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THE CONTRIBUTION OF PARENT PSYCHOSOCIAL FUNCTIONING TO PARENTAL
MONITORING, YOUTH ADHERENCE, AND GLYCEMIC CONTROL DURING
ADOLESCENCE

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of
Philosophy at Virginia Commonwealth University

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Abstract

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By Elizabeth M. Robinson, M.S.

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University.

Virginia Commonwealth University, 2014

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Objective: Type 1 diabetes is one of the most common pediatric chronic illnesses. Adolescents are at risk for poorer adherence and in turn, poorer glycemic control; however, youth whose parents remain involved in diabetes care are in better control. A parent's level of involvement is dependent in part upon his or her own social and emotional functioning. Much is known about the link between separate aspects of parent psychosocial functioning (e.g., depressive symptoms, parental stress) and parent involvement in diabetes care, adherence, and glycemic control. However, no study to our knowledge has examined these constructs simultaneously as they interrelate to one another and to youth diabetes status. Given the complexity of human behavior, use of multiple indicators of parent psychosocial status should provide a comprehensive portrayal of precursors to parental monitoring. **Methods:** The current study used structural equation modeling (SEM) in a sample of 257 parent-youth (aged 11-14) dyads (91% mothers) to examine comprehensive parent psychosocial functioning including parental distress, authoritative parenting, and parental self-efficacy for diabetes management as related to parental monitoring, youth adherence and glycemic control. **Results:** The SEM model fit the data well [$\chi^2(121) = 209.24, p < .001, CFI = .93, TLI = .91, RMSEA = .06, SRMR = .08$]. Overall, the

model accounted for 30% of the variance in parental monitoring, 27% of the variance in adherence, and 22% of the variance in glycemic control. Specifically, lower levels of parental distress (i.e., depressive symptoms, parenting stress, and hypoglycemic fear) related to higher parental self-efficacy for diabetes management and more authoritative parenting, each of which in turn related to more parental monitoring. Further, higher parental self-efficacy related directly to better youth adherence. **Conclusions:** The current study shows interrelated paths of parent psychosocial functioning associated with parental monitoring of youth diabetes care and ultimately, youth adherence and glycemic control. Interventions that target diabetes adherence in adolescents with T1D should consider screening for and treatment of parental distress.

The Contribution of Parent Psychosocial Functioning to Parental Monitoring, Youth Adherence, and Glycemic Control during Adolescence

Type 1 diabetes (T1D) is one of the most common childhood chronic illnesses with a prevalence of 1 in every 400 youth (Centers for Disease Control, 2011). Since T1D is usually diagnosed during childhood, the responsibility of diabetes management often rests with parents and makes parenting behaviors an important component of youth adaptation to and management of diabetes (Anderson, Ho, Brackett, Finkelstein, & Laffel, 1997; Anderson, Miller, Auslander, & Santiago, 1981; Hanson, De Guire, Schinkel, Henggeler, & Burghen, 1992; Hauser et al., 1990; Miller-Johnson et al., 1994; Robinson et al., 2013; Wsocki, 1993). Disease care responsibility is often transferred to youth during early adolescence, as parents gradually transition to a supervisory role. Maintained parent involvement during this transition is essential for successful diabetes management and prevention of deterioration in glycemic control (Ellis et al., 2007; Grey, Davidson, Boland, & Tamborlane, 2001; Hamilton & Daneman, 2002; Skinner, Murphy, Huws-Thomas, Snoek, & Snoek, 2005). However, parents' involvement and effectiveness varies and may be associated with their psychosocial functioning. For example, presence of depressive symptoms or poor self-efficacy for diabetes management may reduce emotional resources necessary to be involved in a youth's diabetes care. Thus, a closer look at the link between parent psychosocial functioning and parental monitoring as they relate to adherence and glycemic control is merited.

The current study aims to better understand the association between parent psychosocial functioning and parental monitoring as they relate to diabetes adherence and glycemic control in adolescents with T1D. Typically, individual components of parent psychosocial functioning have been examined in isolation with parental monitoring and diabetes adherence (Helgeson, Becker, Escobar, & Siminerio, 2012; Wiebe et al., 2011). To our knowledge a comprehensive model that

accounts for multiple domains of psychosocial functioning simultaneously has yet to be proposed. Therefore, three constructs of parent psychosocial functioning will be studied concurrently: parental distress (i.e., depressive symptoms, pediatric parenting stress, hypoglycemic fear), parenting style (i.e., authoritative style), and parental self-efficacy for diabetes management. Each of these components of parent psychosocial has compelling associations with parental monitoring, diabetes self-care, and glycemic control independently, but would more meaningfully comprise an inclusive model. Thus, parental monitoring of diabetes management will be assessed as a mediator between these three domains of parent psychosocial functioning, adherence, and ultimately glycemic control in youth.

Diabetes Management

Diabetes management is complex and involves integration of information from blood glucose monitoring, diet, and physical activity to determine an appropriate insulin regimen. 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). While youth without diabetes experience blood glucose levels within a more narrow range (i.e., 80 to 150 milligrams of glucose per deciliter of blood [mg/dl]), youth with T1D may experience levels that range 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 T1D to maintain levels within range (American Diabetes Association [ADA], 2010).

Youth with T1D require multiple doses of insulin throughout the day, including before meals and snacks and at bedtime (Rewers et al., 2007); however, insulin regimens vary from

patient to patient. Many 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 combined with carbohydrate counting allow for more variety in food choices. Use of continuous subcutaneous insulin infusion (i.e., insulin pump) is increasingly common and allows for increased flexibility in frequency and variety of food consumption, as well as daily activities and physical activity (Rewers et al., 2007). A basal rate delivers insulin continuously over 24 hours to keep blood glucose levels in range between meals and overnight. Bolus doses of insulin are manually administered to cover carbohydrates in meals and to correct or supplement basal doses.

Recommendations for physical activity are the same for children with T1D as for their healthy peers (i.e., 60 minutes/day; U.S. Department of Health and Human Services, 2008); however, more frequent blood glucose testing is required with physical activity, as 10 to 20% of hypoglycemic episodes are associated with exercise (Rewers et al., 2007). Finally, nutritional recommendations for youth with T1D are similar to those of peers without diabetes (Smart, Aslander-van Vliet, & Waldron, 2010); however, they must carefully consider the intake of carbohydrates and fats, both of which affect blood glucose levels. Therefore, youth with diabetes may require routine nutrition education, especially related to carbohydrate counting, in order to meet blood glucose goals without excessive hyperglycemia to maintain normal growth and development (Rewers et al., 2007).

Diabetes Complications

Acute consequences of T1D include abnormal growth rates, diabetic ketoacidosis (DKA), and hypoglycemia (Rewers et al., 2007). DKA results from prolonged hyperglycemia or insulin deficiency, which causes an accumulation of ketones in the blood, whereas hypoglycemia results

from low blood glucose levels, which can cause cognitive impairment, loss of consciousness, or in some cases death. Chronic complications of T1D include higher morbidity from nephropathy, neuropathy, and cardiovascular disease as a result of chronic hyperglycemia (Diabetes Control and Complications Trial Research Group [DCCT], 1993, 1994, 1996, 2005). Successful management of T1D reduces the frequency and severity of these outcomes; however, many families have difficulty maintaining glycemic control within the recommended guidelines, especially during adolescence (Grey, Boland, Davidson, Li, & Tamborlane, 2000).

Diabetes Management during Adolescence

Adolescence is a developmental period in which youth with T1D are particularly at-risk for poorer adherence and glycemic control due to unique biological and behavioral challenges. Despite optimal regimen adherence, biological factors frequently perturb optimal blood glucose management. Pubertal hormones function as glucose counterregulatory hormones that raise blood glucose levels (Amiel, Sherwin, Simonson, Lauritano, & Tamborlane, 1986). Therefore, adolescents must manage increased insulin requirements. Further, several behavioral challenges accompany adolescence that often make diabetes management during this developmental period difficult. As adolescents' autonomy in diabetes management increases, parents and youth must renegotiate roles. While youth may desire more independence in diabetes management, they must also balance an increase in academic, social, and extracurricular demands. Thus, unpredictability in glucose management during the introduction of puberty and the behavioral issues that can accompany adolescence make optimal diabetes management a challenging task.

Glycemic Control

Glycemic control is measured by glycosylated hemoglobin (HbA1c) levels, an indicator of average blood glucose concentration from the previous three-month period. While alternative

indicators of glycemic control exist (e.g., incidence of hypoglycemia, hospitalizations), HbA1c is the only measure for which ample outcome data exists such that it is the gold standard (Rewers et al., 2007). 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). As mentioned, adolescence is a particularly vulnerable period for diabetes care given the biological and behavioral factors at play. As a result, adolescents tend to be in poorer glycemic control than younger youth (Johnson et al., 1992; La Greca, Follansbee, & Skyler, 1990). Even in adolescence, five to seven years of poorer glycemic control related to increased risk of such complications within six to 10 years (Donaghue et al., 1997; Mohsin et al., 2005; Orchard, Forrest, Kuller, & Becker, 2001). In order to maintain an HbA1c close to the normal range, vigilant diabetes management on both the part of an adolescent and a parent is required.

Glycemic control and sociodemographic factors. Glycemic control is related to sociodemographic factors such as socioeconomic status (SES) and parent marital status. SES and parent marital status are each inversely related to glycemic control in youth with T1D (Swift, Chen, Hershberger, & Holmes, 2006). Poorer glycemic control and disease care behaviors previously attributed to ethnicity, are better accounted for by lower SES (Powell, Chen, Kumar, Streisand, & Holmes, 2012). Longer disease duration is also a risk factor for poorer glycemic control (Johnson, Perwien, & Silverstein, 2000). Finally, youth on an insulin pump regimen tend to achieve better glycemic control (Pickup, Mattock, & Kerry, 2002; Weissberg-Benchell, Antisdell-Lomaglio & Seshardi, 2003). As such, the current study considered these sociodemographic factors in the analyses.

Diabetes Adherence and Glycemic Control

T1D requires that youth balance a number of tasks throughout the day, which include blood glucose monitoring, insulin administration, physical activity, and nutrition. Adherence to each individual area of self-care is related to improved glycemic control.

Blood glucose monitoring. Frequency of blood glucose monitoring is associated with better glycemic control above all other disease care behaviors because of the ability to better adjust insulin and consume food in response to blood glucose levels that are out-of-range (Hanson et al., 1996; Johnson et al., 1992; Swift et al., 2006). After controlling for gender, duration of diabetes, and Tanner stage, adherence to blood glucose monitoring recommendations was the most consistent indicator of glycemic control compared to other disease care tasks (Anderson et al., 1997). Further, improvements in glycemic control were predicted by frequency of blood glucose monitoring (Rausch et al., 2012).

Insulin administration. Adherence to the prescribed insulin regimen is also an indicator of glycemic control (DCCT, 1993; Stewart, Emslie, Klein, Haus, & White, 2005). For many, improved insulin adjustments was possible with the use of pump therapy (Pickup et al., 2002; Weissberg-Benchell et al., 2003) and a significant decrease in HbA1c was common when youth transitioned from basal bolus shot therapy to pump therapy (Nimri et al., 2006). Improvements in glycemic control related to adherence to insulin regimen are possible; however, adherence to insulin regimen is not as consistent of an indicator when compared to blood glucose monitoring. This may be due to the variation in insulin regimens that make this behavior more difficult to measure.

Physical activity. Exercise is beneficial for a number of health outcomes; however, the association between physical activity and glycemic control is variable (Austin, Warty, Janosky, & Arslanian, 1993; Hanson et al., 1996; Silverstein et al., 2005; Stewart et al., 2005; Wasserman

& Zinman, 1994). Lower HbA1c levels related to more frequent exercise among lower SES Puerto Rican youth (Streisand et al., 2002); however, this association was not confirmed in less diverse samples (Hanson et al., 1996; Stewart et al., 2005). While it emerged as relevant to glycemic control for some, it may be that blood glucose monitoring and insulin adjustments made in response to exercise are more salient than health benefits related to HbA1c alone.

Nutrition. Finally, the DCCT indicated that patients who follow a recommended diet the majority of the time (i.e., $\geq 90\%$) had up to one percent better glycemic control compared to those that were less adherent (Delahanty & Halford, 1993). Specific dietary composition, such as diet consistency and adjustment of insulin dose for variations in food intake, was associated with lower HbA1c (Delahanty & Halford, 1993). Further, intake of specific nutrients such as higher fat intake was associated with poorer glycemic control (Delahanty et al., 2009). However, the variance in eating behaviors from one individual to the next is likely even greater than variance in insulin regimen. This makes nutrition, like insulin administration and exercise, a less reliable measure of adherence as it relates to glycemic control than blood glucose monitoring.

Parental Monitoring

As discussed, management of T1D requires complex physical and cognitive skills, planning, and daily adherence to a prescribed regimen. Failure to complete these tasks can lead to both short- and long-term consequences (DCCT, 1994). Given that the onset of T1D is most often in childhood, parents initially assume a majority of the responsibility for disease management (Davis et al., 2001; Rubin, Young-Hyman, & Peyrot, 1989). As children get older, responsibility ought to transfer gradually in response to a child's success with independent task completion and demonstration of psychological maturity, at which point parental monitoring is maintained (Anderson et al., 1997). Parental monitoring is a step removed from direct

involvement and is appropriate only once an adolescent demonstrates consistent and successful autonomy of diabetes management. Parental monitoring involves regular contact with an adolescent and knowledge of daily activities (Dishion & McMahon, 1998). While adolescents typically have the ability to perform diabetes tasks, they often need help with decision-making about insulin adjustments (Wysocki et al., 2003), particularly when diabetes care is in competition with typical developmental tasks (Iannotti & Bush, 1993). Parents who remain involved may provide behavioral assistance, as well as model problem-solving to address high and low blood glucose levels (Greening, Stoppelbein, & Reeves, 2006).

Parents may be tempted to relinquish total responsibility for diabetes management to adolescents in order to decrease associated stress (Korbel et al., 2003). However, decline in parental monitoring was concurrent with decline in adherence and glycemic control during adolescence (Anderson, Auslander, Jung, Miller, & Santiago, 1990; Anderson et al., 1997; King, Berg, Butner, Butler, & Wiebe, 2013; Schilling, Knafl, & Grey, 2006; Skinner et al., 2005; Wysocki et al., 1996). Longitudinal analyses demonstrated that greater parental monitoring and less change in monitoring across two and a half years predicted slower declines in adherence during adolescence (King et al., 2013). As a result, treatment programs have targeted sustained parental involvement and promotion of family teamwork in adolescence to prevent deterioration in glycemic control (Anderson, Brackett, Ho, & Laffel, 1999; Holmes, Chen, Mackey, Grey, & Streisand, 2014; Laffel et al., 2003).

Parent Psychosocial Functioning

Parents play an integral role in diabetes care, especially during adolescence; however, their involvement may be reflective, at least in part, of their own psychosocial functioning and ability to manage diabetes (Carcone, Ellis, & Naar-King, 2012; Jaser & Grey, 2010; Whittemore,

Jaser, Chao, Jang, & Grey, 2012). Much is known about elements of parents' psychosocial functioning (e.g., parental distress, parental self-efficacy for diabetes management, authoritative parenting) and parental monitoring in disease care as disparate constructs that relate to adherence and glycemic control. Less is known, however, about the interaction between parent psychosocial functioning and parental monitoring. Often only a single construct of parent functioning has been examined in tandem with parental monitoring, rather than a more inclusive approach. Parenting behavior is complex and areas of psychosocial functioning are often related. For instance, depressive symptoms may relate to a parent's efficacy in his/her ability to manage diabetes. As a result, s/he may be less involved and defer responsibility to an adolescent. Parental distress (i.e., depressive symptoms, pediatric parenting stress, hypoglycemic fear), parental self-efficacy for diabetes management, and parenting style (i.e., authoritative parenting) were each related to parental monitoring and diabetes outcomes in youth, but to date, have not been considered simultaneously to create a comprehensive picture of parent functioning as it relates to youth diabetes care.

Parental distress. Parents of youth with a chronic illness are at risk for poorer mental health outcomes than those of healthy youth (Wallander et al., 1989). Specifically, the rigors of a diabetes regimen can place high demands on parents and may relate to more depressive symptoms than in the general population (Helgeson, Siminerio, Escobar & Becker, 2009). Further, the unpredictable symptoms characteristic of T1D can lead to more stress in the form of social disruption and emotional strain (Dodgson et al., 2000).

Depressive symptoms. Diabetes-specific demands related to elevated symptoms of depression in 10 to 33% of mothers, which exceeds national prevalence rates (Driscoll et al., 2010; Eckshain, Ellis, Kolmodin, & Naar-King, 2009; Jaser, Whittemore, Ambrosino,

Lindemann, & Grey, 2008, 2009). Findings from a study of mothers within the current sample demonstrated that 21% of mothers presented with clinically elevated depressive symptoms (Mackey, Streumph, Powell, Chen & Holmes, 2013) compared to women in the general population (i.e., 5-9%; Snow, Lascher, & Mottur-Pilson, 2000).

These rates raise concern, given that maternal depression has been directly linked to poorer youth adherence (Carcone et al., 2012; Jaser & Grey, 2010; Whittemore et al., 2012) and indirectly linked to poorer glycemic control (Anderson et al., 2002; Eckshtain et al., 2009; McGrady, Laffel, Drotar, Repaske, & Hood, 2009). Both cross-sectional and longitudinal studies suggest that when mothers reported fewer depressive symptoms, parent involvement was an indicator of better glycemic control (Wiebe et al., 2011).

These associations may be best understood by the link between depression and parental involvement in diabetes management (Wiebe et al., 2011). Adolescents benefit from warm, sensitive parents (Berg et al., 2008; Jaser & Grey, 2010) who can collaborate in diabetes care (Wysocki et al., 2009) and assist with problem-solving skills (Wysocki et al., 2008). Parental depressive symptoms can disrupt this dynamic. Symptoms often lead a parent to disengage and focus on personal needs (Dix, Gershoff, Meunier, & Miller, 2004). As a result, youth may exhibit more independence for disease care than is developmentally appropriate. Further, youth may be less likely to seek help from a parent that is depressed. Structural equation modeling (SEM) confirmed that more maternal depressive symptoms directly related to less parental monitoring, and in turn with poorer adherence and glycemic control (Mackey et al., 2013).

On the other hand, when depressed parents remained involved in disease care, they tended to delay the transfer of disease care (Dix et al., 2004; Lovejoy, Graczyk, O'Hare, & Neuman, 2000). The renegotiation of diabetes responsibility requires scaffolding and increased

communication. Rather than allow youth to gradually assume autonomy for age appropriate tasks and resume a more supportive, supervisory role, depressed parents tended toward strategies that require less cognitive effort (Kochanska, Kuczynski, Radke-Yarrow, & Welsh, 1987). For example, depressed mothers' level of responsibility declined at a slower rate across 16 months compared to those that were not depressed (Weibe et al., 2011). Thus, depressed mothers were involved but did not transition to a supervisory role when developmentally appropriate. Further, these youth did not demonstrate the glycemic control benefits associated with increased involvement.

Pediatric parenting stress. Depressive symptoms often co-occur with increased stress (Helgeson et al., 2012; Jaser et al., 2009; Patton, Dolan, Smith, Thomas, & Powers, 2011). Psychological stress in parents is common at the time of diagnosis, e.g., nearly a fourth of parents meet DSM-IV criteria for posttraumatic stress disorder six weeks after diagnosis (Landolt et al., 2002). Given the frequency of hypo- and hyperglycemic episodes, in addition to routine blood glucose checks, carbohydrate counting, and insulin administration, parents can be involved in diabetes care several times throughout the day. Therefore, stress is often maintained past the point of diagnosis. Stress compromises cognitive processes such as learning and recall (Gillis, 1993), and given the complicated nature of a T1D regimen, a distressed parent may not understand or be able to perform disease care tasks as competently (Streisand, Braniecki, Tercyak, & Kazak, 2001).

Similar to parental depression, stressed parents may be overwhelmed by their responsibilities and withdraw from diabetes management, or exert more control over the child's diabetes care that is developmentally appropriate (Helgeson et al., 2012). As such, in most cases pediatric parenting stress related to poorer glycemic control (Helgeson et al., 2012; Stallwood,

2005; Streisand, Swift, Wickmark, Chen, & Holmes, 2005). The association between parenting stress and parental involvement in diabetes care provides some insight into precursors of decreased parental involvement during adolescence. For one, youth begin to demonstrate their own efficacy and parents may feel relief from the stress. That is, parents with fewer psychological resources may feel more overwhelmed by disease care responsibilities and opt out of a supervisory role.

Hypoglycemic fear. Hypoglycemia if untreated can result in unconsciousness, seizures, coma, or at worst death (Silverstein et al., 2005). Given the risk of acute symptoms, many parents develop a fear of hypoglycemia and may maintain higher blood glucose levels and over treat early signs of hypoglycemia (Marrero, Guare, Vandagriff, & Fineberg, 1997). Increased hypoglycemic fear in parents is often a function of past seizure and loss of consciousness episodes, regardless of how recent the event (Marrero et al., 1997).

Most of what is known on hypoglycemic fear is among parents of young children (Clarke, Gonder-Frederick, Snyder, & Cox, 1998) and suggests that youth maintain higher blood levels as a result (Patton, Dolan, Henry, & Powers, 2007). Less is known about this construct in adolescence and most findings do not support an association between parental hypoglycemic fear and glycemic control (Irvine, Cox, & Gonder-Frederick, 1992; Marrero et al., 1997).

Hypoglycemic fear does, however, interact with a number of distal parent psychosocial factors that relate to adherence. For example, hypoglycemic fear in parents related to greater parental distress, such as depression (Jaser et al., 2009) and parenting stress (Streisand et al., 2005).

Parental self-efficacy for diabetes management. In the context of parenting, self-efficacy refers to the extent to which a parent feels competent to manage a child's daily care needs (Bandura, 1977; Johnston & Marsh, 1989). Parents need to both understand and

confidently execute diabetes care, but also have the skills to transfer this knowledge to their child (Leonard, Skay, & Rheinberger, 1998). Parental self-efficacy for diabetes management positively relates to better youth self-management (Evans & Hughes, 1987). For example, maternal self-efficacy related to self-care for ketone monitoring, insulin administration, and overall self-care among youth ages eight to 17 years (Leonard et al., 1998).

Parental self-efficacy often interacts with other parent psychosocial factors, such as depressive symptoms and parenting stress. For instance, alternative pathways between parental depressive symptoms and poorer diabetes outcomes, discussed earlier, may exist. Decreased parental self-efficacy for diabetes management was associated with depressive symptoms (Jones & Prinz, 2005). That is, depressive symptoms may lead to lower self-confidence in diabetes management, which relates to less parental monitoring.

Finally, much like depressive symptoms, pediatric parenting stress operates in tandem with parental self-efficacy for diabetes management. After accounting for SES, parent race, and parent marital status, lower parental self-efficacy, greater parent responsibility for disease care, and greater hypoglycemic fear assumed a significant portion of the variance in the frequency (32%) and difficulty (19%) of parenting stress in a sample of nine to 17-year-olds (Streisand et al., 2005). Almost a third of reported parenting stress was accounted for by their perceived ability to perform diabetes care tasks, completion of tasks, and fear about hypoglycemic symptoms. Herein lies the motivation to assess multiple constructs of parent psychosocial functioning within the same sample in order to better understand the complexity of parenting behaviors that relate to parental monitoring and youth diabetes management.

Authoritative parenting. Parenting style reflects parental interactions with children. Parenting style pertains to two dimensions, warmth or supportiveness and demandingness or

behavioral control (Baumrind, 1967). Authoritative parenting is defined by consistent but flexible limits coupled with high levels of warmth and nurturance. This approach is most often associated with positive child health outcomes (Darling & Steinberg, 1993; Hubbs-Tait, Kennedy, Page, Topham, & Harrist, 2008; Wake, Nicholson, Hardy, & Smith, 2007).

Although less is known about parenting style in pediatric diabetes, evidence suggests that authoritative parenting, an approach that is both demanding and responsive, relates to better outcomes for youth with T1D. Warm, structured parent-youth interactions may serve as a protective factor for poorer adherence and glycemic control during adolescence (Anderson et al., 1997; Greene, Mandelco, Roper, Marshall, & Dyches, 2010; Helgeson et al., 2010; Shorer et al., 2011). For instance, among caregivers, greater authoritative parenting related to greater behavioral adherence in youth (Monaghan, Horn, Alvarez, Cogen, & Streisand, 2012). However, no differences in glycemic control were observed. The inverse was also true in which more parental restrictiveness (i.e., authoritarian parenting style) related to poorer adherence glycemic control (Davis et al., 2001; Greene et al., 2010).

Statement of Problem

T1D is one of the most common pediatric chronic illnesses. Youth with T1D are at risk for poorer glycemic control during adolescence. Although some biological factors are implicated, a number of behavioral factors also emerge during this developmental period. At the forefront is the transition of disease care responsibility from parents to youth, which is a delicate process. Parents aim to foster autonomy in adolescents, but must remain involved in a supervisory role as youth still require assistance with planning and decision-making. While a parent's role is more removed than in childhood, parental monitoring is critical during adolescence to sustain adherence and glycemic control.

A parent's level of involvement and effectiveness is dependent in part upon his or her own social and emotional functioning given the link that exists between parent psychosocial functioning and parent involvement in diabetes care. Parent psychosocial functioning within pediatric diabetes includes parental distress (e.g., depressive symptoms, parenting stress, hypoglycemic fear), parental self-efficacy for diabetes management, and authoritative parenting. Each of these areas of functioning is directly related to youth adherence and in some cases glycemic control. However, no study to our knowledge examines these constructs simultaneously as they relate to parental monitoring in adolescents with T1D. Given the complicated nature of human behavior, use of multiple indicators of parent psychosocial status could provide a more complete picture of how these links relate to parental monitoring.

Thus, the current study used SEM to examine parent psychosocial functioning in a comprehensive manner including parental distress, parental self-efficacy for diabetes management, and authoritative parenting. More parental monitoring should serve as a mediator between better parent psychosocial functioning and adherence, which in turn should link to better glycemic control. A better understanding of the relation among psychosocial factors and their role as indicators of parental monitoring should allow for more targeted parental screening and intervention (see Figure 1).

Hypotheses

Hypothesis 1. Lower levels of parental distress (i.e., fewer depressive symptoms, less parenting stress, and less hypoglycemic fear) should directly relate to more parental self-efficacy for diabetes management, more authoritative parenting, and more parental monitoring. Further, less parental distress should directly relate to better adherence and indirectly relate to better glycemic control (HbA1c).

Hypothesis 2. More authoritative parenting should relate directly to more parental monitoring and better adherence. More authoritative parenting should indirectly relate to better glycemic control.

Hypothesis 3. Higher parental self-efficacy for diabetes management will directly relate to more parental monitoring and better adherence. Further, it should indirectly relate to better glycemic control.

Hypothesis 4. More parental monitoring should directly relate to better adherence and glycemic control.

Hypothesis 5. Finally, lower parental distress, higher parental self-efficacy, and more authoritative parenting should indirectly relate to better adherence and glycemic control via more parental monitoring.

Parent Psychosocial Functioning:

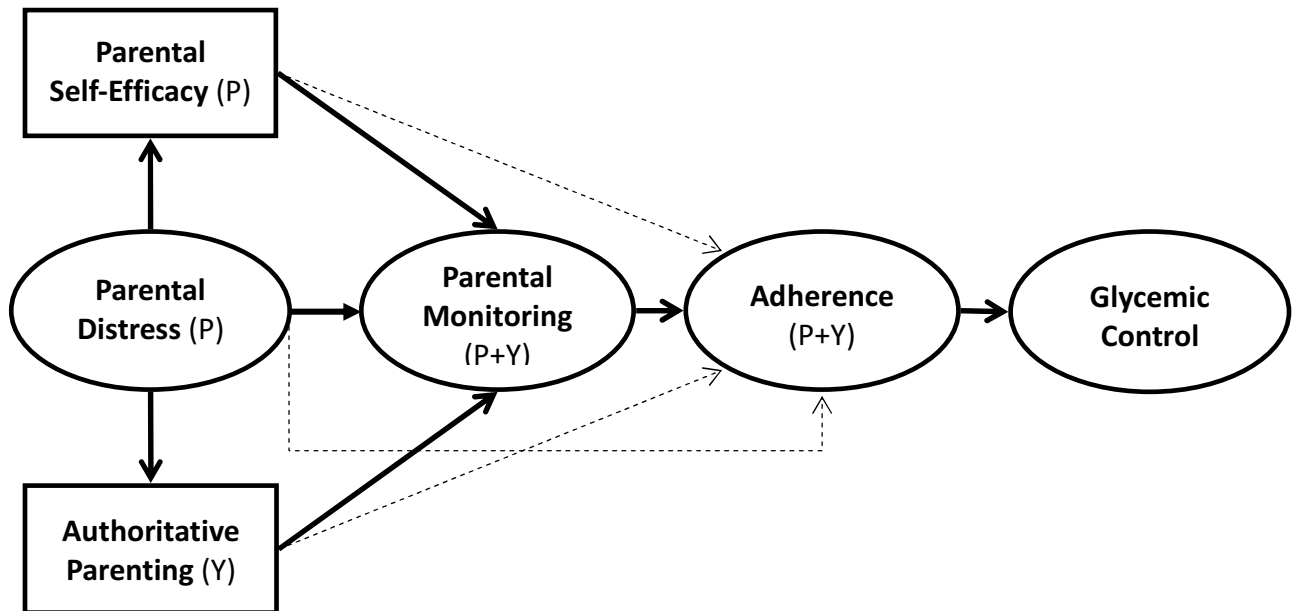


Figure 1. Proposed structural equation model. *Note.* Source of data for each construct is provided within parentheses: P=Parent, Y=Youth, P+Y= Parent and Youth report. Glycemic control values were obtained from medical charts.

Method

Participants

Data were collected from 257 primary caregivers and their youths recruited from two pediatric endocrinology clinics in Richmond, VA and Washington, DC. Inclusion criteria required youth to be aged 11 to 14 years at time of recruitment and have a diagnosis of T1D for at least a year, without significant medical comorbidities.

Procedure

Data were collected as part of a multi-site, 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. Parents were contacted by phone and invited to participate. For those who agreed, assessments were scheduled in conjunction with a youth's upcoming medical appointment. After written informed parental consent and youth assent were obtained, 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 Interview. Phone interviews lasted approximately 20 minutes for each youth and parent.

Measures

Parent psychosocial functioning. Three domains of parent psychosocial functioning were assessed, including parental distress, parental self-efficacy for diabetes management, and authoritative parenting.

Parental distress. This construct comprised of depressive symptoms, pediatric parenting stress, and hypoglycemic fear.

The Beck Depression Inventory, Second Edition (BDI-II; Beck, Steer & Brown, 1996) assessed depressive symptoms. The BDI-II is a self-report measure comprised of 21 items which describe depressive symptoms. Parents rated the severity of symptoms in the past two weeks along a four-point scale that ranged from least to most severe. Parents who scored above a 29 were approached by research staff at the time of assessment and provided referral information for psychological follow-up. The BDI-II is widely accepted measure for state depressive symptomology and has high internal consistency ($\alpha = .92-.93$) and test-retest reliability ($r = .93$; Beck et al., 1996; Dozois, Dobson, & Ahnberg, 1998). Acceptable internal consistency also was detected within the current sample ($\alpha = .91$). Total scores were used in the analyses.

Pediatric parenting stress was measured by The Pediatric Inventory for Parents (PIP; Streisand et al., 2001), a 42-item, parent-report questionnaire. The PIP measures the frequency of stressful events and amount of difficulty experienced as a result. Items are rated along a five-point Likert scale according to Frequency (1 = Never, 5 = Very Often) and Difficulty (1 = Not at all, 5 = Extremely). Higher scores indicate increased frequency and/or difficulty. The PIP spans four domains: Communication (e.g., “Disagreeing with a member of the healthcare team”), Emotional Distress (e.g., “Seeing my child sad or scared”), Medical Care (e.g., “Being with my child during medical procedures”), and Role Function (e.g., “Being unable to go to work”). Internal consistency (Frequency score, $\alpha = .95$; Difficulty score, $\alpha = .96$) for this measure is adequate (Streisand et al., 2005). Within the current sample high internal consistency also was detected (Frequency score, $\alpha = .93$; Difficulty score, $\alpha = .95$). Construct validity is also

established (Streisand et al., 2001). Total Frequency and Difficulty scores were used in the analyses.

The Hypoglycemic Fear Survey-Parent (HFS-P; Clark et al., 1998) is a parent-reported measure of hypoglycemic fear and the negative consequences of such episodes. The HFS-P was adapted from the Hypoglycemic Fear Survey originally designed for adults with T1D (Cox, Irvine, Gonder-Frederick, Nowacek, & Butterfield, 1987). The HFS-P is comprised of two subscales, the Behavior Subscale and the Worry Subscale. The Worry Subscale was administered in the current study and includes 13 items that describe different anxiety-provoking aspects of hypoglycemia (e.g., “My child not having food, fruit, or juice with him/her”). Items are rated on a five-point Likert scale (0 = Never, 4 = Always). The Cronbach’s alpha for the HFS-P Worry subscale is adequate ($\alpha = .96$; Irvine, Cox, & Gonder-Frederick, 1994). In the current sample, internal consistency was adequate as well ($\alpha = .88$).

Parental self-efficacy for diabetes management. The Self-Efficacy for Diabetes Self-Management Scale-Parent (SEDSM-P; Iannotti et al., 2006), originally developed to assess self-efficacy in adolescents, was adapted for parents and used to measure parental self-efficacy. The SEDSM-P is a 10-item self-report measure of parent perceived self-efficacy to perform diabetes care behaviors for youth, such as blood glucose checks and insulin injections. Parents rated each item on a 10-point scale (1 = not sure at all that I could do the target behavior [e.g. “Adjust [my] child’s insulin or food accurately based on how much exercise they got.”], 10=completely sure that I could do the target behavior). Higher scores indicate higher levels of self-efficacy for diabetes self-care behaviors. Parental self-efficacy both shows high internal consistency ($\alpha = .90$) and test-retest reliability ($\alpha = .89$; Iannotti, Schneider, et al., 2006). Internal consistency in the present sample was high ($\alpha = .85$). Total scores were used in the analyses.

Authoritative parenting. The Parenting Style Index (PSI; Steinberg, Lamborn, Darling, Mounts, & Dornbusch, 1994) is a youth-report questionnaire developed to measure authoritative qualities of parents. The original scale has a total of 36 items across three dimensions: Acceptance/Involvement, Parental Monitoring and Control, and Psychological Autonomy. In the present study, nine items were used to measure the extent of parental authoritativeness (three items from each of the dimensions). Items were measured on a five-point Likert scale (1 = Never, 5 = Always). Internal consistency in previous studies ranges from .72 to .82 across the three dimensions. In the current sample, the reliability for the authoritativeness subscale was .66.

Parental monitoring. Parental monitoring was measured in two ways, a global self-report measure of parenting behaviors and a semi-structured interview of diabetes self-care behaviors. Both obtained parent and youth report.

Parents and youth completed the Parental Monitoring of Diabetes Care Scale (PMDC; Ellis et al., 2007; Ellis et al., 2008). Respondents rated the frequency with which parents typically monitor 18 specific tasks of diabetes management on a five-point scale (1 = More than once a day, 5 = Less than once a week). The PMDC is comprised of five domains that include 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. This measure has established adequate internal consistency ($\alpha = .81$) and good temporal stability over a two-week interval (ICC = .80; Ellis et al., 2008). Within the current sample internal consistency was .75. Total scores were used in the analyses.

Parents and youth each completed 24-Hour Diabetes Interviews (DI; Holmes et al., 2006, adapted from Johnson, Silverstein, Rosenbloom, Carter, & Cunningham, 1986). One set of interviews was conducted in-clinic and the second was completed during a follow-up phone

interview. Parents and youth were interviewed separately and asked to recall the previous day's diabetes tasks (e.g., blood glucose checks, insulin administration) in temporal sequence. While the 24-Hour Diabetes Interview has historically assessed adherence, adaptations of the measures capture parental monitoring, by asking if the parent observed or discussed blood glucose checks over the course of the previous day. Percentage of blood glucose checks that parents observed or discussed was calculated and averaged across the two interview days. Of the diabetes care tasks assessed in the DI, blood glucose checks were selected because insulin administration can vary across patients and between multiple daily injections, basal/bolus, and regimens, while recommendations for frequency of blood glucose monitoring are more consistent. Further, frequency of blood glucose monitoring was used previously as a proxy for adherence and is linked with glycemic control (Hilliard et al., 2011). Twenty-four hour recall methodology is a reliable, valid, "well-established" measure of diabetes self-care behavior (Freund, Johnson, Silverstein, & Thomas, 1991; Quittner, Modi, Lemanek, Ievers-Landis, & Rapoff, 2008).

Adherence. Diabetes self-care was assessed in two ways, a global self-report measure of adherence and a semi-structured interview of diabetes self-care behaviors.

Parents and youth completed the Diabetes Behavior Rating Scale (DBRS; Iannotti, 2006). The DBRS is a self-report measure in which respondents report the frequency of completed diabetes care tasks in the week prior. This measure spans four domains along a two different five-point scales that include Daily Prevention Behaviors and Other Diabetes Care Practices (0 = Never, 4 = Always), as well as Modification of Diabetes Care Plan and Intervention Behaviors (0 = None, 5 = five times). The insulin pump version contains 37 items and the non-pump version for insulin injections contains 36 items. The DBRS has good internal consistency ($\alpha = .84$ for both parent and youth report) and test-retest reliability ($r = .71$; Iannotti, 2006). In this sample,

the reliability coefficient was adequate for both versions (pump: parent report $\alpha = .69$, youth report $\alpha = .81$; non-pump: parent report $\alpha = .79$, youth report $\alpha = .80$). Total scores were used in the analyses.

As part of the DI (Holmes et al., 2006; described above), parents and youth provided the total number of blood glucose checks completed throughout the previous 24 hours. The number of blood glucose checks completed was averaged across two days for youth and parent report.

Glycemic control. 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). HbA1c was analyzed via blood assay (DCA 2000, Bayer Inc.; Tarrytown, NY, USA) collected at the diabetes clinic visit and values were extracted from the medical record. Higher HbA1c values indicate poorer glycemic control. HbA1c values from the baseline assessment and three months following baseline were used in the current study to establish greater stability in the primary outcome variable. Both collection points were prior to intervention delivery.

Demographic and additional medical information. Parents provided demographic and additional medical information, including ethnicity, parental marital status, age of disease onset, disease duration, and SES. Medical data were verified through review of medical records. SES was calculated in accordance with the Hollingshead Four Factor Index (Hollingshead, 1975). Parental education level and occupation were transformed into a raw score that ranges 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.” See Figure 2 for the proposed measurement model.

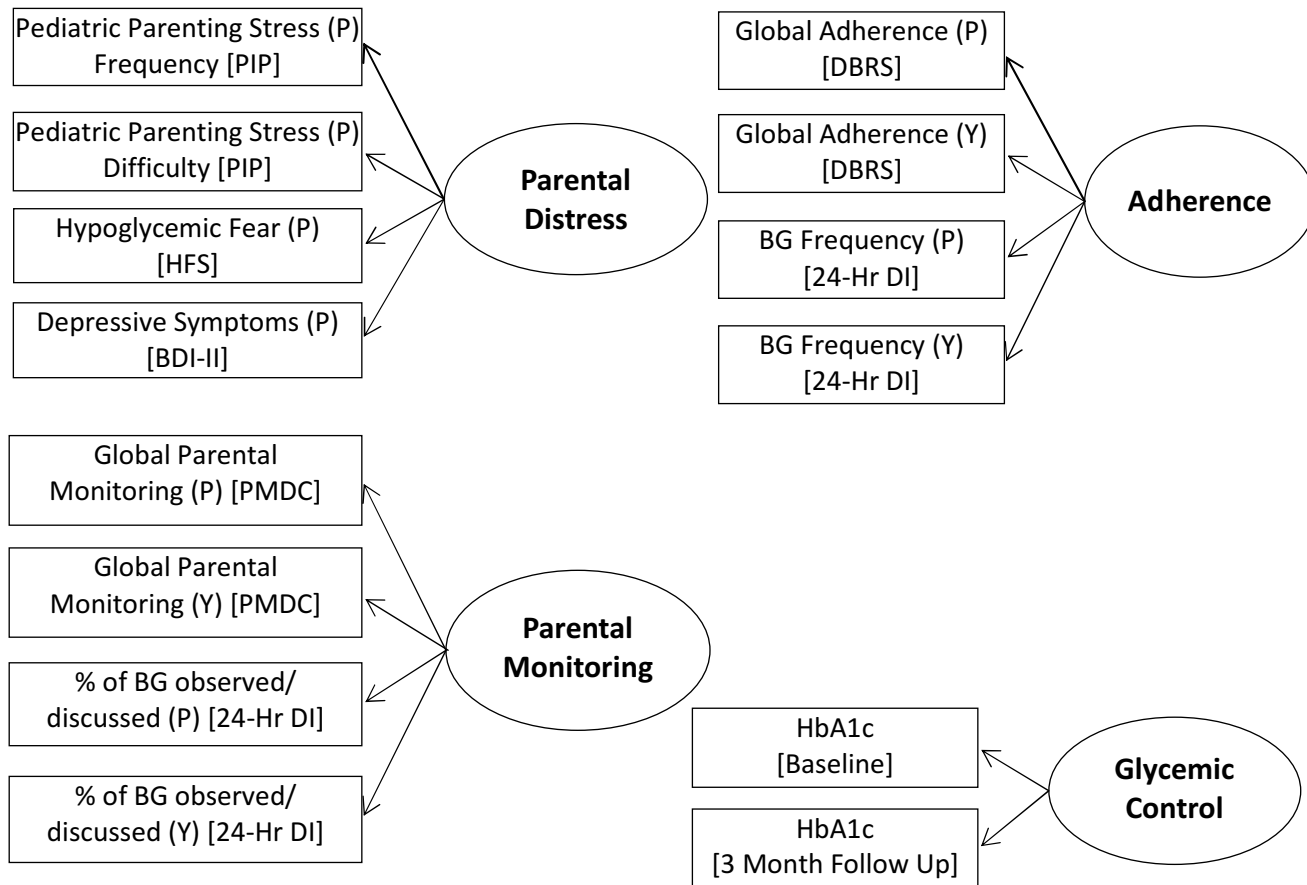


Figure 2. Proposed latent variable content. *Note.* Source of data for each construct is provided within parentheses: P=Parent, Y=Youth, P+Y= Parent and Youth report. Glycemic control values were obtained from medical charts.

Data Analysis Plan

Power analysis was conducted to confirm an adequate sample size for the current study. The data were screened for outliers and normality. Descriptive analyses were conducted with SPSS 21 (IBM Corp., 2012). Pearson’s correlation coefficients evaluated relations among sociodemographic factors, parent psychosocial functioning variables (i.e., parental distress, parental self-efficacy for diabetes management, authoritative parenting), parental monitoring variables, adherence variables, and glycemic control.

SEM analyses were conducted with MPlus 6 software (Muthen & Muthen, 1998-2010). The full information maximum likelihood procedure was used to include participants who had

individual data points missing, presumed to be missing at random. This procedure, which is the default in Mplus 6, estimates missing data values based on the current estimate of known parameters and then re-estimates the parameters based on known and imputed data (Collins, Schafer, & Kam, 2001). This is a preferred method for handling missing data, as it includes all available data in statistical analyses (Collins et al., 2001). Demographic data were not estimated.

The fit and indicator factor loadings of each latent variable were examined using confirmatory factor analysis (CFA). The final measurement model consisted of four latent variables measuring parental distress (BDI-II, PIP, HFS), parental monitoring (PTDB, percent of blood glucose checks observed or discussed on the DI), adherence (DBRS, total number of blood glucose checks on the DI), and glycemic control (HbA1c at baseline, HbA1c at 3 months following baseline; See Figure 2). Two observed variables were also included in the model: authoritative parenting (PSI) and parental diabetes-related self-efficacy beliefs (SEDSM-P). Inclusion of ratings from multiple reporters should reduce rater bias and more accurately measure each construct (Kenny, 1995).

The hypothesized mediation model was evaluated through examination of model fit and standardized path loadings (Kline, 2005; MacCallum & Austin, 2000; see Figure 2). To account for contextual factors that may affect the constructs of interest, correlated medical and demographic variables were considered in the model. Mediation was tested through an analysis of direct and indirect effects, or path coefficients, among the latent and observed variables in the model (MacKinnon, 2008). The mediated, or indirect, effect was calculated in MPlus as the product of the direct effects (standardized coefficients) among the independent, mediation, and dependent variables (Kline, 2005).

Overall model fit was assessed using five empirically established value indicators. A chi-squared value closer to zero with a *p* value greater than .05 indicated good fit (Hu & Bentler, 1999). However, due to the large sample size of the current study, chi-squared statistic is not considered the best assessment of fit because it is closely related to sample size. A root-mean-square error of approximations (RMSEA) value below .06 indicated good fit (Hu & Bentler, 1998, 1999) and a standardized root mean square residual (SRMSR) value less than .08 indicates acceptable fit (Kline, 2011). Additionally, a comparative fit index (CFI) and Tucker-Lewis index (TLI) value above .90 indicated acceptable fit (Hu & Bentler, 1998).

Results

Descriptive Results

Participants included 257 youth (51% male) aged 11 to 14 years ($M = 12.84$, $SD = 1.24$) with T1D and their primary caregivers (91% mothers). A majority of youth were Caucasian (69%) and from middle-class families (42% upper-middle, 39% middle). Mean disease duration was 5.24 years ($SD = 3.06$). Mean HbA1c was 8.81% ($SD = 1.63$) at baseline and 8.93 ($SD = 1.54$) at 3 months. Forty-four percent of youth were on an insulin pump and 20% were on an intensive basal/bolus shot regimen. Demographic and disease characteristics of the sample are reported in Table 1. Means and standard deviations for all study measures are reported in Table 2. Bivariate correlations between primary study and demographic variables are reported in Table 3.

Table 1.

Demographic and disease characteristics of the study sample; N = 257.

	<i>M (SD)</i>	Percentage
<i>Age (years)</i>	12.84 (1.24)	
<i>Age at Disease Onset (years)</i>	7.72 (3.22)	
<i>Disease Duration (years)</i>	5.12 (3.06)	
<i>HbA1c</i>		
Baseline %	8.81 (1.63)	
3 Months Post-baseline %	8.93 (1.54)	
<i>Hollingshead Index of SES</i>		
Total Score (8-66)	46.61 (11.73)	
<i>Gender: Male</i>		51
<i>Ethnicity</i>		
Caucasian		69
African American		19
Hispanic		6
Asian/Asian American		2
Other		4
<i>Insulin Regimen</i>		
Pump Therapy		44
Basal/bolus		20
<i>Relationship to Child: Mother</i>		91
<i>Two-Parent Families</i>		77

Table 2.

Descriptive data for study measures.

	<i>Sample Range</i>	<i>Parent M (SD)</i>	<i>Youth M (SD)</i>
<i>Parental Distress</i>			
Pediatric Inventory for Parents: Stress Frequency	43.00-189.88	90.49 (24.59)	--
Pediatric Inventory for Parents: Stress Difficulty	42.00-161.00	83.70 (26.62)	--
Hypoglycemic Fear Survey	.00-50.00	18.43 (8.93)	--
Beck Depression Inventory-II	.00-44.00	7.87 (7.69)	--
<i>Parent Self-Efficacy for Diabetes Management</i>			
Self-Efficacy for Diabetes Management Scale-P	3.60-10.00	8.09 (1.26)	--
<i>Authoritative Parenting</i>			
Parenting Style Index	3.00-12.67	--	9.02 (1.14)
<i>Parental Monitoring</i>			
% BG Checks Observed/Discussed	.00-100 (P+Y)	60.03 (23.56)	57.68 (21.81)
Parental Monitoring of Diabetes Care Scale	52.25-90.00 (P) 47.00-90.00 (Y)	78.03 (7.94)	77.08 (8.46)
<i>Adherence</i>			
Frequency of BG Checks	1.00-9.50 (P) 1.00-10.00 (Y)	4.30 (1.51)	4.34 (1.53)
Diabetes Behavior Rating Scale	.27-.92 (P) .28-.98 (Y)	.70 (.11)	.63 (.13)

Note. P=Parent, Y=Youth, P+Y= Parent and Youth report.

Table 3.

Bivariate correlations between primary study variables and demographic variables (N = 257).

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
1. SES ^a	-																			
2. Marital Status ^b	-.41***	-																		
3. Ethnicity ^c	-.20**	.22***	-																	
4. Stress Frequency (P)	-.27***	.20**	.23***	-																
5. Stress Difficulty (P)	-.15*	.11	.12	.78***	-															
6. Hypoglycemic Fear (P)	-.06	.15*	.15*	.39***	.44***	-														
7. Depressive Symptoms (P)	-.13*	.18**	.08	.51***	.49***	.26***	-													
8. Self-Efficacy for T1D (P)	.11	-.05	.01	-.30***	-.36***	-.15*	-.33***	-												
9. Authoritative Parenting (Y)	.07	-.13*	-.12*	-.26***	-.22**	-.21**	-.24***	.15*	-											
10. Parental Monitoring (P)	.01	-.07	-.02	-.14*	-.17**	-.07	-.24***	.45***	.22***	-										
11. Parental Monitoring (Y)	.10	-.03	-.07	-.14	-.18*	-.09	-.25**	.12	.34**	.41***	-									
12. BG Checks Obs/Disc (P)	-.12	.08	.08	.07	.00	-.02	-.05	.12	.11	.33***	.30***	-								
13. BG Checks Obs/Disc (Y)	-.03	-.08	-.05	-.01	-.08	-.11	-.14*	.14*	.19**	.26***	.19*	.35***	-							
14. Global Adherence (P)	.29***	-.13*	-.25***	-.14*	-.16*	-.07	-.15*	.35***	.17**	.27***	.23**	.03	.13*	-						
15. Global Adherence (Y)	.24***	-.12	-.12*	-.16*	-.13*	-.03	-.08	.18**	.13*	.13	.27***	.06	.21**	.39***	-					
16. Frequency BG Checks (P)	.27***	-.16*	-.11	-.06	-.10	.02	-.12	.18**	.18**	.22**	.32***	.09	.19**	.38***	.27***	-				
17. Frequency BG Checks (Y)	.31***	-.11	-.10	-.10	-.10	.01	-.09	.12	.18**	.12	.30***	.02	.18**	.35***	.26***	.79***	-			
18. Glycemic Control (Bline)	-.33***	.24***	.16*	.15*	.15*	.09	.07	-.18**	-.08	-.20**	-.21**	.13*	-.00	-.30***	-.17**	-.33***	-.29***	-		
19. Glycemic Control (3 mo)	-.29***	.25***	.21**	.20**	.18**	.15*	.11	-.19**	-.06	-.18**	-.19*	.01	-.06	-.24***	-.19**	-.32***	-.29***	.78***	-	

Note. P = Parent report, Y = Youth report, BG = blood glucose * $p < .05$. ** $p < .01$, *** $p < .001$. ^aSES = Socioeconomic status, higher scores indicate higher SES, ^bCoded as Two-Parent Family = 0, ^cCoded as Caucasian = 0, Other = 1

Latent Variable Measurement Model

Four latent variables were tested for use in the final structural equation model (i.e., parental distress, parental monitoring, adherence, glycemic control). The latent variable representing parental distress included four indicators: parent reported depressive symptoms, frequency and difficulty of pediatric parenting stress, and hypoglycemic fear. This model fit the data well [$\chi^2(2) = .96, p = .618, CFI = 1.00, TLI = 1.01, RMSEA = .00, SRMR = .01$]. The measurement model for parental monitoring was constructed of parent- and youth-report of both global parental monitoring from the PMDC and percentage of blood glucose checks that were observed by or discussed with a parent from the 24-Hour Diabetes Interview. With the inclusion of one covariance for error between parent- and youth-report of the 24-Hour subscales, the model achieved good fit [$\chi^2(1) = .92, p = .923, CFI = 1.00, TLI = 1.06, RMSEA = .00, SRMR = .01$]. The latent variable for adherence included parent- and youth-report of both global adherence from the DBRS and the average frequency of blood glucose checks from the 24-Hour Diabetes Interview. The four indicators fit the data well with the inclusion of one covariance for error between the parent- and youth-report of the 24-Hour subscales [$\chi^2(1) = .56, p = .562, CFI = 1.00, TLI = 1.01, RMSEA = .00, SRMR = .00$]. For all three measurement models, indicators sufficiently loaded onto the hypothesized latent constructs ($\beta > .37, p < .001$). Finally, given that the latent variable for glycemic control consisted of only two indicators, a significant bivariate correlated was sufficient for constructing a latent variable ($r = .78, p < .001$). See Figures 3 and 4 for unstandardized and standardized measurement models.

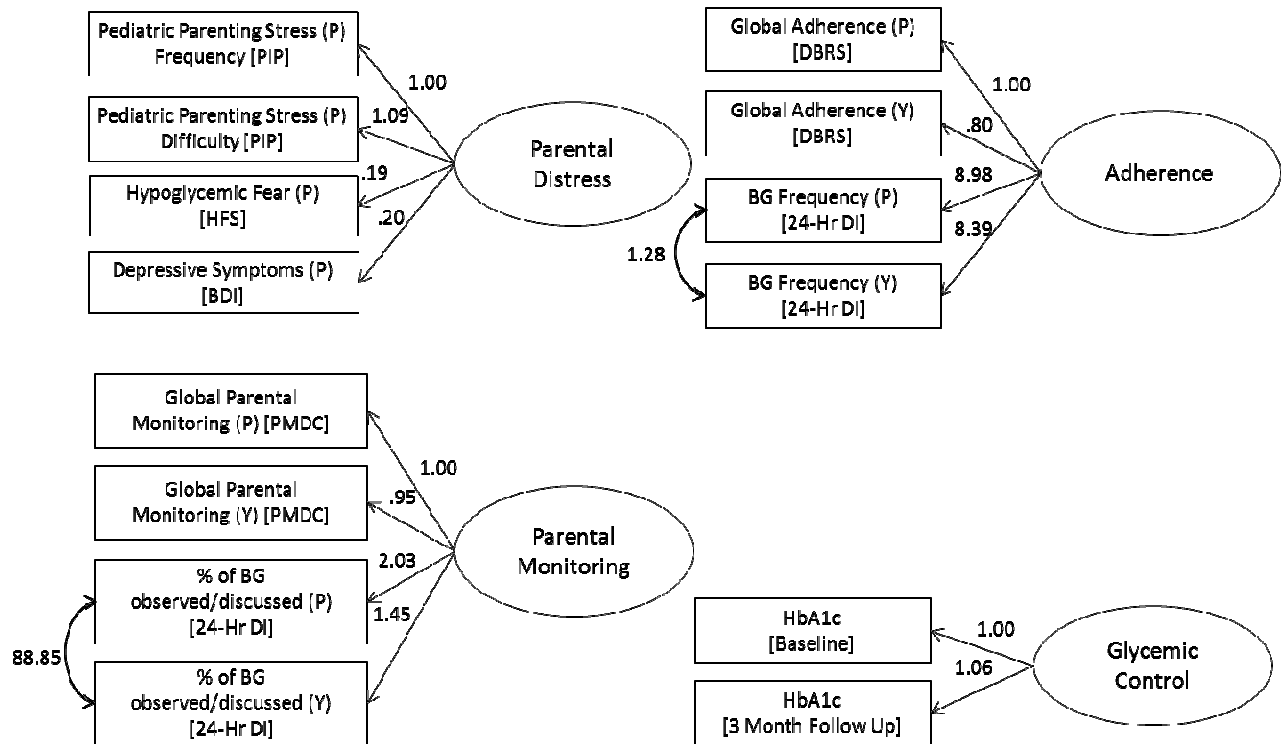


Figure 3. Latent construct measurement models with unstandardized loadings. *Note.* Source of data for each construct is provided within parentheses: P=Parent, Y=Youth, P+Y= Parent and Youth report. Glycemic control values were obtained from medical charts.

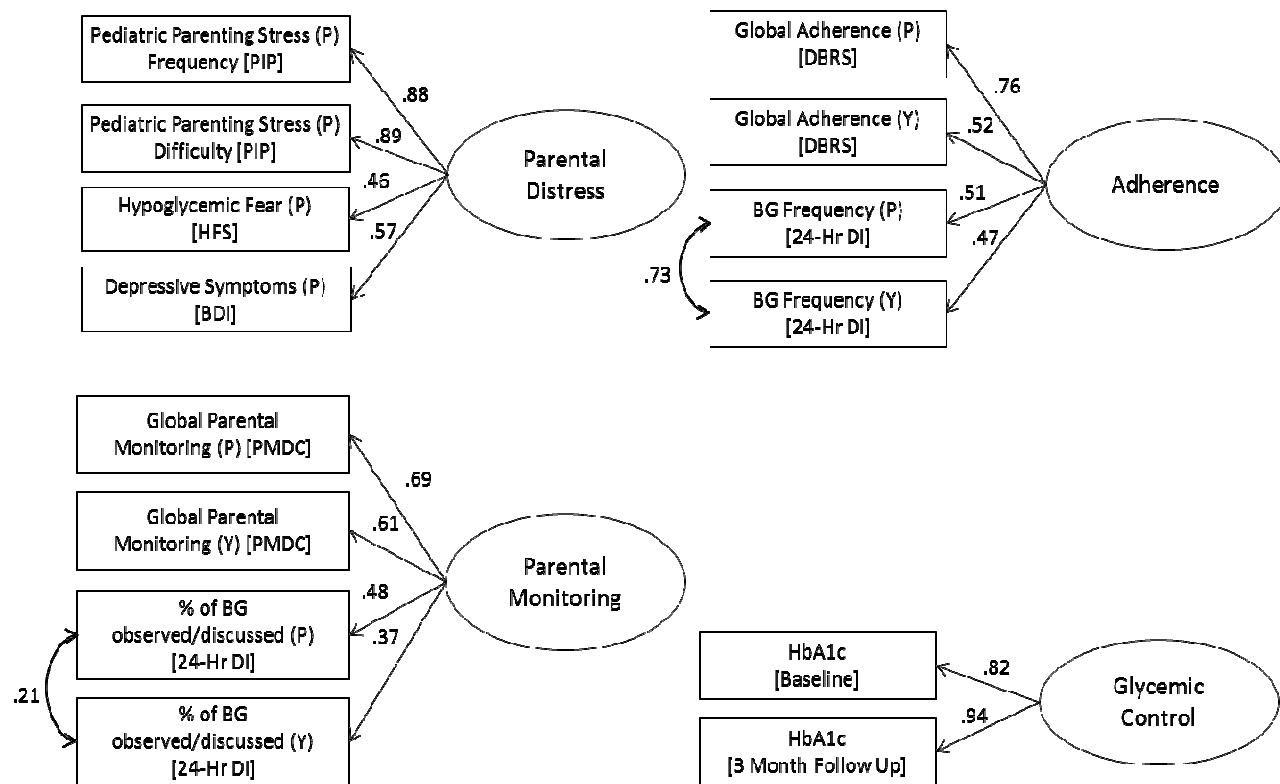


Figure 4. Latent construct measurement models with standardized loadings. Note. Source of data for each construct is provided within parentheses: P=Parent, Y=Youth, P+Y= Parent and Youth report. Glycemic control values were obtained from medical charts.

Structure Equation Model

Next, the proposed structural equation model was tested (see Figure 1). The model fit the data well [$\chi^2(121) = 209.24, p < .001, CFI = .93, TLI = .91, RMSEA = .06, SRMR = .08$; see Figure 5]. Less parental distress related to higher parental self-efficacy for diabetes management ($\beta = -.41, p < .001$) and more authoritative parenting ($\beta = -.29, p < .001$). In turn, higher parental self-efficacy ($\beta = .46, p < .001$) and more authoritative parenting ($\beta = .24, p = .003$) were associated with more parental monitoring. More parental monitoring then related to better adherence ($\beta = .29, p = .022$) and in turn better glycemic control ($\beta = -.35, p < .001$). Finally, higher self-efficacy for diabetes management directly related to better adherence ($\beta = .25, p = .011$). The total indirect path between lower parental distress and better glycemic control was

significant ($\beta = .09, p = .044$). Demographic variables significantly related to glycemic control were tested in the model as covariates. SES ($\beta = -.22, p = .002$) and marital status ($\beta = .11, p = .111$) were included as covariates. Overall, the model accounted for 30% of the variance in parental monitoring, 27% of the variance in adherence, and 22% of the variance in glycemic control.

Parent Psychosocial Functioning:

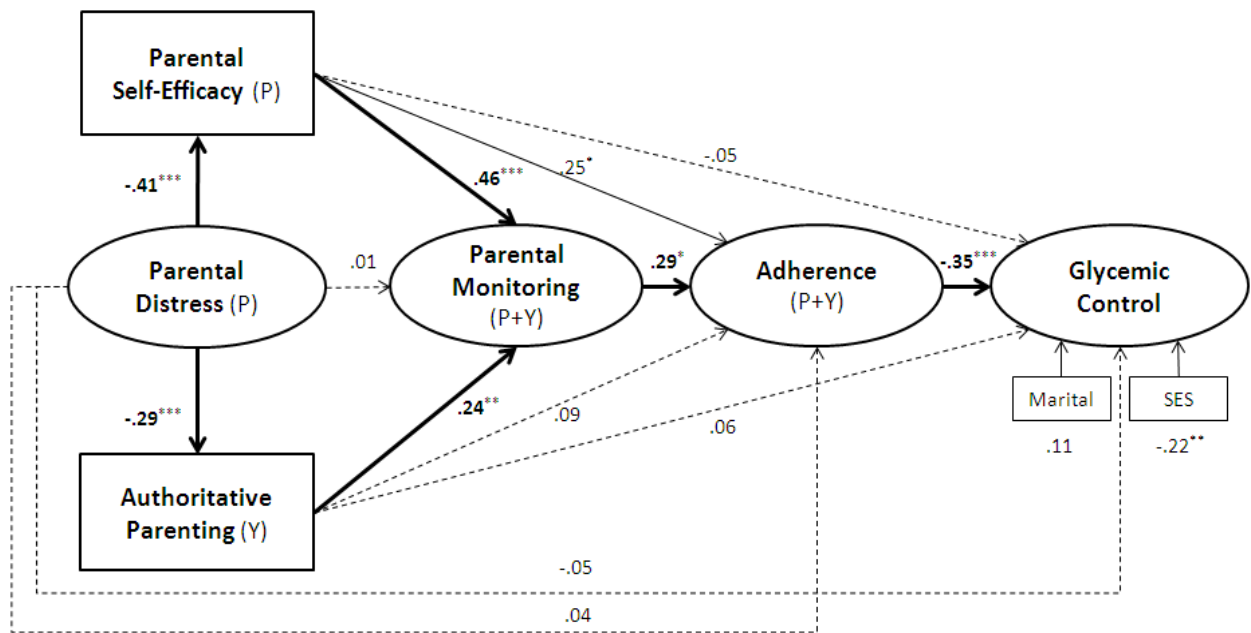


Figure 5. Structural equation model. Values shown are standardized regression coefficients. *Note.* Source of data for each construct is provided within parentheses: P=Parent, Y=Youth, P+Y= Parent and Youth report. Glycemic control values were obtained from medical charts.

Discussion

A comprehensive model of parental psychosocial functioning and its role in parental monitoring, youth adherence, and glycemic control was evaluated with structural equation modeling. Most hypothesized interrelations among the core components of psychosocial functioning were supported. Lower parental distress related to greater self-efficacy and more authoritative parenting each of which related to more parental monitoring, but surprisingly, lower parental distress did not directly relate to more parental monitoring, contrary to prior literature.

Interestingly, parental self-efficacy linked both directly and indirectly to better youth adherence, the latter via more parental monitoring. As expected, more parental monitoring was associated with better adherence which in turn related to better glycemic control. Overall, the SEM model demonstrated that parental psychosocial functioning, composed of parental distress, self-efficacy, and authoritative parenting, combined to account for approximately one-third of the variance in parental monitoring of diabetes care and approximately one-fourth of the variance in youth adherence behaviors and glycemic control.

As expected, less parental distress had beneficial relations with more authoritative parenting and with higher parental self-efficacy for diabetes management. These findings indicate two distinct avenues by which less parental distress is related indirectly to higher levels of parental monitoring, to better youth adherence and ultimately, to better glycemic control. First, less distressed parents were more likely to demonstrate more authoritative parenting, which was associated with more parental monitoring. Authoritative parents are more likely to engage their youth and to exhibit warmth and supportive communication, qualities that are likely to have a positive association with more parental monitoring. In contrast, previous research shows authoritative parenting is related to better youth adherence directly although these earlier studies have not evaluated the concomitant role of parental monitoring (Greene et al., 2010; Mlynarczyk, 2013). New to the literature then, the present results suggest the effect of authoritative parenting is related to youth adherence only indirectly and occurs via more parental monitoring. These findings demonstrate a relatively circumscribed association of authoritative parenting with youth diabetes care when considered within a broader context of parental psychosocial status (see Figure 2b). Pending replication, the current results suggest more parental monitoring is the likely mechanism by which more authoritative parenting is related to better youth adherence.

Less distressed parents also engaged in more monitoring via higher levels of parental self-efficacy which also related to better youth diabetes care. Previously, depressive symptoms have been associated with lower self-efficacy (Jones & Prinz, 2005) and less parental monitoring (Mackey et al., 2014) in relative isolation. Current findings confirm that parents who are more distressed are less likely to believe that they can affect positive diabetes outcomes in youth. New to the literature, however, this study suggests that lower self-efficacy is another mechanism by which parental depressive symptoms relate to less monitoring. Parental depressive symptoms should trigger further clinical attention because of their adverse relation with multiple poorer health-related behaviors.

Beyond the direct association of parental self-efficacy with better youth adherence, parental self-efficacy also indirectly related to diabetes adherence via more parental monitoring. Parents who are confident in their ability to understand and to perform diabetes care tasks were more likely to monitor youth in these tasks and had youth with better adherence. The developmental period captured in this sample (i.e., 11-14 years) represents a time when youth ideally assume more responsibility for disease care. However, due to illness complexity and competing adolescent interests, parents who feel more self-efficacious likely remain involved in their youths' care through more monitoring. At a minimum, parents typically communicate with providers, order supplies, and schedule clinic visits to facilitate care. Others also find parental self-efficacy for diabetes management positively related to better youth self-management (Evans & Hughes, 1987). For example, maternal self-efficacy has been related to better youth insulin administration and overall self-care in youth ages eight to 17 years (Leonard et al., 1998).

Importantly, higher parental self-efficacy for diabetes management had multiple beneficial relations with better diabetes care compared to authoritative parenting. Higher parental

self-efficacy related directly to more parental monitoring and to better youth adherence behaviors, as well as indirectly to better adherence via more monitoring. In contrast, more authoritative parenting related directly to more parental monitoring alone. Further, of these two mechanisms, the diabetes-specific indicator of higher parental self-efficacy had a stronger ($\beta = .46, p < .001$) relation to monitoring, double in magnitude to that of the more global indicator of authoritative parenting ($\beta = .23, p < .01$). Interventions that increase parental self-efficacy for diabetes management should have benefits in their own right but also could have multiple emanative benefits on youth diabetes adherence.

Surprisingly, more parental distress did not relate directly to less parental monitoring. Rather than a direct association, the current model indicates an indirect path between parental distress and less monitoring via the mechanisms of lower parental self-efficacy and less authoritative parenting. Nevertheless, consistent with other reports (Mackey et al., 2014; Patton et al., 2007; Streisand et al., 2005), direct associations were found in the simple correlations (Table 2, available online as supplemental material) among individual components of parental distress (i.e., depressive symptoms, parenting stress, and parental hypoglycemic fear) and individual elements of youth diabetes care (i.e., parental monitoring, youth adherence, and glycemic control). For example, the simple correlations showed parental depressive symptoms were significantly related to less parental monitoring as reported in the literature. However, when parental depressive symptoms were viewed in the present study along with other co-occurring symptoms of parental distress and within the larger context of broader parental psychosocial functioning, then a more nuanced understanding of parental functioning in youth diabetes care was revealed, as hypothesized. Specifically, more parental distress was adversely related to youth disease care via the conduits of less authoritative parenting and lower parental self-

efficacy. Both of these elements related to poorer parental monitoring directly but parental distress did not. Simultaneous modeling of co-occurring parental characteristics and behaviors with SEM demonstrates the capacity to provide a comprehensive portrait of direct and indirect routes by which parental psychosocial functioning, including distress, may be expressed in youths' diabetes care. An understanding of how these constructs interrelate could lead to more strategic interventions along the paths of greatest interest or strength; for example, those that target self-efficacy may be more influential than those that target authoritative parenting.

To our knowledge, this is one of the first attempts to comprehensively evaluate parental psychosocial functioning as it relates to parental monitoring and youth adherence, even though continued involvement of parents in diabetes management throughout adolescence is consistently related to better glycemic control (Ellis et al., 2007; Grey et al., 2001; King, Berg, Butner, Butler, & Wiebe, 2014). Better understanding of parental factors associated with more effective monitoring should help youth achieve better diabetes status. The validity of this SEM model is supported by replication of established demographic and disease relations. Higher SES and two-parent family status each were associated with better adherence and glycemic control, as well as with lower levels of parental distress. Further, inclusion of these factors in the model helps establish its generalizability to family constellations from diverse socioeconomic backgrounds.

Limitations and Strengths

Study limitations include use of cross-sectional data, which do not allow causal inferences about associations among constructs. Future longitudinal research is necessary to determine causality. Further, data were from the baseline assessment of a larger randomized clinical trial. Participants who enroll in a longitudinal study may be inherently different than families who do not and generalizability may be limited accordingly.

Methodological strengths of the current study include use of multi-source, multi-method data (e.g., self-report, semi-structured interview, medical) from a large, ethnically diverse, multi-site sample of adolescents with T1D. However, while multi-source data are preferred, low informant agreement can occur as in the case of parent- and youth- report of parenting style in the present study. Less is known about parenting style in this age group of youth with T1D, therefore reporter bias and results of measurement model testing were weighed in variable selection (Holmbeck, Li, Schurman, Friedman, & Coakley, 2002). A likelihood of reporter bias and halo effects on the parent-completed questionnaire of parenting style led to ceiling effects such that youth-report alone was used in the current study. Use of a single observed value of authoritative parenting should be weighed in the consideration of study findings. Multiple measures of this construct could prove to be more sensitive in future studies. With this one exception, the study's reliance upon latent variables strengthened construct measurement. Further, use of SEM allowed consideration of simultaneous interrelations among parent- and youth-report of behavior and diabetes outcomes to better describe naturalistic functioning.

Clinical Implications

Findings can inform further development of psychological interventions that target adherence in adolescents with T1D. Many family-based interventions aim to bolster parental monitoring during the transition to adolescence to prevent deterioration in glycemic control. The current study highlights parental psychosocial factors that may relate to optimal intervention. Providers may wish to consider parental self-efficacy in conjunction with parental monitoring as a target of intervention. Opportunities may exist to bolster parental monitoring and influence adherence via enhanced parental self-efficacy, perhaps through supplemental diabetes education. Further, given the adverse implications of parental distress, brief assessment of these symptoms

could be incorporated in clinical care with referral for mental health services when warranted. In sum, although providers encourage continued parental monitoring of diabetes management during adolescence; lower parental self-efficacy and more parental distress could hinder effective intervention. Instead, referral for diabetes education or mental health supports may be a first step to more effective intervention.

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