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ASSESSING PARENTAL INVOLVEMENT IN TYPE 1 DIABETES MANAGEMENT DURING ADOLESCENCE

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ASSESSING PARENTAL INVOLVEMENT
IN TYPE 1 DIABETES MANAGEMENT DURING ADOLESCENCE

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science
at Virginia Commonwealth University

By: ELIZABETH MOORE ROBINSON
B.A., Washington and Lee University, June 2007

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Abstract

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By Elizabeth Moore Robinson, B.A.

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Major Director: Clarissa Holmes, Ph.D.
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Type 1 diabetes is one of the most common pediatric chronic illnesses. Adolescents are at risk for poorer glycemic control; however, youth whose parents remain involved in diabetes care are in better control. The current study examined parental involvement (PI) using a multi-method, multi-source approach in a sample of 255 youth (Age M = 12.83). The Diabetes Family Responsibility Questionnaire, Parental Monitoring of Diabetes Care Scale, and 24-Hour Diabetes Interview assessed two types of PI, parental responsibility and parental monitoring. Global and specific assessment served to cross-corroborate indicators of PI related to HbA1c. Higher levels of monitoring related to lower HbA1c for both parent- and youth-report; however, the effect decreased after controlling for socioeconomic status (SES). Additionally, monitoring mediated the relation between age and HbA1c. Controlling for SES, youth whose parents demonstrated higher levels of monitoring were in better glycemic control. Both research and clinical implications are discussed.

Assessing Parental Involvement
in Type 1 Diabetes Management during Adolescence

Type 1 diabetes mellitus is one of the most common chronic illnesses among U.S. youth

less than 20 years of age, with an annual rate of 19 new cases per 100,000 people (National

Institute of Diabetes and Digestive and Kidney Diseases, 2008). Because type 1 diabetes is

usually diagnosed during childhood, the burden of diabetes management often falls on both

youth and parents (Anderson, Ho, Brackett, Finkelstein, & Laffel, 1997). Previous research on

general family functioning and diabetes management suggests that parenting behaviors are

important in facilitating healthy adaptation to diabetes (Anderson, Miller, Auslander, &

Santiago, 1981; Bobrow, Av, Ruskin, & Siller, 1985; Hamilton & Daneman, 2002; Hanson, De

Guire, Schinkel, Henggeler, & Burghen, 1992; Hauser et al., 1990; Miller-Johnson et al., 1994;

Wysocki, 1993) and parental involvement may be essential for successful diabetes management

(Ellis et al., 2007; Grey, Davidson, Boland, & Tamborlane, 2001; Plotnick, Clark, Brancati, &

Erlinger, 2003; Skinner, Murphy, Huws-Thomas, Snoek, & Snoek, 2005).

Diabetes Management and Complications

Diabetes management is a complex process that involves integrating information from

blood glucose monitoring, diet, and physical activity and using this information to determine an

insulin regimen. Youth with type 1 diabetes require multiple injections of insulin throughout the

day, including before meals and snacks and at bedtime (Rewers et al., 2007). Most youth are

prescribed a regimen of intermediate-acting insulin with short-acting insulin at meals; however,

an ideal regimen may consist of six to seven injections per day given the frequency of snacks.

Multiple daily injections when combined with carbohydrate counting allow for greater flexibility

in food choices. In this case, the insulin dose is determined by an insulin-to-carbohydrate ratio

unique to each child. Oftentimes, an insulin pump allows such flexibility in lifestyle, but requires

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more adult support both at home and at school until the child can manage pump tasks independently (Rewers et al., 2007).

All insulin regimens rely on frequent self-monitoring of blood glucose levels to identify patterns of hypoglycemia (i.e., blood glucose levels below the recommended range) and hyperglycemia (i.e., blood glucose levels above the recommended blood glucose range), and insulin dosing decisions are based on interpretation of blood glucose testing results. While healthy youth experience blood glucose levels within a smaller window from 80 to 120 milligrams of glucose per deciliter of blood (mg/dl), youth with type 1 diabetes can experience levels ranging from 60 to 400 mg/dl. Hypoglycemia is typically marked by a blood glucose level of 60 mg/dl or less, whereas hyperglycemia is marked by a level of 180 mg/dl or higher. Four or more blood glucose tests per day are recommended for youth with type 1 diabetes to maintain levels within range (ADA, 2010). Recommendations for physical activity are the same for children with type 1 diabetes as for their healthy peers (i.e., 60 minutes/day; CDC, 2011). More frequent blood glucose testing is required with increasing physical activity levels, as 10 to 20% of hypoglycemic episodes are associated with exercise greater in intensity, duration, or frequency than is typical (Rewers et al., 2007). Finally, nutritional recommendations for youth with type 1 diabetes are also the same as those of their healthy peers. However, youth with diabetes may require regular nutrition therapy, including instruction on carbohydrate counting, in order to meet blood glucose goals without experiencing excessive hyperglycemia, while maintaining normal growth and development (Rewers et al., 2007).

Acute consequences of type 1 diabetes include abnormal growth rates, diabetic ketoacidosis (DKA), and hypoglycemia (Rewers et al., 2007). DKA results from prolonged hyperglycemia or insulin deficiency, causing an accumulation of ketones in the blood, whereas

hypoglycemia results from low blood glucose levels, which can cause cognitive impairment, loss of consciousness, or even death. Chronic complications of type 1 diabetes include higher morbidity from nephropathy, neuropathy, and cardiovascular disease (Diabetes Control and Complications Trial Research Group [DCCT], 1993, 1994, 1996, 2005). Successful management of type 1 diabetes reduces the frequency and severity of these outcomes; however, many families have difficulty maintaining glycemic control within the recommended guidelines (Grey, Boland, Davidson, Li, & Tamborlane, 2000).

Glycemic Control

Glycemic control is measured by glycosylated hemoglobin (HbA1c) levels, an indicator of average blood glucose concentration for the previous three-month period. Recommended HbA1c levels are <8% for youth ages six to 12 years and < 7.5% for youth ages 13 to 19 years (ADA, 2010). A lower HbA1c value indicates better glycemic control which is associated with fewer and delayed microvascular complications (Rewers et al., 2007). Even in adolescence, five to seven years of poorer glycemic control relates to increased risk of such complications within six to 10 years. Such data promote maintaining an HbA1c as close to the normal range as possible, which requires vigilant diabetes management on both the part of the adolescent and the parent. The frequency of self monitoring of blood glucose levels is associated with better glycemic control because of the ability to better adjust insulin and consume food in response to blood glucose levels that are out-of-range. While there are alternative indicators of glycemic control, such as incidence of hypoglycemia, HbA1c is the only measure for which there is ample outcome data such that it is the gold standard (Rewers et al., 2007).

In type 1 diabetes research, it is important to account for existing associations among glycemic control and certain demographic factors, including socioeconomic status (SES), disease

duration, and age. First, previous literature has shown that SES and parental marital status are each significantly related to glycemic control in youth with type 1 diabetes (Swift, Chen, Hershberger, & Holmes, 2006). Further, poorer glycemic control and disease care behaviors previously attributed to ethnicity, are better accounted for by lower SES (Powell, Chen, Kumar, Streisand, & Holmes, 2011). Thus, it is often the case that family structure and race overlap with SES, and variability in glycemic control within these groups are better explained by SES. Second, longer disease duration is a risk factor for poorer glycemic control (Johnson, Perwien, & Silverstein, 2000). Finally, age has been shown as a significant risk factor in predicting glycemic control, such that older youth tend to be in poorer control than younger youth (Johnson et al., 1992; La Greca, Follansbee, & Skyler, 1990). Therefore, adolescence is a particularly vulnerable period in diabetes care. This period in development also presents challenges as adolescents begin to take more responsibility for disease care tasks than they did in early and middle childhood (Rubin, Young-Hyman, & Peyrot, 1989).

Adolescence

Adolescence is a unique developmental period of rapid biological change accompanied by increasing physical, cognitive, and emotional maturity. Adolescence infers a process of self-development and seeing oneself as a differentiated person (Stroufe, Egeland, Carlson, & Collins, 2005). This new autonomy is sometimes met with an increase in relational conflict. Early adolescence, in particular, is a vulnerable time for families, as every member can be taxed by the child's expanding autonomy. As a result, family conflict often peaks, even more so than in the later teenage years. During this period, adolescents have more responsibility, while parents retain the vital role of monitoring the adolescent's behavior. In comparison to middle childhood,

adolescence presents the challenge of coordinating school, extracurricular activities, in addition to a complicated social life.

Considering such developmental factors as they impact diabetes care is critical for clinicians and researchers alike, as adolescents must manage physiological changes while simultaneously developing a sense of self (Silverstein et al., 2005). For instance, less predictable glycemic control is typical in adolescence as a result of developmental hormonal changes (Amiel, Sherwin, Simonson, Lauritano, & Tamborlane, 1986). Further, adolescents are managing increased insulin requirements, glycemic control becomes more difficult, and weight and body image concerns often arise. Several diabetes-specific family issues emerge during adolescence, including renegotiating parent and youth roles in diabetes management, learning coping skills to enhance self-management skills, preventing diabetes-related family conflict, and monitoring for signs of depression, eating disorders, and risky behaviors. While adolescents' autonomy in disease care tasks increases, parents ideally monitor their behavior more closely, which can interfere with adolescents' developmentally normal drive for independence and peer acceptance (Hill & Holmbeck, 1986; Silverstein et al., 2005; Steinberg, 1987). Further, it is tempting for parents to relinquish total responsibility for diabetes management to adolescents in order to decrease associated stress (Berg et al., 2003). However, while adolescents typically have the ability to perform the diabetes care tasks, they often still need help with decision-making about insulin adjustments. The challenge therefore is to find the degree of appropriate parental involvement without risking deterioration in glycemic control.

Parental Involvement

As discussed, managing type 1 diabetes requires complex physical and cognitive skills, planning, and daily adherence to a prescribed regimen. Failure to complete these tasks can lead

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to both short- and long-term consequences (DCCT, 1994). Given that the onset of type 1 diabetes is most often in childhood, parents initially assume a majority of the responsibility for disease management (Davis et al., 2001). Literature demonstrates that parents decrease their responsibility for diabetes tasks as children get older (Rubin, Young-Hyman, & Peyrot, 1989). This decline in parental involvement is concurrent with a decline in adherence and glycemic control in adolescence (Anderson, Auslander, Jung, Miller, & Santiago, 1990; Anderson, Ho, Brackett, Finkelstein, & Laffel, 1997; Schilling, Knafl, & Grey, 2006; Skinner, Murphy, & Haws-Thomas, 2005; Wysocki et al., 1996). Thus, a better understanding of what specific types of parental involvement are beneficial to maintaining glycemic control is merited.

Parental responsibility vs. parental monitoring. It is necessary to distinguish parental responsibility from parental monitoring, which are related but distinct types of involvement. Parental monitoring assumes a parent has knowledge of the completion of diabetes tasks, whereas parental responsibility entails who is actually completing the tasks (Berg et al., 2008). Parental monitoring involves regular contact with an adolescent regarding his or her daily activities and involves knowledge about and supervision of those activities, but does not assume that the parent assists in completing the tasks (Dishion & McMahon, 1998). For instance, an adolescent could manage diabetes care tasks independently, indicating low parental responsibility, but a parent may monitor the completion of those behaviors, indicating high parental monitoring (Berg et al., 2008). While parental monitoring is related to responsibility, it is a step removed from parental responsibility and is appropriate only once an adolescent demonstrates consistent and successful autonomy of his or her diabetes management. Prior to this level of independence, adolescents ideally undergo a period of collaborative involvement with their parents and gradually transfer responsibility to adolescents; unfortunately, this transfer

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often occurs prematurely, and the reduction in parental involvement in these circumstances predicts poorer outcomes for adolescents (Berg et al., 2008; Wysocki et al., 1996).

Transfer of disease care responsibility. A decrease in parental responsibility for diabetes tasks as youth get older is consistent with normative developmental processes (Cooper, Grotevant, & Condon, 1983). Achieving a collaborative relationship between an adolescent and his or her parent may be difficult given the potential decrease in cohesion and increase in conflict within the relationship that frequently occur during this period (Greening, Stoppelbein, & Reeves, 2006). Thus, encouraging parental involvement during adolescence may exacerbate contention within the parent-child relationship. For example, adolescents who perceive a higher level of family support for their diabetes care also engage in more diabetes-related conflict, whereas those who perceive lower levels of support reported less conflict (Pendley et al., 2002).

Investigators have examined factors parents consider when transferring diabetes management responsibility to their children. Previous work has examined the roles of autonomy, self-efficacy, and pubertal status. Palmer and colleagues (2004) examined youth-reported autonomy and parent-reported pubertal status in a sample of 127 youth ages 10 to 15 years ($M =$ 12.85 years). Children who reported lower levels of autonomy and higher levels of parental responsibility were in better glycemic control than youth who reported lower parental responsibility. Parents often gauge a transfer of responsibility based on an adolescent's pubertal status, which can be detrimental given that their physiological development may not accurately reflect their psychological development and maturity (Palmer et al., 2004). However, age more so than autonomy or pubertal status remains the typical factor associated with a decrease in parental responsibility (Palmer et al., 2004). Further, both adolescent self-efficacy and parental perceptions of adolescent self-efficacy may contribute to a decrease in parental responsibility

(Palmer et al., 2009). This is consistent with findings that by age 13, many adolescents are able to successfully complete most diabetes care tasks independently (Wysocki et al., 1992).

While decreased parental involvement is associated with a decline in adherence and glycemic control, maintaining parental responsibility during this developmental period has proven beneficial both physiologically as well as psychosocially. Adolescents whose parents remain involved in daily diabetes management follow their regimen more consistently and are in better glycemic control (Grey, Davidson, Boland, & Tamborlane, 2001). The optimal form of parental involvement, however, remains unclear. For example, in a sample of 127 youth ages 10 to 15 years, Wiebe and colleagues (2005) examined appraisals of maternal involvement as they relate to glycemic control. Youth who perceived their mothers' involvement as collaborative were more likely to be in better glycemic control, a finding mediated by adherence. However, older youth who rated their mothers as controlling were more likely to have poorer adherence. In previous studies, appraisal of parents as controlling (Holmbeck et al., 2002) was related to increased parent-child conflict (Anderson et al., 2002).

Collaborative involvement between parents and adolescents is optimal; however, at what level parents ought to be engaged and at what point they can begin to transfer responsibility is less clear. Parents who remain involved may provide behavioral assistance with daily management tasks, as well as model problem-solving skills to address high and low blood glucose levels (Greening, Stoppelbein, & Reeves, 2006). Although adolescents typically have the necessary cognitive skills to execute daily management tasks, not all are equally capable or have the emotional resources to manage such a complex regimen in the midst of facilitating typical developmental tasks (Iannotti & Bush, 1993; Wysocki et al., 2003). Thus, collaboration involves negotiation, joint decision making, and problem solving (Berg, Meegan, & Deviney, 1998; Berg

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et al., 2004; Rogoff, 1993), while allowing youth to develop autonomy in their disease care skills. Herein lies the essence of parent-adolescent teamwork in diabetes management (Anderson et al., 1999; Laffel, et al., 2003).

Anderson and colleagues (1999) proposed a gradual transfer of diabetes responsibility in response to a child's success with independent task completion and demonstration of psychological maturity, at which point parental monitoring is maintained. Therefore, treatment programs have targeted maintaining parental involvement and promoting family teamwork in adolescence without increasing conflict, in order to prevent deterioration in glycemic control (Anderson et al., 1999; Laffel, et al., 2003). Optimal HbA1c is a primary outcome of successful management. Thus, a need exists to better identify or further develop measures which detect aspects of parental involvement associated with better glycemic control. Such a measure would allow treatment programs to target aspects of parental involvement that have the greatest influence on glycemic control more accurately, and similarly, allow investigators to identify whether treatment programs are successful in maintaining parental involvement. In sum, identifying a reliable measure of parental involvement associated with HbA1c would inform treatment development and evaluation.

Assessing Parental Involvement

Given the heightened concern around maintaining parental involvement during adolescence, intervention and prevention research increasingly targets the child-parent dyad (Grey, Boland, Davidson, Li, & Tamborlane, 2001; Wysock et al., 2000). Several measures of parental involvement exist; however, there is little consensus as to which specific parenting behaviors facilitate optimal involvement and diabetes-related outcomes and how to best measure these behaviors. Three measures frequently used to assess parental involvement will be discussed

herein: The Diabetes Family Responsibility Questionnaire (DFRQ; Anderson, Auslander, Jung, Miller, and Santiago, 1990), the Parental Monitoring of Diabetes Scale (PMDC; Ellis et al., 2008), and the 24-Hour Diabetes Interview (Johnson, Silverstein, Rosenbloom, Carter, & Cunningham, 1986).

Measurement of Parental Responsibility

The DFRQ is among the first developed and most reliable measure of parental responsibility. The DFRQ assesses division of diabetes care tasks between youth and their primary caretakers (Anderson et al., 1990). The measure initially consisted of 22 items that describe diabetes and general health-related tasks. With a 3-point Likert-type response scale, answers range from "parent predominately in charge," scored as a "1" to "child assumes primary responsibility," scored as a "3," with "child and parent share responsibility" as an intermediary response of "2." Initial analyses were derived from a sample of 121 youth (six to 21-year-olds; $M = 13.3$ years) and their mothers. The majority of participants were primarily middle-class, Caucasian youth from two-parent families. Both parent- (alpha = .85) and youth-report (alpha = .84) achieved adequate internal consistency.

In an effort to make the measure valuable clinically and to evaluate informant discrepancy, a dyadic mother-child discordance score was developed (Anderson et al., 1990). Instances of "No One Takes Responsibility" were of particular interest and occur when mother and child disagree on who assumes responsibility, when each reports that the other takes more responsibility for a task, and when one reports shared responsibility and the other reports no responsibility. Thus, mother-child dyadic scores can range from 0 to 17, where each point value represents an incidence of "No One Takes Responsibility." The mean dyadic score for the sample was 2.3 ($SD = 1.8$; Range 0-9). Sixteen percent of the sample had no disagreement, the

majority (71%) had modest disagreement on 1-4 tasks, but a sizable minority (12.6%) disagreed on up to two-thirds of the items (5-9 tasks). Disagreement between parent- and child-report decreased as age increased. Consistent with the literature (Rubin et al., 1989), children assume increasing responsibility with age. Most notably, disagreement between child- and parent-report of diabetes responsibility related positively to HbA1c. When controlling for adherence, mother-child dyadic scores emerged as a significant correlate of HbA1c, explaining 13.4% of the variance in parent-report of adherence. Findings approached significance for child-report of adherence (Anderson et al., 1990).

The DFRQ has been used in a number of studies since development, but often with adapted scoring techniques from the validated parent-child dyadic method (Anderson et al., 1990). First, some maintain the rather unwieldy original parent/child dyadic method described above. Second, some employ continuous Likert-type scores to indicate higher or lower levels of parental responsibility. Third, unique scoring methods have been developed, including frequency counts and percentage of shared tasks. Many methods demonstrate that parental responsibility is related to HbA1c, although findings are inconsistent.

Parent-child dyadic scoring method. First, when the original dyadic scoring methodology is employed (Anderson et al., 1990), results are inconsistently related to glycemic control. In a sample of 109 youth (age 8 to 18.4; $M = 13.7$ years), "No Responsibility" scores correlated with HbA1c ($\beta = .17$, $p \leq .05$), such that a higher frequency of unassigned tasks was associated with a higher HbA1c value. In a later study, dyadic agreement was significantly correlated with HbA1c within the sample. Investigators then dichotomized the broad age range into older ($n = 64$, $M = 13.5$ years) and younger ($n = 57$, $M = 10.6$ years) groups (Anderson et al., 2009). Higher frequency of agreement was correlated with better glycemic control for the

younger group, which suggests agreement about sharing diabetes tasks may be indicative of diabetes-related outcomes. However, this effect was only present in the younger age group.

Finally, a higher instance of discordance between parent- and youth-report was associated with younger age. Within the above study, youth with an episode of DKA (34%) had poorer glycemic control (M HbA1c = 10.25%; SD = 2.02%) than those without an episode (M HbA1c = 8.35%; SD = 1.37%); however, instances of "No One is Responsible" were not different between DKA groups (Anderson et al., 2009). Taken together, this suggests that the DFRQ, a global self-report of responsibility for diabetes tasks, may lack behavioral evidence of actual task completion as compared to an index of self-reported daily behaviors, such as the 24-Hour Diabetes Interview, discussed below.

A self-report measure is more easily administered and ideally reflects typical behavior; however, inherent weaknesses, such as social desirability and dependence on recall, are present. Further, since youth tend to over endorse responsibility for tasks, accuracy can be an issue (Geffken et al., 2008). Finally, while accounting for informant discrepancy is valuable, the dyadic scoring method highlights unassigned tasks but does not provide an indicator of level of parental involvement as addressed below in alternate scoring methods.

Continuous scoring method. Second, the DFRQ has been employed as a continuous measure where a higher score is indicative of higher parental responsibility (Holmes et al., 2006). Findings from a sample of 222 youth ages nine to 17 years old (M = 12.8 years) revealed that greater youth responsibility, as measured by the DFRQ, was negatively associated with adherence, as measured by frequency of blood glucose monitoring, which in turn related to higher HbA1c values. Holmes and colleagues used an average of parent- and child-report data from the DFRQ. Whereas the dyadic scoring method featured tasks overlooked by youth and

parents, this scoring method features the level of parental responsibility and suggests that too much youth responsibility is detrimental to both disease care and glycemic control.

Frequency count scoring method. Third and most recently, frequency counts of particular response options have been employed as yet another scoring method. For instance, the DFRQ was employed to capture lack of parental responsibility in a low-income, Hispanic sample where a frequency of youth-completed tasks was obtained (Hsin et al., 2010). Parent- and child-reports were averaged, resulting in a range of 0 to 12 tasks for which a youth was primarily responsible. In contrast to primarily Caucasian samples (Holmes et al., 2006), youth responsibility for tasks did not relate to glycemic control perhaps because of socioeconomic or cultural differences in which lower-income minority youth might exert more responsibility for their disease care. Isolation of youth responsibility in an underrepresented group is a strength of this study.

Percentage of shared responsibility scoring method. Finally, a percentage of shared responsibility has been used to score the DFRQ. In a sample of youth ages 10 to 14, shared responsibility was related to better glycemic control during the transition into adolescence (Helgeson, Reynolds, Siminerio, Escobar, & Becker, 2008). Other percentages were also calculated, specifically DFRQ tasks for which the adolescent was solely responsible and tasks for which the parent was solely responsible. Shared responsibility between parent and a youth for disease care tasks predicted improvement in glycemic control across one year. Furthermore, the frequency of tasks assumed by youth predicted deterioration in glycemic control, consistent with previous findings (Holmes, et al., 2006). Both findings were based on youth-reported data of responsibility. Novel to prior studies, shared responsibility was conceptualized as optimal for health-related diabetes outcomes. The current study will adopt a similar scoring methodology

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which features shared responsibility as the optimal expression of parental responsibility in a pre-to early-adolescent age group.

Measurement of Parental Monitoring

To evaluate the possibility that parental monitoring rather than responsibility may be a key ingredient in youth glycemic control, the PMDC (Ellis et al., 2008) was developed in an inner-city minority sample. Five domains assess Supervision of the Availability of Medical Supplies/Devices, Monitoring Blood Glucose Checking, Oversight of Diet, Monitoring of Nonadherence, and Direct Oversight of Diabetes Management Behaviors. Parents were asked to respond to items regarding the past month along a Likert-type scale ("more than once a day," "once a day," "several times a week," "once a week," "less than once a week").

Participants in the validation sample included 99 (22% male) parents of 12- to 18-year-old low-income youth ($M = 14.8$ years), in a mixed ethnic group of approximately half majority and half minority participants (45% Caucasian; 36% African American; Ellis et al., 2008). Based on this sample, internal consistency of the PMDC was .81 with stable two-week test-rest reliability (ICC = .80). No significant differences in overall scores between single- and two-parent families were found; however, minority families reported significantly lower levels of oversight than non-minority families. Thus, race was controlled for in further analysis. Similar to findings regarding parental responsibility, adherence served as a mediating factor between parental monitoring and glycemic control. Parental monitoring accounted for 38% of the variance in adherence and ultimately contributed to HbA1c ($\beta = -.24$, $p = .007$), suggesting parental monitoring and not responsibility may be a more ecologically valid construct with lower-income or minority samples.

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An adolescent version of the PMDC was developed using the same sample (Ellis et al., 2007). While adolescent- and parent- report were significantly correlated, neither was directly related to glycemic control. Separate models of youth- and parent-report were evaluated with adherence as a mediator between parental monitoring and parental support while controlling for age and race/ethnicity. Both youth and parent models proved adequate fits with the parent-report model accounting for 20% of the variance in HbA1c and the adolescent-report model accounting for 17% of the variance. Furthermore, the indirect effect of parental monitoring on HbA1c was significant for both youth- ($p < .05$) and adolescent-report ($p < .01$). Overall, the PMDC is a newer tool for assessing parental involvement, conceptualized as parental monitoring. While this findings was demonstrated in a low-income and/or minority populations, few have applied the PMDC in less diverse samples.

Measurement of Diabetes Parenting Behaviors

The 24-Hour Diabetes Interview represents an interview of actual diabetes care behaviors subject to cross-validation, whereas the DFRQ and PMDC are self-report measures of parental involvement (Johnson et al., 1986). The 24-Hour Diabetes Interview was intended to capture "typical" daily management behaviors and is considered a measure of adherence rather than parental involvement. However, it innately measures responsibility by assessing whether the child or parent completed a task, and revisions to the initial design have incorporated measurement of parental monitoring by asking whether child completed tasks are observed or discussed with parents. Using the 24-Hour Diabetes Interview as an indicator of parental involvement is novel in pediatric diabetes research, therefore, consideration of its development is potentially valuable, and will be used in the current study.

As initially construed, parents and youth were interviewed three times across a two-week time period (Johnson et al., 1986). The first interview was conducted in-clinic, followed by two telephone contacts. While participants knew they would be called, they did not know in advance on which days they would be contacted by research staff. Parents and youth were interviewed separately and asked to recall the previous day's events in temporal sequence; if participants did not independently offer relevant diabetes behaviors, the interviewer prompted questions to illicit such information. Each interview took approximately 20 minutes to complete.

Initial analyses were conducted on a sample of 168 primarily Caucasian (88%) youth ages six to 19 years (Johnson et al., 1986). Thirteen sub-domains of adherence were developed, including injection regularity, injection interval, injection-meal timing, regularity of injection-meal timing, calories consumed, percentage of calories from fat, percentage of calories from carbohydrates, concentrated sweets, eating frequency, exercise frequency, exercise duration, and exercise type. Five adherence factors accounted for 70.6% of variance, which suggests that adherence is not a unitary construct, but complex and with several components. These five factors include exercise, injection, diet type, eating and glucose testing frequency, and carbohydrate consumption relative to total calories. A later study confirmed only four factors, including exercise, diet type, insulin injections, and frequency of eating and testing (Johnson et al., 1986), nevertheless supporting a multivariate conceptualization of adherence.

Parent-child agreement across domains ranged from .42 (regularity of injection-meal timing) to .78 (glucose testing frequency); however, for several of the 13 domains of adherence, parent-child agreement differed by child age (Johnson et al., 1986). Youth six to nine years of age demonstrated poorest parent-child agreement for measures involving time, moderate for type of diet, and strongest for calories consumed, exercise type, and frequency measures. Youth 10 to

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15 years of age demonstrated the most consistency in parent-child agreement across all measures. Finally, youth 16 to 19 years of age demonstrated the least consistency in parent-child agreement perhaps reflecting greater autonomy in these youth. Inconsistent findings on agreement by age create caution around combination of parent- and child-reports using a mean frequency approach.

Diabetes care behaviors associated with glycemic control. The association between glycemic control and diabetes care behaviors as measured by the 24-Hour Diabetes Interview is fairly consistent. Most often frequency of blood glucose monitoring relates positively to glycemic control (Ellis, et al., 2004; Holmes et al., 2006). While more support exists for blood glucose monitoring as a correlate of glycemic control, there is also support for other diabetes care behaviors, including exercise (Streisand et al., 2002) and calorie consumption (Johnson, Freund, Silverstein, Hansen, & Malone, 1990).

The above studies demonstrate that diabetes care behaviors relate to glycemic control; however, later studies employ the 24-Hour Diabetes Interview in a way that assesses for parental involvement. An adaptation of the original scoring method assesses adolescents' responses to episodes of hypoglycemia and hyperglycemia (Johnson et al., 2000). Upon report of a blood glucose result in the specified range, an interviewer recorded a diabetes care response. Appropriateness of response to hypo- or hyperglycemic episodes was coded based on ADA recommendations. Overall, adolescents failed to respond appropriately to 38% of hypoglycemic episodes; 14% of adolescents did nothing at all in response to out-of-range blood glucose results. In episodes of hyperglycemia, 29% of adolescents did nothing at all, whereas 64% appropriately checked for ketones. Furthermore, adolescents were divided into two groups: those who predominately responded appropriately to hypoglycemia (i.e., ≥ 75% of episodes) and those who

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were predominately inappropriate responders (i.e., <75% of episodes). This coding method resulted in 49 appropriate responders and 15 inappropriate responders to hypoglycemia, as compared to seven appropriate responders and four inappropriate responders to hyperglycemia. Both older youth age and less parental observation were related to inappropriate responses to episodes of hyperglycemia.

Although these results are concerning, the size of hypo- and hyperglycemia subgroups were small (Johnson et al., 2000). What is notable, however, is the adaptation of the 24-Hour Diabetes Interview to incorporate parental involvement across diabetes care behaviors, in addition to assessing for response to hypo- and hyperglycemic episodes. Additionally, the use of the parental involvement data in conjunction with the diabetes behaviors is novel and important, as current literature has not yet clarified the role of parental responsibility versus monitoring within the same disease care tasks as these components of involvement relate to glycemic control.

Informant Discrepancy in Assessing Parental Involvement

Although often overlooked, informant discrepancy among healthy youth and parent samples may provide insight into trends among youth with type 1 diabetes and their parents. De Los Reyes and Kazdin (2005) addressed informant discrepancy in assessment of youth and presented a theoretical framework to guide clinical research. The authors reviewed trends across age, whereby correlations between children (ages 6-11) and their parents tend to be greater than those between adolescents (ages 12-19) and their parents, suggesting greater agreement in younger youth (Achenbach, McConaughy, & Howell, 1987). This finding may be due to less autonomy in younger youth, increasing the opportunities for parents to observe behavior. Findings across the pediatric diabetes literature, however, are inconsistent where in some cases

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agreement is greater among younger youth and in other cases it is greater among older youth (Anderson et al., 1990; Anderson et al., 2009; Johnson et al., 1986).

In aforementioned studies, adolescents' ratings of youth responsibility were higher than parents' ratings of youth responsibility, consistent with general informant discrepancy patterns in adolescence (Palmer et al., 2004). For instance, boys reported a higher level of responsibility than their parents perceived them to have (Mansfield, Addes, Laffel, & Anderson, 2004). In contrast, parent- and child-report of girls' responsibility did not differ. Furthermore, older children reported more self-reliance, and overall children reported higher self-reliance than their parents reported their children to have, consistent with normative developmental patterns. Specifically, youth perceive earlier transfer of responsibility of developmental tasks than their parents and often demonstrate autonomous behaviors earlier than parents expect (Dekovis, Noom, & Meeus, 1997; De Los Reyes & Kazdin, 2005). Thus, parents may indeed under-report a child's level of responsibility due to a lack of awareness as youth spend less time at home in adolescence and parents have less opportunity to observe youth behavior (Palmer et al., 2004). Similarly, children may report higher levels of responsibility for diabetes care tasks in line with a more autonomous image (Palmer et al., 2004).

A review of diabetes-specific literature, as well as findings in normative samples, suggest that parent- and child-report data are best addressed independently in analysis (De Los Reyes & Kazdin, 2005). Combining information from multiple informants may not be incrementally reliable and may lead to inflated rates of prevalence. Whereas some scoring approaches for measures of parental involvement consider both responses (Anderson et al., 1990), others average parent- and youth-response which may not best portray the data when the goal of research is solely to measure parental involvement, given trends in informant discrepancy.

Statement of Problem

Type 1 diabetes is one of the most common pediatric chronic illnesses. Adolescents are at risk for poorer glycemic control; however, youth whose parents remain involved in diabetes care are in better control. No single method exists as a gold standard for assessing parental involvement in youths' diabetes care. Several methods are available to assess parental responsibility and parental monitoring in adolescents' diabetes management; however, there is little consensus on which measure best relates to glycemic control and how each measure is scored and analyzed. Parental involvement is frequently identified as a target of treatment programs to prevent deterioration in adherence and glycemic control during adolescence. Evaluation of existing measures, combination of measures, or sections of measures that best relate to glycemic control will help to identify which behavioral components relate to HbA1c. Few studies have employed multi-method approaches to measure both parental responsibility and parental monitoring; therefore, little evidence exists to support one technique over another. Direct comparison of the efficacy of different parental involvement measures and their relation to glycemic control is a desirable first step toward establishment of an efficacious, uniformly accepted measure.

To date, no study has compared two or more types of parental involvement (i.e., parental responsibility and parental monitoring), implemented multiple methods of assessment of parental involvement (i.e., self-report questionnaire and semi-structured interview), and incorporated multi-source data (i.e., parent- and youth-report) in a sample of youth in transition through early adolescence with type 1 diabetes. Findings from the current study will have implications for evaluating treatment studies, as well as clinical use. Thus, the goals of the current study are threefold: 1) to compare types of parent involvement as each individually relates to glycemic

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control, 2) compare three existing measures of parent involvement, and 3) to examine parent-child agreement among each measure. One self-report measure of parental responsibility, the DFRQ, and one of parental monitoring, the PMDC will be compared to an interview measure that assesses both parental responsibility and monitoring, the 24-Hour Diabetes Interview.

Hypotheses

Hypothesis 1. Adequate psychometric properties, including internal validity and test-retest reliability will be demonstrated for the DFRQ, PMDC, and 24-Hour Diabetes Interview. It is expected that parent-youth agreement will be less than adequate, which is typical in an adolescent sample.

Hypothesis 2. Significant associations are anticipated between better glycemic control and younger age, higher SES, and shorter duration of diagnosis. Further, significant associations should exist between better glycemic control and more parental involvement (i.e., DFRQ, PMDC, 24-Hour Diabetes Interview). However, it is likely in an adolescent sample that parental monitoring variables will be more related to glycemic control than measures of parental responsibility.

Hypothesis 3. It is hypothesized that scores on the PMDC will account for more variance in glycemic control than DFRQ scores. Further, PMDC subscales pertaining to monitoring of blood glucose testing and insulin administration will assume more variance in glycemic control than those pertaining to other diabetes care behaviors. Finally, within the 24-Hour Diabetes Interview, the monitoring domains (i.e., percentage of tasks observed/discussed) will assume more variance than the responsibility domains (i.e., percentage of tasks completed by the parent).

Hypothesis 4. Based on individual variances assumed by the DFRQ, the PMDC, and the 24-Hour Diabetes Interview in association with glycemic control, a unique

combination of total scores or subscales of these measures will be tested to determine whether more variance in HbA1c is assumed by a unique combination than any of the measures alone. No *a priori* hypothesis will be established for this research question, given the exploratory nature of the analyses.

Method

Participants

Participants and their primary caregivers were recruited from two pediatric endocrinology clinics in Richmond, Virginia and Washington, DC. Inclusion criteria required youth to be aged 11 to 14 years at time of recruitment and have a diagnosis of type 1 diabetes for at least a year, without significant medical comorbidities.

Procedure

Data were collected as part of a multi-site, family-based, randomized clinical trial (RCT) for a treatment program designed to prevent deterioration of parent involvement in adolescence. Families of potential youth participants were identified from clinic schedules at each site within a two-year recruitment period. All potential participants who met criteria received a recruitment letter detailing the purpose of the study. A trained doctoral student contacted parents by phone to invite them to participate. For those who agreed, assessments were scheduled in conjunction with the child's upcoming medical appointment. After obtaining written informed parental consent and youth assent, research staff administered a battery of questionnaires to both parents and youth, in addition to the 24-Hour Diabetes Interview conducted separately with each. In-clinic assessments lasted approximately 60 minutes, and participating families received a $25 gift card upon completion of baseline data. During the two-week period following their clinic appointment, families were contacted by phone to complete a second 24-Hour Diabetes

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Interview. Phone interviews lasted approximately 20 minutes for each child and parent, or 40 minutes total.

Measures

      Demographic and medical information. Questionnaires completed by parent participants collected demographic and medical information, including race/ethnicity, parental marital status, age of disease onset, disease duration, and SES. SES was calculated using the Hollingshead Four Factor Index (Hollingshead, 1975). Parental education level and occupation were transformed into a raw score ranging from 8-66. Scores are associated with levels of social class, as follows: scores 8-17 indicate "Lower Class," scores 18-28 indicate "Lower-Middle Class," scores 29-47 indicate "Middle Class," scores 40-59 indicate "Upper-Middle Class," and scores 60-66 indicate "Upper Class."

      Glycemic control. An index of glycemic control was obtained though medical chart reviews of each participant. Glycemic control was measured by HbA1c levels, an indication of average blood glucose concentration over the previous three-month period. Recommended HbA1c levels are $< 7.5\%$ for adolescents (ADA, 2010). Higher HbA1c values indicates poorer glycemic control.

      Diabetes Family Responsibility Questionnaire. The Diabetes Family Responsibility Questionnaire was administered as a measure of parental responsibility (DFRQ; Anderson, Auslander, Jung, Miller, & Santiago, 1990) and consists of 21 items relating to responsibility for diabetes care tasks. Parents and youth indicated their perceived level of responsibility for each task. A unique scoring method was adopted for the current study in order to isolate frequency of shared responsibility between parents and youth. Each instance of "child and parent share responsibility about equally" was summed for a possible score ranging from zero to 21, and

parent- and child-report remained separate. Appropriate levels of internal consistency have been established for the original 17-item version of the DFRQ, which employs the parent-child dyadic scoring method (.69 - .85; Auslander et al., 1990). Given that a unique scoring method was employed in the current study, psychometric properties have not been established.

Parental Monitoring of Diabetes Care Scale. The Parent Monitoring of Diabetes Care Scale was administered as a measure of parental monitoring in children's daily diabetes care (PMDC; Ellis et al., 2007; Ellis et al., 2008). The PMDC is comprised of 18 items presented on a five-point Likert scale across five domains, including Supervision of the Availability of Medical Supplies/Devices, Monitoring Blood Glucose Checking, Oversight of Diet, Monitoring of Nonadherence, and Direct Oversight of Diabetes Management Behaviors. Parents and youth were asked to respond to frequency of monitoring tasks in the past month along a Likert-type scale ("more than once a day," "once a day," "several times a week," "once a week," "less than once a week"). Parent- and child-report remained separate in the current study to isolate unique contributions of each. The PMDC has established adequate internal consistency ($\alpha = .81$) and good temporal stability over a 2-week interval (ICC = .80; Ellis et al., 2008).

24-Hour Diabetes Interview. Portions of the 24-hour Diabetes Interview were also used as measures of parental responsibility and monitoring (Johnson et al., 1986). One interview was conducted in-clinic, with a second follow-up phone interview. Participants knew they would be called within a two-week period, yet they did not know in advance on which days they would be contacted. Both in-clinic and on the phone, parents and youth were interviewed separately and asked to recall the previous day's events in temporal sequence; if participants did not independently offer relevant diabetes behaviors, the interviewer prompted questions to elicit such information. While the 24-Hour Diabetes Interview has been historically used to measure

adherence, it also captures parental responsibility, in asking who completed each task, and adaptations of the measure in the current study allowed for assessment of parental monitoring, i.e., "did you observe/discuss a task." Three domains were extracted from the 24-Hour Diabetes Interview: 1) percentage of tasks completed by a parent, which represents parental responsibility; 2) percentage of tasks observed by a parent (for youth-completed tasks), and 3) percentage of tasks discussed with a parent, which represents parental monitoring. Percentages for responsibility pertained to blood glucose testing and insulin administration, whereas percentages for monitoring pertained to blood glucose testing, insulin administration, consumption of meals and snacks, and exercise. Parent- and child-report remained separate. The test-retest reliability over a three-month interval varies by diabetes care behavior (i.e., Blood glucose monitoring, $r = $ .72 to .76; Diet behaviors, $r = .45$ to .77; Exercise behaviors, $r = .37$), indicating generally appropriate temporal stability (Freund et al., 1991). However, test-retest properties have not yet been established for the parental involvement variables within the 24-Hour. These were examined in the current study.

Data Analysis Plan

Power analyses were conducted to determine the appropriate sample size for the current study. All variables were assessed for univariate normality (i.e., skewness, and kurtosis). Any variables with skewness or kurtosis values greater than 1.5 underwent transformation. Standardized values were obtained for each variable to assess for univariate outliers. All values greater than $z > 3.29$ were winsorized. In order to conduct multiple regression analysis, normality, linearity, and homoscedasticity were assessed by residual scatterplots, and multivariate outliers were assessed by obtaining Mahalanobis distance for each model.

Hypothesis 1. Psychometric properties, including internal reliability and parent-youth agreement were assessed for the DFRQ, PMDC, and 24-Hour Diabetes Interview. Test-retest reliability was conducted for the 24-Hour Diabetes Interview sub-domains of parental responsibility and monitoring. Parent/youth agreement and test-retest reliability were assessed with Pearson's *r* correlation. Cronbach's alpha tested internal consistencies according to standards ($\alpha > .80$; Garson, 2010).

Hypothesis 2. Descriptive data provided a better understanding of the role of parental involvement and parental monitoring as measured by self-report of global (i.e., DFRQ and PMDC) and actual behaviors (i.e., 24-Hour Diabetes Interview) and better glycemic control. A correlation matrix including primary study and demographic variables was generated.

Hypothesis 3. A set of multivariate regressions were conducted in which both parental responsibility and parental monitoring variables were entered separately to assess their unique contribution to glycemic control. Age, duration, and SES were entered in Step 1 for all models. The PMDC total score, PMDC subscales, and 24 Hour Diabetes Interview subscales were individually entered in Step 2, producing three pairs (i.e., parent- and youth-report) of regressions.

Hypothesis 4. Parental responsibility as measured by the DFRQ and 24-Hour Diabetes Interview and parental monitoring as measured by the PMDC and 24-Hour Diabetes Interview provided indicators of parental involvement. Indicators with significant beta weights from earlier regressions (i.e., Parent-reported Monitoring of Nonadherence subscale of the PMDC) were entered in a regression to assess their incremental validity in accounting for variance in glycemic control. Age, duration, and SES were entered in Step 1. The Monitoring of Nonadherence subscale of the PMDC was entered in Step 2.

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***Post-hoc* Analyses.** Since both youth age and family SES were associated with glycemic control, along with several indices of parental monitoring, follow-up *post-hoc* analyses were conducted to investigate the role of parental monitoring in the relationship between SES, age, and glycemic control. First, parental monitoring was tested as a mediator between SES and HbA1c, controlling for the effects of age. Second, parental monitoring was tested as mediator between age on HbA1c, controlling for the effects of SES. The Baron and Kenny (1986) model for testing mediation was employed. First the relation between the predictor and the outcome must be significant. Next, the relation between the predictor and the mediator must be significant. Finally, when both the predictor and mediator are included in the model, the relation between the mediator and outcome must be significant, while the relation between the predictor and outcome is no longer significance

Results

Preliminary Analyses

Power analyses were conducted to determine the sample size for the current study. Across the three parental involvement measures and subscales, there were a total of 16 individual correlates. Using a 10:1 ratio, a sample size of 255 parent-youth dyads was sufficient for the planned analyses and powered for a significance level of $p < .05$ (Nunnally, 1978). Further, N > 104 + m (where m is the number of predictors, or in the case of cross-sectional designs, correlates) was met in order to conduct multiple regression (Green, 1991).

All variables used in the following analysis were assessed for univariate normality. Variables including parent- and youth-report of percentage of BG checks and insulin administered by the parent revealed skewness or kurtosis values greater than +/- 1.5 which were addressed through square root transformations.

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Descriptive Results

   Participants included 255 youth (51% male) aged 11 to 14 ($M = 12.83$, $SD = 1.24$) with

type 1 diabetes and their primary caregivers (92% mothers). A majority of youth were Caucasian

(69%) and from middle-class families (40 % upper-middle, 38% middle). Mean disease duration

was 5.14 years ($SD = 3.05$) and mean HbA1c was 8.82% ($SD = 1.64$). Forty-four percent of

youth were on an insulin pump. Demographic and disease characteristics of the sample are

reported in Table 1. Means and standard deviations for total scores and subscale scores of the

DFRQ, PMDC, and the 24-Hour Diabetes Interview separated by informant source are reported

in Table 2.

Table 1.

Demographic and disease characteristics; N = 255.

Gender: Male (%)	51
Age (years; M (SD))	12.83 (1.24)
Hollingshead Index of SES (%)	
Upper (60-66)	12
Upper-middle (48-59)	40
Middle (29-47)	38
Lower-middle (18-28)	4
Lower (8-17)	3
Race/Ethnicity (%)	
Caucasian	69
African American	19
Hispanic	6
Asian/Asian American	2
Other	4
Age at Disease Onset (years; M (SD))	7.70 (3.21)
Disease Duration (years; M (SD))	5.14 (3.05)
HbA1c (M (SD))	8.82 (1.64)
Insulin Regimen: Pump Therapy (%)	44
Relationship to Child: Mother (%)	92
Parent Married (%)	69

Table 2.

DFRQ[a], PMDC[b], and 24-Hour Diabetes Interview.

	Possible Range	Parent M (SD)	Youth M (SD)
Diabetes Family Responsibility Questionnaire			
Frequency of Shared Tasks	0-21	5.67 (2.90)	8.21 (3.0)
Parental Monitoring Diabetes Care Scale (# items)			
Total Score *(18)*	18-90	78.00 (7.94)	77.05 (8.48)
Supervision Medical Supplies/Devices *(5)*	5-25	22.95 (2.59)	22.85 (8.48)
Monitoring Blood Glucose Checking *(2)*	2-10	6.45 (2.70)	6.01 (2.86)
Oversight of Diet *(3)*	3-15	12.60 (1.67)	12.00 (2.22)
Monitoring of Nonadherence *(4)*	4-20	17.45 (2.85)	18.01 (2.89)
Direct Oversight of Management Behaviors *(4)*	4-20	18.57 (2.53)	18.22 (2.74)
24-Hour Diabetes Interview (%)			
BG Checks Parent Completed	0-100	6.79 (13.90)	4.80 (11.71)
BG Checks Parent Observed	0-100	53.46 (28.40)	51.08 (25.14)
BG Checks Parent Discussed	0-100	60.84 (30.20)	61.11 (30.26)
Insulin Administration Parent Completed	0-100	16.02 (29.46)	14.26 (29.74)
Insulin Administration Parent Observed	0-100	42.32 (31.63)	43.44 (30.32)
Insulin Administration Parent Discussed	0-100	41.67 (33.58)	41.72 (34.21)
Meals/Snacks Parent Observed	0-100	57.16 (22.49)	55.21 (24.27)
Meals/Snacks Parent Discussed	0-100	47.92 (28.53)	40.83 (31.14)
Exercise Parent Observed	0-100	54.53 (39.83)	52.64 (40.01)
Exercise Parent Discussed	0-100	0.54 (0.40)	0.53 (0.40)

[a] Diabetes Family Responsibility Questionnaire.

[b] Parental Monitoring Diabetes Care Scale.

Hypothesis 1: Reliability of DFRQ, PMDC, and 24-Hour Diabetes Interview

Diabetes Family Responsibility Questionnaire (DFRQ). The correlation between total frequency of shared tasks between youth- and parent-report was not adequate ($r = .24$, $p < .001$) according to established standards of adequate reliability (Garson, 2010).

Parental Monitoring Diabetes Care Scale (PMDC). Correlations between youth- and parent-reported subscales and total scores were less than adequate ($r = .17$-$.44$). Refer to Table 3 for a complete list of the correlations for parent and youth for each of the subscales and the total score of the PMDC.

Internal consistencies for the total score and five subscales of the PMDC was assessed: 1) Supervision of Availability of Medical Supplies/Devices, 2) Monitoring Blood Glucose Checking, 3) Oversight of Diet, 4) Monitoring of Nonadherence, and 5) Direct Oversight of Diabetes Management Behaviors. The internal consistency for the total score in the current sample was adequate to high for parent- ($\alpha = .75$) and youth-report ($\alpha = .76$). Cronbach's alpha for subscales of the PMDC ranged from inadequate to high for parent- ($\alpha = .17$-$.79$) and youth-report ($\alpha = .29$-$.81$). See Table 3 for sample based Cronbach's alpha values by informant source.

24-Hour Diabetes Interview. Correlations between parent- and youth-report of parental responsibility subscales (e.g., Percent of parent-completed BG checks) were less than adequate to adequate ($r = .70$-$.88$). Correlations between parental monitoring subscales (e.g., Percentage of child-completed BG checks observed by parent) were less than adequate ($r = .34$-$.53$). Refer to Table 4 for a complete list of the correlations for parent- and youth-report for each of the subscales of the 24-Hour Diabetes Interview.

Pearson's correlations (r) assessed test-retest intraclass correlations of the parental involvement subscales of the 24-hr: 1) Percentage of parent-completed BG and insulin checks, 2)

Percentage of child-completed BG checks and insulin doses observed by and discussed with a parent, 3) Percentage of meals/snacks observed by and discussed with a parent, and 4) Percentage of exercise observed by and discussed with parent. Of the 255 participant sample, data from 220 participants including both parent and youth interviews completed in-clinic and at two-week follow-up were evaluated. All measures yielded significant Pearson's *r* correlation coefficient's ranging from *r* = .07-.79. Refer to Table 4 for a list of correlations by informant source.

Table 3.

Hypothesis 1: Internal consistency of parental monitoring by informant source and parent/youth agreement on the Parental Monitoring Diabetes Care Scale (PMDC; N = 255).

	Internal Consistency (α)		Parent/Youth Agreement (r)
	Parent	Youth	
Parental Monitoring Diabetes Care Scale			
Total Score	.75	.76	.41***
Supervision of Medical Supplies/Devices	.49	.39	.17*
Monitoring of Blood Glucose Checking	.72	.76	.44***
Oversight of Diet	.17	.29	.34***
Monitoring of Nonadherence	.77	.78	.25**
Direct Oversight of Management	.79	.81	.31***

Note. *p <.05, **p<.01, ***p<.001

Table 4.

Hypothesis 1: Test-retest reliability of parental responsibility and monitoring by informant source and parent/youth agreement on the 24 Hour Diabetes Interview.

_____

	Test-Retest Reliability		Parent/Youth Agreement
	Parent	Youth	
24-Hour Diabetes Interview			
Parental Responsibility (%)			
Parent Completed BG Checks	.66***	.59***	.70***
Parent Completed Insulin Doses	.79***	.79***	.88***
Parental Monitoring (%)			
Observed BG Checks	.30***	.22**	.35***
Discussed BG Checks	.31***	.46***	.34***
Observed Insulin Doses	.46***	.38***	.44***
Discussed Insulin Doses	.46***	.53***	.50***
Observed Meals/Snacks	.13	.29***	.46***
Discussed Meals/Snacks	.40***	.47***	.45***
Observed Exercise	.07	.23*	.53***
Discussed Exercise	.15	.15	.53***

_____

*Note. *$p < .05$. **$p < .01$, ***$p < .001$

Hypothesis 2: Parent Responsibility and Parental Monitoring as They Relate to Glycemic Control (HbA1c)

      Parental responsibility as it relates to HbA1c. A correlation of 0.5 is considered large, 0.3 is considered moderate, and 0.1 is considered small (Cohen, 1988). Pearson's correlations (*r*) between the frequency of shared diabetes tasks on the DFRQ and HbA1c were not significant for parents (*r* = -.03, *p* = .683) or youth (*r* = -.05, *p* = .432). Further, correlations among variables using a more traditional scoring method of the DFRQ (i.e., continuous scoring) were not significant for parents (*r* = -.01, *p* = .846) or youth (*r* = -.04, *p* = .605). Associations between the parental responsibility subscales of the 24-Hour Diabetes Interview and HbA1c varied for parents (*r* = - .04 to -.12) and youth (*r* = .02 to -.15; see Tables 5 and 6), but were very small. Youth-report of parent-completed blood glucose check was the only subscale related to HbA1c (*r* = -.15, *p* = .03).

      Parental monitoring as it relates to HbA1c. Correlations between the PMDC total score and HbA1c were significant for parent- *(r* = -.20, *p* = .002) and youth-report *(r* = -.21, *p* = .005) and small to moderate in size. This represents an improvement upon associations between HbA1c and parent- (*r* = -.19) and youth-report (*r* = -.06) found during measurement development in a largely lower SES, minority sample (Ellis et al., 2007). Correlations among HbA1c and PMDC subscales varied for both parent-report (*r* = .02 to -.20) and youth-report (*r* = .02 to -.25) (see Table 7) and were small to moderate in size.

      Associations between the parental monitoring subscales of the 24-Hour Diabetes Interview and HbA1c varied for parents (*r* = .02 to -.17) and youth (*r* = .01 to -.13) (see Tables 5 and 6) and were small in size. Previous literature is not available on these associations given that this measure has not yet been used to assess parental monitoring.

Demographic variables as they relate to HbA1c. As expected, younger age ($r = .13$, $p = .034$) and higher SES ($r = -.34$, $p < .001$) were each significantly associated with better glycemic control, consistent with the literature. The correlation between age and HbA1c is considered small, whereas the correlation between SES and HbA1c is considered moderate (Cohen, 1988). In contrast, disease duration was not related to glycemic control ($r = .08$, $p = .496$).

Table 5.

Hypothesis 2: Concurrent validity of glycemic control (HbA1c), demographic variables, and parent-reported parental responsibility and monitoring on the 24-Hour Diabetes Interview (N = 254).

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
Parent													
Glycemic Control													
1. HbA1c	-												
Demographic Variables													
2. Age	.13*	-											
3. Disease Duration	.04	.07	-										
4. SES	-.34***	.05	-.05	-									
24-Hour Diabetes Interview (%)													
5. Parent Completed BG Checks	-.12	-.19**	.19**	.04	-								
6. Parent Completed Insulin Doses	.04	-.31***	.00	-.10	.21**	-							
7. Observed BG Checks	.11	-.23***	.00	-.16*	-	.16*	-						
8. Discussed BG Checks	.10	-.10	-.07	-.01	-	-.02	.41***	-					
9. Observed Insulin Doses	.07	-.05	-.03	-.05	-.08	-	.39***	.31***	-				
10. Discussed Insulin Doses	-.17**	-.07	.02	.11	-.47***	-	.07	.35***	.48***	-			
11. Observed Meals/Snacks	.02	-.29***	.12	.00	.17	.18**	.27***	.17**	.20**	.07	-		
12. Discussed Meals/Snacks	-.15*	-.22**	.05	.16*	.10	-.03	.10	.33***	.16*	.49***	.31***	-	
13. Observed Exercise	-.08	-.04	.01	.06	-.02	.05	.13	.10	.08	-.05	.18*	.08	-
14. Discussed Exercise	-.08	-.04	.01	.06	-.02	.05	.13	.10	.08	-.05	.18*	.08	1.0***

Note. *p <.05. **p <.01, ***p<.001

Table 6.

Hypothesis 2: Concurrent validity of glycemic control (HbA1c), demographic variables, and youth-reported parental responsibility and monitoring on the 24-Hour Diabetes Interview (N = 254).

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
Youth													
Glycemic Control													
1. HbA1c	-												
Demographic Variables													
2. Age	.13*	-											
3. Disease Duration	.04	.07	-										
4. SES	-.34***	.05	-.05	-									
24-Hour Diabetes Interview (%)													
5. Parent Completed BG Checks	-.15*	-.17**	.18**	.06	-								
6. Parent Completed Insulin Doses	.02	-.20**	-.06	-.09	.19**	-							
7. Observed BG Checks	.03	-.21**	-.06	-.09	-	.00	-						
8. Discussed BG Checks	.01	-.07	-.10	.04	-	-.05	.26***	-					
9. Observed Insulin Doses	.02	-.18**	.08	-.10	-.05	-	.48***	.27***	-				
10. Discussed Insulin Doses	-.01	-.13*	.11	.12	.00	-	.27***	.60***	.51***	-			
11. Observed Meals/Snacks	-.07	-.24***	.17**	-.05	.10	.03	.43***	.16*	.37***	.23***	-		
12. Discussed Meals/Snacks	-.13**	-.19**	.09	.11	.11	-.10	.32***	.51***	.32***	.65***	.40***	-	
13. Observed Exercise	-.12	-.13	.01	.14*	.12	.15*	.09	.10	-.01	-.02	.30***	.12	-
14. Discussed Exercise	-.12	-.13	.01	.14*	.12	.15*	.09	.10	-.01	-.02	.30***	.12	1.0

*Note. *p <.05. **p <.01, ***p<.001*

Table 7.

Hypothesis 2: Concurrent validity of glycemic control (HbA1c), demographic variables, and PMDC: Intercorrelations by informant source (N = 255).

Variable	1	2	3	4	5	6	7	8	9
Parent									
Glycemic Control									
1. HbA1c	-								
Demographic Variables									
2. Age	.13*	-							
3. Disease Duration	.04	.07	-						
4. SES	-.34***	.05	-.05	-					
Parental Monitoring Diabetes Care Scale									
5. Total Score	-.20**	-.29***	-.08	.02	-				
6. Supervision of Medical Supplies	-.14*	-.06	.07	.02	.61***	-			
7. Monitoring BG Checking	.02	-.27***	-.11	-.11	.69***	.20***	-		
8. Oversight of Diet	-.15*	-.25***	-.09	.12	.59***	.59***	.29***	-	
9. Monitoring of Nonadherence	-.20*	-.33***	-.08	-.06	.71***	.30***	.42***	.34***	-
10. Direct Oversight of Management	-.14*	-.03	-.01	.15*	.57***	.20***	.21***	.30***	.14*

Variable	1	2	3	4	5	6	7	8	9
Youth									
Glycemic Control									
1. HbA1c	-								
Demographic Variables									
2. Age	.13*	-							
3. Disease Duration	.04	.07	-						
4. SES	-.34***	.05	-.05	-					
Parental Monitoring Diabetes Care Scale									
5. Total Score	-.21**	-.13	.05	.11	-				
6. Supervision of Medical Supplies	-.04	-.06	-.03	-.04	.56***	-			
7. Monitoring BG Checking	.02	-.08	.05	-.14	.61***	.23***	-		
8. Oversight of Diet	-.25**	-.12	.04	.21**	.57***	.13	.08	-	
9. Monitoring of Nonadherence	-.25**	-.19*	-.03	.19*	.73***	.21***	.36***	.35***	-
10. Direct Oversight of Management	-.18*	.01	.11	.14	.69***	.23***	.22**	.38***	.35***

Note. *p <.05. **p <.01, ***p<.001

Hypothesis 3: Parental Responsibility vs. Parental Monitoring in Relation to Glycemic Control (HbA1c)

Parental responsibility vs. parental monitoring as they relate to HbA1c. Multiple regression analyses were conducted to determine the best combination of the subscales of the PMDC and the 24-Hour Diabetes Interview by informant source. Given the absence of association between parent responsibility (i.e, DFRQ) and HbA1c, this measure was not considered further in analyses. Age, disease duration, and SES were initially controlled for in these regression analyses.

Parental Monitoring Diabetes Care Scale. Parental monitoring on the PMDC (Total Score, see Table 8) was significantly related to HbA1c for parents, $F(4, 230) = 11.34$, $p < .001$, $R^2 = .17$, and youth, $F(4, 163) = 9.53$, $p < .001$, $R^2 = .19$. Regression analyses revealed 17% and 19% of the variance in HbA1c was explained by each of the models respectively. Parental monitoring on all five PMDC subscales were also significantly related to HbA1c for parents, $F(8, 225) = 6.54$, $p < .001$, $R^2 = .19$ and youth, $F(8, 153) = 5.20$, $p < .001$, $R^2 = .21$. Regression analyses revealed 19% and 21% of the variance in HbA1c was explained by each of the models respectively. Standardized beta weights in Table 9 indicate that for parents, Monitoring of Nonadherence ($\beta = -.19$, $p = .009$), significantly contributed to HbA1c. Although the regression model was significant for youth, there were no significant individual correlates.

24-Hour Diabetes Interview. Parental responsibility and monitoring on the 24-Hour Diabetes Interview were significantly related to HbA1c for parents $F(12, 172) = 3.28$, $p < .001$, $R^2 = .19$, but not for youth. There were no significant individual beta weights within the parent-reported model (see Table 10).

Table 8.

Hypothesis 3: Concurrent validity of parental monitoring on the Parental Monitoring Diabetes Care Scale total score and glycemic control (HbA1c) controlling for age, duration, and SES: Hierarchical multiple regression analysis by informant source (N = 234; 167[a]).

Variable	β	ΔF	F	ΔR^2	Cum. ΔR^2
Parent					
Step 1					
Age	.15[*]	12.47[***]	12.47[***]	.14	.14
Disease Duration	.00				
SES	-.35[***]				
Step 2					
Parental Monitoring Diabetes Care Scale Total Score	-.17[**]	6.99[**]	11.34[***]	.03	.17

Variable	β	ΔF	F	ΔR^2	Cum. ΔR^2
Youth					
Step 1					
Age	.10	10.46[***]	10.46[***]	.16	.16
Disease Duration	.01				
SES	-.39[***]				
Step 2					
Parental Monitoring Diabetes Care Scale Total Score	-.17[*]	5.82[*]	9.53[***]	.03	.19

*Note. *p <.05. **p <.01, ***p<.001*

[a] Sample size was smaller for youth-reported data given that measure was not included in

original assessment battery. It was added mid-way through baseline data collection.

Table 9.

Hypothesis 3: Concurrent validity of parental monitoring on the Parental Monitoring Diabetes Care Scale subscales and glycemic control (HbA1c) controlling for age, duration, and SES: Hierarchical multiple regression analysis by informant source (N = 233; 161 [a]).

Variable	β	ΔF	F	ΔR^2	Cum. ΔR^2
Parent					
Step 1					
Age	.15[*]	12.68[***]	12.68[***]	.14	.14
Disease Duration	-.01				
SES	-.35[***]				
Step 2					
Supervision of Medical Supplies/Devices	-.07	2.59[*]	6.54[***]	.05	.19
Monitoring of Blood Glucose Checking	.11				
Oversight of Diet	-.03				
Monitoring of Nonadherence	-.19[**]				
Direct Oversight of Management Behaviors	-.06				

Variable	β	ΔF	F	ΔR^2	Cum. ΔR^2
Youth					
Step 1					
Age	.10	10.63[***]	10.63[***]	.17	.17
Disease Duration	.01				
SES	-.40[***]				
Step 2					
Supervision of Medical Supplies/Devices	.00	1.78	5.20[***]	.04	.21
Monitoring of Blood Glucose Checking	.03				
Oversight of Diet	-.10				
Monitoring of Nonadherence	-.14				
Direct Oversight of Management Behaviors	-.06				

Note. $*p < .05$. $**p < .01$, $***p < .001$

[a] Sample size was smaller for youth-reported data given that measure was not included in

original assessment battery. It was added mid-way through baseline data collection.

Table 10.

Hypothesis 3: Concurrent validity of percentage of parental responsibility and monitoring on the 24-Hour Diabetes Interview and glycemic control (HbA1c) controlling for age, duration, and SES: Hierarchical multiple regression analysis by informant source (N = 184).

Variable	β	ΔF	F	ΔR^2	Cum. ΔR^2
Parent					
Step 1					
Age	.13	6.81***	6.81	.10	.10
Disease Duration	.00				
SES	-.29***				
Step 2 (%)					
Parent Completed BG Checks	-.13	2.00*	3.28***	.09	.19
Parent Completed Insulin Doses	.05				
Observed BG Checks	.00				
Discussed BG Checks	.11				
Observed Insulin Doses	.11				
Discussed Insulin Doses	-.20				
Observed Meals/Snacks	.11				
Discussed Meals/Snacks	-.08				
Observed Exercise	-				
Discussed Exercise	-.13				

*Note. *p <.05. **p <.01, ***p<.001*

Hypothesis 4: Assessing Incremental Validity of a Unique Combination of Parental Involvement Subscales as they Relate to HbA1c

Results from previous regression models (e.g., factors with significant beta weights) guided subsequent analyses to identify the most powerful contributors to glycemic control. Significant indicators of parental monitoring (i.e., Parent-reported Monitoring of Nonadherence subscale of the PMDC) were entered in a hierarchical regression model to assess the concurrent validity in accounting for variance in glycemic control, while controlling for age, disease duration, and SES $F(4, 229) = 11.96$, $p < .001$, $R^2 = .17$. Beta weights in Table 11 indicate that Monitoring of Nonadherence was a significant contributor to HbA1c ($\beta = -.17$, $p = .010$).

Table 11.

Hypothesis 4: Incremental validity of the Monitoring of Nonadherence subscale of the PMDC with HbA1c: Hierarchical multiple regression analysis (N = 236).

Variable	β	ΔF	F	ΔR^2	Cum. ΔR^2
Step 1					
Age	.15[*]	11.04[***]	11.04[***]	.13	.13
Disease Duration	-.00				
SES	-.33[***]				
Step 2					
PMDC					
Monitoring of Nonadherence	-.17[*]	7.00[*]	10.16[***]	.03	.15

*Note. *p* <.05. **p* <.01, ***p*<.001

Post-hoc **Analyses**

Results revealed significant relations among glycemic control and several indices of parental monitoring, as well as SES and youth age. *Post-hoc* analyses investigated the role of parental monitoring in the relations among SES, age, and glycemic control.

Parental monitoring as a mediator of the effect of SES on glycemic control. Post-hoc analyses were performed to determine whether parental monitoring mediated the relation between SES and HbA1c, controlling for age. As stated in Hypothesis 3, scales and subscales identified as significant contributors to glycemic control were tested as mediators (i.e., Parental Monitoring (PMDC Total Score), Monitoring of Nonadherence (PMDC Subscale)); however, neither of these models were significant.

Parental monitoring as a mediator of the effect of age on glycemic control. Analyses were performed to determine if parent-reported parental monitoring as measured by the PMDC (Total Score) mediated the effect of age on HbA1c while controlling for the effects of SES (see Figure 1). Using the Baron and Kenny (1986) model for testing mediation, a significant relationship between age and glycemic control was first established, $F(2, 243) = 19.48$, $p < .001$; $R^2 = .14$, $\beta = .15$, $p = .014$. Next, age was found to have a significant effect on parental monitoring, $F(2, 232) = 10.05$, $p < .001$; $R^2 = .08$, $\beta = -.28$, $p < .001$. When both age and parental monitoring were included in the model, the relation between parental monitoring and glycemic control was significant, $F(3, 231) = 36.18$, $p < .001$; $R^2 = .17$, $\beta = -.17$, $p = .009$), while the relation of age to glycemic control dropped to nonsignificance ($\beta = .10$, $p = .102$). Using the Sobel test, it was found that the magnitude of the relation between age and glycemic control increased significantly when parental monitoring was included ($z = 2.31$, $p = .021$). Thus, parental monitoring fully mediated the relation between age on glycemic control, such that when

controlling for the effects of SES, older youth who received more parental monitoring were in better glycemic control than those who received less parental monitoring. Mediational analyses for youth-reported parental monitoring as measured by the PMDC (Total Score) were not significant.
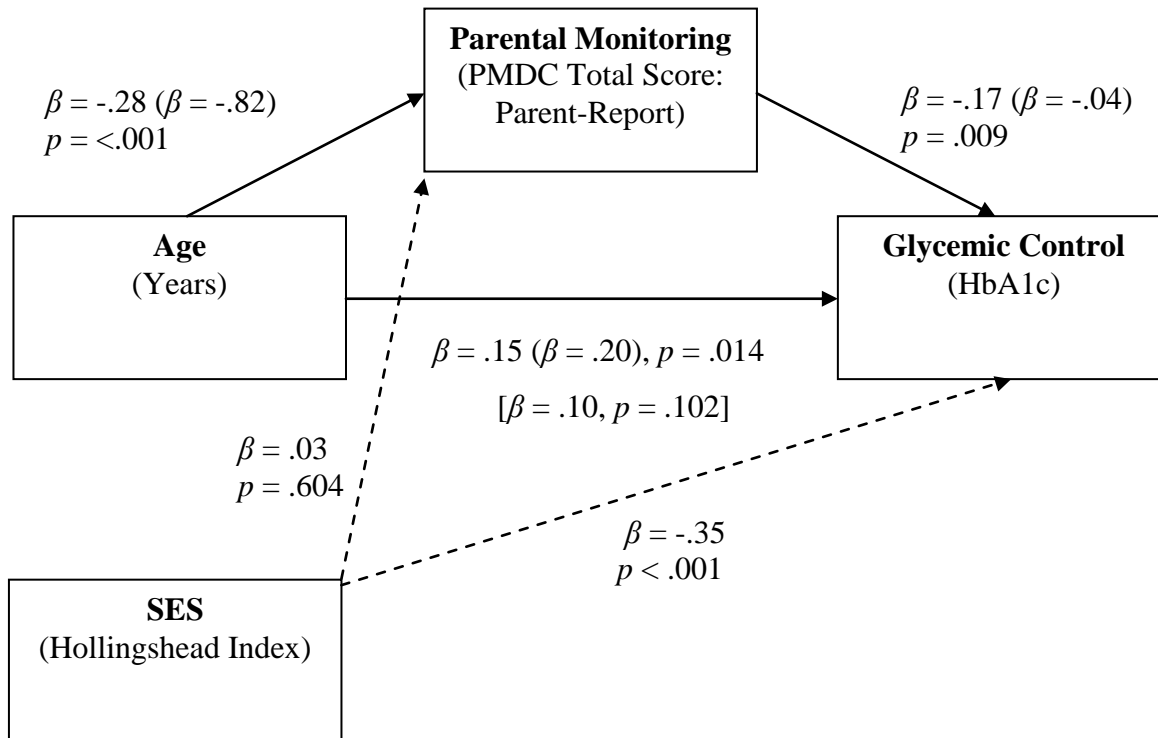
Figure

Figure 1. Parental monitoring Total Score on the Parental Monitoring Diabetes Care Scale (PMDC) as a mediator of the relation between age and glycemic control (HbA1c). Values shown are standardized regression coefficients. Values in italics represent unstandardized beta weights. Values in brackets account for the relation of age on HbA1c after controlling for parental monitoring.

Further analyses were performed to determine whether parent-reported parental monitoring as measured by subscales of the PMDC (i.e., *Monitoring of Nonadherence*), mediated the effect of age on HbA1c (see Figure 2). A significant relationship between age and glycemic control was first established, $F(2, 243) = 19.48$, $p < .001$; $R^2 = .14$, $\beta = .15$, $p = .014$). Next, age was found to have a significant effect on parental monitoring of nonadherence, $F(2, 231) =$

13.62, $p < .001$; $R^2 = .11$, $\beta = -.32$, $p < .001$). When both age and parental monitoring of nonadherence were included in the model, the relation between parental monitoring of nonadherence and glycemic control was significant, $F(3, 230) = 15.97$, $p < .001$; $R^2 = .17$, $\beta = -.19$, $p = .004$), while the relation of age to glycemic control dropped to nonsignificance ($\beta = .09$, $p = .140$). Using the Sobel test, it was found that the magnitude of the relation between age and glycemic control increased significantly when parental monitoring was included ($z = 2.56$, $p = .011$). Thus, parent-reported monitoring of nonadherence fully mediated the effect of age on glycemic control, such that when controlling for SES, older youth who received more parental monitoring of nonadherence were in better glycemic control than those who received less parental monitoring. Mediational analyses for youth-reported monitoring of nonadherence as measured by a subscale of the PMDC were not significant.

Figure

$\beta = -.32\ (\beta = -.74)$
$p < .001$

Monitoring of Nonadherence
(PMDC Subscale: Parent-Report)

$\beta = -.19\ (\beta = -.11)$
$p = .004$

Age
(Years)

Glycemic Control
(HbA1c)

$\beta = .15\ (\beta = .20), p = .014$
$[\beta = .09, p = .140]$

$\beta = -.04$
$p = .500$

$\beta = -.35$
$p < .001$
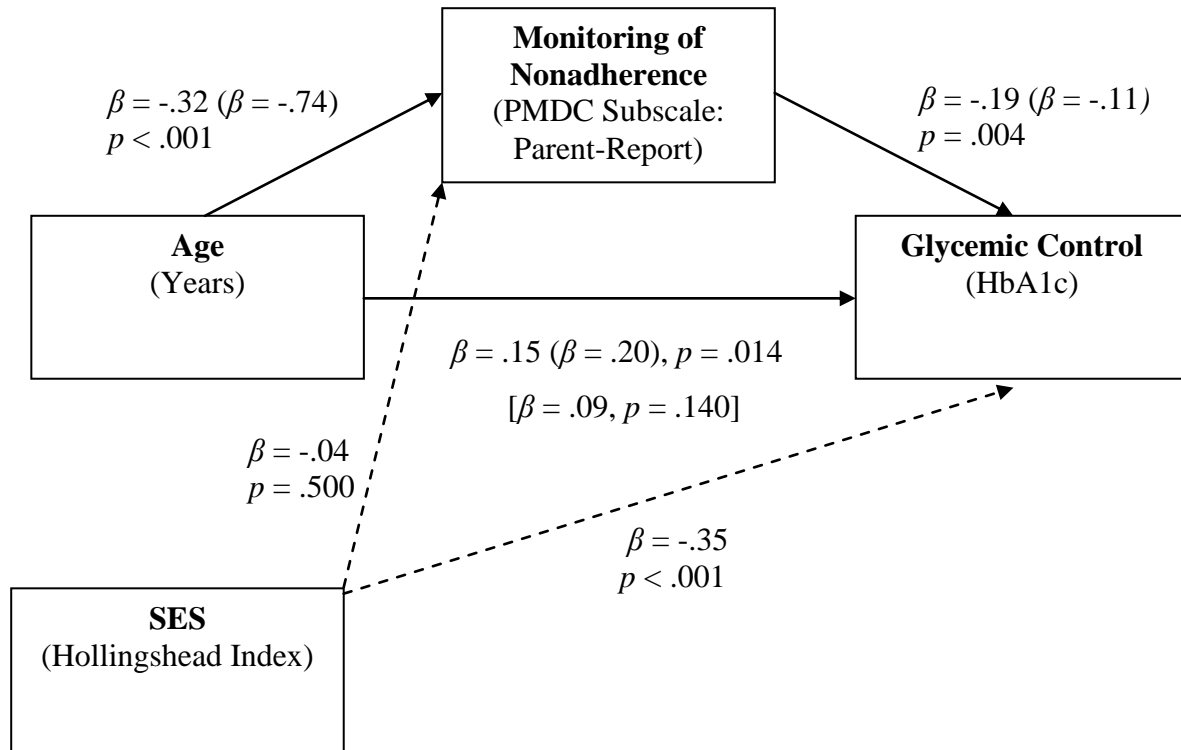
SES
(Hollingshead Index)

Figure 2. Monitoring of nonadherence as measured by the Parental Monitoring Diabetes Care Scale (PMDC) as a mediator between age and glycemic control (HbA1c). Values shown are standardized regression coefficients. Values in italics represent unstandardized beta weights. Values in brackets account for the relation of age on HbA1c after controlling for parental monitoring of nonadherence.

Discussion

Multi-source, multi-method indicators of parental involvement in diabetes care were examined to determine the association between parental involvement and glycemic control (HbA1c) during early-adolescence. Parental monitoring related to better glycemic control, consistent with the literature (Ellis et al., 2007; Grey, Davidson, Boland, & Tamborlane, 2001). New to the literature, however, is that multi-method assessment indicated global indices of parental involvement evidenced similar associations with glycemic control as specific indicators of parental involvement in daily diabetes behaviors. Both youth and parent ratings of global parental monitoring and nonadherence monitoring negatively related to HbA1c, such that higher

levels of monitoring were related to better glycemic control. That is, adolescents whose parents monitored disease care tasks overall, and omission of tasks in particular, were in better glycemic control. Despite these findings, the association of parental involvement diminished when demographic characteristics of age and SES were first evaluated, which suggests significant overlap among these constructs.

A more global measure of parental monitoring (i.e., PMDC; see Table 9) related as well to glycemic control as a measure of monitoring daily behaviors (i.e., 24-Hour Diabetes Interview; see Table 10) when controlling for SES. However, the measures differed in their relation to SES, such that the contribution of parental involvement to glycemic control was smaller. Further, more shared variance with SES was found with the global index of the PMDC in relation to SES and indicates the global measure is more related to demographic factors. In comparison, the 24-Hour Diabetes Interview appears to provide more unique information about parental involvement with less overlap with SES in its relation to glycemic control. Social desirability or knowledge of HbA1c results may be reflected in a global self-report of parental monitoring (i.e., PMDC) in this middle to upper-middle class sample who may wish to appear engaged in their adolescent's disease care or are likely well informed of their child's metabolic control. Additionally, families represented in the current study were recruited for an 18-month treatment study that required multiple assessment phases and follow-up phone participation. Participants may wish to appear more social desirability in their responses than in a purely cross-sectional design. The 24-Hour Diabetes Interview, however, may be less biased by such factors given that it captures a slice of behavior on two different days. Thus, families may more accurately report parental involvement. While the literature does not typically control for the

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effects of SES, findings from the current study suggest it may be a critical variable when examining parental monitoring or other putative factors related to glycemic control.

In order to better understand the role of parental involvement, and particularly parental monitoring which is most relevant to adolescents, future studies ought to consider additional measures of parental involvement. For example, the Collaborative Parent Involvement (CPI; Nansel et al., 2009) scale is a youth-report measure capturing various aspects of parental monitoring, including problem-solving, planning, communication, and knowledge of youth-completed tasks. Use of measures such as the PCI may provide insight into additional parental involvement behaviors or qualities that best protect against the deterioration of glycemic control in adolescence.

A well-established predictive association exists between age and glycemic control, such that as age increases, glycemic control decreases (Johnson et al., 1992; La Greca, Follansbee, & Skyler, 1990). The relations among parental monitoring, age, SES, and glycemic control was further explored through mediational models. In particular, parental monitoring was examined as a potential protective factor to ameliorate the adverse relation of age and glycemic control. Overall parental monitoring (PMDC Total Score) and parental monitoring of nonadherence (PMDC subscale) fully mediate the negative relation between age and glycemic control (see Figures 1 and 2). After controlling for the effects of SES, older youth whose parents demonstrated higher levels of monitoring were in better glycemic control than those whose parents demonstrated lower levels of monitoring. Thus, parental monitoring served as a protective factor against the age-related poorer glycemic control as youth age. While, causal relations cannot be inferred from cross-sectional data, concurrent relationships will be tested in prediction models once follow-up data collection is complete. Additional, the current study relied

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on regression analysis. Use of alternative statistical approaches in future studies, such as Structural Equation Modeling (SEM), may allow for models which account for multiple mediating factors between age and glycemic control.

Previous studies have examined whether there is a point at which high levels of parental monitoring may become counterproductive (Duke et al., 2008). Conflict often accompanies higher levels of parental involvement in adolescence (Greening, Stoppelbein, & Reeves, 2006). Thus, misdirected parental involvement may lead to a decrease in adherence due to the adolescent's expression of autonomy at the expense of disease management. Future studies ought to investigate the optimal level of parental monitoring at which point it is protective without creating conflict. Further, the current study targeted an age group at risk for deterioration in glycemic control. Parental monitoring served as a protective factor for older youth at risk for poorer metabolic control; however, it is unclear whether these findings would hold in later adolescence. The role of parental involvement in later adolescence and emerging adulthood is an area for further investigation.

Overall, an *a priori* decision to manage parent- and youth-reported data separately throughout analyses was supported by less than adequate parent-youth agreement across all measures of parental involvement (see Tables 3 and 4). While parents and youth were more often in agreement regarding behaviors measured by the 24-Hour Diabetes Interview than the PMDC, agreement values were still less than adequate (i.e., $r < .80$; Garson, 2010). Given this documented parent/youth discrepancy, if a single source reporter is available, evidence suggests that in adolescence, parents may be the preferred reporter of parental monitoring since their report more closely related to glycemic control. This information may be useful in streamlining measurement in future research with this age group.

Clinically, the 24-Hour Diabetes Interview appears more sensitive to variations in daily behaviors. The PMDC on the other hand captures global impressions of behaviors across a month's time which better reflect the three-month period of glycemic control (HbA1c). A more congruent time interval between the global index of the PMDC and the HbA1c biometric assay, may better serve the needs of interventions implemented at routine endocrinology appointments. Logistical differences are also important to consider in the clinical application of these findings since the 24-Hour Diabetes Interview takes roughly 30 to 40 minutes to administer to a parent-youth dyad and is labor intensive to score, whereas the PMDC can be completed independently by parents and youth and easily scored. Taken together, these factors suggest the PMDC is more convenient as a measure of parental monitoring (see Table 9) even though it provides less unique information to glycemic control than the 24 hour Diabetes Interview.

Further, the Monitoring of Nonadherence subscale of the PMDC was the largest single contributor to glycemic control when compared to remaining subscales and could serve as an abbreviated measure of parental monitoring. This subscale includes four items that capture how often parents are aware of a missed blood glucose check or insulin dose, as well as how quickly they know (e.g., within a few hours, within a day, etc.). The Monitoring of Nonadherence subscale of the PMDC could provide clinicians with a time-efficient assessment of parental monitoring behaviors that relate to glycemic control. An accurate and concise measure of parental involvement could both identify families appropriate for intervention and track meaningful change over time.

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List of References

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