes care. Items were summed to obtain a total monitoring score and were coded so that higher scores represented higher levels of monitoring. Internal consistency in the current sample was .80 for the parent version and .79 for the adolescent version. Two-week test–retest reliability of the instrument has also been found to be adequate (.80) (Ellis et al., 2007). The PMDC has been shown to have adequate construct validity, as it is related to regimen adherence among youth with diabetes (Podolski et al., 2006).

General parental monitoring was measured by the Monitoring Scale (MS; Chilcoat & Anthony, 1996). This 10-item adolescent-report scale assesses monitoring behaviors such as parental knowledge of the youth’s whereabouts after school and on weekends, knowledge of the youth’s peers and knowledge of the youth’s daily activities. Chilcoat, Breslav, and Anthony (1996) also adapted the scale for use with parents as a self-report scale. For the present study, the adolescent version of the MS was scored by summing the 10 items as in the original study by Chilcoat et al. (1996). The alpha coefficient for the adolescent version was .69. However, the parent version showed evidence of poor internal consistency when one item with a different response set from the others was included. When the remaining nine items were summed, alpha improved to .62. Hence, this version was used in the present study.

The Diabetes Management Scale (DMS; Frey, Ellis, Naar-King, & Greger, 2004) is a 20-item, self-report questionnaire designed to measure a broad range of diabetes management behaviors, such as insulin management, dietary management, blood glucose monitoring, and symptom response. Respondents are asked “What percent of the time do you (take your insulin)” and answer on a 0–100% scale. Items are summed to obtain a total score reflecting overall adherence behavior. The instrument has demonstrated adequate reliability and validity (Frey & Denyes, 1989; Schilling, Grey, & Knaf, 2002). Adolescents and parents each completed the DMS,

with parents completing a parallel form regarding their adolescent’s diabetes management.

Like most questionnaire measures of diabetes regimen adherence, the DMS was developed prior to the widespread use of basal–bolus insulin regimens. Therefore, a subset of dietary items in the DMS, such those that ask about adherence to a prescribed meal plan, were not appropriate for adolescents on basal–bolus regimens and these items were not used in the present study. The alpha coefficient for the version of the DMS used in the present study was .72 for parent report and .70 for adolescent report.

Metabolic control was calculated using hemoglobin A1c (HbA1c), a retrospective measure of average blood glucose during the past 2–3 months. Values were obtained during the medical appointment in the diabetes clinic with a DCA 2000 system (Bayer, Elkhart, IN) that uses an immunoglobulin-agglutination methodology.

## Results

Means and standard deviations for each variable are shown in Table I. Data were checked for normality, as multivariate normality is a critical assumption underlying the use of structural equation modeling (SEM) with maximum likelihood estimation procedures. Results indicated normal distributions for all variables. Missing data accounted for no more than 1% of the available data for any variable except HbA1c where it accounted for 2% of the available data. Given the very small amount of missing data, it was estimated by mean substitution.

### Bivariate Analyses

Bivariate analyses were first conducted to test associations between variables (Table II). For each variable evaluated by questionnaire, parent and adolescent report were significantly related. For parent-reported variables, diabetes-specific parental monitoring was significantly associated with general parental monitoring ( $r = .39$ ,  $p < .01$ ). Diabetes-specific parental monitoring was significantly related to regimen adherence ( $r = .43$ ,  $p < .01$ ), but not to HbA1c ( $r = -.19$ , n.s.). However, general parental monitoring was not significantly related to regimen adherence ( $r = .08$ , n.s.) or to HbA1c ( $r = .11$ , n.s.). Parental support for diabetes care was also not significantly related to regimen adherence ( $r = .13$ , n.s.), but was significantly related to diabetes-specific parent monitoring ( $r = .46$ ,  $p < .01$ ). Regimen adherence was significantly related to HbA1c ( $r = -.35$ ,  $p < .01$ ).

**Table II.** Correlations Among Psychosocial and Health Outcome Variables

Variable	1	2	3	4	5	6	7	8	
1. DFBC-P									
2. DFBC-A	.28**								
3. MS-P	.23*	.31**							
4. MS-A	.08	.53**	.34**						
5. PMDC-P	.46**	.29**	.39**	.02					
6. PMDC-A	.24**	.62**	.26**	.27**	.49**				
7. DMS-P	.13	.16	.08	.08	.43**	.31**			
8. DMS-A	.08	.32**	.10	.20	.39**	.47**	.55**		
9. HbA1c	.09	.08	.11	.15	-.19	-.06	-.35**	-.29**	
Mean	3.43	3.20	4.74	4.77	4.05	3.99	81.3	78.9	9.1
SD	0.70	0.86	0.44	0.52	0.55	0.55	12.8	15.5	2.2

DFBC-P, Diabetes Family Behavior Checklist-Parent Report; DFBC-A, Diabetes Family Behavior Checklist-Adolescent Report; MS-P, Monitoring Scale-Parent Report; MS-A, Monitoring Scale-Adolescent Report; PMDC-P, Parental Monitoring of Diabetes Care Scale-Parent Report; PMDC-A, Parental Monitoring of Diabetes Scale-Adolescent Report; DMS-P, Diabetes Management Scale-Parent Report; DMS-A, Diabetes Management Scale-Adolescent Report; HbA1c, hemoglobin A1c.

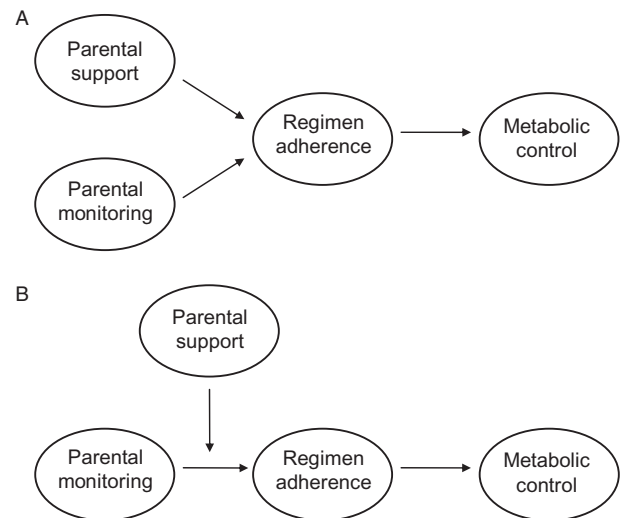
\*\* $p < 0.01$ , \* $p < 0.05$ .

A similar pattern of relationships was found for adolescent-reported variables. As with parent report variables, diabetes-specific parental monitoring was significantly related to regimen adherence ( $r = .47$ ,  $p < .01$ ), but not to HbA1c ( $r = -.06$ , n.s.). Again, general parent monitoring was not significantly related to regimen adherence ( $r = .20$ , n.s.) or HbA1c ( $r = .15$ , n.s.). Regimen adherence was significantly related to HbA1c ( $r = -.29$ ,  $p < .01$ ). However, for adolescent report, parental support for diabetes care was significantly related to both regimen adherence ( $r = .32$ , n.s.) and diabetes-specific parental monitoring ( $r = .62$ ,  $p < .01$ ).

### Structural Equation Modeling

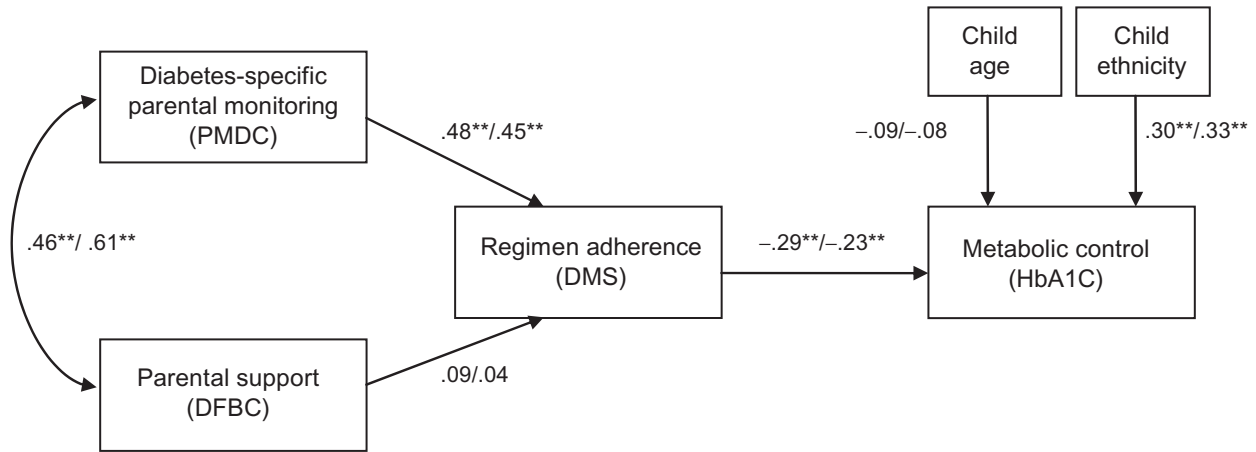
Given that bivariate analyses suggested similarities in the relationships between variables across parent and adolescent report, multivariate analyses initially were conducted using SEM with latent constructs. Since general monitoring was not related to adherence or metabolic control using either parent or adolescent report in bivariate analyses, it was not included in multivariate analyses. Figure 1A and B shows the two alternative hypothesized models with diabetes-specific monitoring and parental support for diabetes care having direct effects on adherence (Fig. 1A) and with support moderating the relationship between monitoring and adherence (Fig. 1B).

A measurement model was initially tested using confirmatory factor analysis as implemented using the PROC CALIS procedure in SAS version 9.1. Parent-and youth-report versions of the variable served as the indicators for the latent variables (e.g., parent-report



**Figure 1.** Hypothesized alternative models of the relationship between parental support, parental monitoring and adherence, with support and monitoring shown as having direct effects on adherence (A) or with support moderating the relationship between monitoring and adherence (B).

DMS and youth-report DMS were indicators for the latent adherence variable). However, the fit of the measurement model was poor. Three fit indices were evaluated: that the likelihood ratio  $\chi^2$  test of model fit was nonsignificant, the comparative fit index (CFI) was  $>.95$ , and the root mean square error of approximation (RMSEA) was  $<.08$ . Using these criteria, no fit index demonstrated adequate fit [ $\chi^2$  (6,  $N = 99$ ) = 27.51,  $p = .001$ ; CFI = .87, RMSEA = .19]. Poor fit may have occurred because each latent construct was estimated by only two indicators,



**Figure 2.** Structural model showing direct effects of parental support and parental monitoring on adherence, controlling for age and ethnicity. Standardized path coefficients are shown (parent-report version/youth-report version). DFBC, Diabetes Family Behavior Checklist; MS, Monitoring Scale; PMDC, Parental Monitoring of Diabetes Care Scale; DMS, Diabetes Management Scale; HbA1c, hemoglobin A1c. \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$ .

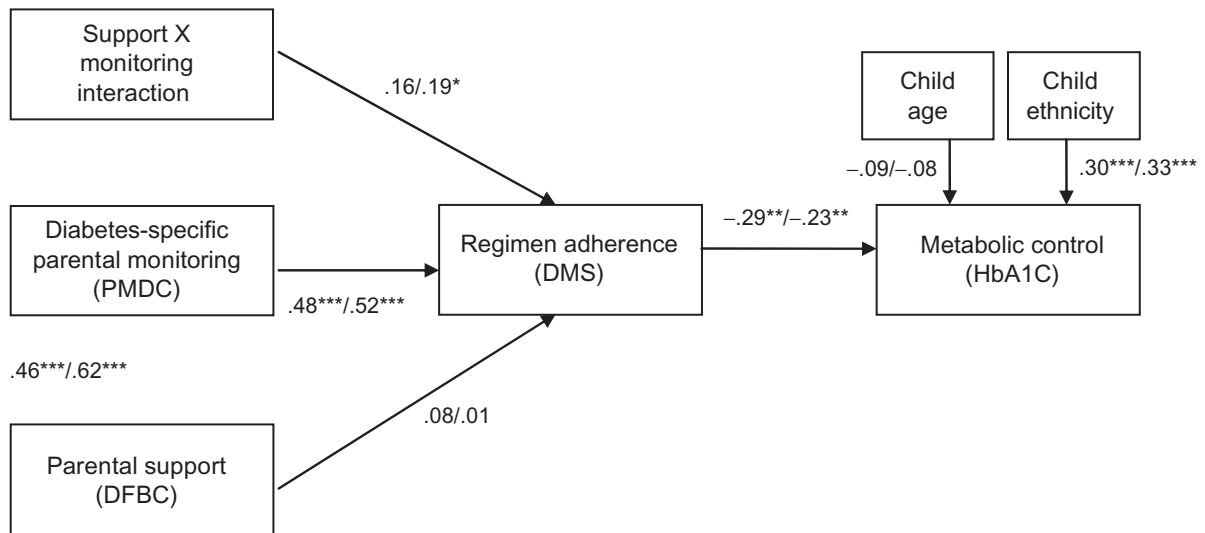
leading them to be underidentified. Therefore, separate models for adolescent and parent-reported variables were subsequently evaluated using path analysis, a form of SEM that uses all single-indicator, measured constructs. Path analysis is similar to ordinary least squares regression but retains the advantage of allowing both the assessment of goodness of fit of a specified model and testing of each estimated path coefficient.

The model with parental support and parental monitoring each having direct effects on adherence was tested first. A structural equation model with all single indicators variables was fit to the variance/covariance matrix using a maximum likelihood solution to model relationships between variables. Parental support and monitoring served as exogenous variables, with adherence and HbA1c serving as endogenous variables. The literature has produced mixed findings on whether parental support for diabetes care has a direct effect upon HbA1c and there have been no studies to date of parental monitoring of diabetes care. Therefore, direct effects of the exogenous variables upon HbA1c were not included so that given the relatively small sample size, the most parsimonious model could be tested. The exogenous variables were allowed to covary. Two additional demographic variables, age and ethnicity, were entered into the model as control variables for HbA1c, as youths' age (as an indicator of pubertal status; Amiel, Sherwin, Simonson, Lauritano, & Tamborlane, 1986; Moran et al., 1999) and ethnicity (Delamater et al., 1999; Frey, Ellis, Templin, Naar-King, & Gutai, 2006) have repeatedly been found to be predictive of metabolic control.

Results are shown in Fig. 2, with standardized path coefficients for both parent and adolescent report.

Results for parent-reported variables showed that the overall fit of the model was excellent [ $\chi^2(4, N = 99) = 4.78, p = .31, CFI = .98$  and  $RMSEA = .04$ ]. In this model, only diabetes-specific parental monitoring had a significant effect on regimen adherence, with higher levels of parental monitoring resulting in better regimen adherence. Regimen adherence had a significant direct effect on HbA1c, with higher levels of adherence resulting in better metabolic control. The model accounted for 20% of the variance in HbA1c. Likewise, the overall fit of the model using adolescent reported variables was excellent [ $\chi^2(4, N = 99) = 5.13, p = .21, CFI = .99$  and  $RMSEA = .05$ ]. As shown in Fig. 2, the adolescent model was essentially the same as the parent version. Diabetes-specific parental monitoring was the only significant predictor of regimen adherence and regimen adherence significantly predicted HbA1c. Seventeen percent of the variance in HbA1c was accounted for by this model. In addition, a statistical test of the indirect effect of parental monitoring on HbA1c was performed using procedures developed by Sobel (1982). The indirect effect was significant for both the parent ( $t = -2.59, p < .01$ ) and adolescent ( $t = -2.57, p < .05$ ) models.

Prior to testing the model in which parental support moderated parental monitoring, predictor variables were first mean-centered. The product variable Parental Support  $\times$  Parental Monitoring was then calculated and added to the model to represent the interaction effect (Joreskog & Yang, 1996). In this model, parental monitoring and the parental support  $\times$  parental monitoring interaction served as exogenous variables, with adherence and HbA1c serving as endogenous variables. Results for this model are shown in Fig. 3 with



**Figure 3.** Structural model showing parental support as a moderator of parental monitoring effects on adherence, controlling for age and ethnicity. Standardized path coefficients are shown (parent-report version/youth-report version). DFBC, Diabetes Family Behavior Checklist; MS, Monitoring Scale; PMDC, Parental Monitoring of Diabetes Care Scale; DMS, Diabetes Management Scale; HbA1c, hemoglobin A1c. \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$ .

standardized path coefficients for both parent and adolescent report. For parent report, model fit was excellent [ $\chi^2(4, N=99) = 2.06, p = .72, CFI = .99$  and  $RMSEA = .001$ ]. However, diabetes-specific parental monitoring continued to be the only significant predictor of regimen adherence; the path from the interaction variable to adherence was non significant. Model fit using adolescent report was likewise very good [ $\chi^2(4, N=99) = 3.63, p = .46, CFI = .99$  and  $RMSEA = .001$ ]. In this model, however, the path from the interaction variable to adherence was significant, indicating that parental support moderated the relationship between parental monitoring and adherence. The parent and adolescent models explained 20% and 17% of the variance in HbA1c, respectively.

## Discussion

Multiple studies have linked youth risk behaviors such as substance use and abuse, academic failure, risky sexual practices, and delinquency to low levels of parental supervision and monitoring. Although studies of adolescents with diabetes have repeatedly found a connection between parental maintenance of responsibility for diabetes care tasks and positive health outcomes (La Greca et al., 1990; Wysocki et al., 1996), and current clinical practice guidelines call for close parental supervision and monitoring of care completion by parents of youth with diabetes (Silverstein et al., 2005), there have been almost no empirical studies of the construct of

parental monitoring in the diabetes literature. Therefore, the purpose of the present study was to determine whether parents' monitoring of their adolescents would be related to diabetes health outcomes such as regimen adherence and metabolic control.

Findings from the study suggest that parental monitoring of diabetes care behaviors had a direct effect upon adolescent regimen adherence and through adherence, an indirect effect upon metabolic control. Adolescents whose parents reported higher knowledge about whether their adolescent had completed their diabetes care or reported more frequent presence during diabetes care completion were significantly more likely to report higher levels adherence; those with better adherence also had better metabolic control. Findings were similar whether the adolescent or the parent was the informant, adding to the strength of this finding and supporting the validity of the model. The finding that only diabetes-specific parental monitoring, not general parental monitoring, was related to regimen adherence highlights the importance of illness-specific measures when investigating the outcomes of chronically ill youth (Drotar, 1997).

Although general parental monitoring of adolescent behavior (e.g., daily activities, school performance, peers relations) was not found to be related to regimen adherence, general monitoring and diabetes-specific monitoring were significantly related to one another based upon both parent and adolescent report. Such findings provide support for the construct validity of

the PMDC. In addition, the association between parental monitoring of diabetes care and monitoring of other youth activities may provide one explanation for why youth with poor regimen adherence are more likely to display behavioral difficulties (Leonard, Jang, Savik, Plumbo, & Christensen, 2002; Rewers et al., 2002); both outcomes could be explained by low levels of parental monitoring. If this were the case, directly targeting parental monitoring and/or factors that influence parental monitoring could be a useful intervention for high-risk youth with diabetes.

In the present study, parental support for diabetes care and diabetes-specific parental monitoring were significantly related to one another, showing that the affective and instrumental components of parenting behavior around diabetes covaried. Thus, parents who provided praise, reinforcement, and opportunities for good diabetes care at home were also more likely to monitor their child's diabetes care closely. Furthermore, adolescent-reported parental support was also related to regimen adherence in bivariate analyses. However, in multivariate analyses, parental support was no longer a significant predictor of adherence when parental support and parental monitoring were considered simultaneously. Results from prior studies showing an association between parental support and regimen adherence and/or metabolic control may have been confounded by the inclusion of supervision items in support questionnaires. For example, La Greca and Bearman (2002) found that parental "support" for diabetes management tasks rather than emotional support related to diabetes, was predictive of regimen adherence. The current study suggests that although related, direct monitoring of diabetes care is not the same as support and by itself is a stronger predictor of adherence outcomes. Research on other adolescent risk behaviors also highlights the importance of parental monitoring (Griffin et al., 2000; Patterson & Stouthamer-Loeber, 1984). For example, Forehand et al. (1997) found that level of parental monitoring contributed more to the likelihood of adolescent deviant behavior than the degree of openness of communication between the parent and youth. These findings held across four independent samples of youth from diverse socioeconomic and racial backgrounds. Study findings are also consistent with recent intervention approaches that have been developed for risk reduction in the areas of risky sexual behavior and substance use (Stanton et al., 2004) that stress parental oversight of youth activities as a vital component in ensuring good health outcomes for adolescents.

Tests of an alternative hypothesis, that parental support for diabetes care moderated the relationship between diabetes-specific parental monitoring and adherence, received some support in the present study. Although not significant in parent-report models, the interaction between parental support and parental monitoring was a significant predictor of adherence when adolescent report variables were used. One possible explanation for this finding is that under supportive conditions, youth with diabetes may disclose more information about their diabetes management practices to parents, hence making parental monitoring processes more effective. Kerr and Stattin (2000) have suggested that parental monitoring effectiveness is just as likely to be affected by adolescent's disclosure of their activities as it is by parental attempts to conduct surveillance of youth activities. Parents can also monitor youth in positive or supportive ways; for example, review of the blood glucose meter by a parent could lead to discussions of steps that the adolescent could take to bring manage blood sugar more effectively or praise for obtaining blood sugars that are in the recommended range. Additional, prospective studies are needed to better clarify the complex relationships between parental support for diabetes care and diabetes-specific parental monitoring.

Study limitations include the use of self-report data, particularly self-reported measures of regimen adherence. Internal consistency of the general monitoring measure was relatively poor, which may have contributed to its lack of relationship to adherence and metabolic control. Although the sample was ethnically diverse, subjects were, on average, from middle class and two parent homes; therefore, it is unclear whether findings might differ in a lower SES sample. Finally, the measure of metabolic control used in the study evaluated a 2–3 month period while the questionnaire measures used to predict metabolic control evaluated current behavior, which may have affected their degree of relatedness.

In summary, results of the present study provide empirical support for the importance of parental monitoring as a predictor of regimen adherence. They also suggest that when clinicians intervene with parents to improve regimen adherence, that close monitoring of care completion should be emphasized as a method of preventing problem health outcomes. General support in the absence of careful supervision of diabetes care tasks may be insufficient to help youth achieve good diabetes management. The development of interventions to promote parental monitoring among youth with chronic



conditions such as diabetes may provide a fruitful means for promoting optimal regimen adherence.

*Conflict of interest:* None declared.

Received August 2, 2006; revisions received January 2, 2007; accepted January 10, 2007

## References

- Amiel, S., Sherwin, R., Simonson, D., Lauritano, A., & Tamborlane, W. (1986). Impaired insulin action in puberty. A contributing factor to poor glycemic control in adolescents with diabetes. *New England Journal of Medicine*, *315*, 215–219.
- Anderson, B. J., Auslander, W. F., Jung, K. C., Miller, J. P., & Santiago, J. V. (1990). Assessing family sharing of diabetes responsibilities. *Journal of Pediatric Psychology*, *15*, 477–492.
- Chilcoat, H. D., & Anthony, J. C. (1996). Impact of parent monitoring on initiation of drug use through late childhood. *Journal of the American Academy of Child & Adolescent Psychiatry*, *35*, 91–100.
- Chilcoat, H. D., Breslau, N., & Anthony, J. C. (1996). Potential barriers to parent monitoring: Social disadvantage, marital status, and maternal psychiatric disorder. *Journal of the American Academy of Child & Adolescent Psychiatry*, *35*, 1673–1682.
- Cohen, D. M., Lumley, M. A., Naar-King, S., Partridge, T., & Cakan, N. (2004). Child behavior problems and family functioning as predictors of adherence and glycemic control in economically disadvantaged children with type 1 diabetes: A prospective study. *Journal of Pediatric Psychology*, *29*, 171–184.
- Delamater, A. M., Shaw, K. H., Applegate, E. B., Pratt, I. A., Eidson, M., Lancelotta, G. X., et al. (1999). Risk for metabolic control problems in minority youth with diabetes. *Diabetes Care*, *22*, 700–705.
- Diabetes Control and Complications Trial (DCCT)/Epidemiology of Diabetes Interventions and Complications (EDIC) Research Group. (2001). Beneficial effects of intensive therapy of diabetes during adolescence: Outcomes after the conclusion of the Diabetes Control and Complications Trial (DCCT). *The Journal of Pediatrics*, *139*, 804–812.
- Dishion, T. J., & McMahon, R. J. (1998). Parental monitoring and the prevention of child and adolescent problem behavior: A conceptual and empirical formulation. *Clinical Child & Family Psychology Review*, *1*, 61–75.
- Drotar, D. (1997). Relating parent and family functioning to the psychological adjustment of children with chronic health conditions: What have we learned? What do we need to know? *Journal of Pediatric Psychology*, *22*, 149–165.
- Ellis, D. A., Templin, T., Podolski, C. L., Frey, M., Naar-King, S., & Moltz, K. (2007). *The parental monitoring of diabetes care scale: Development, reliability and validity of a scale to evaluate parental supervision of adolescent illness management*. Manuscript submitted for publication.
- Forehand, R., Miller, K. S., Dutra, R., & Chance, M. W. (1997). Role of parenting in adolescent deviant behavior: Replication across and within two ethnic groups. *Journal of Consulting & Clinical Psychology*, *65*, 1036–1041.
- French, D. C., & Dishion, T. (2003). Predictors of early initiation of sexual intercourse among high-risk adolescents. *Journal of Early Adolescence*, *23*, 295–315.
- Frey, M. A., & Denyes, M. J. (1989). Health and illness self-care in adolescents with IDDM: A test of Orem's theory. *Advances in Nursing Science*, *12*, 67–75.
- Frey, M., Ellis, D., Naar-King, S., & Greger, N. (2004). Diabetes management in adolescents in poor metabolic control. *The Diabetes Educator*, *30*, 647–657.
- Frey, M., Ellis, D., Templin, T., Naar-King, S., & Gutai, J. P. (2006). Diabetes management and metabolic control in school aged children with type 1 diabetes. *Children's Health Care*, *35*, 349–363.
- Griffin, K. W., Botvin, G. J., Scheier, L. M., Diaz, T., & Miller, N. L. (2000). Parenting practices as predictors of substance use, delinquency, and aggression among urban minority youth: Moderating effects of family structure and gender. *Psychology of Addictive Behaviors*, *14*, 174–184.
- Hanson, C. L., DeGuire, M. J., Schinkel, A. M., Henggeler, S. W., & Burghen, G. A. (1992). Comparing social learning and family systems correlates of adaptation in youths with IDDM. *Journal of Pediatric Psychology*, *17*, 555–572.
- Hanson, C. L., Henggeler, S. W., & Burghen, G. A. (1987). Model of associations between psychosocial variables and health-outcome measures of adolescents with IDDM. *Diabetes Care*, *10*, 752–758.
- Hauser, S. T., Jacobson, A. M., Lavori, P., Wolfsdorf, J. I., Herskowitz, R. D., Milley, J. E., et al. (1990). Adherence among children and

- adolescents with insulin-dependent diabetes mellitus over a four-year longitudinal follow-up: II. Immediate and long-term linkages with the family milieu. *Journal of Pediatric Psychology*, *15*, 527–542.
- Jacobson, A. M., Hauser, S. T., Lavori, P., Willett, J. B., Cole, C. F., Wolfsdorf, J. I., et al. (1994). Family environment and glycemic control: A four-year prospective study of children and adolescents with insulin-dependent diabetes mellitus. *Psychosomatic Medicine*, *56*, 401–409.
- Johnson, S. B., Perwien, A. R., & Silverstein, J. H. (2000). Response to hypo- and hyperglycemia in adolescents with type I diabetes. *Journal of Pediatric Psychology*, *25*, 171–178.
- Joreskog, K. G., & Yang, F. (1996). Nonlinear structural equation models: The Kenny-Judd model with interaction effects. In G. A. Marchoulides & R. E. Schumaker (Eds.), *Advanced structural equation modeling: Issues and techniques* (pp. 57–89). Mahwah, NJ: Lawrence Erlbaum.
- Kerr, M., & Stattin, H. (2000). What parents know, how they know it, and several forms of adolescent adjustment: Further support for a reinterpretation of monitoring. *Developmental Psychology*, *36*, 366–380.
- La Greca, A. M., Auslander, W. F., Greco, P., Spetter, D., Fisher, E. B., & Santiago, J. V. (1995). I get by with a little help from my family and friends: Adolescents' support for diabetes care. *Journal of Pediatric Psychology*, *20*, 449–476.
- La Greca, A. M., & Bearman, K. J. (2002). The diabetes social support questionnaire-family version: Evaluating adolescents' diabetes-specific support from family members. *Journal of Pediatric Psychology*, *27*, 665–676.
- La Greca, A. M., Follansbee, D., & Skyler, J. S. (1990). Developmental and behavioral aspects of diabetes management in youngsters. *Children's Health Care*, *19*, 132–139.
- Leonard, B. J., Jang, Y. P., Savik, K., Plumbo, P. M., & Christensen, R. (2002). Psychosocial factors associated with levels of metabolic control in youth with type 1 diabetes. *Journal of Pediatric Nursing*, *17*, 28–37.
- Levine, B. S., Anderson, B. J., Butler, D. A., Antisdel, J. E., Brackett, J., & Laffel, L. M. B. (2001). Predictors of glycemic control and short-term adverse outcomes in youth with type 1 diabetes. *Journal of Pediatrics*, *139*, 197–203.
- Li, X., Stanton, B., & Feigelman, S. (2000). Impact of perceived parental monitoring on adolescent risk behavior over 4 years. *Journal of Adolescent Health*, *27*, 49–56.
- Moran, A., Jacobs, D. R. J., Steinberger, J., Hong, C., Prineas, R., Luepker, R., et al. (1999). Insulin resistance during puberty: Results from clamp studies in 357 children. *Diabetes*, *48*, 2039–2044.
- Morris, A. D., Boyle, D. I., McMahon, A. D., Greene, S. A., MacDonald, T. M., & Newton, R. W. (1997). Adherence to insulin treatment, glycemic control, and ketoacidosis in insulin-dependent diabetes mellitus. *The Lancet*, *350*, 1505–1510.
- Musey, V. C., Lee, J. K., Crawford, R., Klatka, M. A., McAdams, D., & Phillips, L. S. (1995). Diabetes in urban African-Americans: Cessation of insulin therapy is the major precipitating cause of diabetes ketoacidosis. *Diabetes Care*, *18*, 483–489.
- Parker, J. S., & Benson, M. J. (2004). Parent-adolescent relations and adolescent functioning: Self-esteem, substance abuse, and delinquency. *Adolescence*, *39*, 519–530.
- Patterson, G. R., & Stouthamer-Loeber, M. (1984). The correlation of family management practices and delinquency. *Child Development*, *55*, 1299–1307.
- Pettit, G. S., Bates, J. E., Dodge, K. A., & Meece, D. W. (1999). The impact of after-school peer contact on early adolescent externalizing problems is moderated by parental monitoring, perceived neighborhood safety, and prior adjustment. *Child Development*, *70*, 768–778.
- Podolski, C., Ellis, D. A., Moltz, K., Templin, T., Frey, M., Naar-King, S., et al. (2006). *Diabetes specific parental monitoring in adolescents with type 1 diabetes: Implications for urban youth*. Paper presented at the National Conference on Child Health Psychology, American Psychological Association, Society of Pediatric Psychology, Gainesville, FL.
- Rewers, A., Chase, H. P., Mackenzie, T., Walravens, P., Roback, M., Rewers, M., et al. (2002). Predictors of acute complications in children with type 1 diabetes. *JAMA*, *287*, 2511–2518.
- Rodgers, K. B., & Rose, H. A. (2001). Personal, family, and school factors related to adolescent academic performance: A comparison by family structure. *Marriage & Family Review*, *33*, 47–61.
- Schafer, L. C., McCaul, K. D., & Glasgow, R. E. (1986). Supportive and non-supportive family behaviors: Relationships to adherence and metabolic control in persons with type I diabetes. *Diabetes Care*, *9*, 179–185.

- Schilling, L. S., Grey, M., & Knafel, K. (2002). A review of measures of self-management of type 1 diabetes by youth and their parents. *Diabetes Educator*, 28, 796–808.
- Silverstein, J., Klingensmith, G., Copeland, K., Plotnick, L., Kaufman, F., Laffel, L., et al. (2005). Care of children and adolescents with type 1 diabetes. *Diabetes Care*, 28, 186–212.
- Skinner, T. C., John, M., & Hampson, S. E. (2000). Social support and personal models of diabetes as predictors of self-care and well-being: A longitudinal study of adolescents with diabetes. *Journal of Pediatric Psychology*, 25, 257–267.
- Smith, C. P., Firth, D., Bennett, S., Howard, C., & Chisholm, P. (1998). Ketoacidosis occurring in newly diagnosed and established diabetic children. *Acta Paediatrica Scandinavica*, 87, 537–541.
- Sobel, M. E. (1982). Asymptotic confidence intervals for indirect effects in structural equation models. In S. Leinhardt (Ed.), *Sociological methodology* (pp. 290–312). San Francisco, CA: Jossey-Bass.
- Stanton, B., Cole, M., Galbraith, J., Li, X., Pendleton, S., Cottrel, L., et al. (2004). Randomized trial of a parent intervention: Parents can make a difference in long-term adolescent risk behaviors, perceptions, and knowledge. *Archives of Pediatrics & Adolescent Medicine*, 158, 947–955.
- Sullivan, T. N., Kung, E. M., & Farrell, A. D. (2004). Relation between witnessing violence and drug use initiation among rural adolescents: Parental monitoring and family support as protective factors. *Journal of Clinical Child and Adolescent Psychology*, 33, 488–498.
- Wasserman, G., Miller, L. S., Pinner, E., & Jaramillo, B. (1996). Parenting predictors of early conduct problems in urban, high-risk boys. *Journal of the American Academy of Child & Adolescent Psychiatry*, 35, 1227–1236.
- Wills, T. A., & Cleary, S. D. (1996). How are social support effects mediated? A test with parental support and adolescent substance use. *Journal of Personality and Social Psychology*, 71, 937–952.
- Wysocki, T. (1993). Associations among teen–parent relationships, metabolic control, and adjustment to diabetes in adolescents. *Journal of Pediatric Psychology*, 18, 441–452.
- Wysocki, T., Taylor, A., Hough, B. S., Linscheid, T. R., Yeates, K. O., & Naglieri, J. A. (1996). Deviation from developmentally appropriate self-care autonomy: Association with diabetes outcome. *Diabetes Care*, 19, 119–125.

## Appendix A

### Parental Monitoring of Diabetes Care Scale (Parent-Report Version)

#### Question

1. How often were you present at home when your child tested their blood glucose?
2. How often were you present in the room when your child tested their blood glucose?
3. When your child skips a blood glucose test, how often do you know?
4. When your child skips a blood glucose test, how quickly do you know?
5. How often do you look at the readings in your child's blood glucose meter?
6. How often do you review or go over your child's blood glucose test readings with them?
7. How often were you present at home when your child gave themselves insulin?
8. How often were you present in the same room when your child gave themselves insulin?
9. When your child skips their insulin, how often do you know?
10. When your child skips their insulin, how soon do you know?
11. How often do you check your child's insulin vials to see if the expected amount has been used?
12. How often do you eat meals with your child (sit down together and eat at the same time)?
13. When you do not eat meals with your child, such as lunch at school, how often do you know what they ate?
14. How often does your child eat food (meals or snacks) outside of the home [including at school, neighbors, with relatives, at the mall, restaurants, stores, etc.]?
15. When your child's blood glucose meter breaks or gets lost or misplaced, how quickly do you know?
16. When your child runs out of strips and lancets, how quickly do you know?
17. When your child runs out of insulin, how quickly do you know?
18. When your child's insulin is going to expire, how quickly do you know?