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THE EFFECT OF YOUTH DIABETES SELF-EFFICACY ON THE RELATION AMONG FAMILY CONFLICT, DISEASE CARE AND GLYCEMIC CONTROL

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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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The aim of the current study was to examine the associations among youth diabetes self-efficacy, family conflict, disease care and glycemic control via a comprehensive path model. Data were from a baseline assessment of a longitudinal RCT of 257 adolescent/parent dyads (adolescents aged 11–14). Each member of the dyad separately completed the Self-efficacy for Diabetes Self-Management Scale, Family Environment Conflict subscale, Diabetes Family Conflict Scale, Diabetes Behavior Rating Scale, and 24-hr Diabetes Interview Blood Glucose Frequency subscale. Additionally, a biological marker of glycemic control, or HbA1c, and relevant demographic variables were collected. A mediation model found higher youth diabetes self-efficacy mediated the link between lower family conflict and better disease care ($\beta = -.08$, p <.01) to glycemic control ($\beta = .05$, $p < .05$.). Further, the relation of higher self-efficacy to better glycemic control was mediated by better disease care ($\beta = -.06$, $p < .05$). Higher youth diabetes self-efficacy ($\beta = -.16$, $p < .05$), lower family conflict ($\beta = .19$, $p < .001$), and better disease care ($\beta = -.17$, $p < .01$) each were directly related to better glycemic control. The overall model

with relevant demographic factors fit the data well [χ^2 (2) = .50, p = .78, CFI = 1.00, RMSEA= .00] and accounted for 13% of the variance in self-efficacy, 32% of the variance for disease care, and 25% of the variance in glycemic control. Interventions that target better youth diabetes self-efficacy and lower family conflict concurrently may promote better disease care and glycemic control.

The Effect of Youth Diabetes Self-Efficacy on the Relation among Family Conflict, Disease Care, and Glycemic Control

Type 1 Diabetes (T1D) is the most common chronic endocrinology condition of childhood and adolescence and affects 1 in 400 to 600 youth (American Diabetes Association [ADA], 2009). Successful diabetes management requires a complex interweaving of daily disease care behaviors to achieve good glycemic control. The normative developmental shifts in transfer of diabetes responsibility from parents to youths in adolescence may negatively impact disease care and glycemic control. During this developmental transition, many changes occur within the family environment and the individual. Increased family conflict may occur as parents and adolescents balance the complex demands of diabetes disease care with the increased autonomy characteristic of adolescence. Lower general and diabetes-specific family conflict between parents and adolescents is associated with better disease care and glycemic control. Additionally, as parental involvement decreases and adolescents become more independent, individual self-efficacy becomes increasingly important. Diabetes self-efficacy, or the confidence an individual has to perform disease care behaviors, is related to better disease care and glycemic control.

While previous studies have examined lower family conflict and higher diabetes self-efficacy as independent factors related to better diabetes outcomes, the interaction of family and individual factors is less clear. Preliminary evidence suggests youth diabetes self-efficacy mediates other family factors, such as parental intrusiveness or nagging, and disease care behaviors. Thus, youth diabetes self-efficacy is hypothesized to mediate the relation between family conflict and disease care. Higher youth diabetes self-efficacy may be a protective factor and related to better disease care despite higher family conflict. Further, the relation of higher self-efficacy to better glycemic control may be mediated by better disease care. Finally, higher youth-diabetes self-efficacy, lower family conflict, and better disease care are hypothesized to be directly related to glycemic control. Path analyses will estimate the magnitude of multiple hypothesized mediational connections between the variables of interest and assess model fit. It is hypothesized that an environment characterized by lower family conflict will be associated with higher diabetes self-efficacy in adolescents, which in turn is associated with better disease care and better glycemic control.

Type 1 Diabetes

Type 1 Diabetes (T1D) is a complex chronic illness which requires continuous medical care, adolescent and parent disease management behaviors, and education to prevent acute adverse events and reduce the risk of long-term complications (ADA, 2009). In T1D, the immune system mistakes insulin for a foreign substance and systematically and slowly destroys the beta cells which produce it. Upon beta cell destruction, the body cannot produce insulin, a hormone necessary to allow glucose to permeate the cellular membrane and provide fuel to organs. Unabsorbed glucose remains concentrated in the blood and produces hyperglycemia, or high blood glucose levels, which can lead to diabetic coma if untreated. Exogenous insulin is necessary to maintain adequate glucose uptake and blood glucose levels must be carefully monitored. In addition, hypoglycemia, or low blood glucose levels also may occur as a consequence of the exogenous insulin. The dangers of both hyperglycemia and hypoglycemia create a constant balancing act. Adolescents with T1D face multiple challenges if proper disease care is not executed well. Chronic complications secondary to sustained hyperglycemia include retinopathy, nephropathy, cardiovascular disease, gum disease, and limb amputation (ADA, 2009). Acute complications from hypoglycemia, include dizziness, headaches, sweating, diminished attention, and if untreated, seizures or coma (ADA, 2009).

Glycemic Control

Excess glucose binds immediately and irreversibly to available hemoglobin in a process called glycosylation. Glycosylated hemoglobin (HbA1c) is an index of the percentage of bound or glycosylated hemoglobin molecules. HbA1c is superior to a single blood glucose reading as an indicator of chronic glycemic control because it is a composite index over the previous two- to three-month period, the lifespan of a hemoglobin molecule. Individuals without T1D have HbA1c levels which range from 4.6-6% and correspond to average blood concentrations of 80-120 milligrams/deciliter (ADA, 2009). The HbA1c goal for school-age children with T1D ages 8-12 is < 8% and for adolescents and young adults ages 13-19 is < 7.5% (ADA, 2009). Lower HbA1c levels are recommended for adolescents due to the lower risk of hypoglycemic complications in puberty and higher risk of hyperglycemia (ADA, 2009). The Diabetes Control and Complications trial (DCCT) found the risk of long-term disease complications decreases with as little as one percent decrease in HbA1c, which emphasizes the importance of lowering HbA1c levels (1994). HbA1c is widely accepted as a useful index for mean blood glucose levels and is widely used as a marker of successful control of diabetes.

Correlates of Disease Care

Adherence to multiple recommendations of disease care is necessary to achieve successful glycemic control. Appropriate disease care behaviors generally are associated with better glycemic control and reduce long-term complications (DCCT, 1993), but adherence to a fairly complicated medical regimen is necessary (Morris, Boyle, McMahon, Greene, Macdonald, & Newton, 1997). Adherence to disease care behaviors for adolescents with chronic conditions is generally below 50% and is considered the single, greatest cause of poorer health outcomes (Quittner, Espelage, levers-Landis, & Drotar, 2000). Previous research suggests diabetes disease care is not a monolithic concept because adolescents may better manage some regimen aspects than others (Stewart, Emslie, Klein, Haus & White, 2005). Important disease care behaviors include but are not limited to: Insulin injections, basal/bolus, or continuous subcutaneous insulin infusion (CSII) through an insulin pump, frequent blood glucose monitoring, attention to diet and meal frequency, and regular exercise.

Insulin administration. Adolescents with diabetes do not produce insulin and insulin therapy is necessary to survive. The most common types of insulin administration include continuous subcutaneous insulin infusion (CSII), basal/bolus regimens, and multiple daily injections (MDI). The DCCT (1993) recommends intensive insulin therapy (three or more injections per day) or CSII to obtain optimal HbA1c and to reduce long-term disease complications. Stewart and colleagues (2005) found the single most important predictor of HbA1c was adolescents' adjustment to their insulin to keep blood glucose levels normal. Meta-analyses of studies on CSII therapy have revealed a cumulative reduction of 20.5% to 20.9% in HbA1c when compared with multiple daily injection (MDI) therapy (Pickup, Mattock, & Kerry, 2002; Weissberg-Benchell, Antisdel-Lomaglio & Seshardi, 2003). In a cohort that switched from MDI to CSII, a significant decrease in HbA1c was demonstrated after the start of CSII (Nimri, Weintrob, Benzaquen, Ofan, Fayman & Phillip, 2006). Positive results have been reported with an intensive twice-daily injection approach with a rigid meal schedule. However, this more inflexible approach may not fit with every lifestyle (Dorchy, 2003; Hvidore Study Group on Childhood Diabetes, 2005; Soliman, Omar, Rizk, Awwa & AlGhobashy, 2006).

Blood glucose monitoring. Frequent blood glucose monitoring is necessary to ensure the proper balance of insulin, exercise and meals. Typically, a finger prick derives a drop of blood which is placed on a test strip and read by a blood glucose meter. The American Diabetes Association (ADA, 2009) recommends adolescents check blood glucose levels a minimum of four times daily. Current recommendations for blood glucose levels in the near normal range are between 80-120 mg/dl (ADA, 2009). If blood glucose levels are out of range, corrective actions must be taken such as administration of insulin injection/bolus or appropriate diet modification (ADA, 2009). More frequent blood glucose monitoring is consistently associated with better glycemic control (Hanson, Deguire, Schinkel, Kolterman, Goodman & Buckingham, 1996; Johnson, Kelly, Henretta, Cunningham, Tomer & Silverstein, 1992; Swift, Chen, Hershberger, & Holmes, 2006). After controlling for gender, duration of diabetes, and Tanner stage, adherence to blood glucose monitoring recommendations remained the consistent, significant predictor of glycemic control (Anderson, Ho, Brackett, Finkelstein and Laffel, 1997). Further, glycemic control improved significantly as the frequency of blood glucose monitoring increased.

Nutrition. The American Diabetes Association (2009) nutrition recommendations suggest youth with T1D adjust insulin doses to meal content, meal size, and activity levels to achieve good glycemic control. Nutritional intake is associated with fluctuations in blood glucose levels and insulin doses are adjusted based on the amount/type of food/drink ingested and blood glucose levels. Based on recommendations of the Food and Drug Administration (FDA) for healthy youth, ideal frequency of food consumption is six meals or snacks daily, with a greater percentage of calories from carbohydrates (60%) than fats (25-35%; Trumbo, Schlicker, Yates, & Poos, 2002). The DCCT indicates patients who follow their physician-recommended diet 90% or more of the time have a one percent lower HbA1c than those that are less adherent

(Delahanty & Halford, 1993). Specific dietary compositions, including diet consistency and adjustments of insulin dose for variations in food intake, are associated with better glycemic control (Delahanty & Halford, 1993). Delahanty and colleagues (2009) found higher insulin doses, lower carbohydrate intake, and higher monounsaturated, saturated, and total fat intake were associated with poorer glycemic control. However, research on nutrition and glycemic control remains inconsistent. It is unclear if a particular dietary macronutrient composition promotes improved glycemic control (Garg, Bantle & Henry, 1994; Gergard et al., 2004; Komiyama, Kaneko & Sato, 2002; Neilsen, Jonsson & Iverson, 2005).

Exercise. Although the majority of guidelines are not supported by evidence-based findings due to lack of research, regular physical activity has been shown to be beneficial to body composition, blood pressure, insulin sensitivity, blood glucose utilization, blood lipid profiles, and positively affects quality of life and social interaction (Laaksonen, Atalay & Niskanen, 2000; Norris, Carrol & Cochrane, 1990; Wasserman & Zinman, 1994). The American Diabetes Association (2009) suggests all levels of physical activity can be performed in individuals without disease complications who are in good blood glucose control. The American Academy of Sports Medicine recommends a minimum of 30 to 60 minutes of moderate physical activity daily (Silverstein et al., 2005). While exercise may be beneficial to various health outcomes, the relation between exercise and glycemic control is controversial (Austin, Warty, Janosky, & Arslanian, 1993; Hanson et al., 1996; Silverstein et al., 2005; Stewart et al., 2005; Wasserman & Zinman, 1994). For example, in a lower SES sample of Puerto Rican youth, lower HbA1c levels were associated with more frequent exercise (Streisand, Swift, Wickmark, Chen and Holmes, 2002). In contrast, other researchers found no significant relation between exercise and glycemic control (Hanson et al., 1996; Stewart et al., 2005). However, most research shows positive aspects of exercise on overall health, which must be taken into consideration as an important component of disease care, in addition to general health and well-being.

Despite the strong relation between disease care behaviors and glycemic control (DCCT, 2001), many adolescents with T1D are non-adherent to their disease care regimen, with few achieving optimal glycemic control (Silverstein et al., 2005). Further, even proper adherence to disease care behaviors explains significant but not all of the variance in HbA1c (Morris et al., 1997). The difficulty in achieving optimal glycemic control during adolescence suggests a more detailed investigation of additional factors that may impede optimal adherence to disease care behaviors is necessary. Numerous psychosocial factors have been identified during adolescence that may impede disease care behaviors and result in poorer glycemic control. Before an examination of these factors, the developmental period of adolescence is reviewed for a better understanding of the context in which these factors occur.

Adolescence and Type 1 Diabetes

Adolescence is a time of profound change for all youth and their families (American Psychological Association (APA; 2002). Adolescents begin to develop emotionally, establishing a new sense of who they are and who they want to become (APA, 2002). Experimentation with new behaviors occurs as adolescents' transition from childhood to adulthood (APA, 2002). Additionally, their social development involves relating in new ways both to peers and adults which typically involves increased contact with peers and decreased contact with parents (APA, 2002).

In addition to adolescents' emotional and social development, rapid hormonal and metabolic changes occur during puberty. Physical changes include the development of breasts and menstrual period for girls and deepened voices and broadened shoulders for boys.

Furthermore, adolescent's brains develop and bring new cognitive skills (APA, 2002). The profound metabolic changes caused by T1D may disrupt the usual progressions of hormonal and metabolic changes seen during puberty and may destabilize glycemic control and impact complications (Rogers, 1992). Insulin resistance occurs during puberty (Bloch, Clemons, & Sperling, 1997) and adolescents with T1D generally require more insulin and have more difficulty keeping stable blood glucose levels (Rogers, 1992).

The numerous developmental changes that occur during adolescence make it difficult for adolescents with T1D to adhere to the complex disease care regimen (Anderson & Brackett, 2005). The transition to adolescence is frequently marked by declines in disease care behaviors, glycemic control, and psychosocial well-being (Anderson et al., 1997; Jacobson et al., 1990; Wysocki, 1993; Wysocki, Taylor, Hough, Linscheid, Yeates & Naglieri, 1996). On average, adolescents exhibit poorer glycemic control than either younger youth or adults (Anderson et al., 1997). The rapid developmental changes that occur in adolescence and their subsequent negative impact on disease care behaviors and glycemic control emphasize the importance of a closer examination into factors that may be related to these declines.

Family Factors in Adolescents with T1D

Along with the physical changes that occur in adolescence, significant shifts occur in the family dynamic. Adolescents seek increased separation from parents in favor of peers (Anderson & Coyne, 1991). Adjustments may occur in parenting behaviors and expectations as youth are given greater freedom and decision making and spend less time with parents (Barber, 2002; Larsen & Richards, 1991). Declines in parental involvement and responsibility in diabetes management may occur during adolescence as parents make adjustments to a child's developing autonomy, with pubertal status, and movement towards the teenage years signaling these changes

(Steinberg, 1987). Numerous published studies report age-related declines in glycemic control along with less parental and shared responsibility (Anderson, Auslander, Jung, Miller & Santiago, 1990; Johnson, 1993; La Greca, Auslander, Greco, Spetter, Fisher & Santiago, 1995).

A premature transfer of disease care responsibility from parents to youth may occur as a function of age rather than successful disease management and often results in a decline in disease care behaviors (Anderson, et al., 1997). Holmes and colleagues (2006) found age alone was the primary determinant of parental transfer of responsibility. However, it is necessary for proper management of T1D for parents to stay involved to coordinate disease care behaviors. More youth responsibility was related to less frequent and/or shorter, exercise periods, fewer daily blood glucose tests, and fewer meals/snacks (Holmes et al., 2006). Youth with too much self-care autonomy relative to their psychological maturity have poorer adherence and more hospitalizations compared to youth with more appropriate autonomy (Wysocki et al., 1996). However, when parents remain involved in diabetes management tasks, youth may bypass normative deterioration in disease care behaviors and glycemic control (Anderson et al., 1990; Wysocki, et al. 1996).

Although parental involvement is important in maintaining disease care behaviors, sole parental involvement may be detrimental to disease care. Improper parental involvement may decrease healthy adolescent disease care behaviors and escalate conflict between parents and adolescents (Anderson et al., 2002). Shared responsibility, rather than sole youth or parent responsibility, is optimal for youth psychological and physical health (Hegelson, Reynolds, Siminerio, Escobar, and Becker, 2008). Youth and parent report of sole parent responsibility was associated with poorer disease care behaviors. Shared responsibility was associated with better glycemic control among older adolescents and has implications for the treatment of adolescents and their families (Hegelson et al., 2008). Shared responsibility may assume greater importance, particularly among older adolescents. Although families may believe responsibilities should shift from parent to youth in adolescence, continued parental involvement in diabetes care is important for better disease care outcomes (Hegelson et al., 2008).

Despite the benefits of proper parental involvement and responsibility for T1D management, adolescence continues to be a difficult period to navigate. General family conflict in addition to conflict around disease care behaviors often occur in adolescence and negatively impact disease care behaviors and glycemic control. These two psychosocial factors are examined during the developmental period of adolescence.

General Family Conflict

The transition to adolescence is often linked with the emergence and escalation of family conflict (Laursen, Coy, & Collins, 1998; Montemayor, 1986; Paikoof, & Brooks-Gunn, 1991). Conflict between adolescents and their parents typically increases during the early years of adolescence and is associated with the onset of puberty (Holmbeck & Hill, 1991; Steinberg, 1987). Conflict is a pervasive feature of family life that may have beneficial or harmful effects depending on how it is expressed and resolved (Noller and Fitzpatrick, 1993). Higher family conflict is associated with more frequent anger as well as lower cooperation and emotional support (Swift et al., 2006). Despite the negative associations, conflict in parent-adolescent relationships may serve an important developmental function. Engagement in exchanges that involve different points of view provides adolescents with opportunities to enhance negotiation and abstract thinking skills and consider different ideas (Rubenstein & Feldman, 1993; Steinberg, 1990).

General Family Conflict and Type 1 Diabetes

Conflict between adolescents with T1D and their families often begins before the adolescent period due to increased responsibilities and demands around the disease care regimen (Miller-Johnson, Emery, Marvin, Clarke, Lovinger & Martin, 1994). Usual adolescent conflicts with parents may disrupt adherence to disease care and glycemic control, even aside from conflicts over disease care behaviors. Lower general family conflict is related to better adherence to disease care behaviors (Hauser, Jacobson, Lavori & Wolfsdorf, 1990; Miller-Johnson, Emery, Marvin, Clarke, Lovinger, & Martin, 1994; Schafer, McCaul & Glasgow, 1986) and better glycemic control (Anderson, Miller, Auslander & Santiago, 1981; Bobrow, Avruskin, and Siller, 1985; Jacobson et al., 1994; Gustafsson, Cederblad, Ludvigsson, & Lundin, 1987; Overstreet, Goins, Chen, Holmes, Greer, Dunlap, & Frentz, 1995; Swift, Chen, Hershberger & Holmes, 2006; Wyscocki, 1993). Disease care may be impacted through arousal and negative emotions accompanying conflict (Miller-Johnson et al., 1994). Negative emotions may interfere with the ability to direct and maintain the attention necessary for disease care or can undermine the support necessary for disease care regimens (Orem, 2001).

Higher general family conflict is more typical in family environments with parental restrictiveness, criticism and an “authoritarian” style of parenting characterized by high maturity demands and coercive control (Anderson, 2002; 2004). In contrast, lower general family conflict is typically found in family environments with higher family cohesion, parental warmth, support and affection, and an “authoritative” style of parenting that involves warm engagement with a youth while setting limits with a low level of coercive control (Anderson, 2002; 2004). Hauser and colleagues (1990) examined preadolescents and early adolescents with T1D and found lower family conflict, greater cohesion, and greater organization were strongly associated with better disease care behaviors. The strongest predictor of longer term better disease care was lower family conflict, as reported by adolescents. In addition, parents' and adolescents' perceptions of higher family cohesion predicted better disease care behaviors. Similarly, Anderson and colleagues (1981) examined general family conflict, family cohesion, and glycemic control and found adolescents with better glycemic control reported more cohesion and less conflict among family members. Lastly, Jacobson and colleagues (1994) examined family conflict and cohesiveness in addition to family measures of expressiveness and found all factors linked to differences in long-term patterns of glycemic control. In sum, the beneficial effects of an environment with lower general family conflict suggest it is an important factor to examine in more depth and consider in future interventions for adolescents with T1D.

Diabetes-Specific Conflict

In addition to general family conflict, adolescents with T1D and their parents also may experience diabetes-specific conflict. Diabetes-specific conflict often involves arguments regarding disease care behaviors such as remembering to check blood glucose levels and to give insulin shots/boluses. Whereas some general family conflict is unavoidable and developmentally normal (Holmbeck, 1991), diabetes-specific conflict is counterproductive to successful diabetes management. A family environment characterized by conflict around diabetes management is a barrier to proper adherence to disease care behaviors and relates to poorer glycemic control. Adolescents who are distressed about family conflict surrounding diabetes management may avoid completing disease care behaviors to avoid arguments.

Lower levels of diabetes-specific family conflict are linked to better adherence to disease care behaviors (Anderson et al., 2002; Hilliard, Guilfoyle, Dolan & Hood, 2011; Hilliard, Holmes, Chen, Maher, Robinson, Streisand, 2012; Hood, Butler, Anderson & Laffel, 2007) and better glycemic control (Anderson et al., 2002; Hilliard et al., 2011;2012; Hood et al., 2007; Rubin, Young-Hyman & Peyrot, 1989; Williams, Laffel & Hood, 2009). Minimally elevated levels of diabetes-specific conflict may negatively relate to glycemic control (Hood et al., 2007), in part by detracting from diabetes disease care behaviors (Hilliard et al., 2011). Hood and colleagues (2007) found both child and caregiver diabetes-family conflict scores were correlated negatively with glycemic control. Analysis of factors usually associated with glycemic control showed an additive, independent negative contribution of diabetes-specific family conflict to the understanding of glycemic control. Diabetes-specific family conflict also was examined longitudinally. Hilliard and colleagues (2011) examined 146 dyads composed of an adolescent (aged 13-18 years) T1D and a parent and found lower adolescent-rated diabetes-specific family conflict scores at baseline predicted more frequent blood glucose monitoring at 6 months and better glycemic control at 12 months.

As mentioned previously, improper parental involvement may escalate conflict around disease care behaviors (Anderson et al., 2002). Conflict may emerge as adolescents and their parents negotiate responsibility for diabetes management tasks (Palmer et al., 2004; Hanna & Guthrie, 2003; Miller & Drotar, 2003). As parental responsibility decreases, parents may become nervous or upset about their lack of control of diabetes management and adolescents may become frustrated by parental queries of diabetes behaviors. A conflictual family environment may impede a family's ability to work together to help adolescents adhere to disease care behaviors and achieve good glycemic control. Anderson and colleagues (2002) investigated the relationship between diabetes-specific family conflict and involvement in treatment tasks, adherence to blood glucose monitoring, and glycemic control in youth with short duration T1D. Parental involvement was significantly related to the disease care behavior of blood glucose monitoring, with greater parental involvement related to increased blood glucose monitoring. Additionally, lower diabetes conflict significantly related to better glycemic control. Similarly, Hilliard and colleagues (2012) examined disease care as a mediator of the associations among parental monitoring, family conflict, and glycemic control in early adolescents with type 1 diabetes. A mediation model linked more parental involvement and higher family conflict with better glycemic control through better disease care. In sum, lower family conflict and higher parental monitoring are related to better glycemic control.

Self-Efficacy

In addition to the aforementioned family factors, individual, or self-factors become increasingly important during adolescence. Self-factors have been associated with a wide variety of behavioral and health outcomes (Bandura, 1997; DiClemente, Fairhurst, & Piotrowski, 1995; Kittano, 1989; Liao, Hunte, & Weinman, 1995; Mruk, 1995). Given adolescents increasing autonomy and responsibility for their disease care regimen, individual characteristics that facilitate adherence to disease care behaviors should be considered (Iannotti, 2006).

One individual, or self-factor that is particularly relevant for T1D disease care in adolescence is self-efficacy. Self-efficacy is a judgment of one's capability to perform a particular behavior or task (Bandura, 1986). As children transition to adolescence, numerous changes occur in their self-efficacy beliefs (Schunk & Meece, 2005). In general, adolescents' self-descriptions tend to be more abstract, multidimensional, and hierarchical which may be due to adolescents' increased abilities for cognitive abstraction, reflection, and social comparison (Schunk & Meece, 2005). As adolescents become more skilled at coordinating conflicting information and expectations, they form more stable and integrated views of their own abilities (Schunk & Meece, 2005).

Self-efficacy is one part of the Social Cognitive Theory (SCT) which asserts an individual's actions are the result of a reciprocal interaction between the environment, internal factors (i.e. cognitive, affective and biological factors) and behavioral factors. How people interpret the results of their own actions informs and alters their environments and the personal factors they possess, which, in turn, inform and alter future actions (Bandura, 1986). The outcome individuals anticipate from performing a specific task or behavior depend largely on their judgments of how well they will be able to perform that behavior in a given situation. Therefore, behavior change and maintenance may be related in part to self-efficacy (Bandura, 1997).

Self-efficacy, also known as efficacy expectations, has been defined as the belief that one can do a particular behavior in a particular situation (Bandura, 1986). Efficacy expectations vary by level, strength and generality. Level refers to an individual's perception of their confidence for a particular task or behavior based on the difficulty level of that task or behavior (Bandura, 1986). Individuals who have low-level expectations feel capable of performing simpler tasks, whereas individuals with a high level expectation will feel confident in performing more difficult tasks. Strength refers to an individual's judgment of how confident they are in performing a task or behavior. Generality refers to the extent to which efficacy expectations for a particular action or behavior can be generalized to other situations. For example, if an individual with diabetes is confident in their ability to check their blood glucose level at home, they may or may not feel confident in doing it at school.

Bandura (1986) suggests self-efficacy may influence all aspects of behavior. This includes the acquisition of new behaviors, inhibition of existing behaviors, disinhibition of current behaviors, choices of behavioral settings, the amount of effort expended in a task, and the length of time one will persist in the face of obstacles. For example, self-efficacy can have an influence on whether or not an individual with diabetes begins an exercise program and how much effort that individual puts into each exercise session. Furthermore, self-efficacy contributes to motivation by influencing aspirations and goals and affecting the outcomes expected from one's effort (Senecal, Nouwen, & White, 2000). There are four main sources of self-efficacy which include: performance accomplishments, vicarious experience, verbal persuasion, and interpretation of physiological or emotional state (Bandura, 1997). According to SCT, both self-efficacy and outcome expectancies influence behavior change and are strengthened or weakened through four information sources (Bandura, 1997).

The first source, performance accomplishments, refers to learning through personal experiences in which one achieves mastery over a difficult or previously feared task or behavior. Previous experience will serve as the greatest source of efficacy for an individual. For example, although an adolescent may initially feel uneasy about counting carbohydrates, through proper practice and parental assistance, they will have a better understanding of how to correctly count carbohydrates. Thus, they will experience an increased in self-efficacy for carbohydrate counting.

The second source of self-efficacy, vicarious experiences, involves learning through observation of other people. By watching another individual in a similar situation perform a particular task or behavior, one may be more inclined to feel he or she is capable of performing the same task or behavior. For example, if an individual with T1D observes their parent ordering insulin supplies, the adolescent may eventually believe they are capable of performing the task, thus increasing their self-efficacy.

Verbal persuasion is the third source and consists of encouragement from others to change behavior. This encouragement may come from health care providers, family or friends. For example, an individual with diabetes who communicates well with their parent may experience constant praise and encouragement for his or her daily accomplishments. This will help increase their self-efficacy for performing disease care behaviors.

The last source of self-efficacy is the interpretation of a physiological or emotional state. High physiological arousal may impair performance (Bandura, 1986). For example, an individual with diabetes who is experiencing a hypoglycemic event may misinterpret feelings of lightheadedness or dizziness as something other than hypoglycemia. Therefore, this individual may not feel capable of remedying the situation and may feel anxious. However, if that individual is aware of the typical signs and symptoms of hypoglycemia and is educated on how to treat hypoglycemia, then he or she will be less likely to misinterpret symptoms or feel anxious about the situation.

Self-Efficacy and Type 1 Diabetes

Self-efficacy is consistently an important factor for both short- and long-term changes in a variety of health behaviors. Higher self-efficacy has been related to less addictive behaviors (Diclemente et al., 1995), lower physiological stress responses (O'Leary & Brown, 1995), and lower relapse rates of smoking cessation (Gulliver, Hughes, Solomon, & Dey, 1995). Additionally, greater self-efficacy is related to better adherence to a medical treatment regimen (Dennis & Goldberg, 1996; Rosenbaum & Smira, 1986).

Self-efficacy is identified as an important factor in adolescents with T1D. Diabetes self-efficacy, defined as "how sure an individual is of their ability to perform disease care behaviors" is related to better disease care and glycemic control (Iannotti et al, 2006; Griva, Myers &

Newman, 2000; Johnston-Brooks, Lewis & Garg, 2002; Littlefield, Cravin, Rodin, Daneman, Murray and Rydall, 1992; Nouwen, Law, Hussain, McGovern, and Napier, 2009; Remley & Cook-Newell, 1999). One reason for the link between low diabetes self-efficacy and poor disease care may be that adolescents with low self-efficacy disengage from disease care behaviors because of their belief that they are incapable of achieving the outcome (Sander et al., 2010). Family may also play a role and individual self-efficacy may be connected to the family self-efficacy. The complex disease care behaviors associated with the diabetes regimen require an individual to be goal directed and persistent. Thus, it is reasonable to assume a connection between self-efficacy and adherence to disease care behaviors. Adolescents who believe they can monitor disease care behaviors may be better able to persevere and succeed in disease care tasks which may ultimately translate to glycemic control (Iannotti, 2006).

Lower youth diabetes self-efficacy has been related to poorer T1D disease care behaviors in adolescents in a number of studies (Iannotti et al, 2006; Griva, Myers & Newman, 2000; Johnston-Brooks, Lewis & Garg, 2002; Littlefield, Cravin, Rodin, Daneman, Murray and Rydall, 1992; Nouwen, Law, Hussain, McGovern, and Napier, 2009; Remley & Cook-Newell, 1999). Remley & Cook-Newell (1999) examined adolescents with T1D and found those who scored higher on self-efficacy specifically for managing meal plans in difficult situations were more likely to demonstrate better disease care behaviors. Similarly, Johnston-Brooks, Lewis & Garg (2002) found higher youth diabetes self-efficacy was significantly related to better disease care behaviors cross-sectionally. Littlefield, Craven, Rodin, Danaman, Murrary & Rydall (1992) found adolescents who reported better adherence to disease care behaviors tended to report higher self-efficacy and had better glycemic control compared to those with poorer disease care scores. Additionally, self-efficacy and the interaction of self-efficacy with expectations of positive outcomes were significantly associated with adherence to disease care behaviors in older adolescents. The effect of self-efficacy was greatest when adolescents had stronger beliefs in the beneficial outcomes of adherence (Iannotti, 2006). Nouwen, Law, Hussain, McGovern, and Napier (2009) examined the joint effects of self-efficacy and illness representations on dietary self-care and diabetes distress in 151 adolescents with T1D. Together with dietary self-efficacy, perceived short-term treatment effectiveness was a significant predictor of dietary disease care.

Higher diabetes self-efficacy also is related to better glycemic control in a number of studies (Chich, Jam, Shu, & Lue, 2010; Griva, Myers & Newman, 2000; Grossman, Brink & Hauser, 1987; Iannotti et al., 2006; Johnston-Brooks, Lewis & Garg, 2002). Grossman**,** Brink and Hauser (1987) examined 68 adolescents with T1D and found self-efficacy scores predicted glycemic control in adolescent girls. Similarly, Iannotti and colleagues (2006) examined 168 adolescents (ages 10-16 years) with T1D. Higher self-efficacy and the interaction of self-efficacy with expectations of positive outcomes were significantly associated with better glycemic control in older adolescents. The effect of self-efficacy was greatest when adolescents had stronger beliefs in the beneficial outcomes of adherence. Chich, Jam, Shu, & Lue (2010) found a relation between higher self-efficacy and poorer glycemic control. Logistic regression analysis demonstrated self-efficacy scores significantly influenced glycemic control; patients with higher self-efficacy scores were 1.63 times more likely to reach target glycemic control. Last Griva, Myers, & Newman (2000) examined the role of illness perceptions and self-efficacy in disease care behaviors and glycemic control among 64 young patients with T1D and found 30.8% of the variance in glycemic control was explained by patients' diabetes specific self-efficacy, consequences and identity.

In addition to their individual relations, research has identified a mediational relation in which higher diabetes self-efficacy leads to improved disease care, which leads to improved glycemic control (Johnston-Brooks, Lewis & Garg, 2002). Adherence to disease care behaviors is one mediational mechanism through which psychosocial factors such as self-efficacy affect glycemic control (Glasgow, McCaul & Schafer, 1987) given that adherence to disease care behaviors is associated with better glycemic control (Goodall & Halford, 1991) and that psychosocial factors have been found to influence both disease care (Kavanaugh, Gooley, & Wilson, 1993) and glycemic control (Talbot, Nouwen, Gingras, Gosselin, & Audet, 1997).

Interaction of Self-Efficacy and Family Factors

Although there is an abundance of T1D research on family conflict and self-efficacy independently, only one study to date has examined them together. The paucity of research examining the variables of family conflict and self-efficacy together warrants an examination of related family factors to self-efficacy. The literature indicates self-efficacy mediates numerous other family factors. A review of the literature in this area may clarify the mechanisms involved in the relation between family conflict and self-efficacy and their subsequent impact on disease care and glycemic control.

Families provide experiences that influence children's self-efficacy from infancy to adulthood. Self-efficacy may be enhanced when children have positive family models and are taught strategies to overcome challenges (Schunk & Meece, 2005). Adolescents acquire self-efficacy information from their families and home environments (Schunk & Miller, 2002). Family influences that promote effective interactions with the environment enhance self-efficacy and competence beliefs. Parents who are most successful in promoting positive competence perceptions are able to modify their expectations and demands according to the changing needs, abilities, and temperaments of children as they develop (Eccles et al., 1998). Developmental researchers have identified four major types of parenting styles that differ in levels of warmth, responsiveness, and control (Baumrind, 1967; Maccoby & Martin, 1983). In general, an authoritative parenting style has the best combination of warmth, responsiveness, and control to support adolescents and is associated with many positive developmental outcomes.

Self-efficacy is associated with parental involvement and responsibility in adolescents with T1D. Self-efficacy may be used to determine when parents should transfer increasingly complicated tasks to the child (Ott, Greening, Parlardy, Holderby, and DeBell, 2000). For example, one way that parents may choose to decrease parental responsibility is adolescents' self-efficacy in conducting disease care tasks (Holmes et al., 2006). High adolescent self-efficacy and/or parental perceptions of adolescents' self-efficacy may signal parents they can safely decrease their responsibility. Palmer and colleagues (2009) examined 185 adolescents and their parents with T1D and found greater parental responsibility was negatively associated with age, perceptions of pubertal status, and self-efficacy for all reporters. Interactions between parental responsibility and parental perceptions of adolescents' self-efficacy indicated that parental responsibility was associated with better glycemic control when adolescents were perceived to have lower self-efficacy. Results suggested glycemic control is best when high parental responsibility is maintained among adolescents with lower self-efficacy. Similarly, Berg, King, Butler, Pham, Palmer, and Wiebe (2009) examined mediating processes linking parental involvement to disease care and glycemic control during adolescence in 252 adolescents with T1D. Associations of mothers' and fathers' relationship quality with diabetes disease care behaviors were mediated by adolescents' perceptions of self efficacy and externalizing behaviors. Further, the associations of fathers' monitoring and behavioral involvement with adherence were partially mediated by adolescents' self-efficacy. The authors concluded that quality of the parent–adolescent relationship and monitoring are important for better disease care adherence and glycemic control among adolescents through higher diabetes self-efficacy. The previously mentioned studies support the mediational role of self-efficacy on family factors of parental responsibility and involvement.

Self-efficacy also is related to parental affect in adolescents with T1D. Because negative mood influences information processing (Bower, 1981; Cameron, 2003), parents who feel depressed or anxious may weigh negative evidence of adolescents' disease care more heavily when forming beliefs about adolescent competence (Cameron, Young, & Wiebe, 2007). Parents' beliefs of adolescent self-efficacy may, in turn, be associated with adolescents' own self-efficacy (Fredricks & Eccles, 2002). Parents may steer adolescents toward behaviors believed to match adolescent's skill and adolescents may adapt their self-efficacy beliefs to parents' perceptions (Frome & Eccles, 1998; Pomerantz & Dong, 2006). Thus, parental affect may relate to perceived adolescent self-efficacy. Butler, Berg, King, Gelfand, Fortenberry, Foster, and Weibe (2009) investigated whether parental perceptions of adolescent self-efficacy are colored by parental negative affect and are associated with adolescents' self-perceptions of efficacy for diabetes management in 183 adolescents with T1D and their parents. Parental negative affect was associated with parental perceptions of poorer adolescent efficacy beyond the association of glycemic control. The relationship between fathers' negative affect and adolescents' self-efficacy was mediated by fathers' perceptions of adolescent efficacy. The results suggest parental negative affect may negatively color their views of adolescents' self-efficacy and may relate to adolescent self-efficacy.

Self-efficacy also is related to family organization. Herge, Streisand., Chen, Holmes, Kumar, & Mackey (2012) examined the association of family organization with glycemic control through the mechanisms of family self-efficacy for diabetes and disease care in 257 adolescent-parent dyads (adolescents aged 11-14) with T1D. Structural equation modeling demonstrated greater family organization was associated indirectly with better disease care behaviors via greater family self-efficacy. Greater self-efficacy was indirectly associated with better glycemic control via better disease care both concurrently and prospectively. The full model indicates more family organization is indirectly associated with better glycemic control concurrently and prospectively through greater self-efficacy and better disease management. Families with more organization and routine have adolescents who are more likely to have better disease care and glycemic control (Greening et al., 2007; Safyer et al., 1993; Seiffge-Krenke, 1998). Likewise, youth who have higher levels of adherence to disease care behaviors were more likely to have parents who reported higher levels of family organization, and youths themselves were more likely to perceive better family organization (Hauser et al., 1990). Family organization may relate to disease care adherence through self-efficacy since greater diabetes self-efficacy relates to better disease care.

Negative family interactions also are related to poorer self-efficacy (Hood, Butler, Anderson, & Laffel, 2007; Jaser & Grey, 2010; Lewin et al., 2006; Schafer, McCaul, & Glasgow, 1986). Critical parenting (i.e., criticism, nagging, and negativity) is a significant predictor of poorer adherence and glycemic control, especially for older adolescents (Duke et al., 2008; Lewin et al., 2006). In adolescents with T1D, a parenting style characterized by guilt and criticism was associated with higher adolescent reported depression and lower diabetes self-efficacy (Butler, Skinner, Gelfand, Berg, & Wiebe, 2007). Critical parenting has been related to poorer adherence and glycemic control (Duke et al., 2008; Jaser & Grey, 2010), adolescent reported depression (Jaser & Grey, 2010), and adolescent reported self efficacy for diabetes management (Butler et al., 2007). Armstrong, Mackey, and Streisand (2011) examined the association of critical parenting behaviors with preadolescent reported depressive symptoms, self-efficacy, and disease-care behaviors in 84 youth with T1D (ages 9-11). Preadolescents who reported more critical parenting behaviors reported more depressive symptoms and lower self-efficacy. Depressive symptoms were associated with lower self-efficacy and fewer disease care behaviors. The relationship between depressive symptoms and disease care was fully mediated by self-efficacy. Critical parenting behaviors were associated with preadolescents' psychological well-being, which may have implications for the disease care regimen.

In sum, self-efficacy has an important relation to several family factors. If self-efficacy mediates the relation between family factors such as organization, negative parental affect, and critical family behaviors and their relation to disease care behaviors and glycemic control, it follows that self-efficacy also may mediate the relation between family conflict, disease care behaviors, and glycemic control.

Family Conflict and Youth Diabetes Self-Efficacy

Although the relation between other family environment factors and diabetes self-efficacy provides preliminary evidence of the link between family conflict and diabetes self-efficacy, only one study to date has examined family conflict and diabetes self-efficacy together. Sander, Odell and Hood (2010) determined whether the association between diabetes-specific family conflict and blood glucose monitoring is mediated by youth diabetes self-efficacy in a study of 276 adolescents with T1D. Lower diabetes-specific family conflict was associated with higher diabetes self-efficacy and more frequent blood glucose monitoring. In the combined model, the effect of diabetes-specific family conflict on blood glucose monitoring frequency became less significant when youth diabetes self-efficacy was added. The indirect effect of diabetes-specific family conflict on blood glucose monitoring frequency through youth diabetes self-efficacy was significant and explained 22% of the association between family conflict and blood glucose monitoring frequency. Results suggest a family environment characterized by lower diabetes-specific conflict may result in higher youth diabetes self-efficacy in the adolescent. Despite the positive results, this study failed to explore the relation to disease care behaviors beyond blood glucose monitoring. It also did not explore their link to the gold standard of diabetes control, glycemic control. Additionally, the study only examined diabetes-specific conflict and did not examine general family conflict. Although this study provides evidence of the link between family conflict and youth diabetes self-efficacy, a more comprehensive examination of these factors is necessary.

Statement of Problem

While previous studies have examined family conflict and youth diabetes self-efficacy as independent risk factors for diabetes outcomes, their possible connection in youth with Type 1 diabetes is unclear beyond a suggestion of less blood glucose monitoring associated with each (Sander et al., 2010). Previous research indicates higher youth diabetes self-efficacy mediates other negative family interactions such as parental nagging and better disease care. Thus, higher youth diabetes self-efficacy may mediate the relation between lower family conflict and better disease care. An environment characterized by lower family conflict is hypothesized to be associated with higher youth diabetes self-efficacy in adolescents, which in turn may be associated with better disease care and better glycemic control. Higher youth diabetes self-efficacy is likely to occur in a lower conflict environment where individuals feel confident in their ability to execute disease care behaviors. Higher youth self-efficacy may be a protective factor that relates to less deleterious effects of family conflict on disease care. Further, the relation of higher self-efficacy to better glycemic control may be mediated by better disease care. Higher youth diabetes self-efficacy may be associated with better glycemic control in an environment where youth have better disease care behaviors.

Hypotheses

1. A path model is hypothesized in which higher youth diabetes self-efficacy mediates the relation between lower family conflict and better disease care. Additionally, the relation between higher self-efficacy and better glycemic control is hypothesized to be mediated by better disease care (See Figure 1). Specifically, within the model:
    a. Higher diabetes self-efficacy will mediate the relation between lower family conflict and better disease care.
    b. Higher youth diabetes self-efficacy will relate to better glycemic control via better disease care.
    c. Higher diabetes self-efficacy, lower family conflict, and better disease care each should relate directly to better glycemic control.
    d. Demographic factors of socioeconomic status, age, and number of parents in home should also have direct effects on the study variables and will be used as covariates.

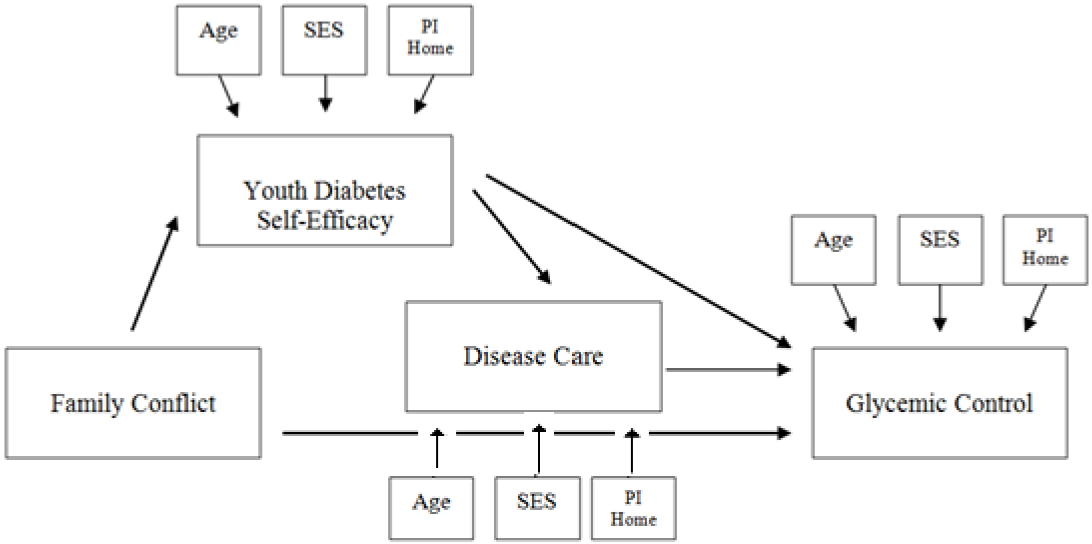


Figure 1. Hypothesized Path Model

Method

Participants

Participants were youth age 11 to 14 and an accompanying parent seen at one of two metropolitan pediatric endocrinology clinics. Data were from a baseline assessment of a Randomized Clinical Trial (RCT) of parental involvement in youth's diabetes disease care. Participation in the RCT included four brief sessions of a coping skills intervention or diabetes education intervention in conjunction with quarterly diabetes appointments. Inclusion criteria required diagnosis of T1D for a minimum of one-year prior to enrollment, no other major chronic illness or injury, fluency in reading and writing English, and the absence of developmental disorders (e.g. Down's Syndrome, Autism).

Procedure

Potential participants and their parents or guardians received a recruitment letter for a baseline assessment in a RCT designed to prevent deterioration in youth diabetes disease care during adolescence. After a recruitment letter was sent, parents were contacted by telephone and invited to participate. If parents and youths agreed, assessments were scheduled in conjunction with youths' upcoming endocrinology appointments. After written informed parental consent and youth assent was obtained, a trained research assistant interviewed parent and youth separately and distributed questionnaire packets. Upon completion, each family received $25 for participation.

Measures

Youth diabetes self-efficacy. The Self-efficacy for Diabetes Self-Management Scale (SEDSM; Iannotti, Schneider, et al., 2006), is a 10-item self-report scale that assessed youth's perceived self-efficacy to complete or perform diabetes care behaviors, such as blood glucose checks and insulin injections. Participants rated each item on a 1–10 scale to indicate different levels of youth self-efficacy (1 = not sure at all that I could do ‘‘X’’ behavior, 10 = completely sure that I could do ‘‘X behavior’’). Higher scores on this measure indicate higher levels of self-efficacy for diabetes disease care behaviors. Only youth scores were used in the current analyses. Youth diabetes-related self-efficacy shows high internal consistency (a = .90) and test-retest reliability (a = .89; Iannotti, Schneider, et al., 2006).

General family conflict. General family conflict in the home environment was measured using the Conflict subscale of the Family Environment Scale (FES, Moos & Moos, 2002). Parents and adolescents completed the 9-item measure about the occurrence of conflict behaviors (e.g., temper outbursts, anger at home). Conflict scores used a true/false format and ranges from 0 to 9; higher scores indicate more general conflict. The FES conflict scale historically demonstrates modest yet sufficient reliability in adolescent- and parent-completed forms (Boyd, Gullone, Needleman, & Burt, 1997; Loveland-Cherry, Youngblut, & Leidy, 1989; Moos & Moos, 2002). Total scores were used for analyses. Parent and youth reports were averaged in the current study.

Diabetes-specific family conflict. Diabetes-specific family conflict was measured using the Diabetes Family Conflict Scale-Revised (DFCS-R; Hood et al., 2007). Parents and adolescents independently rated the frequency of conflict of 19 specific diabetes management tasks on a 5-point Likert scale ranging from ‘never’ to ‘almost always’, with higher scores indicating greater diabetes-related conflict. Parent and adolescent reports were averaged in the current study. The 2007 revision of the DFCS utilized a 3-point Likert scale. To facilitate comparison with earlier findings, the current study was transformed to a 3-point scale (1, 2 = 1, 3 =2, 4, 5, = 3) yielding a scale range of 19 to 57 (19 = no conflict to 57 = high level of conflict).

Total scores were used in the analyses. Administration time is approximately five minutes, per questionnaire for parent and youth. Hood and colleagues (2007) report evidence of acceptable construct validity, internal consistency, concurrent validity, and predictive validity.

Diabetes Behavior Rating Scale (Iannotti, 2006). The Diabetes Behavior Rating Scale (DBRS) is a self-report measure of youth disease care which assesses parallel report by parent and youth, separately. In the current study, parent and adolescent reports were averaged. Subscales include Daily Prevention Behaviors (0 = *never* to 4 = *always*), Modification of Diabetes Care Plan (0 = *never* to 5 = *five times*), Intervention Behaviors (0 = *never* to 4 = *always*), and Other Diabetes Care Practices (0 = *never* to 5 = *five times*). The insulin pump version contains 37 items with a possible total score of 148. The non-pump version for insulin injections contains 36 items with a possible total score of 144. To provide comparable insulin pump and non-pump/injection results, scores were calculated as a proportion of the maximum total possible score (0.06-1.00), in which higher scores demonstrated greater adherence to disease care. Previous analyses by Iannotti (2006) reveal the mean total score to be .75 +/- .10, with acceptable internal consistency (α = .84), test-retest reliability (r = .71), and parent/youth agreement (r = .48).

Blood glucose frequency. The 24-hour Diabetes Interview (24-hr) measured youths' disease care (Johnson, 1986; Holmes et al., 2006). Parents and youths were interviewed separately and asked to report all diabetes-relevant behaviors from the previous 24-hour period in temporal order upon arising in the morning. The 24-hr is a complex interview; research assistants were trained in its administration with a detailed manual that included specific interview prompts, and practice was provided with an advanced graduate student until all manual guidelines were followed to 85% accuracy. In addition, advanced graduate students observed the first two interviews administered to participants to establish research assistant's adherence to all 24-hr rules. Parents and adolescents completed the 24-hour on two occasions over two weeks. In the current study, parent and youth scores were averaged. Next, parent and adolescent reports were averaged to create a composite variable. For the current study, the *Frequency of Blood Glucose Monitoring* variable was used as a second indicator disease care. *Frequency of Blood Glucose Monitoring* is established as an indicator of diabetes disease care in previous studies (Hilliard et al., 2011; Hilliard et al., 2012) that is significantly related to glycemic control. Pearson product-moment correlations for glucose monitoring has acceptable agreement between parent/youth dyads (Johnson, 1986). The test-retest reliability varies slightly by age over a three-month interval (e.g., blood glucose monitoring, $r = .72$ to .76; which indicates generally appropriate temporal stability (Freund, Johnson, Silverstein & Thomas, 1991).

Glycemic control. Glycemic control was measured by glycosylated hemoglobin (HbA1c) level at the time of the youth's medical appointment as well as at three months post-baseline. Glycosylated hemoglobin values were averaged across the two time periods for greater stability. HbA1c provided an estimate of average blood glucose concentration over the previous two- to three-month period. The American Diabetes Association (2009) recommends HbA1c levels for children to be < 8.0% and < 7.5% for adolescents. Poorer glycemic control is indicated by higher HbA1c levels. HbA1c levels were obtained by medical chart review.

Demographic information. Youth demographic information was obtained from questionnaires completed by a parent who accompanied youth to a baseline evaluation. Information was obtained about youth's gender, date of birth, socioeconomic status (SES), ethnicity, age of disease onset, number of parents in home, and disease duration. Age, socioeconomic status, and the number of parents in home have been identified in previous studies as significant demographic correlates to the variables of interest (Herge et al., 2012) and were included as control variables in the current study.

Results

Data Analytic Plan

The current study evaluated a path model to examine the association of youth diabetes self-efficacy, family conflict, disease care, and glycemic control. To create a composite score of family conflict, *Z*-scores of the Family Environment Conflict subscale (a measure of general family conflict) and the Diabetes Family Conflict Scale (a measure of diabetes-specific family conflict), which both had similar relations to HbA1c, were averaged. To create a composite score of Disease Care, *Z*-scores of the Diabetes Behavior Rating Scale and the BG Frequency Subscale of the 24-hour Diabetes Interview were averaged. Analyses were conducted with SPSS Version 22 (IBM Corporation, 2013) and AMOS Version 7 (Arbuckle, 2006). 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. Normality, linearity, and homoscedasticity were assessed by residual scatterplots, and multivariate outliers were assessed by obtaining the Mahalanobis distance for each model.

The hypothesized model was evaluated via path analyses through examination of model fit and standardized path loadings (Kline, 2011; MacCallum & Austin, 2000). To account for factors that may affect the variables of interest, relevant and correlated demographic variables were included in the model. Mediation was tested through an analysis of direct and indirect effects, or path coefficients, among model variables (MacKinnon, 2008). Indirect effects were calculated in AMOS as the product of the direct effects (standardized coefficients) among the independent, mediating, and dependent variables (Kline, 2011). Per recommendations by Kline (2011), overall model fit was assessed with a chi-square analysis, root-mean-square error of approximations (RMSEA; values below .06 indicate good fit; Kline, 2011), the comparative fit index (CFI; values above .90 indicate acceptable fit; Hu & Bentler, 1998, 1999), and an examination of correlation residuals (values $\geq$ .10 suggest the model does not explain the corresponding sample correlations very well; Kline, 2011). Standardized path coefficients were examined. Effect sizes, or standardized beta (*B*) values of *B* = .2 represent a small effect, *B* = .5 a medium effect, and *B* = .8 a large effect (Cohen, 1998).

Demographics and Descriptive Data

Results included data from 257 youths and their parents. Demographic and disease characteristics of the sample are reported in Table 1. The sample was 51% boys with a mean age of 12.8 years (*SD* = 1.2). Participants were predominantly middle class with a Hollingshead Index score of 46.6 (11.5); 69.6% Caucasian, 19.1% African American, 5.4% Asian/Asian American, 1.9% Hispanic, and 3.9% other. Most families lived in a home with two or more adults (81%). Participants had a mean onset age of 7.7 years (*SD* = 3.2) and a mean disease duration of 5.1 years (*SD* = 3.1). Mean HbA1c of youths at baseline was 8.8% (*SD* = 1.6) and three months later was 8.9% (*SD* = 1.5). Parents reported 44% of youths used insulin pump regimens, 20.2% used basal/bolus regimens, and 35% used 2-3 insulin shots a day. On average, youths and parents reported 4.3 (*SD* = 1.4) blood glucose checks a day.

Table 1

Demographic and Disease Characteristics. Percentiles and Mean Scores reported with (SD)

N	257
Gender	
Boys	50.6%
Girls	49.4%
Age (yrs)	12.8 (1.2)
Hollingshead Index of SES	46.6 (11.5)
Ethnicity	
Caucasian	69.6%
African-American	19.1%
Asian/Asian-American	5.4%
Hispanic	1.9%
Other	3.9%
Parents in Home	
One	19.4%
Two or More	80.6%
Disease Onset (yrs)	7.7 (3.2)
Disease Duration (yrs)	5.1 (3.1)
Insulin Regimen	
Pump	44%
Basal Bolus	20.2%
2-3 Shots	35%
Youth Self Efficacy	7.1 (1.7)
General Conflict	48.66 (12.79)
Diabetes Conflict	27.03 (7.10)
Diabetes Management (DBRS)	.65 (.10)
Average Freq of BG Checks (24-hr)	4.3 (1.4)
Baseline HbA1c	8.8 (1.6)
3 months post-baseline HbA1c	8.9 (1.5)

Bivariate Correlations

Bivariate correlations among observed measures, including demographic and medical covariates, were examined (see Table 2). First bivariate correlations of the individual psychosocial measures were examined. Higher youth diabetes self-efficacy was associated with better disease care (*r* = .47***) and better glycemic control (*r* = -.35***). Lower family conflict was significantly associated with better youth diabetes self-efficacy (*r* = -.26***), better disease care (*r* = -.18**), and better glycemic control (*r* = .30***). Better disease care was associated with better glycemic control (*r* = -.37***).

Finally, correlations among demographic and medical variables were examined. Younger age was associated with higher youth diabetes self-efficacy (*r* = -.15*), better disease care (*r* = -.22***), and better glycemic control (*r* = .14*). Higher socioeconomic status was associated with higher youth diabetes self-efficacy (*r* = .22***), lower family conflict (*r* = -.20***), better disease care (*r* = .36***), better glycemic control (*r* = -.33***), and more parents in the home (*r* = .21**). More than one parent in the home was associated with higher youth diabetes self-efficacy (*r* = .16**) and better glycemic control (*r* = -.13*).

Table 2

Correlations among Key Demographic and Disease Care Variables

	1	2	3	4	5	6	Mean (SD)
1. Age			.				12.8 (1.2)
2. SES	.04						46.6 (11.5)
3. PIH	.02	.21**				.	1.34 (.17)
4. HbA1c	.14*	-.33***	-.13*				8.87 (1.9)
5. Family Conflict (z-score)	-.01	-.20**	-.11	.30***			0.0 (.76)
6. Youth Self-Efficacy	-.15*	.22***	.16**	-.35***	-.26***		7.1 (1.7)
7. Disease Care (z-score)	-.22***	.36***	.09	-.37***	-.18**	.47***	0.0 (.83)

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

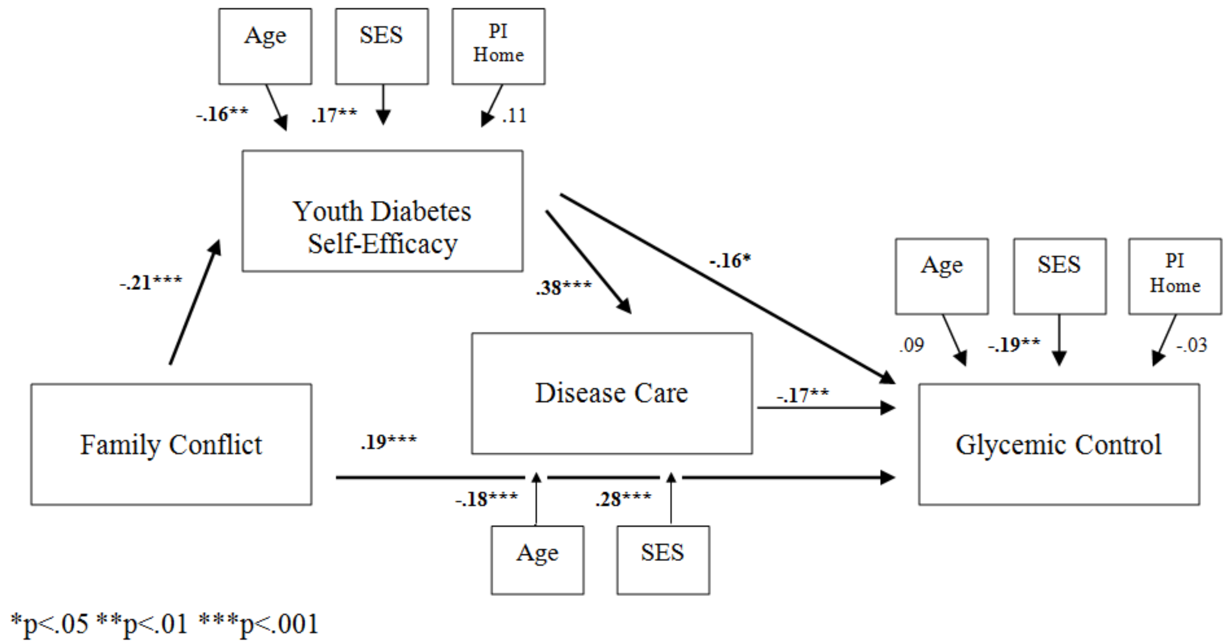
Note. SES = Socioeconomic Status, PIH = Number of Parents in Home, HbA1c = glycemic control, Family Conflict = Composite of the Family Environment Conflict Subscale and Diabetes Family Conflict Scale, Youth Self-Efficacy = Self-Efficacy for Diabetes Self Management, Disease Care = Composite of Diabetes Behavior Rating Scale and BG Frequency of the 24-hour Diabetes Interview

Path Model

The hypothesized path model (see Figure 2) proposed higher youth diabetes self-efficacy would mediate the relation between lower family conflict and better disease care (Hypothesis 1a). Higher self-efficacy also was hypothesized to relate to better glycemic control via better disease care (Hypothesis 1b). Further, due to previously known associations, higher youth diabetes self-efficacy, lower family conflict, and better disease care, each were hypothesized to be directly associated with better glycemic control (Hypothesis 1c). Demographic factors with significant bivariate correlations to the dependent variables (i.e., socioeconomic status, youth age, and number of parents in home) also were included as control variables in the path model (Hypothesis 1d; see Figure 2).

As hypothesized, higher youth diabetes-self efficacy mediated the link between lower family conflict and better disease care; the total standardized indirect effect of family conflict through youth diabetes self-efficacy on disease care was $\beta = -.08$, $p < .01$ (Hypothesis 1a). Higher youth diabetes self-efficacy also mediated the link between lower family conflict and better glycemic control; the total standardized indirect effect of family conflict through youth diabetes self-efficacy and disease-care on glycemic control was $\beta = .05$, $p < .05$. Further, the effect of higher self-efficacy to better glycemic control was mediated by better disease care; the total standardized indirect effect of youth diabetes self-efficacy on glycemic control through disease care was $\beta = -.06$, $p < .05$ (Hypothesis 1b). Direct effects were also examined (Hypothesis 1c). As hypothesized, higher youth diabetes self-efficacy ($\beta = -.16$, $p < .05$), lower family conflict ($\beta = .19$, $p < .001$) and better disease care ($\beta = -.17$, $p < .01$) were directly related to better glycemic control. Additionally, lower family conflict was directly related to higher youth diabetes self-efficacy ($\beta = -.21$, $p < .001$) and higher youth diabetes self-efficacy was directly related to better disease care ($\beta = .38$, $p < .001$). As hypothesized, demographic factors also had direct effects on the dependent variables in the model (Hypothesis 1d). Higher socioeconomic status was related to higher youth diabetes self-efficacy ($\beta = .17$, $p < .01$), better disease care ($\beta = .28$, $p < .001$), and better glycemic control ($\beta = -.19$, $p < .01$). Younger age was related to higher youth diabetes self-efficacy ($\beta = -.16$, $p < .01$) and better disease care ($\beta = -.18$, $p < .001$). The number of parents in the home did not exhibit any significant direct effects.

The proposed model fit the data well, as indicated by all fit indices within suggested parameters [χ^2 (2) = .50, $p = .78$, CFI = 1.00, RMSEA= .00]. Per recommendations of Kline (2011), correlation residuals were examined and all residuals were <.10 (-.02-.004) between observed and predicted covariances. Overall, the model accounted for 13% of the variance in self-efficacy, 32% of the variance for disease care, and 25% of the variance in glycemic control. Additional information regarding correlation residuals, maximum likelihood estimates for the path model, and direct, indirect and total effects for the path model are listed in Appendices A, B and C, respectively.



χ^2 (2) = .50, p = .78, CFI = 1.00, RMSEA= .00

Figure 2. Path Model with Standardized Path Coefficients

Note: Demographic variables with significant bivariate correlations were included in the model

Discussion

The current cross-sectional study evaluated a comprehensive path model of the relations among youth diabetes self-efficacy, family conflict, disease care, and glycemic control with associated demographic factors. Higher youth diabetes self-efficacy mediated the link between lower family conflict and better disease care behaviors (Hypothesis 1a); further, the association of higher self-efficacy to better glycemic control was mediated by better disease care (Hypothesis 1b). Consistent with previous research, higher youth diabetes self-efficacy, lower family conflict and better disease care each were directly related to better glycemic control (Hypothesis 1c), controlling for the effects of pertinent demographic factors (Hypothesis 1d). During model fit analyses, the relation between family conflict and disease care was removed from the model and not included in hypothesis due to being a weaker, non-significant path. The full model accounted for 25% of the variance in glycemic control and demonstrated good fit statistics. The current study supports the existing literature of the benefits of higher youth self-efficacy and lower family conflict and provides a first look at the link between these joint factors and their interplay in understanding youth diabetes care and glycemic control.

Higher youth diabetes self-efficacy mediated the relation between lower family conflict and better disease care (Hypothesis 1a). Lower family conflict is consistently related to better adherence, in part via more parental monitoring (Hauser, Jacobson, Lavori & Wolfsdorf, 1990; Miller-Johnson, Emery, Marvin, Clarke, Lovinger, & Martin, 1994; Schafer, McCaul & Glasgow, 1986). However, this study was one of the first to demonstrate the mediational and positive effects of higher youth self-efficacy as an avenue between lower family conflict and its relation to better adherence. This work broadens similar findings (Sander, et al., 2010) of a mediational role of higher youth diabetes self-efficacy and more narrowly defined diabetes-specific conflict and more circumscribed blood glucose frequency. These relations substantiate the idea that families who report lower family conflict are more likely to have youth who perceive themselves as more capable of diabetes management and who have better disease care. Families with lower family conflict may have parents who demonstrate positive family influences that promote effective interactions with the environment and enhance diabetes self-efficacy and competence beliefs. In turn, youth with higher diabetes self-efficacy may feel more capable to treat their disease and engage in more disease care behaviors (Ott et al., 2000). In contrast, families with higher conflict may have parents who are more restrictive, critical and display an "authoritarian" style of parenting (Anderson, 2004, Sander et al., 2010) that may undermine youth self-confidence and/or allow fewer opportunities for adolescents to develop disease care self-efficacy. Higher conflict may be associated with poorer adherence to disease care behaviors as adolescents may no longer feel capable of carrying out disease management tasks and become discouraged in their management of their disease care behaviors.

Higher youth diabetes self-efficacy was related to better glycemic control via better disease care (Hypothesis 1b). Consistent with previous research, a mediational relation was found in which higher diabetes self-efficacy was associated with better disease care and better disease care was associated with better glycemic control (Johnston-Brooks, Lewis & Garg, 2002). In the current study, youths who perceived themselves to be more efficacious for disease management had better disease management and ultimately better glycemic control. Further, consistent with previous research, higher youth diabetes self-efficacy (Sander et al., 2010), lower family conflict (Anderson, Miller, Auslander & Santiago, 1981; Bobrow, Avruskin, and Siller, 1985; Jacobson et al., 1994; Gustafsson, Cederblad, Ludvigsson, & Lundin, 1987; Overstreet, Goins, Chen, Holmes, Greer, Dunlap, & Frentz, 1995; Swift, Chen, Hershberger & Holmes, 2006; Wyscocki, 1997), and better disease care (DCCT, 2001; Morris et al., 1997; Silverstein et al., 2005) each were directly associated with better glycemic control (Hypothesis 1c). Together, the mediational associations of these factors, along with each of their direct relations with glycemic control combine to create a more nuanced and comprehensive understanding of how diabetes self-efficacy and lower family conflict contribute to better youth glycemic control.

Demographic factors also contributed significantly to the model (Hypothesis 1d). Younger youth age and higher socioeconomic status were each related to better disease care and better glycemic control, consistent with previous research (Anderson et al., 1997; Jacobson et al., 1990; Swift et al., 2006; Wysocki, 1993; Wysocki, Taylor, Hough, Linscheid, Yeates & Naglieri, 1996). Interestingly, younger age was actually linked to higher youth diabetes self-efficacy in the current study. Perhaps before the onset of pubertal hormones in younger preteens, 11 to 12 years of age, understanding of a direct cause/effect relation between beneficial diabetes behaviors and corresponding better glycemic control may be easier to detect and hence, reinforce self-efficacy beliefs and consistent disease care management. Higher socioeconomic status and more than one parent in the home each were related to higher youth diabetes self-efficacy. Consistent with previous research (Swift et al., 2006), more parents in the home related to better glycemic control perhaps through the additional support provided by two caregivers. Little research exists about the relation of diabetes self-efficacy and SES but indication is provided that it is a relevant topic for future research. In short, the current research demonstrates demographic factors play a role in the understanding of youth diabetes self-efficacy in disease management such that future efforts to build a more thorough description of their role should necessarily include relevant demographic factors to better refine existing information.

The present model included multiple measures of family conflict and disease care as well as glycemic control within a comprehensive path model to provide a deeper understanding of the role of higher youth diabetes self-efficacy in diabetes care than previously published (Sander, et al., 2010). Further, the model also incorporates well-known demographic factors related to diabetes care. An examination of both general and diabetes-specific conflict concurrently confirms the importance of the family environment in which youth manage their diabetes. Further, this study uniquely examined disease care as measured by the Diabetes Behavior Rating Scale and the 24-Hour Diabetes Interview Blood Glucose Frequency subscale together as a composite indicator of disease care. Both disease care measures display relatively similar associations with glycemic control (Iannotti et al., 2006; Hilliard, 2012), but researchers commonly adopt an either/or approach and choose a single disease care measure. The use of both an interview and a self-report questionnaire provides unique assessment information about different aspects of disease care. Blood Glucose Monitoring frequency provides information about the single best disease care behavior related to glycemic control that can be readily translated into treatment recommendations. In contrast, the Diabetes Behavior Rating Scale provides an overview of key disease management factors, such as knowledge of prevention behaviors like carrying diabetes supplies. Together these factors should provide a more comprehensive indicator of disease care. Inclusion of glycemic control in the model further completes the picture of diabetes care.

The current model expands that of Sander, Odell and Hood (2010) and indicates families who report lower family conflict and higher youth diabetes self-efficacy also report better disease care behaviors, which in turn is associated with better glycemic control. Although a significant portion of variance related to the understanding of disease care (32%) and glycemic control (25%), numerous other factors such as family organization (Herge, 2012), parental affect (Butler et al., 2009), and parental responsibility (Palmer et al., 2009) could not be included in the current model and undoubtedly contribute to the understanding of youth disease care and glycemic control. Additionally, this study examined a single indictor path model via averaged scores. Future research may use latent variables to combine variables of interest for a more sophisticated approach. Longitudinal research also will be important to confirm directionality within this model. As previous self-efficacy research asserts, an individual's actions are the result of reciprocal interactions among the environment; internal factors and behaviors that may not be best captured in a cross-sectional sample (Bandura, 1986; 1997).

Clinical Implications

The current study, in conjunction with previous literature, indicates more comprehensive, clinic-based interventions could include both individual and family approaches to improve youth diabetes self-efficacy and lower family conflict with the intent to promote better disease care behaviors and glycemic control. For instance, interventions that target family conflict may also add self-efficacy as a complementary component. Further, interventions such as motivational interviewing that include self-efficacy typically target individuals and rarely examine youth self-efficacy in the context of the family and may an area of future research. Numerous behavioral and psychosocial interventions in adolescents with T1D have improved self-efficacy via Coping Skills Training (Grey et al., 1998; 1999; 2000; Holmes, et al., 2014), Motivational Interviewing (Viner, Christie, Taylor and Hey, 2003) and text-messaging interventions (Franklin et al., 2008). Similarly, family conflict has been lowered through interventions such as Behavioral Family Systems Therapy (BFST; Robin & Foster, 1989; Wysocki et al., 1997; Wysocki and colleagues, 2000), Behavioral Family Systems Therapy for Diabetes (BFST-D; Wysocki et al., 2007), Family Teamwork (Anderson, Brackett, Ho & Laffel, 1999; Anderson, Ho, Brackett, Finkelstein & Laffel, 1997), and peer group interventions (Greco et al., 2001). Self-efficacy and family conflict can be modified through a variety of intervention techniques. Attention to these areas in tandem may promote better individual and family diabetes functioning, and ultimately result in better disease care behaviors and glycemic control.

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Appendix A

Correlation and Standardized Residuals for Path Model

Variable	1	2	3	4	5	6	7
Correlation Residuals							
1. Parents in Home	0						
2. SES	0	0					
3. Age	0	0	0				
4. Family Conflict	0	0	0	0			
6. Self-Efficacy	0	0	0	0	0		
6. Disease Care	-.01	0	0	-.02	0	0	
7. Glycemic Control	.003	0	0	.004	0	-.004	.003
Standardized Residuals							
1. Parents in Home	0						
2. SES	0	0					
3. Age	0	0	0				
4. Family Conflict	0	0	0	0			
6. Youth Self-Efficacy	0	0	0	0	0		
6. Disease Care	-.40	0	0	-.36	0	0	
7. Glycemic Control	.07	0	0	.06	0	-.05	.01

Appendix B

Maximum Likelihood Estimates for Path Model

Parameter	Unstandardized	SE	Standardized
Direct Effects			
Family Conflict → Self-Efficacy	-.49***	.14	-.21
Age → Self-Efficacy	-.22**	.08	-.16
SES→ Self-Efficacy	.03**	.01	.17
PIH → Self-Efficacy	.44	.25	.11
Self-Efficacy → Disease Care	.18***	.03	.38
Age → Disease Care	-.12***	.04	-.18
SES → Disease Care	.02***	.00	.28
Disease Care → HbA1c	-.30**	.12	-.17
Age → HbA1c	.11	.07	.09
SES → HbA1c	-.02**	.01	-.19
PIH → HbA1c	-.12	.20	-.03
Family Conflict → HbA1c	.38***	.11	.19
Self-Efficacy → HbA1c	-.14**	.05	-.16
Variances			
Family Conflict	.58***	.05	
Age	1.53***	.14	
SES	131.59***	11.63	
PIH	.18***	.02	
Disturbance Variances			
Self-Efficacy	2.64***	.23	.87
Disease Care	.47***	.04	.68
HbA1c	1.67***	.15	.75
Covariances			
Age → Family Conflict	-.01	.06	-.01
SES → Family Conflict	-1.78***	.56	-.20
SES → Age	.59	.89	.04
PIH→SES	.99***	.31	.21
PIH → Age	.01	.03	.02
PIH → Family Conflict	-.04	.02	-.11

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

Note. SES = Socioeconomic Status, PIH = Number of Parents in Home, HbA1c = glycemic control

Appendix C

Direct, Indirect and Total Effects of Path Model

	PIH	SES	Age	Family C	SEDSM	Disease Care
Unstandardized						
Direct						
SEDSM	.44	.03	-.22	-.49	.00	.00
Disease Care	.00	.02	-.12	.00	.18	.00
HbA1c	-.12	-.02	.11	.38	-.14	-.30
Indirect						
SEDSM	.00	.00	.00	.00	.00	.00
Disease Care	.08	.01	-.04	-.09	.00	.00
HbA1c	-.08	-.01	.08	.09	-.06	.00
Total Effects						
SEDSM	.44	.03	-.22	-.49	.00	.00
Disease Care	.08	.03	-.16	-.09	.18	.00
HbA1c	-.20	-.04	.19	.47	-.19	-.30
Standardized						
Direct						
SEDSM	.11	.17	-.16	-.21	.00	.00
Disease Care	.00	.28	-.18	.00	.38	.00
HbA1c	-.03	-.19	.09	.19	-.16	-.17
Indirect						
SEDSM	.00	.00	.00	.00	.00	.00
Disease Care	.04	.06	-.06	-.08	.00	.00
HbA1c	-.02	-.09	.07	.05	-.06	.00
Total Effects						
SEDSM	.11	.17	-.16	-.21	.00	.00
Disease Care	.04	.35	-.24	-.08	.38	.00
HbA1c	-.06	-.27	.16	.24	-.22	-.17

Vita

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