THE ROLE OF PEERS IN THE MANAGEMENT OF TYPE 1 DIABETES IN AN EMERGING ADULT SAMPLE

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THE ROLE OF PEERS IN THE MANAGEMENT OF TYPE 1 DIABETES IN AN EMERGING ADULT SAMPLE

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Background*:* During emerging adulthood, individuals with type 1 diabetes are confronted with unique illness-related challenges that place them at risk for adverse health outcomes. There is a sparse and divided literature examining the role of potential protective factors, such as peer support, across this time period. **Purpose:** To examine whether diabetes specific peer support is associated with diabetes outcomes cross-sectionally in late adolescence and in emerging adulthood, and longitudinally across the transition from late adolescence to emerging adulthood. **Method:** Longitudinal observational multi-site study design that focused on youths (N=132) with type 1 diabetes during the last year in high school and then again during the first year post high school. Report of diabetes specific peer support was measured during each of these time points and was used to predict diabetes outcomes above and beyond parental relationship quality as measured by report of parental acceptance. Diabetes outcomes were measured with glycemic control (HbA1c) and adolescent report of adherence. **Results:** Diabetes specific peer support was associated cross sectionally and longitudinally with adherence above and beyond parental relationship quality. Changes in diabetes specific support across the two time points were associated with changes in both glycemic control and adherence across this time period. **Conclusions:** Proximal sources of support, such as diabetes specific peer support, should be examined as potential protective factors for emerging adults with type 1 diabetes.

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CHAPTER 1

Statement of the Problem

Diabetes is a chronic illness whose daily management requires engagement in several tasks that have the potential to be affected by numerous social environment factors such as varying levels and sources of social support (Helgeson et al., 2014). Diabetes management during developmental life transitions – such as the transition from adolescence into adulthood – may be complicated by changes in the social relationships that one can draw on to support diabetes tasks. Little is known about the impact of diabetes specific peer support and involvement in the care of diabetes during the emerging adulthood period. Although there is a large literature indicating that illness specific peer support may be associated with improved health outcomes among adults with various chronic illnesses (Heisler, 2007), only one study has described the associations of peer support with emerging adults' engagement in diabetes adherence (Helgeson et al., 2014). However, Helgeson et al (2014) examined positive and negative aspects of general peer relationships (i.e., peer support and peer conflict), rather than of peer support for diabetes per se. There is no literature to date that examines the role that *diabetes-specific peer support* plays in diabetes management during the transition to emerging adulthood.

The proposed study was designed to address this gap in the literature by examining longitudinally the role of peers in diabetes care during late adolescence and emerging adulthood. This study was the first to examine peer support as it directly relates to aspects of type 1 diabetes management in the periods of late adolescence and emerging adulthood. Specifically, this study examined associations between diabetes-specific peer support and diabetes outcome measures (glycemic control and adherence) during the last year of high school, and then again one year

later. Parental acceptance, a known factor that contributes to diabetes management during adolescence and that may influence the types of relationships that adolescents develop with their peers, was controlled in analyses designed to assess the unique role of diabetes specific peer support in diabetes management. Lastly, this study examined whether changes over time in diabetes specific peer support measures were associated with changes in diabetes outcomes. These findings may help identify the risk and resilience factors of young people with type 1 diabetes so as to inform the development of potential clinical interventions and screening assessments for enhancing disease management and transition readiness in this population.

CHAPTER 2

Review of Literature

The Juvenile Diabetes Research Foundation (JDRF, 2011) estimates that 3,000,000 individuals living in the United States have type 1 diabetes. Although most individuals living with diabetes are adults, 15 percent are children or adolescents (JDRF, 2011). The prevalence of type 1 diabetes for those under age 20 rose 23% between 2001 and 2009, and the incidence rate of type 1 diabetes in children under the age of 14 is estimated to continue to rise 3% annually worldwide (Patterson, Dahlquist, Gyurus, Green, & Soyltez, 2009*)*. This illness is costly to our nations' health care system, accounting for 14.9 billion US dollars in healthcare costs each year (ADA, 2012), and poses formidable challenges to patients and families who must manage the illness every day for the rest of their lives.

The American Diabetes Association (ADA, 2015) classifies type 1 diabetes as a disorder of carbohydrate metabolism caused by the autoimmune destruction of insulin-producing cells in the pancreas. Insulin is necessary to metabolize carbohydrates as a source of energy and to minimize high blood glucose levels. In the absence of an ability to produce insulin, individuals are required to take exogenous insulin in a manner that regulates blood glucose levels close to the normal range. Successful self-management of type 1 diabetes has various components including blood glucose testing, insulin administration, logging blood glucose levels, interpreting blood glucose patterns and adjusting insulin amounts accordingly, managing blood glucose excursions, self monitoring of diet and exercise, ordering/refilling supplies and medication, and

scheduling and attending clinic appointments and education classes (ADA, 2015). Each of these tasks has to be accomplished successfully, often daily, in order to ensure optimal illness management. Lack of engagement in diabetes self-management behaviors may lead to various complications that can include diabetic ketoacidosis, hypoglycemia, hypertension, dental disease, heart disease, kidney disease, nervous system disease, blindness, amputation, and even death (ADA, 2015).

The quality of diabetes management is measured in a number of ways. Healthcare providers use a blood sample to determine a patient's "HbA1c", or the percent of glycosylated hemoglobin within the blood system. This measure is essentially the average of the patient's blood sugars over the past two to three months, and the ADA (2015) recommends levels below 7% for adults in order to minimize the risk of long-term complications (DCCT, 1993). For a pediatric and adolescent population the recommendation is below 7.5% (ADA, 2015). The HbA1c recommendation for younger individuals is slightly higher in order to account for this population's inherent risk for adverse effects due to hypoglycemic episodes. HbA1c is considered the "gold standard" measure of how well the person's diabetes is medically managed and is regularly used as an index for a patient's glycemic or metabolic control, the degree to which a person has maintained their blood glucose levels within the preferred range. An HbA1c of 7% essentially means that a person has maintained their blood sugars in the 80-150 mg/dl range (ADA, 2008). Additionally, the level to which the patient engages in diabetes related self-management behaviors, or their adherence, has been shown to be associated with glycemic control and is often used as a diabetes related outcome measure within the context of health psychology literature.

The increasing prevalence, high health care costs, and complex and consequential self-management demands of type 1 diabetes make it imperative to understand the risk and resilience factors associated with managing this serious illness. The present study examined the role of one presumed resilience factor - peer support of diabetes management - during an important but understudied time of risk involving the developmental transition from late adolescence into emerging adulthood.

Managing Diabetes across the Transition to Emerging Adulthood

Emerging adulthood is increasingly recognized as a unique developmental stage spanning ages 18 to 25 years that is distinct from late adolescence and early adulthood. Arnett (2000) describes emerging adulthood as a time of great change and opportunity. Emerging adults are in the midst of numerous changes including transitioning out of the family home, into first full-time jobs or the first year in college. It is a time of unusual geographic mobility in which individuals accomplish major growth in various areas: work, living situations, identity exploration, and self-reliance. This journey is marked by changes that can be seen through the striving for a level of self-sufficiency in all domains. There is a focus on accepting responsibility for oneself and making independent decisions during this transitional time (Arnett 1997; 1998). Research indicates that supportive relationships may ease this transition into the various roles of adulthood (Shulman, Kalnitzki, & Shahar, 2009). Emerging adulthood, although a time of opportunity and growth across multiple life domains, is also a time of risk as evidenced by heightened levels of distress, risk behaviors such as alcohol use and disordered eating, and stress (Monaghan, Helgeson, & Wiebe, in press).

For young people with type 1 diabetes, emerging adulthood is a particularly risky and challenging time (Balfe et al., 2009; Palladino et al., 2013). Recent data suggest that young

people with diabetes engage in equal amounts of risky behavior as their non-diabetes counterparts (Palladino et al., 2013). Thus, young people with diabetes face the risks and normative challenges that come with this developmental transition while also learning to manage a serious chronic illness more independently.

Emerging adults with diabetes may also experience unique transitions related specifically to diabetes management. The period of emerging adulthood may be the first time some young people are learning to manage a chronic illness independent of their parents' close monitoring (Weissberg-Benchell, Wolpert, & Anderson, 2009). The geographical mobility that is typical of this age period may interfere with an emerging adult's ability to maintain consistent healthcare (Peters & Laffel, 2011). Emerging adults may also be in the process of transferring their medical care from a pediatric to adult setting, further adding to the potential risks associated with this developmental period. The rate at which emerging adults attend clinic during this transition has been shown to decrease as much 37% (Kipps et al., 2002). Multiple studies have shown that patients are at higher risk for adverse diabetes events and long-term complications when they do not receive consistent, ongoing diabetes care (Rewers et al., 2002; Krolewski, Warram, Christlieb, Busick, Kahn, 1985).

Given these multiple transitions, it may not be surprising that emerging adulthood has been identified as a time of risk for managing type 1 diabetes (Weissberg-Benchell et al., 2007). Bryden (2003) discovered that glycemic levels for young adults aged 22-35 years did not improve when compared to glycemic levels measured in adolescence. Furthermore, Kokkonen, (1997) has established that young people (mean age 20.9) have poor blood glucose monitoring, and often experience HbA1c levels outside the optimal range. Emerging adulthood also happens to be the developmental time period in which diabetes-related health complications such as

retinopathy and nephropathy begin to arise (Kokkonen, Lautala, & Salmela, 1997; Torffvit et al., 2007). Finally, young people with type 1 diabetes are at higher risk for mortality than their non-diabetes counterparts, especially when taking differences in psychosocial factors such as previous diagnosis of depression and/or socioeconomic status into account (Laing, Jones, Swerdlow, Burden, Gatling, 2005).

Social/Peer Support Within the Context of Chronic Illness

It has long been established that individuals do not develop independently of their social systems (Bronfenbrenner, 1989). In the current study, we examined one of these social systems, specifically peer support, within the context of emerging adulthood development and chronic illness management. Mead (2003, pp.6) suggests peer support can be viewed as "a system of giving and receiving help, founded on key principles of respect, shared responsibility, and mutual agreement of what is helpful." There are no specific criteria for defining peer support within the context of a chronic illness, and to the best of our knowledge there is no universally accepted operational definition of this construct. As such, measures for this construct are varied, and capture different dimensions of support. The current study focused on friend emotional and instrumental support for diabetes management.

Social support is a presumed protective factor for adults with a chronic illness, and specifically for adults with diabetes (Gallant, 2003; Cohen, 2004). Patients with chronic illness who experience emotional support and help from family members or friends are more likely to be adherent to treatment (Stromberg, Brostrom, Dahlstrom & Fridlund, 1999; Thomas et al 2001; Loffler, Kilian, & Toumi, 2003). DiMatteo (2002) conducted a meta-analysis examining 121 studies that described high associations between social support and adherence to medical regimens. Various literature reviews (Heisler, 2007; Tang, Ayala, Cherrington, Rana, 2011)

indicate that there are numerous adult intervention studies whose goal is to foster and encourage peer support in order to improve disease outcomes. The perception of peer support is presumed to have benefits in adulthood and intervention studies have explored the utilization of peers to improve health outcomes in diabetes, but this has only been found in the type 2 diabetes literature (Boothroyd & Fisher, 2010; Carolan, 2011; Dennis, Finney, & Chuateco, 2003; Heisler, Vijan, Makki, & Piette , 2010; Brownson & Heisler, 2009; Tang, 2011). All of these studies are specific to an older patient population, are usually aimed at patients already experiencing complications from their chronic illness, include mostly patient peer groups, and no review included studies on a type 1 diabetes population during the emerging adulthood period.

Illness specific support, or regimen specific support, has been found to be associated with higher levels of engagement in diabetes self management tasks and better diabetes outcomes (Glasgow & Toobert, 1988; Ruggiero, Spirito, Bond, Coustan, & McGarvey, 1990; Tillotson & Smith, 1996; Kulik & Mahler, 1993; Gallant, 2003). All of these studies were focused on mainly type 2 diabetes, included an older adult population, examined support in relation to complications of diabetes, and none studied type 1 diabetes. Kyngas and Rissanen (2001) found that illness specific support was an important factor in adherence related behaviors, but this study did not examine type 1 diabetes exclusively, and included a sample with several other autoimmune illnesses. The current study explored the role of social support, in the form of diabetes specific peer support, during the last year of high school and at the beginning of the emerging adult period for individuals with type 1 diabetes.

Peer Support During Adolescence and Emerging Adulthood

Peers and friendships are important for development in childhood (Gottman, 1997), but take on added significance during adolescence and emerging adulthood. During adolescence,

individuals begin to spend more time with peers when compared to time spent with parents (Nelson, Leibenluft, McClure, & Pine, 2005). Peers are particularly noted to be important sources of emotional support for adolescents, often helping an adolescent through emotional difficulties (Stanton-Salazar & Spina, 2005). As a result, peer support is associated with lower rates of depression and higher self-esteem in adolescents (Colarossi & Eccles, 2003; Collins & Laursen, 2004; Connolly & Goldberg, 1999; Armsden & Greenberg, 1987). Support from peer groups has also been associated with lower rates of hyperactivity and higher leadership skills (Rueger, Malecki, & Demaray, 2010). La Greca and Prinstein (1999) noted that an adolescent's peer group is vital to social and emotional development because adolescents derive a sense of belonging and acceptance from peers.

Peer support often changes during life transitions and has been associated with psychological well being outcomes before and after such transitions as beginning college (Hirsch & Dubois, 1992; Newman, Newman, Griffin, O'Connor, Spas, 2007; Pettit, Roberts, Lewinsohn, Seeley, Yaroslavsky, 2011). Research has established that changes occur in the positive qualities of friendship over the course of adolescence (Furman & Buhrmester, 1992). Support from different sources, including from peers, show positive relations with adjustment and coping in emerging adulthood (Tao, Dong, Pratt, Hunsberger, & Pancer, 2000). Among college students, higher levels of peer emotional support have been generally related to better academic and mental health outcomes (Whiteman, Barry, Mroczek, Macdermed, Wadsworth, Shelley, 2013). College age students with lower quality social support are more likely to experience mental health problems, and are six times more likely to experience depressive symptoms when compared to students with higher quality social support (Hefner & Eisenberg, 2009). Higher levels of peer support have also been associated with better college grade point averages and

improved adjustment to college (Astin, 1993; Dennis, Phinney & Chuateco, 2005).

The perception of peer support may be especially relevant for adolescents with type 1 diabetes, who have to complete management behaviors throughout a school day or during other social events away from home and parental support (Prinstein, Boegers, Spirito, 2001). Adolescents with type 1 diabetes have rated peer support as important for successful diabetes management (Greco, et al. 1991). Skinner, John & Hampson (2000) note that perceived support from friends is an important determinant of dietary self-care and psychosocial well-being for adolescents with diabetes. In fact, adolescents with diabetes perceive peers to be even more important sources of emotional support than their parents (La Greca, Greco, Spetter, Fisher, & Santiago, 1995). Karlsson, Arman & Wikblad (2008) found that perceived emotional support from friends in the form of encouragement and acceptance is related to adolescents feeling more secure with incorporating self-care activities into their daily routines.

Despite such benefits of peer support, peers may not always be so helpful in terms of diabetes management. Pendley et al. (2002) showed that adolescents perceived higher levels of peer support than school age children, yet this peer support was not associated with metabolic outcomes. Hains et al. (2007) found that when adolescents with diabetes made negative attributions to a friend's reaction to their diabetes self-care tasks, higher peer support was associated with poorer adherence to these diabetes tasks, and such poorer adherence was associated with poorer metabolic control for these individuals. Helgeson, Lopez & Kamarck (2009) found no associations between friend support and diabetes outcomes, but found that conflict with friends was associated with more depressive symptoms, worse self-care behavior, and poor metabolic control. The association of peers with negative diabetes outcomes is potentially related to an adolescent's extreme peer orientation, or their willingness to sacrifice

aspects of diabetes management to receive peer acceptance (Drew, Berg, & Wiebe, 2010). That is, higher levels of affiliation with and support from peers could occur when adolescents are more oriented to their relationships with friends than to their diabetes management.

Overall, research on the association of peer support and diabetes outcomes has yielded mixed findings. In a systematic review of peer influences on diabetes care and self-management, Palladino and Helgeson (2012) concluded that research regarding associations between peer support and diabetes outcomes is inconclusive. Peer conflict was found to be more harmful than social support was helpful in the context of diabetes management, and associations were more likely in studies that measured specific self-care variables. Only two of the studies examined found a positive link between diabetes specific peer support and adherence outcomes (La Greca & Bearman, 2001; Kyngas & Hessinen, 2002). La Greca and Bearman (2001) found an association between diabetes specific peer support and blood sugar monitoring, but not with an overall index of adherence. Kyngas and Hessinen (2002) found a positive relationship between adherence behaviors and illness specific support, but this study included illness populations other than diabetes. Additionally, all of these studies included those individuals under the age of 18 years old.

A single observational, longitudinal study has examined peer support in emerging adults. Helgeson et al. (2013) examined groups of young people with and without diabetes in the last year of high school and then again in the first year out of high school. In the group with diabetes, friend conflict was a more potent predictor than friend support of changes in health behaviors and psychological well-being. In a separate report on this same sample, Helgeson et al. (2014) reported that those with diabetes reported less friend support but similar friend conflict compared to those without diabetes, and that general peer support was unrelated to glycemic control and

related to *poorer* adherence.

Peer relationships across the transition are likely to be in flux as adolescents move away from their high school friends, and interact with new peers at work or college. It may be that the types of supportive relationships adolescents develop *during* emerging adulthood are more important than the peer supports they enjoyed during high school (Monaghan, Helgeson, & Wiebe, in press) Their ability to maintain or even enhance their peer support for diabetes as they are increasingly away from parents – that is their changes in peer support across the transition – may be an important component of how they weather the transition out of high school. Thus, in the present study we explored peer support during emerging adulthood and whether changes in peer support for diabetes across time are associated with changes in diabetes management across the transition out of high school.

Parent Relationship Quality During Adolescence and Emerging Adulthood

Peer relationships are not the only important social environment context for adolescents and emerging adults. The quality of relationships with parents is an important context that has long been associated with better psychosocial outcomes. Adolescents who have higher levels of parental acceptance are less likely to experience behavioral problems and to engage in high-risk behaviors (Jensen, 1972; Resnick, 1997; Ellis, 2003; Bronte-Tinkew & Moore, 2006). Additionally, adolescents reporting higher levels of acceptance from their parents have better grades, attain higher levels of education and experience better emotional health outcomes (Gray & Steinberg, 1999; Carlson, 2006). Higher levels of parental acceptance during this period have also been associated with lower levels of engagement in risky drug and alcohol behaviors (Wright & Pemberton, 2004; Guo, Hill, Hawkins, Catalano, & Abbott, 2002; Ellickson, Tucker, & Klein, 2008).

Many studies have established that higher levels of parental involvement are associated with improved diabetes outcomes in early adolescence (Anderson, Ho, Brackett, Finkelstein, & Laffel,1997; Wysocki et al., 1996; Beveridge, Berg, Wiebe & Palmer, 2006; Berg et al., 2008; Horton, Berg & Wiebe, 2009). Palmer and colleagues (2011) analyzed the structure of parental involvement in diabetes, and found that general relationship quality with parents was one of three related but distinct dimensions underlying parental involvement in diabetes. Parent-adolescent relationship quality has been associated with diabetes outcomes during adolescence (Miller-Johnson, 1994; Wysocki, Hough,Ward, & Green, 1992). Importantly, in the context of the present study, relationship quality with parents has been found to decline linearly across ages 10 to 17 years, and these declines were associated with the rate of decline in adherence into late adolescence (King, Berg, Butner, Butler, & Wiebe, 2013).

In addition to being an important component of diabetes management, relationship quality with parents also likely serves as a template on which the adolescent will base future relationships (Bowlby, 1969; Karen, 1994). Family systems theory has shown that the parent-child relationship can have influences on relationships outside and beyond the family unit (Minuchin, 2002; Minuchin, 1974;). De Goede, Branje, Delsing, and Meeus (2009) noted that the parent-child relationship can serve as a type of training ground for other relationships. Specifically, quality of the parental relationship itself can have an impact on relationships with peers (Brown, Mounts, Lamborn, Steinberg, 1993; Fuligni & Eccles, 1993). Such associations raise the possibility that the quality of relationships with parents may contribute to the manner in which adolescents and emerging adults access support from peers.

Given these associations of parental relationship quality with peer relationships, the role of parents cannot be ignored in our investigation of peer support and diabetes management in

late adolescence and emerging adulthood. Just as a young person begins to mature in multiple domains throughout adolescence, a parent's role in diabetes management will also likely evolve as these adolescents burgeon into emerging adulthood. Once adolescents are poised to leave the home, and as they spend increasing time away from parents, it is unlikely that a parent's involvement in diabetes management completely ceases. Rather, this parental involvement perhaps continues in a different and less direct manner. Parents in general continue to be involved in a number of ways during emerging adulthood, continuing to provide financial and emotional support to their emerging adult children (Arnett, 2013). Because parental relationship quality during adolescence has been associated with diabetes outcomes, any variance contributed by parental relationship quality must be accounted for if we are to accurately characterize the impact of diabetes specific peer support on diabetes outcomes across the transition out of high school. Thus, for this study, relationship quality with parents was used as a control variable in all analyses to understand unique associations of peer support for diabetes with diabetes outcomes.

CHAPTER 3

Rationale, Aims, & Hypotheses

The purpose of this study was to examine the role of peers in the management of type 1 diabetes during the transition out of high school and into emerging adulthood. Using a longitudinal data set, we examined whether diabetes specific peer support was associated with diabetes outcomes (i.e., adherence and metabolic control) during the senior year of high school (Time 1) and again one year later during early emerging adulthood (Time 2). We further examined whether peer support at each time point was associated with changes in diabetes outcomes across the transition to emerging adulthood, and whether changes in levels of peer support were associated with changes in diabetes outcomes over time. Although not the main focus of the study, the role of parents was also examined. Because the quality of relationships with parents partially determines the type of relationships that youths have with others, and is also associated with diabetes outcomes, it was important to ensure that the association between peer support and diabetes outcomes was not simply reflective of the parent-adolescent relationship. Thus, relationship quality with parents was used primarily as a covariate to examine whether peer support was associated with diabetes outcomes independent of this important social context. However, because the role of parents in diabetes management during emerging adulthood has rarely been examined, the association between relationship quality with parents and diabetes outcomes was also explored.

This study had three main aims. The first main aim was to examine the bivariate relationships of diabetes specific peer support and parental relationship quality with diabetes outcomes at each time point. We hypothesized that diabetes peer support and parental

acceptance would both be associated with better diabetes outcomes in a cross sectional manner at both time points (Hypothesis 1).

The second aim examined the multivariate relationships of peer support with diabetes outcomes while controlling for parental acceptance and other covariates. These multivariate analyses allowed us to determine whether peer support for diabetes was associated with diabetes outcomes independent of parental acceptance in late adolescence and again during emerging adulthood. We hypothesized that peer support for diabetes would contribute variance to diabetes outcomes above and beyond parental acceptance and other covariates in both late adolescence and emerging adulthood (Hypothesis 2).

The third set of aims examined whether peer support for diabetes at Time 1 or at Time 2 was associated with changes in diabetes outcomes across time (Aims 3a and 3b). More specifically, we examined whether Time 1 peer support was associated with changes in adherence and glycemic control across the two time points (Aim 3a). Given prior research that peers have some influence on diabetes outcomes at least in adolescence, and that peers may have increasing influence as adolescents mature, we predicted that levels of peer support at Time 1 would be associated with changes in diabetes outcomes from Time 1 to Time 2, and that these associations would occur independent of parental relationship quality (Hypothesis 3a). However, because one's peer support system is likely to change as adolescent's transition out of high school, peer support for diabetes at Time 2 is likely to be a more proximal predictor of how emerging adults weather the transition into emerging adulthood, regardless of peer support levels at Time 1. Thus, we also examined whether Time 2 peer support was associated with changes in adherence and metabolic control across the two time points (Aim 3b). We hypothesized that higher levels of Time 2 peer support would be associated with improved adherence and

metabolic control across the two time points (Hypothesis 3b).

The last aim of the study explored whether changes in diabetes specific peer support were related to changes in diabetes outcomes (glycemic control and adherence) between the two time points. We anticipated that those with higher peer support at Time 2 would most likely have better outcomes during the post high school year even after statistically controlling peer support at Time 1. However, we considered this aim to be exploratory for several reasons. First, we are not aware of research that has carefully examined whether and how changes in peer support across the transition out of high school are associated with changes in adjustment. Second, change in peer support across time may have different meaning for those who have better or worse support at Time 1. For example, individuals with consistently high peer support at both time points may have a better transition than those who begin with poor support but display improved support across time. For these reasons, we explored whether changes in peer support were associated with changes in diabetes outcomes across time, but made no directional hypotheses.

CHAPTER 4

Methodology

Participants for the present study were drawn from a larger longitudinal study examining associations of adolescent neurocognitive skills and parental involvement with diabetes management during the transition to emerging adulthood. High school seniors with type 1 diabetes and their parents were recruited for a two-year longitudinal multi-site study. Participants were recruited from outpatient pediatric endocrinology clinics during routine clinic visits or by phone in two southwestern US cities. Youth were eligible to participate if they had been diagnosed with type 1 diabetes for at least one year (*M* length of diagnosis= 7.35 years, *SD* =3.88), had English as their primary language, were in their final year of high school, lived with a parent (68.4% lived at home with both biological parents, 27.1% with one biological parent), would be able to have regular contact with parents over the subsequent two years (consistent with objectives of the broader longitudinal study), and had no condition that would prohibit study completion (e.g., severe intellectual disability, blindness). Adolescents who had dropped out of high school were eligible if they met all other criteria. Of the qualifying 507 individuals approached, 301 (59%) agreed to participate. Of those who initially agreed, 247 (82%) were enrolled in the study. Primary reasons for not participating included lack of interest (33%) or being too busy in their senior year to participate (34%); the remainder declined to give a reason.

Consistent with the patient population at participating clinics, 75.2% of the full sample enrolled (N = 247) identified as non-Hispanic White, 14.2% as Hispanic, 4.8% as African American, and the remainder identified as Asian/Pacific Islander, American Indian, or more than one race. Patients were 17.76 years old on average (*SD*= 0.39) at enrollment, and 60% were

female. Educational background of parent included 12.9% of mothers and 18.2% of fathers having a high school education or less, 37.2% of mothers and 25.1% of fathers with some college or a vocational degree, and 34% of mothers and 46.3% of fathers with a bachelor's degree or higher. Forty-two percent of individuals were on an insulin pump while the remainder were prescribed multiple daily injections.

The present study included the first 132 participants who had been eligible to complete both the initial senior year of high school assessment (Time 1) and the subsequent post-high school assessment (Time 2). This included a fairly even split between adolescents recruited through the outpatient pediatric endocrinology clinics at the Utah Diabetes Center (N=65) and at Children's Medical Center Dallas (N=67). Full information on the sample included in the present study can be found in Table 1. There were five participants who did not complete the second assessment point, two of whom formally withdrew from the study.

Procedure

Adolescents were recruited during a routine clinic visit and were invited to enroll in a two-year longitudinal study, where assessments were completed annually. Participants were invited to attend a research appointment at which time informed consent/assent were completed and training in the use of an HbA1c home-test kit assay and an online-survey were provided. Adolescents who were 18 years old provided informed consent, while those who were younger than 18 provided assent with the parent's consent. Participants who provided assent only at Time 1 provided consent at Time 2 after they reached majority age. Participants then completed Time 1 measures of peer and parental support and adherence via an online survey. An HbA1c measure to index metabolic control was obtained at this initial visit. One year later, participants were contacted and asked to complete the online survey, as well as a second HbA1c home-test kit.

Participants were compensated $50 for completing the online survey and HbA1c assay at each time point. Retention efforts included phone calls, emails, letters, and greeting cards for birthday, holidays and graduation.

Measures

The following measures represent a subset of those obtained for the larger study. Copies of measures utilized in the present study can be found in Appendix A.

Demographic and Illness Information

Demographic variables such as gender, date of birth, race, ethnicity, language spoken, and religion were collected. Demographic items related to changes that occur within the family (e.g., financial dependence on parents), living arrangements (who they were in most frequent contact with), and work and school activities were also collected. Adolescents also provided illness-specific information, such as type of insulin therapy prescribed and use of technology for diabetes management.

Peer Support

Peer support was measured at each time point to capture diabetes specific aspects of both emotional and instrumental support. Emotional support items were drawn from the emotional support subscale of the Diabetes Social Support Questionnaire – Friends measure (La Greca & Bearman, 2002). This subscale is comprised of three items regarding the extent to which friends understand the challenges of managing diabetes, provide encouragement, and listen to concerns. For each item, participants reported how often friends engaged in the behaviors on a 0 (*never*) to 4 (*several times weekly*) scale, as well as the degree of helpfulness of each behavior on a -1 (*not helpful*), 0 (*neutral*), or 1 (*a little helpful or supportive*) to 3 (*very helpful or supportive*) scale. Following LaGreca and Bearman's instructions, a single score on these items was obtained by

multiplying the frequency by helpfulness ratings. These items showed good internal consistency at each time point in the present study (T1 α=.80; T2 α=.84). Three additional items were developed to index more instrumental aspects of support including: a) peers' awareness of participant's diabetes diagnosis; b) peers' knowledge of actions needed to take in emergent diabetes situations and c) peers' degree of helpfulness in providing support for diabetes. Participants rated the degree to which they agreed with each statement on a 5 point scale (1= *Strongly Disagree*, 5=*Strongly Agree*). Internal consistency for these items was acceptable at T1α = .65; T2 α = .74. It should be noted that these peer support items were added after the first 32 participants had completed T1 surveys, resulting in the need to use multiple imputation to impute missing values for these participants prior to analyses (see analysis plan below).

A principal component analysis was conducted on the six items (after multiplying the frequency and helpfulness ratings for each of the emotional support items). Examination of the eigenvalues greater than 1 and of the scree plot indicated the items formed a single factor (see Appendix B), with acceptable reliability (α = .73 at each time point). We thus combined these two sources of items to form a single index of peer support for each time point by computing z-scores for the emotional and instrumental support items and averaging.

Parental Acceptance

Relationship quality with parents was assessed by a measure of parental acceptance, that taps into the extent to which adolescents or emerging adults feel emotionally close to and accepted by mothers and fathers. The acceptance subscale of the Mother-Father-Peer Scale (Epstein, 1983) was measured at each time point. Participants separately reported on relationship quality with mother (5 items) and with father (5 items) using a 1 (*strongly disagree*) to 5 (*strongly agree*) scale (e.g., "My mother gives me the feeling that she likes me as I am").

Participants' report of mother acceptance and of father acceptance were correlated at r = .43 and .55, at Time 1 and Time 2, respectively. The internal consistencies of adolescent report of mother acceptance (T1α = .89; T2α = .82) and of father acceptance were good (T1α = .87, T2α = .77). Composite variables of adolescent report of parental acceptance were created by averaging across mother and father acceptance scores at each time point.

Adherence

Adherence was measured through the Diabetes Behavioral Rating Scale (DBRS, Iannotti et al., 2006) collected at each time point. This 37-item scale was chosen because it included items relevant to current diabetes practice recommendations and technologies (e.g., intensive therapy, insulin pump) and has good psychometric properties. The scale correlates well with more time-intensive interview measures and with metabolic control, and had good internal consistency (T1α =.86; T2α =.83). Following manual procedures, scores were calculated as the proportion of the maximum possible score, ranging from 0 to 1, with higher scores indicating better adherence.

Metabolic control

Metabolic control was measured via adolescents' completion of a dried blood spot assay, which was completed at the in-person research visit at Time 1 (at which time participants were trained in the correct use of the assay), and was mailed to participants for completion at Time 2. Mail-in HbA1c assay kits were obtained from and processed by CoreMedica Laboratories. This test kit was approved by the U.S. Food and Drug Administration for home use and over the counter sales, and is commonly used by patients with diabetes. This kit was certified by the National Glycohemoglobin Standardization Program (NGSP). The purpose of NGSP certification is to standardize glycated hemoglobin test results so they are comparable to results

reported in the Diabetes Control and Complications Trial (DCCT), the gold standard for reliable HbA1c testing. This procedure allowed us to: a) use the same method across all participants, sites and time points, b) match the timing of the annual measures to the HbA1c measure, and c) reduce subject burden and minimize missing data by allowing participants to complete the test kit at their convenience. The kit was labeled with the participant's coded identifier (i.e., no personally identifying information), and mailed to participants with instructions on how to mail their blood sample to CoreMedica laboratories for HbA1c processing. Test results were sent to researchers and results were then provided to participants via electronic mail once they were available.

CHAPTER 5

Statistical Analyses

The data were tested to ensure that they did not violate statistical assumptions and for any outliers that may impact analyses. There was no need for data transformations, as the data fit a normal curve distribution. Based on a review of previous diabetes literature, covariates of insulin pump status, time since diagnosis, and gender were included in all analyses. Because some of the peer support measures were added after participants had been enrolled and completed time 1 assessments, multiple imputation was conducted to replace missing values. Ten data sets were imputed using 1,000 iterations each (Schafer, 1999), and all reported results are based on pooled statistics from these imputed data files. This resulted in a recovery of 32 cases in comparison to using a listwise procedure. Missingness of data was examined and determined to be missing at random for all variables of interest. Thus, all data were kept in their original scales for ease of interpretation. Analyses were conducted both with site as a control and without, and results were the same. The following analyses did not control for site.

Initial descriptions of the sample and changes across time in study variables were explored. Within sample paired t-tests were conducted to test differences between means of variables of interest across the two time points. Where appropriate, chi-squared tests were conducted to compare proportions of participant characteristics across the two time points. Pearson correlation coefficients were then calculated to examine the bivariate relationships of peer support and parental relationship quality variables with diabetes outcomes at each time point (Hypothesis 1). A series of multiple regression analyses were utilized to examine the remainder of the aims.

Forced entry multiple regression analyses were conducted to test whether peer diabetes-

specific support was associated with diabetes outcomes at each time point, after controlling for parental acceptance (Hypothesis 2). In order to do this, the main covariates, including pump status, illness duration, sex, and parental acceptance were included as covariates in the first step. The Time 1 peer support variable was entered in a separate, second step. Time 1 HbA1c and Time 1 adherence were the dependent variables utilized in this first set of regression analyses. A parallel set of regression analyses was performed to examine associations of Time 2 peer diabetes-specific support with Time 2 diabetes outcomes.

Multiple regression was again utilized to test whether levels of peer support at each time point were associated with change in diabetes outcomes across the two time points (Hypothesis 3). In order to analyze whether Time 1 peer diabetes-specific support was associated with change in diabetes outcomes, we entered in the first regression step: pump status, illness duration, sex, and Time 1 parental acceptance as covariates, along with Time 1 levels of diabetes outcomes (Time 1 HbA1c or adherence). In a second step, we added Time 1 peer diabetes- specific support. The dependent variables were Time 2 HbA1c and Time 2 adherence (Hypothesis 3a). In this manner, we captured the residualized change in these outcomes. In a similar way, we examined whether Time 2 peer diabetes-specific support was associated with changes in diabetes outcomes across time by entering Time 2 peer diabetes-specific support as an independent variable rather than Time 1 peer diabetes-specific support (Hypothesis 3b).

For the final aim, to explore whether changes in peer diabetes-specific support were associated with changes in diabetes outcomes over time, we conducted similar analyses described for aim 3, but now included peer diabetes-specific support at both time points as predictors. This allowed us to determine whether residualized change in peer diabetes-specific support predicted residualized change in the diabetes outcome.

CHAPTER 6
Results

Sample Description

Descriptive statistics of the study sample at each time point are depicted in Tables 1a and 1b. As can be seen in Table 1a, average levels of adherence decreased significantly across the two time points, while other study variables, including glycemic control, peer diabetes-specific support and parental acceptance did not differ significantly between the two time points. Table 1a shows that the average glycemic control was 8.4% and 8.5% at Time 1 and Time 2, respectively; these are above the recommendations for HbA1c levels for young adults. Given these HbA1c levels, this sample experienced average blood sugar levels between 194 mg/dl and 200 mg/dl at Time 1 and Time 2, respectively. As displayed in Table 1b, significant differences were found between Time 1 and Time 2 in regards to numerous life transitions including changes in school status, living situation, relationship status, and mode of diabetes related healthcare.

Correlations

Zero order correlations showing bivariate associations of peer diabetes-specific support and parental relationship quality with diabetes outcomes are detailed in Table 2. As can be seen, peer diabetes-specific support was associated with adherence cross-sectionally at each time point, and T1 peer diabetes-specific support was related longitudinally to T2 adherence. Peer diabetes-specific support was unrelated to HbA1c in these bivariate correlations. Parental acceptance was associated cross-sectionally with better HbA1c and adherence at Time 1, but not at Time 2, and parental acceptance was not associated longitudinally with diabetes management at Time 2. Finally, it should be noted that no associations were found between parental acceptance and peer support for diabetes at each time point. This finding is inconsistent with the

notion that parental relationship quality sets a foundation from which adolescents and emerging adults develop peer relationships that support diabetes management.

Regression Analyses

We next analyzed Aim 2 to determine whether diabetes-specific peer support was associated with outcomes at each time point independent of parental relationship quality. Four multiple regression analyses were conducted. In each analysis, covariates (illness duration, sex, and insulin pump status), and parental acceptance were entered into an initial step and diabetes-specific peer support was entered separately into a second step to predict either adherence or metabolic control at each time point. As can be seen in Table 3, after controlling for covariates, diabetes-specific peer support contributed significantly to the variance in adherence, but not glycemic control, at both Time 1 and Time 2. Thus, my prediction that diabetes-specific peer support would be associated with diabetes outcomes was partially supported, being consistently found for adherence at each time point, but not for glycemic control.

The third set of aims regarding associations of diabetes-specific peer support with changes in glycemic control or adherence across the transition into emerging adulthood was also analyzed with multiple linear regressions. In these analyses, the outcome variable (adherence or metabolic control) at Time 2 was predicted from covariates, the outcome variable at Time 1, parental acceptance and diabetes specific peer support. The first two analyses examined Time 1 diabetes-specific peer support and parental acceptance as predictors, while the second two analyses examined Time 2 diabetes specific peer support and parental acceptance as predictors. Tables 4 and 5 depict the results for each of these regression analyses.

As can be seen in Table 4, Time 1 diabetes-specific peer support longitudinally predicted adherence at Time 2, while controlling for Time 1 adherence and all covariates. In contrast, Time 1 diabetes-specific peer support was not longitudinally associated with glycemic control at Time 2, after covarying glycemic control at Time 1. Table 5 depicts the associations of Time 2 diabetes-specific peer support variables with Time 2 diabetes outcomes, while controlling for Time 1 diabetes outcomes. Diabetes-specific peer support at Time 2 was associated with better adherence at Time 2, while controlling for adherence at Time 1, suggesting that diabetes-specific peer support *during* emerging adulthood may also facilitate a more adaptive transition into emerging adulthood. However, diabetes-specific peer support at Time 2 was only marginally associated with improved glycemic control at Time 2, after controlling for glycemic control at Time 1. Thus, to the extent that diabetes-specific peer support can facilitate diabetes management during the transition to emerging adulthood, this association was most evident in the adherence measures.

The final aim explored whether changes in diabetes specific peer support from Time 1 to Time 2 were associated with changes in diabetes outcomes from Time 1 to Time 2. In these analyses, the outcome variable (adherence or metabolic control) at Time 2 was predicted from: covariates, the outcome variable at Time 1, parental acceptance and diabetes-specific peer support at Time 1, and parental acceptance and diabetes-specific peer support at Time 2. As depicted in Tables 6 and 7, we can see that Time 2 diabetes-specific peer support was associated with better Time 2 adherence and metabolic control, after controlling for Time 1 levels of diabetes-specific peer support and diabetes outcomes. This indicates that there is something about how diabetes-specific peer support for diabetes shifts from late adolescence to emerging adulthood that may facilitate better adherence and glycemic control across the transition.

Parental acceptance was included as a covariate in all regression models. Thus, all results regarding diabetes-specific peer support are independent of parental acceptance. Although not a primary aim, it is important to note that parental acceptance at Time 1 contributed significantly to both glycemic control and adherence during the senior year of high school when adolescents were still living in the parental home, but this association was not present in the post-high school year.

CHAPTER 7

Discussion

The current study was the first to examine the relationship of diabetes specific peer support with diabetes management as late adolescents transitioned out of high school and into emerging adulthood. Diabetes specific peer support was associated with better adherence cross-sectionally at both time points, and predicted better adherence longitudinally across the transition year. Although peer support for diabetes was less consistently associated with metabolic control, there was evidence that increases in peer support for diabetes during the year after high school was associated with both better adherence and glycemic control across the transition. Taken together, the current study provides compelling evidence that peer support for diabetes may be a protective factor as young people navigate the multiple transitions that occur in the first year after high school, a developmental period that has been characterized as a "high risk" transition period for those with type 1 diabetes (Weissberg-Benchell et al., 2007).

Before examining these findings in detail, it is important to consider the extent to which the present participants experienced the multiple transitions theorized to occur during emerging adulthood. To be sure, participants were experiencing transitional changes between the two time points. For example, although all participants lived in the parental home and were in pediatric care during the senior year of high school, 50% of the sample moved out of the parental home, 58% transitioned out of pediatric care, 74% began higher education, and 17% began working full time over the subsequent year. Interestingly, despite many participants making significant life changes, there were few significant changes across time on average levels of study variables, with only adherence showing significant declines. In addition, the autocorrelations of study variables across time were significant, ranging from .33 for diabetes-specific peer support to .69

for adherence. Yet, participants showed a fair amount of variability in changes across time, with some showing deterioration and others showing improvements. For example, differences between Time 1 and Time 2 scores in HbA1c ranged from a 4% decrease to a 7.2% increase. Such findings suggest our participants experienced both stability and change as they navigated multiple developmental transitions after graduating from high school.

There was clear evidence that diabetes-specific peer support for diabetes was associated with better diabetes management, although this appeared more evident for adherence than for metabolic control. In both the senior year and the first year post high school, those who perceived greater diabetes-specific peer support for diabetes had better adherence, and diabetes-specific peer support was longitudinally associated with better adherence across the transition year. In contrast, diabetes-specific peer support was not associated with concurrent levels of metabolic control at either time point, although it did show associations with better metabolic control across the transition year in the final longitudinal model. Such findings reveal that peers are an important source of support for managing type 1 diabetes in late adolescence and emerging adulthood.

Although diabetes-specific peer support was associated with better adherence during the senior year of high school, peer support for diabetes appeared to become increasingly important as late adolescents transitioned to emerging adulthood. For example, diabetes-specific peer support in high school was unrelated to metabolic control in high school and to changes in metabolic control over the subsequent year, but diabetes-specific peer support in the post high school year was marginally related to better metabolic control longitudinally across the transition year. More importantly, changes in diabetes-specific peer support across the transition year were significantly related to both

better metabolic control and better adherence longitudinally across time. This pattern suggests that emerging adults who developed stronger peer support for diabetes as they transitioned out of high school were able to enhance their diabetes management or at least minimize deterioration in diabetes management across the transition. The increasing importance of diabetes-specific peer support across time may reflect that emerging adults need to find alternative social resources to support their diabetes care as they transition to greater independence and manage diabetes increasingly out of the purview of parents.

Prior research on peer support and type 1 diabetes has primarily focused on younger adolescents, and has yielded mixed support for the benefits of peers in supporting its management. Although there is some evidence that peer support is helpful for diabetes management, some studies show no associations or even negative associations with outcomes (Palladino et al., 2013). Notably, the single study with emerging adults with diabetes actually found peer support to be associated with poorer adherence (Helgeson et al., 2014). Contrary to Helgeson et al. (2014), the current study found positive association between diabetes specific peer support and adherence. A major difference between the two studies is that the current study examined diabetes specific peer support specifically, while Helgeson et al. (2014) utilized a general index of peer support that was not specific to diabetes. The current study is the first to discover positive associations between diabetes-specific peer support and an overall index of adherence in both cross-sectional and longitudinal analyses in type 1 diabetes during emerging adulthood.

Potential explanations for why we found positive findings for diabetes specific peer support when others have not may be found in what makes the current study very

unique, namely, the fact that it captures a transition period that is known to be a difficult and high risk time period for young people. Existing literature that examines peer support and diabetes outcomes commonly focuses on younger adolescents, who are developmentally quite different from the emerging adults we studied. Since we examined diabetes specific support in a longitudinal capacity across a unique developmental period, it may be that we are capturing an aspect of peer relationships that evolve over time as a result of intrinsic developmental changes or transitions. As young people leave home and are increasingly away from parents, an emerging adult's ability to develop support for diabetes from peers may become increasingly important.

Although the context of parental relationship quality was introduced mainly as a control variable, the importance of its contribution to diabetes management during emerging adulthood cannot be overlooked. All findings for diabetes-specific peer support occurred above and beyond associations with parental acceptance. Both theory and research suggest that parent-child relationships serve as a model or a training ground for other relationships (De Goede, Branje, Delsing, & Meeus, 2009). By controlling for relationship quality with parents, we can be more confident that diabetes specific peer support was not merely an extension of a young person's ability to connect and form relationships with others. Given this presumption, however, we would expect that diabetes specific peer support and parental acceptance to be associated with each other. Yet, no such associations were found. It is likely that the global quality of the parental acceptance measure did not translate directly to the specificity of the diabetes peer support context. In other words, young people can experience love and acceptance from parents without feeling a need or desire to develop or utilize emotional and instrumental support for

diabetes from friends. Relationship quality with parents may facilitate the ability to develop the types of supportive relationships with friends that could support diabetes management, but other variables may influence the extent to which this ability actually translates into diabetes specific peer support.

There may be some value in further examining the specific role of parental acceptance in diabetes management during late adolescence and emerging adulthood. For example, parental acceptance was associated with better glycemic control and adherence at the first time point, but was unrelated to both outcomes one year later. Although studies have established that by late adolescence, individuals with diabetes are primarily but not solely responsible for day to day management (Wiebe et al., 2014), there are also data that parents remain involved in more indirect ways in diabetes care during emerging adulthood (Monaghan, Hilliard, Sweeney, & Riekert, 2013). The global nature of the parental acceptance measure may not be tapping into the ways in which parents are likely to influence aspects of diabetes care during emerging adulthood.

Time 2 parental acceptance was associated with poorer glycemic control at Time 2 after controlling for time 1 glycemic control, Time 1 parental acceptance and both measures of peer support. Somewhat similarly, Time 1 parental acceptance was associated with poorer adherence at Time 2 after controlling for time 1 adherence, Time 2 parental acceptance, and both measures of peer support. It is conceivable that young people with type 1 diabetes maintain positive relationships with parents by hiding poor management or by minimizing parental involvement which could undermine diabetes. However, these were unanticipated findings and were only found in the most complex multivariate models. A replication of this effect will be necessary before we can comfortably interpret its implications.

Clinical and Research Implications

The American Diabetes Association cites "a lack of well-defined criteria for transition readiness" as a major obstacle for providing adequate care to young people as they transition from pediatric to adult medical care (ADA, Diabetes Care 2011, p. 2477). Existing transition screening measures for young people with chronic illnesses, while potentially useful in determining general logistical aspects of transition care, may leave out social aspects of care that are unique to diabetes. Because type 1 diabetes is an illness that involves everyday, social aspects of behavior and that is managed literally in front of peers (Prinstein, Boegers, & Spirito, 2001), the impact of diabetes specific peer support should be considered an important aspect of this transition. With the evidence found in this study, more social support aspects of care, such as diabetes specific peer support, should be considered in the future development of diabetes specific assessments of transition readiness. For example, an assessment that taps into the aspects of peer specific support that this study examined could be utilized. This could be used in addition to usual transition readiness measures in a clinic setting to identify youth at greater risk for glycemic deterioration and provide targeted interventions accordingly. Additionally, clinics may benefit from integrating a peer-focused intervention to their transition readiness materials. Some research has already examined the feasibility of integrating a support group for young adults with diabetes and preliminary data indicate that involvement in such groups is associated with better glycemic control (Markowitz & Laffel, 2012).

In terms of future research, there is a need for a standard measure of peer support. Research in the development of brief, and clinic-friendly assessments will be particularly important. Our measure reflected a blend of emotional and instrumental support. It may be useful to clarify whether it is the specific functions of support from peers that is helpful, or whether it reflects more about simply having peers who are aware of and considerate of their diabetes

management responsibilities. Future research may also benefit from including a diabetes-specific measure of parental support so that we can compare the role of parents and peers using the same types of diabetes support constructs more directly.

Limitations and Strengths

The present study had limitations that should be considered when interpreting the findings. With the exception of the HbA1c measure, all data gathered through the current study was based on self-report measures that are open to biased reporting and inaccurate recall. More objective measures of adherence such as frequency of blood glucose monitoring from glucometers may yield different findings. The missing data for the first 32 participants was problematic, although multiple imputation allowed us to recover most of those cases. Also, one of the measures of peer support was developed for this study, reflecting the general lack of a standard measure of peer support within the diabetes literature. Peer support has been measured in multiple ways in the literature, ranging from vignette based questionnaires to more open-ended, structured interview measures (Hains et al., 2014; Kyngas & Rissanen, 2001), and sometimes includes general support and other times diabetes-specific support measures. The quantitative examination of diabetes specific peer support used in this study may have played a role in the findings. Finally, despite the longitudinal design, the correlational and observational design limits causal interpretations.

The study also had a number of strengths. There was a relatively large sample size of a hard to reach population that was recruited across two sites and followed over time to examine a unique and presumably high-risk transition. Further, although the sample was largely non-Hispanic White, type 1 diabetes is more prevalent among Caucasians and the race/ethnicity distribution is consistent with national samples of youth with type 1 diabetes. For example, the

SEARCH for Diabetes in Youth study (Lawrence et al., 2014) found 75% of youth with type 1 diabetes are non-Hispanic white and 15.6% are Hispanic; the present study reflects this distribution with 75% non-Hispanic white and 14.2% Hispanic. Lastly, the targeted examination of peer specific support within a diabetes context should also be considered a study strength.

Conclusions

In conclusion, this research study demonstrated that young people's views of their friends' support for diabetes is positively associated with their perception of their ability to engage in diabetes self care management behaviors. This association was found in a cross sectional and longitudinal manner across the last year of high school and in the first year post high school. Changes in how young people perceived their friends to be helpful in the context of diabetes were related to changes in both adherence and glycemic control outcomes. Results of this study provide a context on which to base future investigations of diabetes specific peer support and its relation to diabetes outcomes. This study also highlights the importance of the need to understand how proximal sources of support, such as peer support, can be utilized in the improvement of diabetes management during the high-risk developmental period of emerging adulthood.

Table 1a. Participant Characteristics across Both Time Points

Characteristic	Time 1 (n=132)	Time 2 (n= 132)	Difference across Time[1] M(SD); range
Teen Age (yrs) M (SD)	17.8 (.38)	18.8 (.39)	1.01 (.05); .91 to 1.27
Teen Sex (% female)	62.9	62.9	---------
Use Pump[1] (%)	40.5	42.7	---------
Illness Duration (yrs)	7.6 (3.9)	8.5 (3.9)	1.01 (.05); .91 to 1.27
Teen HbA1c (%) M (SD)	8.4 (1.7)	8.6 (1.8)	.27 (1.61); -4.0 to7.0
Teen Adherence*	.61 (.13)	.59 (.13)	-.02 (.10); -.45 to .27
Peer Support	-.08 (1.8)	.00 (1.7)	.13 (.89); -1.96 to 2.19
Parental Acceptance	4.3 (1.5)	4.4 (1.3)	-.03 (.60); -2.20 to 2.30

* Time 1 and Time 2 values differ at $p < .05$; 1=Difference scores are Time 2-Time 1

Table 1b. Evidence of Life Transitions across Time

Characteristic	Time 1 (n=132) %	Time 2 (n= 132) %
Living Situation		
Living in parental home**	100	50.0
Non shared apartment or home	----	3.8
Shared apartment or home	----	11.3
College Dorm	----	34.0
School Status		
Full Time**	99.2	61.0
Part Time	-----	13.1
Not Enrolled	-----	26.0
Work		
Paid Employee**	30.3	51.5
Relationship Status		
Committed long term relationship*	15.0	23.9
Dating, no committed relationship*	27.5	28.0
No current romantic relationship*	57.5	48.1
Diabetes Healthcare Utilization		
Pediatric Diabetes Specialty Clinic**	100	24.2
Adult Diabetes Specialty Clinic	----	34.1
Pediatric Endo Private Practice	----	4.5
Adult Endo Private Practice	----	15.2
Family Physician	----	9.1
Other/Did not answer	----	12.9
Diabetes Related Events (past 6 months)		
% Hospitalized	6.0	6.9
% Emergency Department visit	8.4	8.4

** Time 1 and Time 2 values differ at $p < .001$
* Time 1 and Time 2 values differ at $p < .05$

Table 2. Correlations of Study Variables Within and Across Time Points

		1	2	3	4	5	6	7	8
1	T1 Peer Support	-------	-------	-------	-------	-------	-------	-------	-------
2	T1 Parental Acceptance	.08	-------	-------	-------	-------	-------	-------	-------
3	T1HbA1c	.02	-.26**	-------	-------	-------	-------	-------	-------
4	T1Adherence	.36**	.32**	-.30**	-------	-------	-------	-------	-------
5	T2 Peer Support	.33**	.11	-.10	.15	-------	-------	-------	-------
6	T2 Parental Acceptance	-.04	.55**	-.22*	.20*	.15	-------	-------	-------
7	T2 HbA1c	.07	-.18	.58**	-.25**	-.17	-.03	-------	-------
8	T2 Adherence	.40**	.12	-.25**	.69**	.35**	.15	-.28**	-------

*p<.05, **p<.01; T1 = Time 1; T2 = Time

Table 3. Multiple Regressions Examining Cross-sectional Associations of Diabetes-Specific Peer Support and Diabetes Outcomes at Each Time Point

	Dependent Variable HbA1c N=132				Dependent Variable Adherence N=132			
	B (SE)	R^2	t	*p*	B (SE)	R^2	t	*p*
Time 1								
Step 1		.17				.14		
pump status	-.98 (29)**		-3.38	.001	-.02 (.02)		-.86	.391
time since dx	.04(.03)		1.16	.254	-.003 (.003)		-1.02	.307
sex	.46 (.29)		1.57	.116	-.03 (.02)		-1.23	.219
T1Parental Acceptance	-.52(.18)**		-2.90	.004	.05 (.01)**		3.56	.000
Step 2		.17				.24		
pump status	-.96 (.29)**		-3.30	.001	-.008 (.02)		-.395	.693
time since dx	.04 (.04)		1.12	.261	-.004 (.003)		-1.34	.182
sex	.47 (.29)		1.59	.112	-.02 (.02)		-.92	.360
T1 Parental Acceptance	-.52. (.18)**		-2.81	.004	.05 (.01)		3.43	.001
T1 Peer Support	.04 (.18)		.23	.816	.05 (.01)**		3.73	.000
Time 2								
Step 1		.08				.03		
pump status	-.66(.35)		-1.89	.059	.005 (.03)		.21	.835
time since dx	-.03 (.04)		-.77	.440	-.001 (.003)		-.38	.703
sex	.53 (.35)		1.52	.129	-.005 (.025)		-.19	.846
T2 Parental Acceptance	-.05 (.25)		-.19	.937	.03 (.02)		1.66	.097
Step 2		.10				.13		
pump status	-.73 (.35)		-2.10	.035	.02 (.02)		.65	.513
time since dx	-.03 (.04)		-.613	.540	-.002 (.003)		-.73	.464
sex	.46 (.35)		1.33	.183	.005 (.024)		.22	.828
T2 Parental Acceptance	.02 (.25)		.08	.937	.02 (.02)		1.17	.241
T2 Peer Support	-.39 (.21)		-1.88	.061	.06 (.01)**		3.84	.000

*p< 0.05, **p<0.01

T1=Time 1; T2=Time 2

Table 4. Multiple Regression Analyses Examining Associations of Time 1 Diabetes-Specific Peer Support with Changes in Diabetes Outcomes

	Dependent Variable Time 2 HbA1c N=132				Dependent Variable Time 2 Adherence N=132			
	B (SE)	R^2	t	*p*	B (SE)	R^2	t	*p*
Step 1								
pump status	-.03 (.31)	.36	-.11	.912	.02 (.02)	.49	1.09	.276
time since dx	-.06 (.04)		-1.64	.093	.001 (.002)		.53	.593
sex	.16 (.30)		.60	.596	.02 (.02)		1.02	.307
T1HbA1c or T1Adherence	.63 (.09)**		6.72**	.000	.78 (.07)**		10.68	.000
T1 Parent Acceptance	-.06(.20)		-.35	.759	-.02(.01)		-1.66	.097
Step 2								
pump status	.001 (.31)	.37	-.004	.997	.02 (.02)	.53	1.38	.168
time since dx	-.06 (.04)		-1.68	.093	.001 (.002)		.22	.827
sex	.18 (.30)		.602	.547	.02 (.02)		1.15	.253
T1HbA1c or T1Adherence	.63 (.09)		6.72**	.000	.71 (.08)		8.80	.000
T1 Parent Acceptance	-.07 (.20)		-.35	.729	-.02 (.01)		-1.51	.129
T1 Peer Support	.15 (.18)		.83	.409	.03 (.01)		2.11	.038

*p<.05, **p<0.01
T1=Time 1; T2=Time 2

Table 5. Multiple Regression Analyses Examining Associations of Time 2 Diabetes-Specific Peer Support with Changes in Diabetes Outcomes

	Dependent Variable Time 2 HbA1c N=132				Dependent Variable Time 2 Adherence N=132			
	B (SE)	R^2	t	*p*	B (SE)	R^2	t	*p*
Step 1		.37				.49		
pump status	.002 (.31)		.006	.995	.02 (.02)		1.02	.307
time since dx	-.07 (.04)		-1.74	.082	.001 (.002)		.473	.636
sex	.18 (.30)		.60	.548	.03 (.02)		1.17	.242
T1HbA1c or T1Adherence	.67 (.09)**		7.30**	.000	.74 (.07)**		10.3	.000
T2 Parent Acceptance	.30(.22)		1.38	.168	.003(.01)		.22	.826
Step 2		.39				.55		
pump status	-.06 (.31)		-.20	.838	.03 (.02)**		1.51	.130
time since dx	-.06 (.04)		-1.58	.114	.000 (.002)		.11	.914
sex	.13 (.29)		.453	.650	.03 (.02)		1.63	.104
T1HbA1c or T1Adherence	.66 (.09)		7.20**	.000	.71 (.07)		10.4	.000
T2 Parent Acceptance	.35 (.22)		1.56	.119	-.003 (.01)		-.27	.785
T2 Peer Support	-.29 (.18)		-1.65	.100	.04 (.01)		4.16	.000

*p< 0.05, **p<0.01
T1=Time 1; T2=Time

Table 6. Multiple Regression Analyses Examining Associations of Change in Time 2 Diabetes-Specific Peer Support with Change in Metabolic Control

	Dependent Variable Time 2 HbA1c N=132			
	B (SE)	R^2	t	*p*
Step 1		.39		
pump status	.03 (.31)		.10	.919
time since diagnosis	-.07 (.04)		-1.82	.069
sex	.16 (.30)		.55	.548
T1HbA1c	.65 (.09)**		7.05	.000
T1 Parent Acceptance	-.31 (.23)		-1.31	.190
T2 Parent Acceptance	.50 (.26)		1.92	.056
T1 Peer Support	.18 (.19)		1.02	.312
Step 2		.42		
pump status	.03 (.30)		-.10	.918
time since diagnosis	-.06 (.04)		-1.66	.097
sex	.12 (.30)		.418	.676
T1HbA1c	.63 (.09)		6.89	.000
T1 Parent Acceptance	-.32 (.23)		-1.41	.160
T2 Parent Acceptance	.57 (.26)		2.21	.028
T1 Peer Support	.31 (.19)		1.62	.110
T2 Peer Support	-.40 (.19)*		-2.13	.034

*p< 0.05, **p<0.01
T1=Time 1; T2=Time 2

Table 7. Multiple Regression Analyses Examining Association of Change of Time 2 Diabetes-Specific Peer Support with Change in Adherence

	Dependent Variable Time 2 Adherence N=132			
	B (SE)	R^2	t	*p*
Step 1		.53		
pump status	.03 (.02)		1.41	.158
time since diagnosis	.00 (.002)		.12	.907
sex	.02 (.02)		1.10	.271
T1Adherence	.70 (.08)**		8.74	.000
T1 Parent Acceptance	-.03 (.01)*		-2.12	.034
T2 Parent Acceptance	.02 (.02)		1.59	.113
T1 Peer Support	.03 (.01)*		2.30	.024
Step 2		.58		
pump status	.03 (.02)		1.74	.082
time since diagnosis	.000 (.002)		-.083	.934
sex	.03 (.02)		1.45	.146
T1Adherence	.70 (.08)		9.21	.000
T1 Parent Acceptance	-.03 (.01)		-2.20	.028
T2 Parent Acceptance	.02 (.02)		1.13	.261
T1 Peer Support	.02 (.01)		1.37	.176
T2 Peer Support	.04 (.01)**		3.33	.001

*p< 0.05, **p<0.01
T1=Time 1; T2=Time 2

APPENDIX A

La Greca Diabetes Friend Support Subscale Items

We want to know how often your friends do things to **help or support your diabetes**. There are no right or wrong answers. Just circle the number that indicates how often these things happen with your friends.

We also want to know how you feel about your friends' behaviors. Everyone has different ideas about what is helpful and supportive. **We want to know what is helpful and supportive for you**. Circle the number that shows how supportive each behavior is for **YOU**.

How Often Do Your Friends..... **How does this make you feel?..... or How would you feel?**

1. Encourage you to do a good job of taking care of your diabetes.

   How often? 0 1 2 3 4 5 It feels: -1 0 1 2 3

2. Understand when you sometimes make mistakes in taking care of your diabetes.

   How often? 0 1 2 3 4 5 It feels: -1 0 1 2 3

3. Are available to listen to concerns or worries about your diabetes care.

   How often? 0 1 2 3 4 5 It feels: -1 0 1 2 3

Guide for what "How often" and "It feels" mean:

How often does this happen?

0	**1**	**2**	**3**	**4**	**5**
Never	Less Than 2x a month	Twice a Month	Once a Week	Several times a Week	At least once a day

When this happens, how do you feel about it?

-1	**0**	**1**	**2**	**3**	
Unhelpful Or NOT Supportive	Neutral	A little Helpful or Supportive	Supportive	Helpful/ Supportive	Very

**Note: If a behavior listed never happens, circle "0" for "never". Please try to rate how you think you would feel if this did happen.

General Diabetes Support Items created for the present study

Please answer the following items regarding the friends you currently spend the most time with:

1.) The friends I currently spend the most time with know I have diabetes.

1 = Strongly disagree …. 5 = Strongly agree

2.) These friends are helpful in providing support for my diabetes.

1 = Strongly disagree …. 5 = Strongly agree

3.) These friends know what to do when I have an emergency with my diabetes (e.g., have a reaction, go low, etc.).

1 = Strongly disagree …. 5 = Strongly agree

ADHERENCE BEHAVIOR SCALE

Diabetes Behavior Rating Scale (Teen Non-Pump Version)

The following questions are about behaviors that either you or your parents do to help you take care of your diabetes. We would like to know how often these behaviors are being done. We do not care who in your family does the behavior, just how often it is done.

A. DAILY PREVENTION BEHAVIORS
For the following question please think about how often you or your parents have done each of the described behaviors in the last 7 days.

How often	**Never**	**Seldom**	**About half the time**	**Usually**	**Always**
1. were your meals planned according to the system you use?	1	2	3	4	5
2. were your foods weighed or measured?	1	2	3	4	5
3. were food labels used for planning meals?	1	2	3	4	5
4. were fatty foods eaten more than your meal plan allowed or your doctor recommended?	1	2	3	4	5
5. were sweets eaten more than your meal plan allowed or your doctor recommended?	1	2	3	4	5
6. was the amount of insulin that your doctor prescribed (including adjustments for diet or blood glucose level) actually taken?	1	2	3	4	5
7. was your insulin taken at the time you were supposed to?	1	2	3	4	5
8. was the amount of insulin you took written in your daily log?	1	2	3	4	5
9. were insulin shots given correctly?	1	2	3	4	5
10. were insulin shots given in different parts of the body?	1	2	3	4	5
11. were blood sugar levels tested as often as recommended by the doctor?	1	2	3	4	5
12. was your blood sugar checked at the time of the day it should be?	1	2	3	4	5
13. were your blood sugar numbers written in your log, diary, or chart?	1	2	3	4	5
14. was "fast sugar" (like candy, juice) with you?	1	2	3	4	5

How often	Never	Seldom	About half the time	Usually	Always
15. did you get exercise or participate in physical activity for at least 20 minutes?	1	2	3	4	5
16. was a bracelet or necklace that tells people you have diabetes worn?	1	2	3	4	5
17. were blood sugar levels tested every time you ate?	1	2	3	4	5

B. MODIFICATIONS OF DIABETES CARE PLAN

There are some adjustments that need to be made in diabetes care in certain situations. These may or may not be done on a daily basis. We are interested in knowing how often these behaviors are practiced when called for.

Please think about the last 5 times that the described situation occurred, not just the most recent

Out of the last 5 times…	**None**	**1 time**	**2 times**	**3 times**	**4 times**	**5 times**
18. that the amount of exercise you did changed, how often were your meals and snacks changed?	1	2	3	4	5	1
19. that the amount of exercise you did changed, how often was total insulin dose changed?	1	2	3	4	5	1
20. that less or more food was eaten than usual, how often was total insulin dose changed?	1	2	3	4	5	1
21. that blood sugar levels were higher or lower than usual, how often was the amount of exercise changed?	1	2	3	4	5	1
22. that your blood glucose was out of the target range, how often was your total insulin dose adjusted?	1	2	3	4	5	1
23. that you needed help for your diabetes in school, home, or social settings, how often was help obtained?	1	2	3	4	5	1

C. INTERVENTION BEHAVIORS

There are also actions that are taken only when you have symptoms of "low" or "high" blood sugar. Many of these actions are listed below. Please think about the last five times that you had symptoms, not just the most recent time. How often were the described behaviors practiced then?

Out of the last 5 times when you had symptoms of being "LOW", how often…	**None**	**1 time**	**2 times**	**3 times**	**4 times**	**5 times**
24. was your blood sugar checked?	1	2	3	4	5	1

Out of the last 5 times when you had symptoms of being "LOW", how often…	None	1 time	2 times	3 times	4 times	5 times
25. was "fast sugar" (like juice) taken within 10 minutes?	1	2	3	4	5	1
26. was your blood sugar checked within 20 minutes after having taken "fast sugar"?	1	2	3	4	5	1
27. was "regular food" eaten after needing to take "fast-sugar"?	1	2	3	4	5	1
28. was too much food eaten so that your blood sugar went too high after being low?	1	2	3	4	5	1

Out of the last 5 times when you had symptoms of being "HIGH", how often…	None	1 time	2 times	3 times	4 times	5 times
29. was your blood sugar checked?	1	2	3	4	5	1
30. was insulin dose changed based on the results of a blood sugar test?	1	2	3	4	5	1

How often…	Never	Seldom	Half the time	Usually	Alway
31. is insulin correctly adjusted for meals you eat away from the home (e.g., at restaurants, parties)?	1	2	3	4	5
32. are your friends, teachers, coaches, and others told how to treat "low" blood sugar?	1	2	3	4	5
33. are your school nurse, dentist, and eye doctor told that you have diabetes?	1	2	3	4	5
34. are clinic or doctors appointments kept?	1	2	3	4	5
35. is your doctor/nurse called for changes in insulin dose if you get frequent "high" or "low" blood sugar levels?	1	2	3	4	5

Parental Acceptance Scale

MOTHER

Instructions: Indicate the extent to which the following statements describe **your relationship** with **your mother** by using the following scale:

1 = Strongly Disagree with Statement
2 = Somewhat Disagree with Statement
3 = Uncertain about Statement
4 = Somewhat Agree with Statement
5 = Strongly Agree with Statement

1.	Sometimes disapproves of specific things I do, but never gives me the impression that she dislikes me as a person.	1	2	3	4	5
2.	enjoys being with me.	1	2	3	4	5
3.	can always be depended upon when I really need her help and trust.	1	2	3	4	5
4.	tries to make me feel better when I am unhappy.	1	2	3	4	5
5.	gives me the feeling that she likes me as I am; she doesn't feel she has to make me over into someone else.	1	2	3	4	5

Parental Acceptance Scale

FATHER

Instructions: Indicate the extent to which the following statements describe **your relationship** with **your father** by using the following scale:

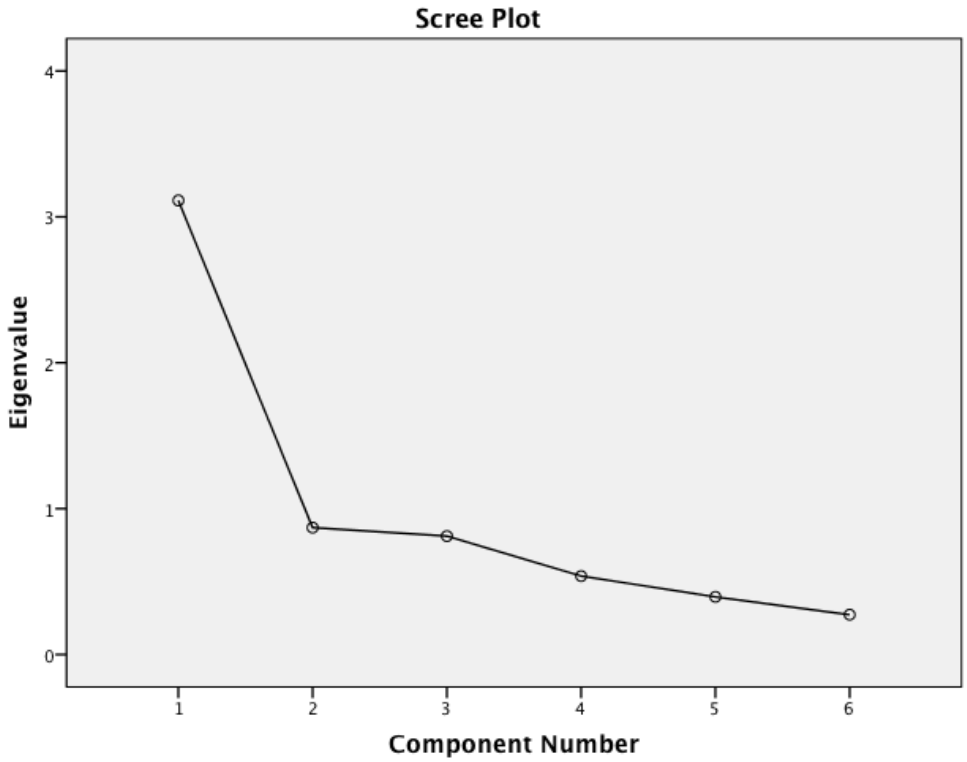
1 = Strongly Disagree with Statement
2 = Somewhat Disagree with Statement
3 = Uncertain about Statement
4 = Somewhat Agree with Statement
5 = Strongly Agree with Statement

1.	Sometimes disapproves of specific things I do, but never gives me the impression that he dislikes me as a person.	1	2	3	4	5
2.	enjoys being with me.	1	2	3	4	5
3.	can always be depended upon when I really need him help and trust.	1	2	3	4	5
4.	tries to make me feel better when I am unhappy.	1	2	3	4	5
5.	gives me the feeling that he likes me as I am; he doesn't feel he has to make me over into someone else.	1	2	3	4	5

APPENDIX B

Peer Item Principal Component Analysis Results
(La Greca Items 1-3 & General Diabetes Support Items 1-3)

Total Variance Explained						
	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.112	51.872	51.872	3.112	51.872	51.872
2	.870	14.498	66.370			
3	.812	13.533	79.902			
4	.538	8.968	88.870			
5	.395	6.582	95.452			
6	.273	4.548	100.000			
Extraction Method: Principal Component Analysis.						



Component Matrix[1]

Item Type	Component 1
La Greca Item 3 Composite	.817
La Greca Item 1 Composite	.784
Ready Item 2	.770
La Greca Item 2 Composite	.723
Ready Item 3	.706
Ready Item 1	.464

[1]Extraction Method: Principal Component Analysis; 1 component extracted, no rotation possible

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