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Diabetes-Specific Distress and Glycemic Control in Children and Adolescents with Type 1 Diabetes: A Longitudinal Analysis of the Moderating Effect of Social Support

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Diabetes-Specific Distress and Glycemic Control in Children and Adolescents with Type 1

Diabetes:

A Longitudinal Analysis of the Moderating Effect of Social Support

A Thesis

Presented in

Partial Fulfillment of the

Requirements for the Degree of

Master of Arts

By

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Biography

The author was born in Berwyn, Illinois on August 26, 1992. She graduated from Nazareth Academy High School in La Grange Park, IL. She received her Bachelor of Arts degree in Psychology from the University of Notre Dame in 2014.

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Abstract

This thesis examines the roles diabetes-specific distress and social support play in impacting glycemic control trajectories in youth with type 1 diabetes. Due to the increase in responsibilities and stressors occurring during pre-adolescence and adolescence, it is particularly important to consider the impact of diabetes-specific distress on glycemic control trajectories during this time, in order to determine best practices for screening and treating this population. It is also important to consider how social support may serve as a buffer against negative diabetes outcomes. In order to determine how diabetes-specific distress and social support impact glycemic control trajectories in this population, scores on the Problem Areas in Diabetes Scale (PAID-5), Multidimensional Scale of Social Support (MSPSS), and hemoglobin A1c values over three time points were collected from 121 youth (55.4% male) between the ages of 8 and 18 years visiting a diabetes clinic at a large academic medical center in an urban city in the Midwestern United States. Multilevel modeling was used to test for the effects of diabetes-specific distress and social support on glycemic control trajectories. Results found that diabetes-specific distress significantly predicted glycemic control trajectories over time, when moderated by the significant other subscale of the MSPSS ($\beta = -0.799, p = 0.007$). A trend toward a significant interaction between diabetes-specific distress and the total social support score in predicting glycemic control trajectories was also found ($\beta = -0.572, p = 0.053$). Simple slopes analyses found that the trajectory for youth with higher levels of distress and lower levels of support (both total and for significant others) was significantly different from zero and increasing (i.e., becoming poorer) over time (Total support: $\beta = 1.42, p = 0.033$; Significant other support: $\beta = 1.93, p = 0.007$). Results suggest that diabetes-specific distress and social support may be important areas of screening and intervention for youth with type 1 diabetes.

Diabetes-Specific Distress and Glycemic Control in Children and Adolescents with Type 1

Diabetes:

A Longitudinal Analysis of the Moderating Effect of Social Support

Insulin-dependent diabetes mellitus (more commonly known as type 1 diabetes) is the most common chronic medical condition diagnosed in children and adolescents, and it is estimated that over 18,000 people under the age of 20 are diagnosed with type 1 diabetes in the United States each year (Centers for Disease Control and Prevention, 2014; Shulman & Daneman, 2010). Due to the increasing prevalence of type 1 diabetes, it is important to understand factors that are associated with both positive and negative diabetes control outcomes, in order to explore ways medical professionals can increase positive and reduce negative outcomes in as many youth as possible. Therefore, the current study aims to determine how two factors related to diabetes care and coping, diabetes-specific distress and social support, influence glycemic control trajectories, either positively or negatively, in youth with type 1 diabetes. The current study hypothesizes that (1) higher levels of diabetes-specific distress at time point 1 will predict poorer glycemic control trajectories across three time points, and (2) social support will moderate the relation between diabetes-specific distress and glycemic control trajectories, such that youth who report experiencing greater social support (overall, from friends, from family, and from significant others) will show better glycemic control trajectories than youth who report experiencing less social support. It is predicted that social support will serve as a buffer in this relationship, reducing the negative effect of diabetes-specific distress on glycemic control trajectories. In order to test these hypotheses, youth were administered measures of diabetes-specific distress (Problem Areas in Diabetes Scale; PAID-5) and social

support (Multidimensional Scale of Social Support; MSPSS), and their glycemic control (hemoglobin A1c; HbA1c) values were measured across three time points.

Type 1 diabetes is a lifelong autoimmune illness characterized by the body's inability to produce insulin. Consequently, individuals with type 1 diabetes must regulate blood glucose levels artificially, through the use of multiple daily injections (MDI) of insulin or through continuous subcutaneous insulin infusion (CSII) using an insulin pump. In order to maintain their health, individuals with diabetes must check their blood glucose levels multiple times a day, and monitor and regulate food intake, insulin dosages, and exercise levels.

The maintenance of diabetes, especially for youth, may seem stressful and overwhelming; in fact, stressors have been implicated in both the onset and exacerbation of diabetes (Lloyd, Smith, & Weinger, 2005). Additionally, failure to carefully regulate diabetes can result in a variety of physiological and psychological complications, such as kidney disease, retinopathy, eating disorders, anxiety, and depression (Bernstein, Stockwell, Gallagher, Rosenthal, & Soren, 2013; Edgren & Odle, 2006). Due to the importance of successfully managing diabetes in order to avoid complications, and due to the inherently stressful nature of managing a chronic illness, it is important to explore the relationship between diabetes-specific stress and glycemic control. It is also important to consider factors, such as social support from friends, family, and significant others, which may serve to influence the impact of stress on glycemic control in youth.

Type 1 Diabetes

Type 1 diabetes is characterized by the body's failure to produce insulin. Insulin plays an important role in processing glucose from foods in order to convert it to energy. Failure of the body to appropriately process glucose results in a dangerous build-up of glucose in the blood

stream. Consequently, an individual whose body no longer produces insulin must closely monitor and regulate his or her blood glucose levels and food intake. In order to manage blood glucose levels and remain healthy, individuals with type 1 diabetes must take multiple daily insulin injections or use an insulin pump, which delivers insulin subcutaneously. In order to appropriately adjust insulin dosages based on the caloric or carbohydrate content of foods and one's blood glucose levels, individuals must check their blood glucose levels multiple times a day and they must keep track of the foods they eat. Managing type 1 diabetes requires that an individual invest a great deal of time and attention into his or her daily diabetes management routine in order to prevent complications due to unmanaged or poorly managed diabetes.

Due to the lifelong nature and persistent course of type 1 diabetes, constant and close management of the disease is required in order to prevent a variety of serious complications from occurring. Unmanaged or poorly managed diabetes can lead to many physical complications, such as those relating to the kidneys, eyes, and liver (Edgren & Odle, 2006). Persistently high blood glucose levels (a condition called hyperglycemia) can lead to ketoacidosis. Ketoacidosis is a dangerous and potentially life-threatening condition in which ketones (acids) build up in the blood (Edgren & Odle, 2006). If left untreated, ketoacidosis may lead to coma or death. In order to avoid complications, such as those mentioned above, and maintain good control of one's diabetes, individuals must monitor and regulate blood glucose levels and insulin dosages, and they must carefully attend to food intake and participation in exercise. The responsibilities of managing diabetes are persistent and unceasing.

Type 1 diabetes not only poses risks for physical complications, but for psychosocial complications, as well. Psychological conditions such as depression, anxiety, and eating disorders frequently co-occur with diabetes in young people; one study found rates of these

disorders to be as high as 11.3%, 21.3%, and 20.7%, respectively (Bernstein et al., 2013). It has been suggested that co-occurrence of mental health disorders and type 1 diabetes in adolescents might make the acquisition of strong diabetes management skills difficult (Bernstein et al., 2013). It is also possible that the stressors and worries related to diabetes management might contribute to the occurrence and exacerbation of psychological disorders. The comorbidity of type 1 diabetes and psychological disorders tends to impact glycemic control, in that adolescents with type 1 diabetes and a psychological disorder tend to have poorer glycemic control and diabetes management than their counterparts without psychological disorders. One study found that higher rates of state anxiety (anxiety occurring at the immediate time of testing) were associated with infrequent blood glucose monitoring habits and suboptimal glycemic control (Herzer & Hood, 2010). Depressive symptoms in youth with diabetes have been shown to related to poor glycemic control, as well (Grey, Whittemore, & Tamborlane, 2002; Johnson, Eiser, Young, Brierley, & Heller, 2013; Reynolds & Helgeson, 2011). Finally, many adolescent females with diabetes will manipulate their insulin dosages in such a way as to lose weight. This is a dangerous practice which can cause severe complications and even death. It has been found that increased symptoms of bulimia in adolescents with diabetes is associated with poorer glycemic control, as compared to those with fewer symptoms of bulimia (Meltzer et al., 2001).

Due to the demanding nature of managing a chronic illness, such as diabetes, and the many possible complications related to its management, it is important to consider how individuals adapt, both psychologically and physiologically, to living with this illness.

Adaptation to Chronic Illnesses/Diabetes

Adaptation to illness, as defined by Grey and Thurber (1991), is “the degree to which an individual adjusts both psychosocially and physiologically to the stress of a long-term illness” (p.

303). Adaptation to diabetes has been conceptualized as both physiological (as measured by metabolic control) and psychosocial (as measured by quality of life) management of diabetes (Whittemore, Jaser, Guo, & Grey, 2010). Inherent in the definition of adaptation is the idea that an individual with a chronic illness experiences a great deal of stress in his or her daily life, and that successful management of illness-related stressors will result in positive adaptation to one's illness. Stress and poor diabetes management can have serious and long-term negative consequences for individuals with diabetes; specifically, poor diabetes management in childhood and adolescence may relate to negative physiological outcomes later in life (Genuth et al., 2001). Stress, related and unrelated to diabetes care, can serve to make management of diabetes more difficult, impacting diabetes outcomes, as well (Lloyd et al., 2005).

Thus, in order to attempt to avoid negative diabetes outcomes, it is particularly important to understand factors influencing adaptation to diabetes in children. Whittemore, Jaser, Guo, & Grey (2010), building upon the original Grey & Thurber (1991) model of diabetes adaptation, have identified sets of factors that serve to influence successful or unsuccessful adaptation to diabetes in children. It is proposed that individual and family characteristics (e.g., age, duration of diabetes, socioeconomic status, family environment), psychosocial responses (e.g., depressive symptoms, anxiety/stress, disordered eating), and individual and family responses (e.g., coping, self-management, family functioning, social competence) serve to influence each other and a child's adaptation to diabetes (Whittemore et al., 2010; see *Figure 1*). From the models of adaptation developed by Grey & Thurber (1991) and Whittemore et al. (2010), one is provided a basis from which to consider factors, such as stress and social support, which are important to diabetes adaptation in children and adolescents.

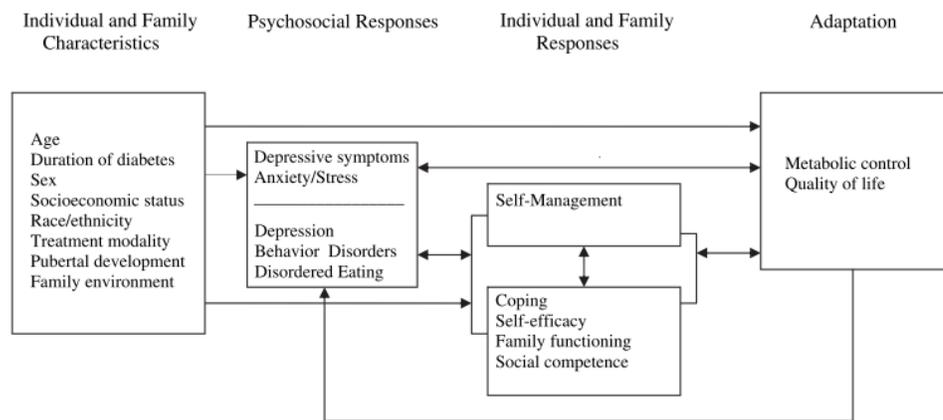


Figure 1. Conceptual model of childhood adaptation to type 1 diabetes. Reprinted from “A Conceptual Model of Childhood Adaptation to Type 1 Diabetes,” by R. Whittemore, S. Jaser, J. Guo, and M. Grey, 2010, *Nursing Outlook*, 58(5), p. 244.

Stress and Adaptation

It is clear from past research and writings that adaptation to life with diabetes is context-dependent and thus, necessarily, a continuous and life-long process (Grey & Thurber, 1991; Whittemore et al., 2010). Diabetes management is a task requiring a great deal of attention and energy; oftentimes, the demands of diabetes management increase as one’s responsibilities and stressors, related to both diabetes and general areas of life, increase in adolescence and into adulthood (Wolpert, Anderson, & Weissberg-Benchell, 2009). It has been recognized, through the identification of diabetes-specific distress, that the chronic nature of diabetes and its demanding management regimen can elicit feelings of distress in those with type 1 diabetes (Esbitt, Tanenbaum, & Gonzalez, 2013). The experience of diabetes-specific distress serves as a psychosocial response to living with diabetes, and as a factor relevant to diabetes adaption, as per the adaptation model proposed by Whittemore et al. (2010).

Diabetes-Specific Distress

Diabetes-specific distress is emotional stress related specifically to diabetes care and management (Esbitt et al., 2013). Thus, diabetes-specific distress is a response to one's diagnosis of diabetes, and a key component influencing the adaptation process. Diabetes-specific distress is conceptually distinct from general emotional distress and from major depressive disorder in that diabetes-specific distress relates specifically to diabetes management experiences, such as "disease management, support, emotional burden, and access to care" (Esbitt et al., 2013; Fisher, Glasgow, Mullan, Skaff, & Polonsky, 2008, p. 1). As diabetes care and management require constant attention and conscientiousness in areas of food, exercise, and medication, many opportunities exist for stress related to these areas to develop. Diabetes-specific distress is important to consider when evaluating the adaptation and functioning of individuals with diabetes, as it may be associated with diabetes self-management and glycemic control (Esbitt et al., 2013; Weissberg-Benchell & Antisdel-Lomaglio, 2011). It is especially important to consider the demands placed upon pre-adolescents and adolescents with diabetes and how these might impact diabetes care, control, and distress.

Pre-adolescence and adolescence is a time of many changes and it is filled with competing academic, social, and emotional demands. As compared to youth without diabetes, youth with diabetes must manage the additional medical demands required by a chronic illness, and may experience additional stress that may impact their desire and willingness to attend to diabetes management tasks required to maintain their health.

A recent study found that when asked to select their top three stressors from a list of seven stressors (school, social life, diabetes, family, looks, activities/sports, other), 48.1% of adolescents with diabetes selected "diabetes" as one of their top three stressors (Chao et al.,

2015). Additionally, the same study found that of the seven stressors presented, adolescents perceived “diabetes” as being the most stressful (Chao et al., 2015). Another study considered the most-common diabetes-related concerns of youth aged 11-19 years. These included worry about weight, worry about complications, upset due to “off-track” diabetes management, feeling “policed” about diabetes by friends and family, and feeling that others do not understand the difficulty of living with diabetes (Weissberg-Benchell & Antisdel-Lomaglio, 2011). Youth with diabetes who experience stressors related to diabetes care often respond by ignoring maintenance of their disease; oftentimes, adolescents will fail to check blood glucose levels, monitor food intake, and administer insulin due to stressors related to the desire to fit in with peers (Davidson, Penney, Muller, & Grey, 2004). By failing to adhere to diabetes management tasks, youth with diabetes place themselves at an increased risk for poor glycemic control and diabetes-related complications.

While increased diabetes-specific distress has consistently been found to be associated with poorer glycemic control (as measured by increased HbA1c levels) in populations of adults and mixed age samples with both type 1 and type 2 diabetes (Fisher et al., 2008; Polonsky et al., 1995; Strandberg et al., 2015; Strandberg, Graue, Wentzel-Larsen, Peyrot, & Rokne, 2014), results relating to children and adolescents with type 1 diabetes have been limited and mixed. While no significant relation between diabetes-specific distress and glycemic control was found when using a pediatric-specific measure of diabetes-specific distress in a group of youth between the ages of 8 and 17 years (Markowitz, Volkening, Butler, & Laffel, 2015), a significant positive correlation between diabetes-specific distress and HbA1c levels was found when using an adolescent (i.e., “teen”)-specific measure of diabetes-specific distress in a group of youth between the ages of 11 and 19 years (Weissberg-Benchell & Antisdel-Lomaglio, 2011).

Similarly, there was a significant positive correlation between glycemic control and diabetes-specific distress severity in a sample of late adolescents with type 1 diabetes (Baucom et al., 2015). Finally, it was also found that diabetes-specific distress mediated the effect of avoidant coping styles in predicting glycemic control in a group of adolescents, such that increased avoidant coping led to increased diabetes-specific distress, which led to deterioration in glycemic control over time (Iturralde, Weissberg-Benchell, & Hood, 2016). When one considers the increased stressors and demands placed on youth with diabetes, as compared to peers without diabetes, and the association between diabetes-specific distress and glycemic control, it is clear that it is necessary to further examine the relation between diabetes-specific distress and glycemic control in this population.

Factors Impacting Stress and Adjustment in Youth with Type 1 Diabetes

As suggested by the adaptation to chronic illness models laid out by Grey & Thurber (1991) and Whittemore et al. (2010), multiple factors are thought to influence youths' adaptation to life with type 1 diabetes. Whittemore et al. (2010) suggest that family functioning and social competence may play a role in influencing how a child or adolescent with diabetes learns to adapt to the diagnosis. Given the importance of family and social relationships play in the lives of developing children and adolescents, it is possible that perception of received social support might impact the way diabetes-specific distress influences glycemic control in youth with diabetes.

Social support. Chronic illnesses and the constant attention they require can oftentimes be overwhelming and at times, debilitating. Therefore, it is important for youth with diabetes to build a strong support network, comprised of family, friends, and significant others. Previous research has shown mixed results relating to the impact diabetes-specific and general (non-

diabetes-specific) support plays in impacting youths' glycemic control. It has also shown mixed results regarding the sources of social support (i.e., family, friends, significant others/romantic partners) that are most important. While two studies (Helgeson, Siminerio, Escobar, & Becker, 2009; Doe, 2016) have considered both general and diabetes-specific support simultaneously (and have found that general support, rather than diabetes-specific support, impacts glycemic control), most have failed to do so. Additionally, most studies consider either one or two sources of social support, but not all three. Due to these variations in measurement and study design, results in this area are inconsistent and varied.

In terms of support from family, it has been found that general parental support, but not diabetes-specific support, serves as a source of resilience against poor metabolic control in adolescent females with type 1 diabetes (Helgeson et al., 2009). Additionally, it has been shown that greater family support in diabetes care tasks is associated with greater treatment adherence in adolescents (La Greca & Bearman, 2002; La Greca et al., 1995).

Literature regarding peer or friend support and diabetes control tends to be more complicated than the literature on family support. A recent meta-analysis found no support for the relationship between general peer support and glycemic control, and limited, mixed support for the relationship between diabetes-specific peer support and glycemic control (Palladino & Helgeson, 2012). Interestingly, one study included in the meta-analysis found that friend support has been shown to relate to poor metabolic control in a cross-sectional study (Helgeson et al., 2009). It has been suggested that the connection between increased peer support and poorer metabolic control may be explained by adolescents' increased desires to fit in with friends and peers, to the detriment of diabetes care behaviors (Wiebe, Helgeson, & Berg, 2016). Importantly, though the results from the meta-analysis suggested that peer support may not play an important

role in glycemic control outcomes, a recent study comparing the effects of general peer and diabetes-specific peer support found that global (general) peer support, but not diabetes-specific peer support, predicted glycemic control (Doe, 2016). The mixed findings related to peer and friend support are interesting in that they might suggest that relationships with friends and family may impact, either positively or negatively, the ways youth view and understand themselves as individuals with diabetes. This view of diabetes and what it means to live with diabetes might, in turn, influence diabetes management, adherence, and adaptation.

Finally, research regarding support from significant others or romantic partners in adolescents and emerging/young adults with diabetes is severely limited. Only one study, to the author's knowledge, has considered both friend and romantic partner social support over time. This study found that social support from romantic partners did not significantly predict glycemic control in late adolescents and emerging adults (Helgeson et al., 2015). However, it did find that less romantic conflict was related to better self-care behaviors. Due to the lack of research in this area, and the increasing importance that youth place on romantic relationships as they progress through adolescence and into adulthood, it is important that this source of social support continue to be explored.

Based on the current mixed research findings regarding social support in youth with diabetes, it is possible that general emotional support and acceptance from friends and family, as compared to diabetes-specific support, might differentially impact youths' experiences with diabetes. It is also important to consider how changing social focuses and relationships for pre-adolescents and adolescents, from a focus on family toward a focus on friend and/or romantic relationships, might impact the relative influences friends, family members, and significant others might have on attitudes and behaviors. A need to better understand how general social

support from family, friends, and significant others impacts adaptation to diabetes in adolescents is indicated.

Rationale

Maintenance of good glycemic control, an indication of positive adaptation to life with diabetes, is of the utmost importance for the health of children and adolescents with type 1 diabetes. The negative consequences of poor diabetes management and glycemic control may be serious and long lasting, and can include liver problems, kidney problems, and retinopathy. Current literature supports connections between diabetes-specific distress and glycemic control in children and adolescents with type 1 diabetes. Research also supports associations between family and peer relationships and support, and diabetes behaviors and outcomes. However, less is known about how social support from different sources impacts the effects of diabetes-specific distress on glycemic control and how this changes throughout childhood and adolescence. Adolescence is a period of many changes—physiological, psychological, and social—associated with increased stress. It is also a time during which compliance and adherence to diabetes care regimens are lacking and during which time glycemic control tends to worsen (Helgeson et al., 2009). It is possible that changes in diabetes management and control during this time might be impacted by pre-adolescents and adolescents' increasing desires for autonomy and independence. Clinically, it is important to better understand how stress related to diabetes care and management and social support might predict glycemic control in youth so that clinicians might determine best practices in terms of screening and providing support to youth's changing needs related to adapting to life with diabetes.

Statement of Hypotheses

Hypothesis I. Higher levels of diabetes-specific distress at time point 1 will predict poorer (i.e., increasing) glycemic control trajectories across three time points.

Hypothesis II. Social support will moderate the relation between diabetes-specific distress and glycemic control trajectories, such that youth who report experiencing greater social support (overall, from friends, from family, and from significant others) will show better (i.e., decreasing) glycemic control trajectories than youth who report experiencing less social support. It is predicted that social support will serve as a buffer in this relationship, reducing the negative effect of diabetes-specific distress on glycemic control trajectories.

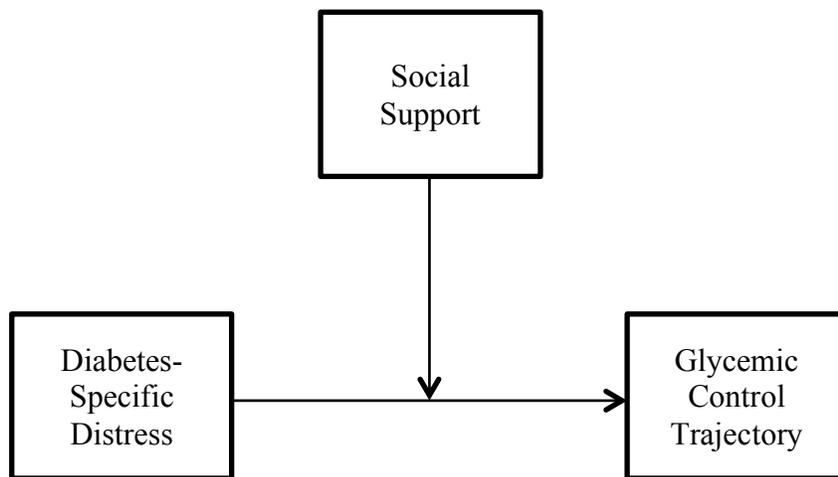


Figure 2. Hypothesis model illustrating proposed relations between diabetes-specific distress and glycemic control, as moderated by social support.

Method

Research Participants

Data for participants in the current study was drawn from a larger sample collected through a study examining psychosocial factors and diabetes outcomes in children and adults. Youth with type 1 diabetes, between the ages of 8 and 18 years at the start of the study, were

included in the current study's analyses. The current study will considered data from 121 adolescents.

Participants were recruited at the Kovler Diabetes Center at the University of Chicago Medicine during routine visits to the clinic. Pediatric psychotherapy externs identified patients with diabetes through EPIC, the electronic medical records system, and approached patients (and their guardians, if patients were minors) in the waiting room of the diabetes clinic. The aims and requirements of the study were explained and informed consent was obtained from either the adult patient or the child's parent/guardian. Written assent was also obtained for all children over the age of 7 years. The larger studied aimed to consider psychosocial factors and their relations to diabetes outcomes. Requirements of the study included the completion of a routine screening interview with a Health and Wellness provider, the completion of self-report questionnaires, and consent to utilize patient health data in the study analyses. Patients and families were informed that participation in the study would not affect their eligibility to receive the same medical and psychosocial care and services available to those not participating in the study. No incentives were awarded for participation.

Procedure

Children, adolescents, and their guardians completed a routine psychosocial screening with trained members of the Health and Wellness Team. This screening occurred either before or after the patient's visit with his or her endocrinologist and/or diabetes educator, based on scheduling availability and wait time available between appointments. The screenings were one-on-one interviews between the child, adolescent, and/or parent (depending on the child's age and preference), and a Health and Wellness provider. Participants were asked questions about demographics, social support, stress and coping (used in the current study), feelings and attitudes

toward life with diabetes, psychological treatment history, and family psychological history; they were also screened for indicators of psychopathology, using a semi-structured interview. The diabetes-specific distress measure used in the current study (Problem Areas in Diabetes Scale- 5; PAID-5; McGuire et al., 2010) was administered orally to participants during the screening interview. If psychopathology was indicated in the interview, Health and Wellness providers scheduled follow-up visits with the patient and offered resource suggestions. During their visits to the clinic, participants were also asked to complete a battery of self-report questionnaires, which include the measure of social support (Multidimensional Scale of Perceived Social Support; MSPSS; Zimet, Powell, Farley, Werkman, & Berkoff, 1990) used in the current study. Finally, demographic variables and HbA1c levels, which indicate glycemic control, were collected, with permission, from participants' electronic medical files and entered into the study database.

Materials

Diabetes-specific distress. Diabetes-specific distress was measured using the Problem Areas in Diabetes Scale-5 (PAID-5; McGuire et al., 2010). The PAID-5 is a self-report measure of emotional distress related to living with diabetes. It was administered orally to patients during the psychosocial screening interview. The PAID-5 is a short-form of the PAID-20, and it consists of 5 items, which are rated on a 5-point scale (0 = *Not A Problem*; 1 = *Minor Problem*; 2 = *Moderate Problem*; 3 = *Somewhat Serious Problem*; 4 = *Serious Problem*). Patients were asked to indicate how much of a problem they felt each diabetes-related emotional experience to be. Items include: "Feeling scared when you think about living with diabetes," "Feeling depressed when you think about living with diabetes," "Worrying about the future and the possibility of serious complications," "Feeling that diabetes is taking up too much of your mental and physical

energy everyday;” and “Coping with the complications of diabetes.” Scores on each item are summed to form a total score, ranging from 0 to 20; higher scores indicate greater diabetes-related distress (McGuire et al., 2010). The PAID-5 considers how different aspects of diabetes care impact emotional functioning and distress. Internal consistency of the PAID-5 is good ($\alpha = 0.86$) (McGuire et al., 2010). As expected, the PAID-5 correlates significantly with the PAID-20 ($r = 0.92, p < 0.001$), and with the WHO Five Item Measure of Wellbeing ($r = -0.47, p < 0.001$) (McGuire et al., 2010). Additionally, it has been shown that the PAID-5 overall score correlates positively with the subscale scores (treatment problems, food problems, and lack of social support) on the larger PAID-20 ($r = 0.64, 0.61, \text{ and } 0.58$, respectively) (McGuire et al., 2010). While the PAID-5 has only been validated in samples of adults with diabetes, the PAID-5 does correlate strongly with the PAID-20, which is included in its entirety in the PAID-T (adolescent version of the PAID-20) (Weissberg-Benchell & Antisdell-Lomaglio, 2011). The PAID-T was shown to have face validity and internal consistency ($\alpha = 0.96$) with a sample of 11-19 year olds; it was also shown to correlate with measures of depression, anxiety, diabetes quality of life, and diabetes family behaviors (Weissberg-Benchell & Antisdell-Lomaglio, 2011). All five items comprising the PAID-5 were included in the PAID-T (Weissberg-Benchell & Antisdell-Lomaglio, 2011). In the current study, the PAID-5 demonstrated acceptable internal consistency ($\alpha = 0.756$).

Social support. Social support was measured using the Multidimensional Scale of Perceived Social Support; MSPSS; Zimet et al., 1990). The MSPSS is a self-report measure of perceived social support from family, friends, and significant others. It was administered to participants as part of a battery of self-report questionnaires. The MSPSS contains 12 items and asks participants to indicate the extent to which they agree or disagree with statements related to

support. Responses are measured on a 7-point Likert-type scale (1 = *Very Strongly Disagree*; 2 = *Strongly Disagree*; 3 = *Mildly Disagree*; 4 = *Neutral*; 5 = *Mildly Agree*; 6 = *Strongly Agree*; 7 = *Very Strongly Agree*). Sample items include: “My family really tries to help me,” “I can count on my friends when things go wrong,” and “I have a special person who is a real source of comfort to me.” A total score of perceived social support and three scores of perceived support from family, friends, and significant others may be calculated using the MSPSS (Zimet et al., 1990). A total score is produced by summing the scores from all twelve items and dividing by 12; Family, Friends, and Significant Other subscale scores are calculated by summing the scores from each subscale’s 4 relevant items and dividing by 4 (Zimet, n.d.). Internal consistency of the MSPSS is strong in an adolescent sample ($\alpha = 0.84, 0.81, 0.92,$ and 0.83 for the total, family, friends, and significant other scales, respectively) (Zimet et al., 1990). The scale also has good test-retest reliability in an undergraduate sample when tested 2 to 3 months after the initial test administration ($\alpha = 0.85$ for the total score) (Zimet, Dahlem, Zimet, & Farley, 1988). Additionally, MSPSS scores have been shown to correlate negatively with measures of depressive symptoms and anxiety, such that decreased social support correlates with increased depressive and anxiety symptoms (Kazarian & McCabe, 1991; Zimet et al., 1988). In the current sample, internal consistency of the MSPSS was good for the total score ($\alpha = 0.882$) and significant other subscale ($\alpha = 0.871$), and excellent for the family subscale ($\alpha = 0.900$) and friend subscale ($\alpha = 0.902$),

Glycemic control. Glycemic control was measured using three hemoglobin A1c (HbA1c) values obtained from participants’ medical records. HbA1c values are estimates of average blood glucose levels over a two- to three-month period and are collected through blood tests. By taking an average of blood glucose levels over a multiple month time period, HbA1c

measures avoid problems related to outlier blood glucose episodes. Higher HbA1c levels indicate poorer glycemic control. It is recommended that children and adolescents with diabetes maintain HbA1c levels below 7.5% (American Diabetes Association, 2015). HbA1c levels are routinely collected in diabetic patients in order to measure changes in glycemic control, and they help to inform treatment plans for individuals with diabetes. HbA1c measurements are considered the “gold standard” in measuring average blood glucose levels (Krieza, 2014), and HbA1c values correlate with other measures of glycemic control ($r_s = 0.57$ and 0.56 for glycated albumin and fructosamine, respectively), and with blood glucose levels as measured using continuous glucose monitoring ($r_s = 0.56$) (Beck et al., 2011).

Data Analyses

The current study included data from 121 children and adolescents who were between the ages of 8 and 18 years at the first data collection point ($M = 13.91$, $SD = 2.73$). Time of first data collection varied among participants; data was first collected from participants between 2011 and 2015. Of the 121 children participating in the study, 20 did not have HbA1c data at the three time points required for hierarchical linear modeling, but were included in the analyses to estimate intercepts. Based on data collection dates, 17 of these 20 participants seem to have stopped attending regular diabetes appointments at University of Chicago Medicine, and three participants began participation in the study at a date too near to data analysis to have completed three regular diabetes appointments with associated HbA1c values. Mean time between first and second HbA1c time points was 16.03 weeks ($SD = 10.81$; range = 3.71-82.00). Mean time between second and third HbA1c time points was 16.10 weeks ($SD = 8.22$; range = 4.00-43.00). Mean time between the first and third HbA1c time points was 30.89 weeks ($SD = 12.16$; range = 8.43-85.00).

Preliminary and longitudinal data analyses were carried out using SPSS Statistics (Version 23). Simple slopes analyses used to examine interactions were conducted using the online calculation tool developed by Preacher, Curran, & Bauer (2006). Interaction plots were graphed using worksheets developed by Dawson (n.d.).

Results

Preliminary Analyses

ANOVAs were run to determine whether or not there existed differences in continuous baseline variables (age at diagnosis, age at Time 1, diabetes-specific distress, social support, and HbA1c level at Time 1) between those 17 individuals who stopped attending regular diabetes appointments and all other participants. No significant differences were found on these variables between those who stopped attending diabetes appointments and those who did not.

Chi-square cross-tabulations were run on those baseline variables that were categorical (gender and race). There were no significant differences between the groups based on race or gender.

Descriptive statistics including percentages, means, and standard deviations are reported for demographic variables of interest in Table 1.

Table 1
Demographic Characteristics of the Sample (N = 121)

<i>Variable</i>	<i>Mean ± SD</i>	<i>%</i>
Age (years)	13.91 ± 2.73	
Male gender		55.4
Race/Ethnicity		
White/Caucasian		57.0
Black/African		19.8
Hispanic		9.1
Other		1.7
Not reported		12.4
Time 1 HbA1c	8.93 ± 2.28	
Mean HbA1c ^a	8.79 ± 1.91	
Age at diagnosis (years)	9.20 ± 3.55	
Time since diagnosis (years)	4.27 ± 3.84	
New diagnosis (within current year)		21.7

a. Mean HbA1c indicates the average of 3 A1c values for each participant.

Overall, participants were ethnically diverse, and were nearly evenly split between genders. Of the 121 children, 55.4% were male; 44.6% were female. 57.0% of the sample identified as White/Caucasian; 19.8% as Black/African; 9.1% as Hispanic; and 1.7% as Other. 12.4% of participants declined reporting of racial identification.

Preliminary analyses were conducted using zero-order correlations, ANOVAs and chi-square tests to identify any pre-existing differences between groups in the sample. First, correlations were run for all demographic variables and outcome variables of interest. Zero-order correlations of baseline variables are reported in Table 2.

Table 2
Intercorrelations Among Baseline Variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1. Age at Time 1	--	-.26**	.46**	.01	.06	-.05	.06	.08	-.01	-.20	.16	.02
2. Age at onset		--	-.73**	-.16	.09	-.17	-.18	-.05	-.35**	-.34**	-.16	-.29*
3. Years since onset			--	.14	-.01	.10	.15	.07	.35**	.19	.27*	.30*
4. Race/Ethnicity				--	-.11	-.29**	-.30**	-.19	.22	.18	.26*	.07
5. Gender					--	.06	.05	.08	-.04	.02	-.12	.01
6. Time 1 HbA1c						--	.88**	.25*	.02	-.20	.15	.13
7. Mean HbA1c							--	.24*	.01	-.22	.15	.10
8. Diabetes-Specific Distress (PAID)								--	-.26	-.22	-.28*	-.10
9. Social Support-Total									--	.78**	.62**	.87**
10. Social Support-Family										--	.09	.65**
11. Social Support-Friend											--	.35**
12. Social Support-Significant Other												--

Note. * $p < 0.05$. ** $p < 0.01$.

Age at diagnosis was significantly correlated with overall social support ($r = -0.350, p = 0.005$), social support from significant others ($r = -0.293, p = 0.017$), and social support from family ($r = -0.342, p = 0.005$), such that children diagnosed at an older age reported less social support overall, from family and from significant others than children who were diagnosed at a younger age. Time since onset of diabetes was also significantly correlated with social support from significant others ($r = 0.303, p = 0.013$) and social support from friends ($r = 0.270, p = 0.029$),

such that children who had diabetes longer reported more social support in these areas than children who had diabetes for a shorter period of time.

Additionally, significant correlations between Time 1 HbA1c and diabetes-specific distress ($r = 0.253, p = 0.014$), and Mean HbA1c and diabetes-specific distress ($r = 0.240, p = 0.040$) were found, such that youth who reported higher levels of diabetes-specific distress demonstrated higher mean HbA1c and Time 1 HbA1c levels than youth who reported lower levels of diabetes-specific distress.

Notably, no significant correlations between gender and any other variable of interest were found. However, significant correlations between race/ethnicity and the following baseline variables were found: mean HbA1c ($r = -0.297, p = 0.040$), HbA1c at Time 1 ($r = -0.287, p = 0.003$), and social support from friends ($r = -0.281, p = 0.030$). ANOVAs and post hoc tests were run to determine how racial/ethnic groups differed on these variables. Due to a lack of homogeneity of variance, Welch's ANOVAs and Games-Howell post hoc tests were run to determine group differences in mean HbA1c and HbA1c at Time 1. Due to the presence of data for only one individual identifying with the "Other" racial/ethnic group for the social support from friends variable, analyses were conducted only on individuals identifying as White/Caucasian, Black/African, and Hispanic for this analysis. No significant differences were found between groups in terms of social support from friends and HbA1c at Time 1. A Welch ANOVA analysis determined there existed a significant difference between racial groups in terms of Mean HbA1c, $F(2, 15.61) = 4.974, p = 0.021$, such that White/Caucasian youth ($M = 8.35, SD = 1.48$) had lower mean HbA1c values (indicating better glycemic control) than Hispanic youth ($M = 10.29, SD = 2.86$) ($p = 0.028$). Due to racial/ethnic group differences in mean HbA1c levels, race was controlled for in all subsequent analyses. Since the majority of the

sample was White/Caucasian (57%), this was accomplished by splitting the sample into “White/Caucasian” and “Not White/Caucasian” groups.

Longitudinal Analyses

The current study examined the hierarchical relationship between diabetes-specific distress (DSS) and hemoglobin A1c (HbA1c) trajectories in youth with type 1 diabetes. Social support (including overall social support and friend, family, and significant other subscales of social support) was examined as a moderator of this relationship. Analyses were performed using multi-level modeling techniques consistent with those presented by Singer & Willett (2003). Multi-level modeling is suitable for use with this dataset because it enables the analysis of change trajectories within individuals over time. It is robust to the effects of incomplete datasets and it accounts for time-unstructured data (i.e., data in which collection schedules vary across individuals). In order to account for change in HbA1c longitudinally, participant age was used as the time variable. Participant age at each HbA1c collection point was recorded and then transformed into z-scores for analyses. For ease of interpreting and labeling graphs following simple slopes analyses, age z-scores were transformed back into regular scores.

A hierarchical linear model was run in order to test the first hypothesis, which predicted that increased levels of diabetes-specific distress at Time 1 would predict poorer glycemic control trajectories. Results found that level of diabetes-specific distress at Time 1 did not significantly predict glycemic control intercept ($\beta = 0.158, p = 0.417$) or trajectories ($\beta = -0.071, p = 0.680$). These results fail to support Hypothesis I.

A hierarchical linear model was also run in order to test the second hypothesis, which predicted that social support (overall, from friends, from family, and from significant others) would moderate the relation between diabetes-specific distress and glycemic control trajectories,

such that youth who reported experiencing greater social support would show better glycemic control trajectories than youth who reported experiencing less social support, when diabetes-specific distress was high. It was predicted that increased social support would serve to buffer the relation between increased diabetes-specific distress and poorer glycemic control trajectories.

Separate analyses were conducted for each of the social support variables. Each of these models contained a standardized interaction term between diabetes-specific distress and social support and the main effects of diabetes-specific distress and social support as predictors of HbA1C intercepts and slopes.

Results of a multi-level model analysis indicated that a trend toward significance was found for the interaction between diabetes-specific distress and total social support score predicting HbA1c trajectories over time ($\beta = -0.572, p = 0.053$). Simple slopes for the association between glycemic control trajectory and the predictor variables were tested at low (-1 SD) and high (+1 SD) levels of diabetes-specific distress and social support. The trajectory for youth with higher levels of distress and lower levels of support was significantly different from zero and increasing (i.e., becoming poorer) over time ($\beta = 1.42, p = 0.033$). See Figure 3. No other trajectories were significantly different from zero. Additionally, in this model, there was a significant main effect of diabetes-specific distress ($\beta = 0.444, p = 0.026$) and race ($\beta = -1.47, p = 0.001$) predicting A1c intercept. These results indicated that youth with higher levels of diabetes-specific distress and ethnic minority youth reported higher A1c levels at baseline. Results of this model partially support Hypothesis II, in that there was a trend indicating that

overall social support may moderate the relation between diabetes-specific distress and glycemic control trajectories in youth with high levels of diabetes-specific distress.¹

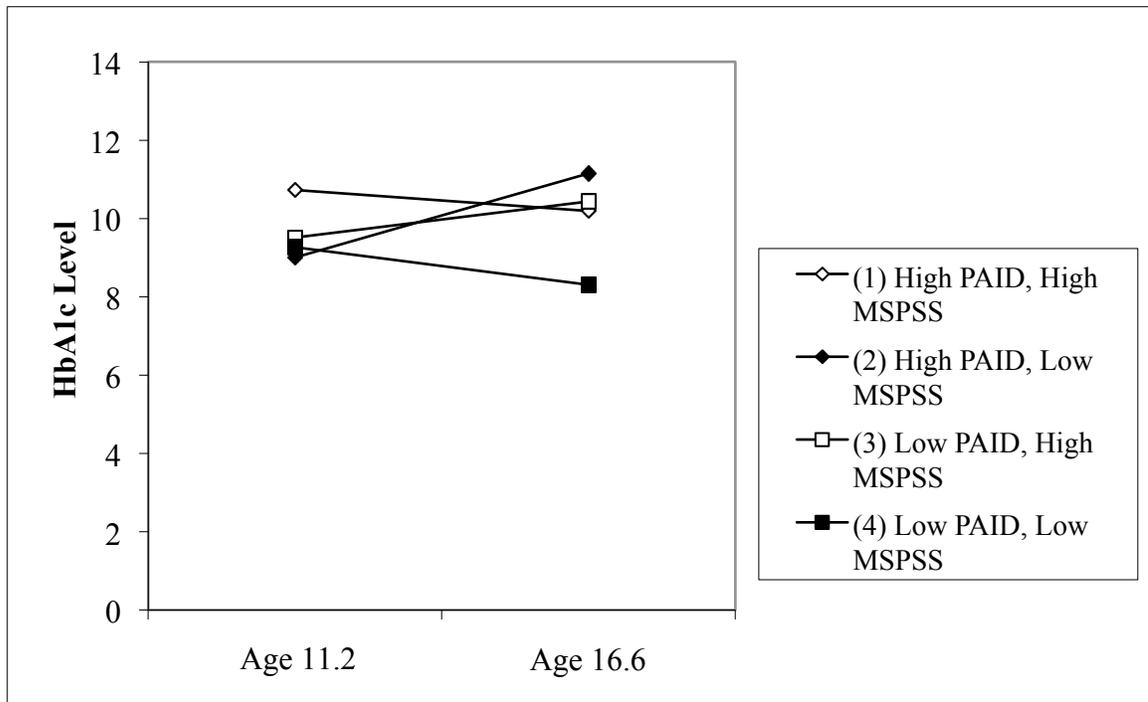


Figure 3. Graph depicting the interaction between diabetes-specific distress (PAID), overall social support (MSPSS), and age and its predictive relationship with HbA1c levels in younger and older adolescents.

Similarly, results indicate that the interaction between diabetes-specific distress and the significant other subscale of the MSPSS significantly predicted HbA1C trajectories over time ($\beta = -0.799, p = 0.007$). Simple slopes for the association between glycemic control trajectory and the predictor variables were tested at low (-1 SD) and high (+1 SD) levels of diabetes-specific

¹ Parallel analyses controlling for age of onset were conducted. All results remained the same, with the exception of the interaction between overall social support, age, and diabetes-specific distress as predictors of HbA1c trajectory. When age of onset with diabetes was controlled, this relationship no longer trended toward significance ($\beta = -0.519, p = 0.085$).

distress and social support. The glycemic control trajectory for youth with higher levels of distress and lower levels of support was significantly different from zero and increasing (i.e., becoming poorer) over time ($\beta = 1.93, p = 0.007$). See Figure 4. No other trajectories were significantly different from zero. Significant main effects for diabetes-specific distress ($\beta = 0.432, p = 0.032$) and race ($\beta = -1.355, p = 0.003$) were found to predict glycemic control intercept in this model. As in the first model, these results indicated that youth with higher levels of diabetes-specific distress and ethnic minority youth reported higher A1c levels at baseline. Overall, these findings are partially consistent with Hypothesis II, in that one subscale measure of social support (significant other) showed a significant moderation effect in the relation between diabetes-specific distress and glycemic control trajectories. It appears that low social support from significant others served as a risk factor for poor glycemic control trajectories in the current sample. Additionally, analyses considering social support from friends and social support from family indicated that these factors were not significant moderators of the relationship between diabetes-specific distress and glycemic control trajectories (Family: $\beta = -0.495, p = 0.088$; Friend: $\beta = 0.023, p = 0.909$).

Results from the two multilevel models are presented in Table 3.

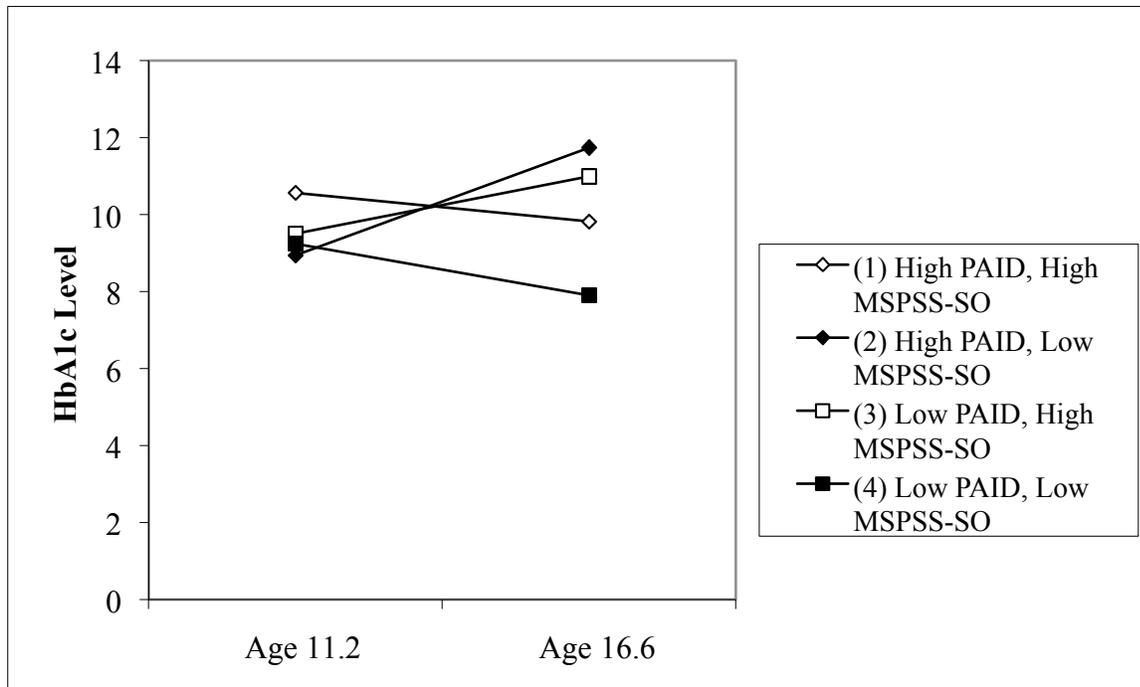


Figure 4. Graph depicting the interaction between diabetes-specific distress (PAID), social support from significant others (MSPSS-SO), and age and its predictive relationship with HbA1c levels in adolescents over time.

Table 3.

Multilevel modeling results for main effects of diabetes-specific distress and protective factors of social support on glycemic control intercept and trajectory

	Model 1- MSPSS Total		Model 2- MSPSS Significant Other		Model 3- MSPSS Family		Model 4- MSPSS Friend	
	B	SE	B	SE	B	SE	B	SE
<i>Fixed effects</i>								
Intercept	9.82***	.37	9.84***	.37	9.70***	.38	9.80***	.37
Race	-1.47**	.41	-1.36**	.43	-1.40**	.43	-1.42**	.41
DSD	.44*	.19	.43*	.20	.28	.19	.50**	.18
MSPSS	.39	.20	.39	.21	.12	.21	.67**	.21
DSD x MSPSS	-.20	.23	-.46	.25	-.31	.22	.11	.19
Time (rate of change)	.20	.20	.28	.19	.35	.20	.21	.21
DSD	.21	.21	.24	.20	.07	.21	.11	.21
MSPSS	-.20	.23	-.10	.20	-.36	.25	.45*	.22
DSD x MSPSS	-.57	.29	-.80**	.29	-.49	.29	.02	.20
<i>Variance component</i>								
Within-person	.87***	.10	.87***	.10	.87***	.10	.90***	.10
Between-person								
Random intercept	1.40**	.45	1.52**	.49	1.40**	.45	.95*	.37
Covariance between intercept and slope	.56*	.26	.52*	.24	.43	.24	.33	.22
Random linear slope	.65	.41	.53	.39	.60	.41	.81	.41

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

Discussion

The current study was designed to examine factors that may serve to increase positive diabetes outcomes and decrease negative outcomes. Therefore, diabetes-specific distress and

social support were considered as predictors of glycemic control trajectories in pre-adolescents and adolescents with type 1 diabetes, in order to determine the role that these factors play in influencing glycemic control outcomes. Through the use of hierarchical linear modeling techniques, the current study found that perceived social support from significant others moderated the relationship between diabetes-specific distress and glycemic control trajectories. Youth with higher levels of distress and lower levels of support showed steeper increases in their HbA1c levels compared to youth with higher levels of support. Similarly, there was a trend toward significance when overall level of perceived social support (from multiple sources including friends, family, and significant others) was considered as a moderator. Diabetes-specific distress did not significantly predict A1c trajectories on its own, but high levels of diabetes-specific distress, when combined with low levels of social support from significant others, served to negatively impact (lead to worsening) glycemic control in youth over time.

These findings serve to elucidate multiple facets of youths' experiences with glycemic control over time. Findings indicate that glycemic control tends to worsen over time for those youth who have low social support and high levels of diabetes-specific distress. This finding is consistent with previous findings suggesting that glycemic control worsens as youth enter and move through the adolescent and young adult years (Bryden, Peveler, Stein, & Neil, 2001; Helgeson et al., 2009; Luyckx & Seifge-Krenke, 2009; Petitti et al., 2009). The consistency of this finding indicates the importance of considering factors that may serve to worsen glycemic control in older adolescents. The current findings suggest possible mechanisms by which youths' glycemic control worsens, implicating diabetes-specific distress and social support in this relationship.

Importantly, the current study is one of the first to consider the relationship between diabetes-specific distress and glycemic control trajectories in pre-adolescents and adolescents. Though previous research has shown that rates of diabetes-specific distress tend to increase as youth move through adolescence and into emerging adulthood (Lašaitė et al., 2016), only one study (Iturralde et al., 2016), to the author's knowledge, has considered how diabetes-specific distress predicts longitudinal changes in glycemic control in this population. Additionally, though few studies have considered diabetes-specific distress and its role in predicting glycemic control trajectories in youth, increased diabetes-specific distress has been shown to predict poorer glycemic control in adults with type 1 diabetes both cross-sectionally and longitudinally (Strandberg et al., 2015; Strandberg et al., 2014). While previous research in this area is limited, it does show the importance of understanding diabetes-specific distress as a predictor of glycemic control in diabetic individuals. However, the mechanisms by which diabetes-specific distress operates are unclear. Therefore, the findings from the current study begin to fill the gap in this literature by underscoring the importance of diabetes-specific distress in influencing glycemic control outcomes and, specifically, in exploring the circumstances under which diabetes-specific distress plays a role in impacting glycemic control trajectories in youth.

Findings from the current study suggest that diabetes-specific distress plays an important role in impacting glycemic control trajectories, but only for those youth who also experience low levels of social support. This finding helps to clarify the roles of both diabetes-specific distress and social support in impacting youths' glycemic control by suggesting circumstances under which these two constructs interact to affect diabetes outcomes. Though diabetes-specific distress has previously been related to glycemic control outcomes in individuals with diabetes, it has not been clear how this relationship operates. One possibility, suggested by the current

study's results, is that diabetes-specific distress affects glycemic control trajectories in youth when social support is low. It is possible that an absence of social support in pre-adolescents and adolescents serves to exacerbate the effect high diabetes-specific distress has on glycemic control outcomes. Therefore, one possible mechanism by which diabetes-specific distress operates-- social support-- is suggested through the current results. Lack of social support, when considered in combination with high levels of diabetes-specific distress, may serve as a risk factor for worsening glycemic control over time for youth with diabetes.

Previous findings have indicated the positive effect social support from family and peers can have on glycemic control and adherence behaviors in youth (Helgeson et al., 2009; La Greca et al., 1995). However, there is a lack of clarity regarding the types of social support (i.e., general support, diabetes-specific support) and the sources of social support (i.e., family, peers, romantic partners) that are most important in these relationships, and the outcomes that they predict. The current study helps to clarify discrepancies in this research literature by considering general social support from a variety of sources (i.e., family, friend, and significant other).

While some studies consider social support in diabetes-specific areas and tasks, others consider general support (i.e., that which is unrelated to diabetes). Few studies (excepting Helgeson et al. (2009) and Doe (2016)) have considered both forms simultaneously, though in both of these studies, general support from friends or family, and not diabetes-specific support, was shown to be predictive of glycemic control. Interestingly, a meta-analysis of general peer support and diabetes-specific peer support found that general support from peers had no effect on glycemic control outcomes or trajectories, and that only a few studies found mixed results regarding the relation between diabetes-specific peer support and glycemic control (Palladino & Helgeson, 2012). Taken together, these findings indicate the conflicting state of the research

literature in this area, and suggest the need to further explore general social support and its many facets within a pediatric diabetic population. The current results supporting effects of general support on the relationship between diabetes-specific distress and glycemic control highlight this need.

Additionally, studies of social support tend to consider social support from only one source (e.g., family or peers), rather than from multiple. Furthermore, few studies consider the effect that social support from significant others or romantic partners may have on glycemic control (Helgeson et al., 2015), despite the fact that significant others and romantic partners tend to gain increased importance and influence in the lives of adolescents. Due to the important role that these significant others and romantic partners play in the lives of adolescents and emerging adults with diabetes, social support from this source should be considered in conjunction with family and peer support when studying an adolescent population (Wiebe, Helgeson, & Berg, 2016). Therefore, the current study's ability to consider social support from multiple sources, and its findings related to general support from multiple sources, including from a significant other, help to further research relating to types and sources of social support that may be important in adolescents' management of glycemic control.

While some studies suggest relationships between friend and family support in influencing youths' glycemic control outcomes, and while one study found a moderating and statistically positive effect of diabetes-specific friend support on the relationship between diabetes-specific distress and cross-sectional glycemic control (Hains et al., 2007), the current study found the strongest suggestion that social support from a significant other impacts glycemic control trajectories in youth with diabetes. The current study did not find significant relationships between friend support or family support in predicting glycemic control

trajectories. These findings suggest that social support from a significant other, or from an individual person rather than an entire group of individuals (i.e., all friends or all family members) may be important in buffering the negative relationship between diabetes-specific distress and glycemic control trajectories. Social support from a “special person” buffered the negative effect high levels of diabetes-specific distress had on glycemic control trajectories. These findings might indicate the desire and/or need of youth to have the support of an individual person, rather than the support of an entire group of people (i.e., all friends or a whole family). It has been reported that late adolescents and emerging adults with diabetes tend to report less general support from friends than those without diabetes, and that emerging adult females with diabetes report less romantic partner support than their non-diabetic counterparts (Wiebe et al., 2016). It is possible that lack of this support from those individuals perceived to be most important and influential in the lives of youth serves to exacerbate the impact that stress related to diabetes care and management has on glycemic control. Perhaps youth desire a close companion or confidante (romantic or non-romantic) who may serve as a buffer against the negative effects of diabetes-specific distress, or who may serve as a non-parental source of support which can assist the individual as he/she navigates new independence.

Based on these results, further research into the underexplored area of social support from significant others is warranted. To the author’s knowledge, only one other study (Helgeson et al., 2015) has considered the role of romantic partner support in predicting adolescents’ glycemic control outcomes; this study did not find a significant relationship between these two constructs. Due to the contradictory findings between this study and the current study, it is clear that this area requires additional research. Furthermore, due to the inconsistency of social support measures in the ways questions are asked in relation to support from groups of people or from

individuals, it is necessary that differences in perception of social support from individuals and groups be further examined, especially in relation to peers and romantic partners. Overall, findings of the current study serve to highlight the need to expand research in this area to further clarify the role of romantic partner/significant other support in this population.

Additionally, the current study found suggestion that overall general support from friends, family, and significant others may also impact glycemic control trajectories in this population. This finding differs from the Palladino & Helgeson (2012) meta-analysis, which concluded that general social support from peers (i.e., non-diabetes-specific social support) did not predict glycemic control trajectories. However, in this meta-analysis, only three studies considered this relationship longitudinally, and results from this meta-analysis did not include studies that focused on social support from romantic partners or significant others. Therefore, it is possible that the current study's inclusion of questions regarding social support from family and significant others contributes to the finding that general support from all three of the aforementioned sources is important.

Clinical Implications. The current findings support multiple recommendations relevant to clinical care for youth with type 1 diabetes. Diabetes-specific distress is common in both youth and adults and plays a role in impacting glycemic control. Social support from a variety of sources may play a role in preventing negative glycemic control outcomes. The current study's findings serve to further clinical care of youth with type 1 diabetes by supporting the importance of monitoring diabetes-specific distress in this population, in order to prevent negative glycemic control outcomes as youth age. They also inform suggestions for prevention of negative outcomes, via the use of social support groups and interventions.

In order to help prevent deterioration in glycemic control due to increases in diabetes-specific distress for youth, the current study supports recommendations for gradual transitions in diabetes management for adolescents. Adolescence has been identified as a high-risk period for youth with diabetes; it is during this period that many care providers see a decrease in engagement with the medical system and an overall deterioration in glycemic control (Peters & Laffel, 2011). Due to the many changes taking place in the lives of adolescents with diabetes, gradual transitions in care between parents and adolescents are recommended to help prevent overwhelming increases in stress related to diabetes care at any one time, and to prevent subsequent complications in glycemic control. It has been recommended by the American Diabetes Association that transitions between pediatric and adult diabetes care take place gradually with families and providers and be tailored to the unique needs of adolescents and emerging adult populations (Peters & Laffel, 2011). It is also recommended that responsibilities of the adolescent be gradually transferred, with guidance from parents and medical professionals that is specific to each adolescent's unique needs and circumstances (Wolpert et al., 2009). Due to the multitude of responsibilities youth with type 1 diabetes must undertake, it is crucial that each adolescent's particular set of circumstances be considered when making diabetes care plans. The current study highlights the need for health care professionals to appropriately identify and treat those youth who are at risk for experiencing poorer glycemic control trajectories by considering levels of diabetes-specific distress and levels of social support available to the child. Clinical interviews related to stress, social resources, and support, in addition to quantitative self-report measures of these topics, may be useful in allowing for continued monitoring of youth as they age.

In addition to indicating the need for appropriate screening and monitoring of diabetes-specific distress, the current study and previous research show that it is important that all youth with diabetes receive support from a significant individual in their lives, in order to reduce the effect that diabetes-specific stress can have on glycemic control outcomes. It is possible that youth at risk for developing increased diabetes-specific distress and subsequent glycemic control challenges might benefit from one-on-one work with therapists or diabetes educators to identify individuals in their lives to whom they could go for general support and guidance. As adolescents face growing challenges and responsibilities during the transition to adulthood, and as they continue to develop independence from family members, it is important for them to be able to identify those individuals in peer and romantic relationships to whom they can look for connection, guidance, and support. Therefore, results suggest that important individuals in the lives of youth with high levels of diabetes-specific distress may consider increasing their overall interest in and emotional support of youth in order to help prevent negative diabetes outcomes. It may be helpful for care providers to consider implementing interventions similar to those described by Greco, Pendley, McDonnell, & Reeves (2001), in which adolescents with diabetes and their best friends participated in group interventions, which improved diabetes knowledge in adolescents and their friends, and increased the proportion of support received from peers as compared to family. Though this intervention did not measure glycemic control outcomes, it is possible that participation by adolescents with diabetes and their significant others or romantic partners in an intervention similar to this one might increase levels of perceived support and assist in buffering against the negative effects of diabetes-specific distress.

Strengths and Limitations. The current study represents an important contribution to the literature, in that it considers the roles diabetes-specific distress and social support can play in the

lives of adolescents over time. Few studies have considered diabetes-specific distress in youth and its impact on glycemic control longitudinally. It is important to understand the trajectories of pre-adolescent and adolescent glycemic control, as proliferation of stress, diabetes management habits, and diabetes outcomes can change rapidly during this period of transition. Studies, such as this one, that consider how glycemic control patterns change longitudinally, allow for the opportunity to examine factors that may contribute to these changes.

Additionally, the current study allows for a variety of sources of social support to be examined in relation to diabetes-specific distress and glycemic control trajectories. Few studies of this population have considered social support from multiple sources at once, and even fewer have considered social support from significant others. Due to the increased importance youth place on peer and romantic relationships during the adolescent period, it is crucial that support from this source is examined in relation to diabetes control. Finally, the current study allowed for consideration of constructs important to glycemic control in a racially/ethnically diverse sample from within a diabetes clinic. By studying patients who are actively participating in continued diabetes care at an urban diabetes clinic, the current study allows for translational research to take place both in the setting from which the study population is drawn and in similar urban medical settings. While the current study possesses strengths that allow it to contribute to the research literature, several limitations must also be acknowledged.

First, it is acknowledged that the current sample was relatively small and fairly racially/ethnically homogenous. Future studies will include more racial/ethnic diversity and the possibility for analyses based on socioeconomic status (SES). Due to variation in recording, many participants in the current study were missing data on parental education and family income level, and analyses based on SES were not possible. Future studies may consider how the

experience of stress related to diabetes care may be different for those youth growing up in different socioeconomic contexts (Hassan, Loar, Anderson, & Heptulla, 2006).

Secondly, it is noted that the current study was limited in its measurement of diabetes-specific distress and social support at only one time point. Adolescents take increased responsibility for diabetes management and often tend to rely more heavily on social support from peers and romantic partners than from parents as they age (Wiebe et al., 2016; Wolpert et al., 2009). Diabetes-specific distress increases between adolescence and emerging adulthood (Lašaitė et al., 2016). Therefore, it is important to consider which sources of support may be most important across different time points in the lives of youth. In the future, it is hoped that these measures, like HbA1c, can be measured across time in order to more completely understand the relationships between diabetes-specific distress, social support, and glycemic control over time. The researcher hopes that this study will serve as an indication that future research into this area is warranted.

Finally, limitations in the current measure of social support from a “significant other” must be acknowledged. While it is possible that some youth interpreted questions on the MSPSS-Significant Other subscale to reflect support from romantic partners, it is likely that different participants referenced different types of significant others. Some youth, particularly younger adolescents and pre-adolescents, may have answered these questions with an individual parent, sibling, friend, or other important person in mind, rather than a romantic significant other, as the scale intended. Due to the potential for variation, it is important to interpret the results as indicating the need youth might have for support from a single important person, rather than groups of people (e.g., entire families or friend groups) or from a romantic partner, specifically. This might indicate the need to identify a person who can serve as a care partner for youth as

they manage their diabetes care. In the future, utilization of social support measures that have been specifically developed for and validated with youth is encouraged. Measures that ask the child to think of or name a particular person might be useful in this case, as current results indicate that youths' perceived support from one individual might be more important in impacting diabetes outcomes than support from general groups of people.

Future Directions. The current findings serve to highlight the need for the continuation of research into the roles diabetes-specific distress and social support play in youths' processes of adaptation to life with type 1 diabetes. The current study highlights the need to continue developing appropriate screening measures to identify youth at particular risk for poor diabetes outcomes due to high diabetes-specific stress levels. As the stressors youth experience increase as they move into adolescence, it is especially important to accurately identify and consider factors, such as diabetes-specific distress and social support, that may serve to exacerbate those risks.

Summary. The current study suggests that youth who experience high levels of diabetes-specific distress and low levels of social support from special people in their lives may be at particular risk for poor glycemic control trajectories as they get older. Results emphasize the need for continued and long-term monitoring and education of adolescents with type 1 diabetes as they move into adulthood, in order to ensure successful transitions and diabetes outcomes. Based on the current study, the need for appropriate education of health-care professionals about the stressors related to diabetes management and the importance of social support in the adolescent population is clear. It is especially important that research into the sources of social support that are salient for adolescents be continued and expanded. In order to ensure the future health and well being of individuals with type 1 diabetes, it is crucial that health care

professionals consider both the psychological and physiological factors that contribute to youths' management of type 1 diabetes.

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