HOPE AND EXECUTIVE FUNCTIONING AS CORRELATES OF HEALTH OUTCOMES IN ADOLESCENTS WITH TYPE 1 DIABETES

by

MELISSA A. RAFFERTY

Submitted in partial fulfillment of the requirements

for the degree of Master of Arts

Department of Psychological Sciences

CASE WESTERN RESERVE UNIVERSITY

January 2019

CASE WESTERN RESERVE UNIVERSITY

SCHOOL OF GRADUATE STUDIES

We hereby approve the thesis/dissertation of

Melissa A. Rafferty

candidate for the degree of **Master of Arts***.

Committee Chair

Rebecca Hazen, Ph.D.

Committee Member

Arin Connell, Ph.D.

Committee Member

Julie Exline, Ph.D.

Date of Defense

November 30, 2018

*We also certify that written approval has been obtained

for any proprietary material contained therein.

Table of Contents

List of Tables

List of Figures

Acknowledgements

Thank you to the Masters Committee (Rebecca Hazen, Ph.D., Arin Connell, Ph.D., and Julie Exline, Ph.D.) for their helpful guidance and constructive insight. Special thanks to Dr. Hazen for her mentorship during this project and her reviews of this thesis. Thank you to the Rainbow Babies and Children's Hospital Division of Pediatric Endocrinology, especially Sarah McLeish, D.O. Finally, thank you to the youth and their parents who participated in this research, making this study possible.

Hope and Executive Functioning as Correlates of Health Outcomes in Adolescents with Type 1 Diabetes

Abstract

By

MELISSA A. RAFFERTY

Objective: The purpose of this study was to investigate hope and executive functioning as they related to adherence, glycemic control, and depression in youth with type 1 diabetes mellitus (T1DM). **Methods:** Youth (n=67) ages 11-17 with T1DM completed questionnaires on hope, depressive symptoms, and adherence, and parents completed a questionnaire on executive functioning. HbA1c and average number of checks were gathered from medical charts as indicators of glycemic control and adherence, respectively. **Results:** The interaction of hope and executive dysfunction predicted a significant amount of the variance in self-reported adherence, with hope as a main effect. Higher hope and lower executive dysfunction predicted better adherence, whereas lower hope with lower executive dysfunction predicted worse adherence. There was a main effect of gender on glycemic control, and of executive dysfunction on depression. **Conclusion:** Hope may be an important target for improving adherence in those youth with higher levels of executive functioning.

Hope and Executive Functioning as Correlates of Health Outcomes in Adolescents with Type 1 Diabetes

Type 1 diabetes mellitus (T1DM) is a disease affecting the endocrine system that renders the pancreas unable to produce insulin. T1DM is among one of the three most prevalent chronic diseases of childhood and the prevalence of T1DM in youth in 2009 was approximately 167,000 cases (Pettitt et al., 2014). Between 2011 and 2012, an additional 17,900 youth under 20 years of age were diagnosed with T1DM (CDC, 2017).

There is no cure for diabetes, but there are available treatments, all of which require multiple complex daily tasks. Given that the body cannot produce insulin on its own, the individual must get their insulin artificially, either by multiple injections throughout the day or through an insulin pump. T1DM management also includes carefully regulating one's diet, specifically the intake of carbohydrates, consistently monitoring blood-glucose levels throughout the day, and daily exercise (Wysocki, Buckloh, & Greco, 2009). If not properly managed, youth with T1DM run the risk of developing severe, potentially life-threatening health consequences; in the long-term, youth can develop heart, kidney, eye, and/or nerve disease. Potentially fatal consequences such as severe hypoglycemia, hyperglycemia and ketoacidosis can occur if glucose and insulin levels are not monitored and managed (Wysocki, Buckloh, & Greco, 2009).

Given the many management tasks required for T1DM and the severe consequences if poorly managed, adherence to treatment regiments is an important topic for children and adolescents. A primary goal of proper adherence is adequate glycemic control, with hemoglobin A1c (HbA1c) values being the gold standard measure of glycemic control. HbA1c assesses the amount, or percentage, of glucose that is in the

bloodstream for the prior 3 months. The relationship between adherence and glycemic control in youth has been supported in the literature as a moderate positive relationship, indicating that as adherence increases, glycemic control increases (lower HbA1c; Hood, Peterson, Rohan, & Drotar, 2009). For children and adolescents, many factors can influence adherence, but there is particular support for family and parental characteristics. For example, higher levels of parental involvement (Anderson, Brackett, Finkelstein, & Laffel, 1997; Helgeson, Reynolds, Siminerio, Esobar, & Becker, 2008), perceived family support for diabetes specific tasks and activities (La Greca & Berman, 2002), and family communication (Bobrow, AvRuskin, & Siller, 1985) have all been shown in the literature to be related to better adherence. There is also support for child factors that can influence adherence and glycemic control, such as temperament, depression and anxiety, and executive functioning (Buchberger et al., 2016; Garrison, Biggs, and Williams, 1990; McNally, Rohan, Pendley, Delameter, and Drotar, 2010; Smith et al., 2014; Perez et al., 2017). One individual characteristic that has not been widely explored in the context of adherence to pediatric T1DM treatment is Snyder's (1991) concept of hope. One of the primary aims of the current study was to explore the individual characteristics of hope and executive functioning as they relate to health outcomes in adolescents with T1DM.

Hope

Hope is an important construct in positive psychology that is formally defined as "a positive motivational state that is based on an interactively derived sense of successful (a) agency (goal-directed energy), and (b) pathways (planning to meet goals)" (Snyder, et al., 1991, p. 287). Put simply, hope is essentially one's ability to make plans toward a goal and belief in the ability to achieve that goal. Agency is best described as "one's successful determination or resolve about reaching goals" (e.g., "I can reach the goals

that I set for myself"), whereas pathway is "one's effective ability to pursue different means to obtaining goals" (e.g., "If a problem comes up, I can think of many ways to solve it"; Chang, 2003). The two components are meant to have a reciprocal interaction, meaning that one must be able to successfully move toward goals while also having the perception that there are effective strategies to reach those goals; agency cannot exist without pathway, and vice versa. According to Snyder's hope theory, an individual who does not possess both components would not have hope. Furthermore, there is an emotional feedback loop which can effect one's level of hope over time. Successful attainment of a goal produces positive emotions, whereas unsuccessful goal attainment produces negative emotions, both of which affect future perceptions of one's potential success.

Hope has been compared to other positive psychology constructs such as optimism and general hopefulness, and while there is some overlap, the specific cognitive and behavioral components of both agency and pathway are the main ways in which hope is different from similar constructs (Scheier & Carver, 1985; Wong & Lim, 2009). For example, while general hopefulness may involve similar hopeful thinking to Snyder's theory of hope (Snyder, 2002), the difference is that hope involves more goal-directed thoughts and behaviors. Regarding optimism, Snyder explains that while Scheier and Carver's (1985) model of optimism implicitly emphasizes the agency pathway, hope differs in that it involves the specific identification of pathways, or specific ways to meet a goal, rather than a general expectation of or confidence in a positive outcome (Snyder, Sympson, Michael, & Cheavens, 2001). Hope and optimism have frequently been compared in the literature, but hope has been found to be a strong predictor of a variety of

constructs, including grade expectancy, life satisfaction, and general well-being (Bailey, Eng, Frisch & Snyder, 2007; Magaletta & Oliver, 1999; Rand, 2009). In addition, Snyder differentiates hope from Bandura's (1977) model of self-efficacy, emphasizing two key factors: 1) self-efficacy must always be based on situation-specific goals, thus the outcome expectancy component (similar to pathways thinking) must be based on the situation-specific contingencies, whereas hope can involve broad and cross-situational goals, and 2) the efficacy expectancy component of self-efficacy, which is comparable to agency thinking, is based on whether the individual *can* achieve their goal, whereas the agency thinking in hope is based on whether the individual *will* achieve their goal (Snyder, 2002).

In initial studies of hope related to health outcomes in individuals with medical conditions, including adults with spinal cord injury and adolescent burn survivors, results showed that those with higher hope showed more positive health outcomes, such as better coping, lower likelihood of engaging in behaviors that would impede recovery, and less depression (Elliott, Witty, Herrick, & Hoffman, 1991; Barnum, Snyder, Rapoff, Mani, & Thompson, 1998). Thus, it is important to consider how hope may also play a role in pediatric diabetes. However, the literature on hope specifically relating to diabetes is relatively limited. In one of the earliest studies by Vieth et al. (1997), 45 participants ages 15 to 32 years diagnosed with type 1 diabetes for an average of 11 years were asked to complete The Hope Scale (Snyder et al., 1991), along with measures of health status and positive and negative affect. Hemoglobin A1c (HbA1c) was used as the diabetes-related health outcome. Using linear multiple regression, they found no significant relationship between hope and HbA1c. It is important to note that as a whole, the sample

demonstrated adequate and perhaps slightly better HbA1c levels than is typical, indicating relatively good glycemic control.

Recent research has been more supportive of the relationship between diabetes-related health outcomes, particularly HbA1c, and hope. Lloyd, Cantell, Pacaud, Crawford, and Dewey (2009) measured hope and adherence in a group of adolescents (*M* = 14.8 years) with T1DM. In this sample, higher levels of hope were positively correlated with both better adherence and better glycemic control. Santos et al. (2015) found similar results in a small study of Brazilian adolescents and young adults, ages 11-23, with T1DM. They found that hope was positively associated with glycemic control, as measured by HbA1c, and negatively associated with depression.

Additionally, in a longitudinal study of adolescents ages 10 to 16 (*M* = 13.6) with T1DM, Van Allen et al. (2016) reported results that further supported the role of hope in diabetes. At time point 1 and then again six months later, youth completed measures of hope and optimism. HbA1c and frequency of self-monitored blood glucose (SMBG) were also calculated as diabetes-related outcomes. SMBG is obtained through the downloading of the blood glucose values from the youth's blood glucose meters at clinic visits, which is often used as a measure of adherence as it reflects how often the youth checks their blood glucose levels. Results indicated that increases in hope from time 1 to time 2 were associated with decreases in HbA1c levels (better glycemic control) and increases in frequency of SMBG. However, mediation analysis revealed that SMBG mediated the relationship between hope and HbA1c, such that increases in frequency of SMBG partially explained the association between increases in hope and decreases in HbA1c. Notably, changes in optimism were not related to changes in adherence (SMBG) or

glycemic control (HbA1c). Given these findings suggesting that hope is associated with important diabetes-specific health outcomes, hope is an important construct to consider when investigating potential relationships that may impact the health of youth with T1DM.

Executive Functioning

While hope may be important for youth with T1DM, it must be noted that diabetes treatment requires many different tasks and children and adolescents must possess certain cognitive abilities to adequately perform diabetes related tasks. One such cognitive skill is executive functioning. Executive functioning involves a range of goal-directed skills, including organization, planning, problem solving, working memory, and behavioral self-regulation (Bagner et al., 2007). Previous research is supportive of the relationship between executive function and aspects of diabetes adherence. Specifically, there is strong support for a positive relationship between better overall executive functioning, as measured by a total score of executive functioning using a parent report, the Behavior Rating Inventory of Executive Functioning (BRIEF; Gioia, Isquith, Guy, & Kenworthy, 2000), and higher levels of adherence in youth (McNally, Rohan, Pendley, Delameter, and Drotar, 2010; Smith et al., 2014; Perez et al., 2017), meaning that youth with better executive functioning are more likely to be adherent to their treatment. In children ages 8-19 years, Bagner, Eillismd, Geffkin, Silverstein, and Storch (2007) reported that better problem solving, self-monitoring, and better working memory skills predicted a significant portion of the variability in adherence within the last three months.

Additionally, other studies have investigated executive functioning as it relates to glycemic control. Results from McNally, Rohan, Pendley, Delamater, and Drotar (2010)

reported that both executive functioning and glycemic control were significantly related to adherence, such that higher levels of executive functioning and better glycemic control were separately related to better adherence. Moreover, results suggested that the relationship between executive functioning and glycemic control was partially mediated by adherence. Similarly, in a sample of youth ages 8-18 years, Smith et al. (2014) also found that adherence mediated the relationship between executive functioning and glycemic control.

Furthermore, there is some evidence supporting gender differences in the relationship between EF and diabetes. For example, in one study on adolescents, specific self-regulation measures (cognitive flexibility, attentional control, goal setting, and emotion regulation) were found to be significantly related to adherence and glycemic control for boys only (Graziano et al., 2011). Boys with greater executive dysfunction were also more likely to report better adherence, whereas the opposite was true for girls, which may be due to greater parental involvement in treatment on behalf of the boys (Perez et al., 2017). Despite speculations about age-based differences in EF and adherence due to the assumption that older children are likely to have more responsibility in their treatment than younger children, no study has found significant differences based on age (Bagner, Eillismd, Geffkin, Silverstein, & Storch, 2007; McNally, Rohan, Pendley, Delamater, & Drotar, 2010; Perez et al., 2017).

Hope and Executive Functioning. Both hope and executive functioning share several overlapping themes, including formulating goals, identifying realistic paths, and flexibility (Sears, 2007). However, the relationship between hope and executive functioning has not been widely examined in the literature, and has not been studied in

children with T1DM. Nonetheless, it may be important to consider the relationship between the two constructs, especially because it seems that executive functioning is necessary for hope to lead to successful outcomes.

In the two relevant studies to-date, the results are promising of a positive relationship between executive functioning and hope. In a study of students ages 17-24, Kruger (2011) found that not only did hope correlate with certain aspects of executive functioning, such as organization and strategic planning, but hope also accounted for the largest unique and significant amount of the variance in executive functioning compared to all other positive psychology constructs considered, such as optimism and gratitude. Additionally, in a dissertation completed by Sears (2007) studying hope, executive function, and behavioral/emotional regulation specifically related to school functioning in 5th and 6th graders, a significant negative correlation was found between hope and executive dysfunction, such that as hope increased, executive dysfunction decreased. When breaking executive function down in to smaller, more specific components, hope was significantly related to working memory, plan/organize, and task completion.

Depression

In addition to examining the diabetes related health-outcomes of adherence and glycemic control, another aim of this study is to examine hope and executive functioning as correlates of depression in youth with T1DM. Compared to the average population, children with T1DM are twice as likely and adolescents three-times more likely to be depressed (Grey, Whittemore, & Tamborlane, 2002). Depression in children and adolescence with T1DM is a significant issue for a number of different reasons. For example, in a study of 144 adolescents with T1DM, of which a quarter of the participants

endorsed clinically significant levels of depression on the Children's Depression Inventory (CDI), the presence of depressive symptoms was also associated with current A1c levels, as well as blood glucose monitoring frequency six months later (McGrady & Hood, 2010). Hood et al. (2006) also found that higher levels of depressive symptoms were associated with less frequent blood glucose monitoring and poorer glycemic control. For older children in particular, the existence of a psychiatric disorder, including depression, has been shown to be a significant predictor of diabetic ketoacidosis and severe hypoglycemia, both life-threatening complications of T1DM which require hospitalization (Rewers et al., 2002; Stewart, Rao, Emslie, Klein, & White, 2005). Additionally, the combination of depression and T1DM is associated with an increase in suicide and suicidal ideation (Grey, Whittemore, & Tambolane, 2002). This is further complicated by the fact that youth with T1DM have relatively easy access to potential methods of committing suicide through the lethal use of insulin.

Not only can depression put youth with T1DM at risk for major health consequences, but T1DM may also put children at a greater risk of developing depression. While there is little to no evidence for biological mechanisms that may be impacting the relationship, there is some longitudinal data that suggests that depression may occur after diabetes. In an older study, children ages 8-13 were followed for up to nine years after the onset of their T1DM to assess for psychological disorders and noncompliance (Kovacs, Goldston, Obrosky, & Iyengar, 1992). Major affective disorders, including depression, made up the largest percentage of the psychiatric disorders assessed in the population. Of the sample of 95 children, a total of 29.5% were considered noncompliant to their diabetes regiment at some point during the span of the

study and this noncompliance was closely associated with psychiatric disorders. Furthermore, these psychiatric disorders emerged after diagnosis, as opposed to pre-existing disorders, implying that youth with T1DM are at a greater risk of developing psychiatric disorders, including depression.

The correlates of depression in this population are varied and similar to correlates in children without T1DM. There is some support that adolescent females with T1DM are more likely to have a clinical diagnosis of depression (Hood et al., 2006; Kovacs, Goldston, Obrosky, & Drash, 1997; Lawrence et al., 2006), and older, rather than younger, adolescents are at greater risk for depression (Whittemore et al., 2002). Additionally, family factors also play a role in depression in youth with T1DM. Such family factors include family adaptability, family cohesion, and warm and caring family behaviors (Grey, Whittemore, & Tambolane, 2002) and diabetes-related family factors such as youth-reported diabetes-specific family conflict and parent-reported diabetes-specific burden (Hood et al., 2006). The largest family factor appears to be maternal depression (Jaser, Whittemore, Ambrosino, Lindemann, & Grey, 2008; Kovacs, Goldston, Obrosky, & Bonar, 1997). However, there remain many other factors which may be potential correlates of depression in youth with T1DM, but on which there is currently either limited or no literature. One of the primary aims of this study is to further investigate two such factors – the individual characteristics of hope and executive functioning – as correlates of depression in adolescents with T1DM.

Hope and Depression. Given the role of negative emotion in the hope model as a feedback mechanism contributing to lower hope, it is to be expected that hope and depression should have a negative interaction. Results are mostly supportive of a

relationship between hope and depression in both children and adults without T1DM. In a study involving children in an obesity intervention, hope mediated the relationship between depression and quality of life, with a negative relationship between hope and depression (Van Allen, Seegan, Haslam, & Steele, 2016). In a study of adults, Thimm, Holte, Brennan, and Wang (2013) split participants into three groups – never depressed, previously depressed, and clinically depressed and reported that the groups differed significantly on their levels of hope as measured by the Hope Scale, with the never depressed having the highest hope, the clinically depressed having the lowest, and the previously depressed falling in the middle. Additionally, in a study comprised of college students (M = 19.8 years) in the U.S., Chang and DeSimone (2001) investigated the relationship between hope and dysphoria, or general negative emotion. They found an inverse interaction between hope and dysphoria, meaning that those individuals with higher hope reported lower levels of dysphoria.

In contrast to the above findings, in a study of 68 Chinese children with depressive symptoms using a hope and gratitude intervention, there was not a significant relationship between hope and changes in depression (Kwok, Gu, & Kit, 2016). It should be noted that the children in this study were at subclinical levels of depression and changes in depression levels throughout the intervention were small in both the control group and the experimental group. Additionally, in a study of Singaporean adolescents, Wong and Lim (2009) found that hope did not account for a significant portion of the variance in depression and life satisfaction beyond what was accounted for by optimism. Given the sample differences, it is not surprising to find such mixed results, especially considering the potential cross-cultural differences. Such differences include the notion

that hope is a relatively individualistic construct, so while it may be important to consider in cultures where individualism is emphasized, it may be less impactful in cultures that stress collectivism. Nonetheless, the differences in findings suggests that it is important to further investigate this relationship. Additionally, relationships between hope and depression in youth with T1DM have yet to be studied.

Executive Functioning and Depression. Depression is associated with significant cognitive deficits, such as rumination, memory impairment, and attention deficits. The nature of these cognitive components of depression shares similar features with executive functioning, and the literature on the relationship between executive functioning and depression in adults is supportive of the relationship (Snyder, 2013). In fact, executive dysfunction may predict increased depressive symptomology over time (Demeyer, De Lissnyder, Koster, & De Raedt, 2012; Zetsche & Joormann, 2011).

However, much less is known about the relationship between executive functioning and depression in children and adolescents, and to our knowledge, there are no studies to date that have investigated the relationship between executive functioning and depression in children and adolescents with T1DM. The current literature on the relationship in the general population of children and adolescents presents mixed results, potentially due to inconsistencies in the classifications of depression in youth (e.g. major depression vs. dysthymia). There is some support that adolescents with depression have impaired working memory (Baune, Czira, Smith, Mitchell, & Sinnamon, 2012; Brooks, Iverson, Sherman, & Roberge, 2010), as well as that increased depressive symptomology, specifically rumination, is associated with the executive functioning skills of

perseveration, set-shifting, and inhibitory impairments (Connolly et al., 2014; Dickson, Ciesla, & Zelic, 2016).

Alternatively, in a study on adolescents with major depressive disorder (MDD), no evidence was found of any deficits in executive functioning, specifically verbal fluency, set-shifting, and inhibition (Klimkeit, Tonge, Bradshaw, Melvin, & Gould, 2011). Furthermore, results from a systematic review on executive function in children and adolescents with depressive disorders again were mixed (Vilgis, Silk, & Vance, 2015). There was some support for a difference in executive function depending on the severity of the depression; for example, impairment in planning difficulties was observed in children who were acutely depressed but not those who were moderately depressed (Maalouf et al., 2011). However, many studies did not differentiate groups based on severity, and results otherwise were not consistent.

Taken together, although the adult literature on the relationship between executive functioning and depression is supportive of a relationship, the evidence is mixed in youth. However, executive functioning is also involved in emotion regulation, which is often looked over for the more cognitive aspects of executive functioning. This emotion component provides even more reason to investigate the relationship of executive functioning and depression, but also relates to the impact of hope on depression. Hope can provide a positive emotional benefit to those individuals who are high in hope, which may go above and beyond the emotional regulation the executive functioning provides. This gives further reason to suggest that these relationships are worth investigation.

Value-Added Contribution

Adherence, depression, executive functioning, and hope have all been independently investigated to some degree within youth with T1DM, especially as they contribute to significant health outcomes. Research supports the relationship between executive functioning, adherence, and glycemic control (Bagner et al., 2007; McNally, Rohan, Pendley, Delameter, and Drotar, 2010; Smith et al., 2014; Perez et al., 2017). Although understanding risk factors for poor adherence and health outcomes is an important goal of research in T1DM in youth, it is equally important to consider the potential positive psychological constructs which contribute to health outcomes. One such construct is hope (Snyder et al., 1991), which involves goal-directed thoughts and behaviors. It is likely that certain cognitive factors may impact the effect of hope on adherence and glycemic control, such as executive functioning, but this has not yet been explored in the literature. By testing hope as it relates to adherence and glycemic control, as well as its interaction with executive functioning, this study contributes to the literature about hope in youth with T1DM.

Finally, health outcomes directly related to T1DM such as adherence and glycemic control are only two of the important factors to consider. Depression is a particular concern for adolescents with T1DM, as the rates of depression are much higher in this population compared to adolescents without T1DM (Grey, Whittemore, & Tamborlane, 2002) and depression can put youth at higher risk for severe health consequences related to T1DM, such as hypoglycemia and ketoacidosis (Rewers et al., 2002; Stewart, Rao, Emslie, Klein, & White, 2005). In individuals without T1DM, hope has been shown to have a negative relationship with depression (Chang & DeSimone,

2001; Van Allen, Seegan, Haslam, & Steele, 2016). Additionally, little is known about relationships of hope and executive functioning with depression in adolescents. By exploring these relationships and the interaction of hope and executive functioning in adolescents with T1DM, this study aims to expand knowledge of factors that may impact depression in adolescents with T1DM.

Aims and Hypotheses

Aim 1

The first aim is to examine the relationships between hope, executive functioning, and adherence. The current study will also investigate the separate relationships of agency and pathway with executive functioning. Finally, this study will investigate how the interaction between hope and executive functioning predicts adherence in adolescents with T1DM.

Hypothesis 1. It is expected that hope and executive dysfunction will be negatively correlated, such that higher hope will be correlated with lower scores of executive dysfunction on the D-REF. When examining the two main components of hope, it is expected that the pathway component will be more strongly correlated with executive dysfunction than the agency component.

Hypothesis 2a. It is predicted that hope and adherence will be positively correlated, and that executive dysfunction will have a negative correlation with adherence, such that lower executive dysfunction will be related to better adherence.

Hypothesis 2b. After controlling for statistically significant demographic variables and mains effects of hope and executive dysfunction, the interaction between hope and executive dysfunction is expected to account for a statistically significant

portion of the variance in adherence, such that higher levels of both hope and lower executive dysfunction are expected to predict the greatest adherence but the combination of higher hope and higher executive dysfunction is expected to be associated with comparatively lower levels of adherence. Lower levels of hope with higher levels of executive dysfunction are expected to be related to the worst adherence.

Aim 2

The second aim of this study is to investigate hope and executive functioning as they relate to glycemic control in adolescents with T1DM, both independently and the interaction between the two. Additionally, given the known relationship between adherence and glycemic control (Hood, Peterson, Rohan, & Drotar, 2009), the three-way interaction of hope, executive functioning, and adherence will be explored in predicting glycemic control.

Hypothesis 3a. It is expected that hope and executive dysfunction will each be significantly correlated with glycemic control as measured by HbA1c, with higher levels of hope being correlated with lower HbA1c, and higher levels of executive dysfunction being associated with higher HbA1c.

Hypothesis 3b. It is further hypothesized that after controlling for significant demographic variables and main effects of hope and executive dysfunction, the interaction between hope and executive dysfunction will predict a significant proportion of the variance in glycemic control. As with adherence, the combination of higher levels of both hope and lower levels of executive dysfunction are expected to be related to better glycemic control, whereas higher levels of hope with higher levels of executive dysfunction are expected be related to lower levels glycemic control. Finally, it is

hypothesized that lower levels of hope and higher levels of executive dysfunction will statistically predict the worst glycemic control.

Hypothesis 4. Given the known relationship between adherence and glycemic control, an exploratory three-way model will investigate the interaction of hope, executive dysfunction, and adherence in predicting glycemic control.

Aim 3

The third and final aim of this study is to investigate the relationships between hope, executive functioning, and depressive symptoms in adolescents with T1DM. Specifically, the goal is to investigate the correlations between the three variables as well as how the interaction between hope and executive functioning predict depressive symptoms.

Hypothesis 5a. Hope and executive dysfunction will be independently related to depressive symptoms. Hope and depressive symptoms will have an inverse relationship, such that higher levels of hope will be related to lower levels of depressive symptoms. Executive dysfunction and depression are expected to have a positive relationship, such that higher levels of executive dysfunction will be related to higher levels of depressive symptoms.

Hypothesis 5b. It is hypothesized that the interaction between hope and executive dysfunction will statistically predict depressive symptoms after controlling for significant demographic variables and the main effects of hope and executive dysfunction. Although it is expected that lower levels of hope in combination with and higher levels of executive dysfunction will be related to higher depressive symptoms, it is expected that the combination of higher levels of hope and higher levels of executive dysfunction will be

related to comparatively higher levels of depressive symptoms than the combination of higher levels of hope and lower levels of executive dysfunction.

Method

Participants and Recruitment

Participants included youth ages 11-17 and their parents, and were recruited as part of a larger study from pediatric endocrinology clinics at University Hospitals Rainbow Babies and Children's Hospital in Cleveland, Ohio. The larger study investigated predictors of adherence and glycemic control in children and adolescents with T1DM, specifically sleep and sleep disturbance in both children/adolescents and their parents, as well as the role that stress plays in parental sleep disruption. Inclusion criteria were a diagnosis of T1DM diagnosis of at least 12 months in duration and currently being followed by Rainbow Babies and Children's Hospital Endocrinology Division. Youth who were diagnosed with T1DM within the previous 12 months, non-English speaking families, and children with significant developmental delay were excluded from the study.

Eligible families were informed about the study at the time of their endocrine visit for diabetes care. If interested, the family met with the PI or research staff privately to further discuss the study and were given the option to enroll in the study. Written youth assent and parent consent were obtained from all participants. All data were de-identified and stored in password-protected files and locked file cabinets, to which only approved co-investigators and research assistants had access. This study was first be approved by University Hospitals IRB before beginning data collection.

Procedures

After consent and assent were obtained, the youth and parent completed the questionnaires, which took approximately 15 minutes to complete for the child and ten minutes for the parent. The family completed the questionnaires privately and any individual was free to stop at any point. If a child indicated elevated depression levels, the individual was assessed for suicide/suicidal ideation. If at any point the child or parent reported that the child talks about killing themselves or has deliberately tried to harm themselves, the primary investigator for the larger study (Dr. Rebecca Hazen), or if the PI is unavailable, a qualified research staff member, discussed the concerns with the participant. If it was determined that the research participant was not in immediate danger, referrals for psychological services outside of the study were provided. In the case that the research participant was in immediate risk of self-harm, arrangements were be made for the participant to go to the emergency room at Rainbow Babies and Children's Hospital. The family was compensated for their time with separate $5 Target® gift cards for the parent as well as the child or adolescent.

Measures

Objective Measures

Adherence was measured by reviewing the medical chart for the average number of blood glucose tests per day, based on data from the blood glucose meter download at the most recent clinic visit. Glycemic control was measured using hemoglobin A1c (HbA1c) levels from the most recent clinic visit.

Parent-report Measures

Delis Rating of Executive Functions. The Delis Rating of Executive Functions (D-REF; Delis, 2012) is a 36-item questionnaire designed to measure executive function

in children ages 5 to 18. Each item on the D-REF falls into one of three domains: (1) behavioral functioning (BF), which includes hyperactivity, impulsivity, poor organization, difficulty following rules, and insufficient self-monitoring; (2) emotional functioning (EMF), which measures frustration tolerance, sensitivity to criticism, anger control, emotional instability, and interpersonal issues; and (3) executive functioning (EXF), which includes attention and working memory, difficulty initiating/sustaining behavior, disorganization, cognitive rigidity, problem-solving and decision-making skills. Additionally, there are four clinical index scores: attention/working memory (AWM), activity level/impulse control (AIC), compliance/anger management (CAM), and abstract thinking/problem-solving (APS). Finally, a total composite score can be calculated. The total composite score has very good internal consistency (Cronbach's α = .95-.97). When compared to the BRIEF, a separate measure of executive function for children, the total composite scores on both measures were highly correlated (r = .75; Rueter, 2014). The current study utilized the total composite score on the D-REF. It should be noted that higher scores on the D-REF represent higher levels of executive dysfunction and thus lower levels of executive functioning.

Child-report Measures

Short Mood and Feelings Questionnaire. The Short Mood and Feelings Questionnaire (SMFQ; Angold et al., 1995) is a 13-item self-report measure designed to assess depressive symptoms in children and adolescents ages 8-16 years. The child is asked to respond with either "true," "sometimes true," and "not true" to the questions according to their mood over the last two weeks. Internal reliability has been shown to be good (Cronbach's α = 0.85), and the measure has 80% positive predictive power and 68%

negative predictive power with a cutoff score of 8 for predicting a diagnosis of depression (Angold et al., 1995).

Self Care Inventory-Revised Version. The Self Care Inventory-Revised version (SCI-R; La Greca Swales, Klemp, Madigan, 1998) is a 14-item self-reported questionnaire designed to measure a patient's perceptions of the degree to which they adhere to diabetes self-care treatment recommendations. Internal consistency findings of $\alpha = .80$ or greater have been reported in studies of children and adolescents (Davis et al., 2001). Delamater and colleagues (1997) reported a test-retest reliability of .77 over a 2-4-week time period.

The Children and Adolescent Scales of Hope. The Children and Adolescent Scale of Hope (CASH; Van Allen, Poppert, Seegan, & Steele, 2014) is a scale to measure children's hope, intended for use with youth ages 12-20 years. The three different subscales - agency, pathways, and goals – are assessed using three questions each. The three scales together comprise the total composite score. Children may respond to the questions on a 7-point Likert scale, ranging from "None of the time" to "All of the time." Items with responses lower than the fourth point on the scale ("A lot of the time") may indicate a particular area of concern or weakness. The CASH has exhibited good reliability ($\rho=0.92$), and has also been significantly correlated with measures of quality of life and depression ($r = 0.28$, $p<0.01$; $r = -0.20$, $p<0.01$) **(**Van Allen et al., 2014). The current study used the total composite score on the CASH, except for in Hypothesis 1, which used the separate subscales of pathways and agency.

Data Analysis

Statistical analyses were performed using R and PSPP (1.2.0) statistical software. Descriptive statistics and correlation matrices were run for each variable. Before conducting regression analyses to examine interactions effects, correlations were computed to examine whether there are statistically significant demographic correlates (age, sex, and parental education level) of the primary outcomes of adherence, glycemic control, and depression.

Multiple linear regressions were used to examine the proposed interactions (Holmbeck, 2002). These include the two-way interactions between hope and executive dysfunction in predicting adherence, glycemic control, and depression. Significant demographic variables from the correlation analyses were entered in the first step. In the second step, the standardized main effects of hope and executive dysfunction were entered, and the interaction term was entered in the third step. For the three-way interaction, all relevant 2-way interactions were added in the third step and an additional fourth step was added into the regression analyses that tested the interaction of hope, executive dysfunction, and adherence. Multicollinearity diagnostics and tests for outliers and influential data points were computed.

Results

Ninety-nine families were approached regarding participation in the study, 88 families consented to participation, and 11 declined participation. Twenty-one parent and youth dyads (23.9%) took their packets home but did not return them. Parent and child questionnaires were completed by 65 dyads and two dyads had the child questionnaires

completed at the time of the visit but the parents did not return their completed questionnaires in the mail.

Youth participants had a mean age of 14 years (*SD* = 1.9) and 60% of the sample were male. Mean duration of diabetes was 6.94 years (*SD* = 3.88), and the mean A1c was 9.62% (*SD* = 2.01), which falls above recommended ranges for children and adolescents with type 1 diabetes. Approximately 58.5% of participants wore an insulin pump. According to parent/caregiver report, the majority of families were white, non-Hispanic, had a total family income of $80,000 and below, and had at least one parent who completed some college or obtained a college degree (see Table 1 for descriptive statistics). Means and standard deviations for hope, executive dysfunction, depression, and adherence are shown in Table 2.

Bivariate Analyses

Correlations between all study variables can be found in Table 3. Notable significant correlations include correlations between the diabetes outcomes: adherence was significantly correlated with average number of checks ($r = 0.28$, $p \leq .05$) and A1c ($r = -0.32$, $p \leq .01$) and A1c was significantly correlated with average number of checks ($r = -0.49$, $p \leq .001$). All other significant correlations are described in the following sections. Of note, adherence and depression were not significantly correlated ($r = -0.20$, $p = .10$), nor were adherence and executive dysfunction ($r = -0.01$, $p = .915$), number of checks and hope ($r = -0.03$, $p = .825$), number of checks and depression ($r = .08$, $p = .514$), or number of checks and executive dysfunction ($r = .18$, $p = .164$). Furthermore, A1c was not correlated with depressive symptoms ($r = .07$, $p = .568$) or executive dysfunction ($r = .17$, $p = .172$).

Multivariate Analyses

Hypothesis 1. The first hypothesis was that hope and executive dyfunction would be negatively correlated, and that the pathways component of hope would be more strongly related to executive dysfunction than agency. Results indicated that youth report of hope and parent report of executive dysfunction were significantly correlated (r = -0.31, $p \leq .05$), indicating that higher levels of hope were correlated with lower levels of reported executive dysfunction. When hope was broken apart into the agency and pathways components, the magnitudes of the correlations were similar. Contrary to our prediction, only the correlation between executive dysfunction and agency reached statistical significance (r = -0.29; p = .017), whereas the relationship between pathways and executive dysfunction suggested a trend (r = -0.24, p = .053), but the two correlations were not significantly different from each other. Given this, we chose to keep the two components together in the remaining analyses.

Hypothesis 2a. It was predicted that higher levels of hope and and lower levels of executive dysfunction would be correlated with higher levels of adherence, as measured by both self-reported adherence and average number of blood glucose checks. As predicted, youth reported hope and adherence were positively correlated (r = .38, $p \leq .01$); however, hope and average number of checks, as gathered from chart review, were not (r = -0.03, p = .825). No significant correlations were found between parent report of executive dysfunction and youth report of adherence (r = -0.01, p = .915) or average number of blood glucose checks (r = .18, p = .164).

Hypothesis 2b. It was hypothesized that after controlling for significant demographic variables, the interaction between hope and executive dysfunction would

account for a statistically significant portion of the variance in adherence. With regard to self-report of adherence on the SCI-R, there were no statistically significant correlations with demographic variables (e.g. age, gender, parental education level; see table 3), therefore they were not included as control variables in regression analyses. Regression diagnostics did not suggest the presence of problematic multicollinearity, outliers, or influential data points. Results of the regression analyses indicated a main effect of hope ($\beta = .43$, $p \leq .01$), indicating that hope predicted a significant amount of the variance in youth-reported adherence. Although the main effect of executive dysfunction was not statistically significant, there was a significant interaction between hope and executive dysfunction ($\beta = .30$, $p = .004$; see Table 4). Secondary analyses of the simple slopes utilizing one standard deviation above and below the mean revealed that the slope of high executive dysfunction was not significantly different from zero ($\beta = .03$, $p = .816$), whereas the slope for low executive dysfunction was significant ($\beta = -.51$, $p < .001$). This indicates that hope was only significant for predicting adherence for those with lower executive dysfunction. Specifically, the combination of lower levels of executive dysfunction and lower levels of hope were associated with lower self-reported adherence but higher levels of hope and lower levels of executive dysfunction were associated with higher levels of adherence (see Figure 1).

For the second measure of adherence, average number of checks, there were no significant demographic variables for which to control and regression diagnostics did not suggest significant multicollinearity, outliers, or influential data points. The interaction between hope and executive dysfunction was not significant ($\beta = -.17$, $p = .145$), nor were there any significant main effects (see Table 4).

Hypothesis 3a. It was expected that hope would be inversely correlated with glycemic control, as measured by lower HbA1c, and executive dysfunction would be positively correlated with glycemic control. In partial support of this hypothesis, higher levels of hope were significantly correlated with higher levels of glycemic control, as indicated by the negative correlation between hope and A1c (r = -0.31, p ≤ .05), but executive dysfunction was not significantly correlated with A1c (r = .17, p = .172).

Hypothesis 3b. It was predicted that the interaction between hope and executive dysfunction would predict a significant proportion of the variance in glycemic control. Multicollinearity, outliers and influential data points were not apparent when regression diagnostics were examined. A1c was significantly negatively correlated with parental education level (r = -.26, p ≤ .05), indicating that lower parental education was associated with worse glycemic control (higher A1c). It was also significantly correlated with gender (r = .29, p ≤ .05), indicating that females had higher HbA1c, and thus poorer glycemic control. After controlling for education and gender, no main effects of hope or executive dysfunction were found. Furthermore, the interaction between hope and executive dysfunction was not statistically significant (β = .06, p = .58; see Table 4). However, gender remained statistically significant in all steps (β = .25, p ≤ .05).

Hypothesis 4. It was further hypothesized that the three-way interaction between hope, executive dysfunction, and self-reported adherence would predict a significant portion of the variance in glycemic control. The results did not support this hypothesis, as the interaction was not statistically significant (β = -.06, p = .69).

Hypothesis 5a. As predicted, hope was inversely correlated with depressive symptoms (r = -0.24, p ≤ .05), indicating that higher levels of hope were related to lower

levels of depressive symptoms. Executive dysfunction was positively correlated with depressive symptoms (r = .36, p ≤ .01), such that greater executive dysfunction was correlated with higher levels of depressive symptoms (see Table 3).

Hypothesis 5b. Finally, it was predicted that after controlling for significant demographic variables, the interaction between hope and executive dysfunction would account for a significant proportion of the variance in depressive symptoms. No demographic variables were significantly correlated with depressive symptoms and regression diagnostics did not raise concern for multicollinearity, outliers or influential data points. In the regression analyses without controlling for demographic variables, there was a main effect of executive dysfunction (β = .35, p ≤ .01); however, the interaction between hope and executive dysfunction did not predict a significant proportion of the variance in depressive symptoms beyond other variables (β = .19, p = .082; see Table 5). Although gender was not a statistically significant correlate of depression (r = .20, p = .102), due to the theoretical importance of gender, gender was controlled for in a second regression. The interaction remained nonsignificant (β = .18, p = .096; see Table 5), while the main effect of executive dysfunction remained significant (β = .38, p = .003).

Discussion

Previous work in the diabetes literature is mixed on the relationships of hope and executive functioning with the outcomes of glycemic control (HbA1c), adherence, and depression (Lloyd, Cantell, Pacaud, Crawford, & Dewey, 2009; Kruger, 2011; Santos et al., 2015; Sears, 2007; Van Allen et al., 2016) and the relationship between hope and executive functioning has not been investigated in the youth with diabetes. The current

study added to the literature by examining relationships of hope and executive functioning with adherence, glycemic control, and depressive symptoms as well as the role of interactions of hope and executive functioning in predicting these outcomes. Results partially supported the hypothesis that the interaction of hope and executive functioning would be significantly associated with adherence but the interaction did not significantly predict glycemic control and levels of depressive symptoms.

Consistent with previous, albeit limited, research in youth without diabetes (Kruger, 2011; Sears 2007), higher self-reported hope was related to lower parent-reported executive dysfunction. Although Snyder (1991) originally asserted that the components of agency and pathways are necessary for hope, given that the ability to meet one's goals would seem to be more likely to be related to executive functioning, we first did a separate analysis to examine agency and pathways as correlates of executive dysfunction. Contrary to our hypothesis that the pathways component would be significantly related to executive dysfunction, there was only a statistical trend and the agency component was significantly correlated with executive dysfunction, thus supporting the role of both components when assessing the construct of hope.

Adherence

Youth with diabetes often show a decline in adherence as they reach adolescence (Ellis, Frey, Naar-King, Templin, Cunningham, & Cakan, 2005), making it important to better understand potentially modifiable variables that can be targeted in interventions. Results replicated previous research that has indicated a significant relationship between hope and executive functioning (Lloyd, Cantell, Pacaud, Crawford, & Dewey, 2009), with higher levels of hope being associated with lower levels of executive dysfunction.

Furthermore, while executive dysfunction and adherence were not significantly related in our analysis, our results supported the interaction between hope and executive dysfunction in predicting a significant portion of the variance in self-reported adherence. Further analysis showed that high hope coupled with low executive dysfunction predicted better adherence, whereas low hope and low executive dysfunction predicted lower adherence. Furthermore, low executive dysfunction with low hope was associated with worse adherence than high executive dysfunction with low hope. These results suggest that hope may be an important factor in predicting adherence for children with lower levels of executive dysfunction but less important for those with high executive dysfunction. Those with high executive dysfunction may have difficulties with adherence which changes in hope do not affect. For those with lower executive dysfunction, their skills may not be as influential in predicting adherence if they do not have a belief in their ability to carry out their goals. Another possible explanation is that parents who perceive that their child is functioning relatively well, as in those with lower executive dysfunction, may decrease their involvement in treatment, which may have negative impacts on adherence. One implication of these results is that focusing on ways to increase hope in this population may be an avenue leading to better adherence. Based on the results that higher adherence occurred with a combination of high hope and low executive dysfunction, increasing executive functioning in conjunction with hope could be even more critical in increasing adherence. Focusing on diabetes adherence as goal-based, asking individuals how they have been working toward meeting their goals, and how they could overcome obstacles could be one way to increase hope in youth with T1DM. Language like this that is consistent with hope theory could be incorporated into

diabetes clinic visits to improve adherence as a whole in youth with diabetes, and also into therapeutic work with individuals with chronic adherence problems.

Although Van Allen et al. (2016) reported that hope and the number of blood glucose checks were positively correlated, we did not find a relationship between hope and average number of checks. In regression analyses, neither the main effects of hope and executive dysfunction nor the interaction predicted a significant amount of the variance in average number of checks. This is an unexpected finding, given that previous literature has shown a relationship between hope and average number of blood glucose checks. However, it is noteworthy that the number of blood glucose checks is confounded by a number of other variables; the number of checks reported in the chart may not be entirely accurate, as it is sometimes the case the individual has a second meter at school which they did not bring to the appointment. Thus, for some children the number of checks as recorded in the medical chart may be lower than the actual number of checks. Additionally, 27% of participants used a continuous glucose monitor (CGM), which is a likely confound for which we did not account. CGM continuously monitors the individual's glucose level and provides immediate feedback. Individuals with a CGM typically have better glycemic control (DeSalvo et al., 2018) even though they may or may not be manually checking their blood sugar as frequently. The technology for CGMs continues to advance, such that some individuals with CGMs no longer have the same recommendations regarding the number of manual blood glucose checks per day. In addition, some individuals may input readings from the CGM into their insulin pump, which then are not distinguished from manual blood glucose checks when the average number of blood glucose checks is reported. Thus, although blood glucose monitoring

has traditionally been viewed as a valid and objective measure of adherence, rapid advances in technology have made findings more difficult to interpret and there is currently no gold standard for assessment of adherence. Finally, it should be acknowledged that frequency of blood glucose monitoring only measures one aspect of adherence and the self-report measure used in the current study assessed adherence across the multiple diabetes-related tasks.

Glycemic Control

Although there were no significant demographic correlates of adherence, glycemic control was significantly correlated with parental education level, indicating that as parental education level increased, glycemic control increased (HbA1c decreased). It may be that parents of a higher educational level have a better knowledge of factors impacting glycemic control and are more involved in treatment, which may contribute to better glycemic control (Hassan, Loar, Anderson, & Heptulla, 2006; Hsin, La Greca, Valenzuela, Moine, & Delameter, 2010; Sanders, Thompson, & Wilkinson, 2006). Results also suggested a relationship between gender and glycemic control, such that females had better glycemic control, which is consistent with previous work (Pettiti, et al., 2009). However, unlike previous literature that suggests that glycemic control changes across time in adolescence (Helgeson, Reynolds, Siminerio, Escobar, & Becker, 2008), our results did not support the finding of age being significantly correlated with glycemic control. This may be because of the restricted age range of participants (11-17), with 61% of the sample being 14 years old or older, which may have limited the ability to detect an effect of age. Other studies that have involved a similar age range (e.g. Ingerski,

Anderson, Dolan, & Hood, 2010) also did not find a significant change in glycemic control across age.

When examining bivariate correlations, hope was significantly related to glycemic control, such that higher hope was related to better glycemic control. This replicates previous work that indicates a positive correlation between hope and glycemic control (Lloyd, Cantell, Pacaud, Crawford, & Dewey, 2009; Santos et al., 2015; Van Allen et al., 2016). Although the direction of the relationship is unknown, this does help us understand that those who have more belief in their ability to meet goals and plan for those goals are more likely to have better glycemic control. Maintaining healthy glycemic control requires goal-related behaviors such as monitoring glucose levels, taking the correct doses of insulin, maintaining a proper diet, and avoiding highs and lows in blood sugar. Thus, individuals with higher hope may have greater belief in themselves to be able to carry out these behaviors and their ability to solve a problem when one occurs, which may help them maintain better glycemic control. Better glycemic control may also serve as reinforcement in one's beliefs about goal-directed behaviors and problem solving.

The correlation of executive dysfunction and glycemic control was not statistically significant. Furthermore, in regression analyses, there were no main effects of hope and executive dysfunction and the interaction of hope and executive dysfunction did not account for a significant amount of the variance in glycemic control. This is inconsistent with previous literature that has found a positive relationship between executive functioning and glycemic control (McNally, Rohan, Pendley, Delameter, and Drotar, 2010; Smith et al. 2014). It is important to note that there are many factors which

can affect blood glucose levels, some of which are biological and largely out of control of the individual. For example, infections (e.g. colds and flu) can greatly affect blood glucose levels (Casqueiro, Casqueiro, & Alves, 2012). Moreover, hormones can cause fluctuating blood glucose levels, which is particularly pertinent in adolescents (Chowdhury, 2015). Other psychosocial factors include the changing responsibility of treatment as youth get older, such that parents can be both over- or under-involved in treatment, both of which can have adverse effects on adherence and glycemic control (Miller & Drotar, 2003; Greenley, Josie, & Drotar, 2006; Cameron et al., 2008; Feinstein et al., 2005; Shemesh et al., 2004). Given the many variables that can impact glycemic control, it is not uncommon to find psychosocial variables that correlate with adherence behaviors without specifically correlating with glycemic control (Anderson, Brackett, Ho, & Laffel, 1999).

The literature supports adherence as a correlate of glycemic control (Duke & Harris, 2014; Hood, Peterson, Rohan, & Drotar, 2009) and results of the current study replicated these findings, with both higher self-reported adherence and greater number of average number of blood glucose checks being associated with better glycemic control. Given the importance of adherence in understanding glycemic control, we tested the three-way interaction of hope x executive dysfunction x adherence in predicting glycemic control. However, our results were not supportive of this hypothesis. Limited power to detect a 3-way interaction may have contributed to the lack of statistically significant results.

Depression

There is support in the literature for an increased rate of depression in youth with diabetes (Grey, Whittemore, & Tamborlane, 2002), which has been correlated with negative and even potentially life-threatening outcomes, such as poor glycemic control, less frequent blood glucose checks, diabetic ketoacidosis, and severe hypoglycemia (Rewers et al., 2002; Stewart, Rao, Emslie, Klein, & White, 2005; McGrady & Hood, 2010; Hood et al., 2006). In contrast, results from the current study did not indicate significant correlations between depression and self-reported adherence, number of checks, or glycemic control. This may be related to the fact that we used only a self-report measure of depression symptoms, as opposed to relying on a depression diagnosis or a multi-informant method, indicating that we may have missed some individuals who were not captured by the screener and thus limited the power to find these relationships. It is noteworthy that the mean total score on the SMFQ (M = 3.48, SD = 3.97) was lower than expected for a T1DM sample. This was lower than a study using the same measure in a sample of 16-19-year-old adolescents with T1DM, with a mean of 6.5 (Sivertsen, Petrie, Wilhelmsen-Langeland, and Hysing, 2014). The mean depression score for the current study was closer to the mean reported in the original development of the questionnaire (Angold et al., 1995) and a more recent study utilizing a non-clinical sample (Rhew et al., 2010, M=3.8). Given the higher risk for depression in youth with diabetes, it would be expected that depression scores would be higher than that of non-clinical samples. It is possible that those who were more depressed may have been less likely to attend their appointments, mail in their questionnaires, or to participate in the first place. In addition, the pediatric endocrinology team has adopted an improved method for assessing depression within the past six months and medical providers are

now asking about depression on at least a yearly basis. This may have increased the likelihood that individuals were receiving treatment for depression symptoms. It should also be noted that a psychologist is a member of the team and is available to provide assessment and intervention as needed when concerns arise.

In line with hypotheses, hope and executive dysfunction were significantly correlated with depression, with higher levels of hope and lower levels of executive dysfunction being correlated with lower levels of depressive symptoms. In the regression analyses that included hope and executive dysfunction, executive dysfunction predicted a significant portion of the variance in depression. The interaction of hope and executive dysfunction was not a significant predictor of depressive symptoms, but there was a nonsignificant trend. The cognitive deficits related to depressive symptoms, such as difficulty with memory and concentration, are similar to executive functioning difficulties; regardless of whether executive functioning difficulties lead to depressive symptoms or develop as a result of depression, these results suggest that they are related. These results also support previous work in adults on executive functioning and depression, which suggests that lower levels of executive functioning are related to higher levels of depression (Snyder, 2013). The research in youth on this relationship is mixed, and this is the first study to investigate the relationship in a sample of youth with T1DM. It is important for future research to better understand other factors that may impact these relationships (e.g., other comorbid disorders, such as ADHD, developmental level, genetics), as depression is a complex disorder that is further complicated by increased risk for depression in youth with type 1 diabetes.

Contrary to the general literature on depression in youth, we did not find a relationship between gender and depressive symptoms. In the general population, the rates of depressive symptoms are significantly higher in adolescent girls than boys (McGuinness, 2012). However, in the diabetes literature, the evidence for this gender discrepancy is inconsistent (La Greca, Swales, Klemp, Madigan, Skyler, 1995; Jacobson et al., 1997). One possible explanation is that the added chronic stress of living with diabetes increases risk for depression for both boys and girls and may lessen the importance of gender as a correlate of depression.

Limitations

An important limitation of the current study is the relatively small sample size which limited the power to detect significant interactions, particularly the 3-way interaction. Racial diversity in our sample was limited, however this is representative of the rates of T1DM in the population. Additionally, it should be acknowledged that a portion of participants consented to participation but elected to take their questionnaires home to complete and did not return their packets. There may be unaccounted for differences between those participants who took their questionnaires home and returned them and those who took them home and did not return them. The correlational nature of the study also does not allow for causality to be determined.

With regard to measures, we relied on the same reporter for hope, depressive symptoms, and self-reported adherence. Future work should implement a more multi-method approach to data gathering when possible. We also used a subjective, rather than objective, measure of executive functioning, which may limit the accuracy of measurement of actual executive functioning. The subjective measure does provide insight into the aspects of daily functioning which are impacted, which is important when

examining relationships with daily adherence behaviors. Finally, as discussed above, given changes and advances in blood glucose monitoring systems, it may be appropriate to reevaluate the reliability of the use of average daily checks. Given these limitations, the generalizability of these results should be interpreted with caution.

Strengths, Clinical Implications, and Future Directions

Despite the above limitations, there are several strengths of the current work. This study adds to the relatively limited literature in the T1DM population on several of the relationships investigated herein. For example, this study is the first of its kind to examine the relationship of executive functioning with hope and depressive symptoms in the T1DM population. Moreover, it adds further support for the relationship between hope and self-reported adherence in youth with T1DM. The literature on hope is growing and there is an increased interest in the construct in the pediatric endocrinology field especially, as hope could have important clinical applications, such as providing a possible path toward increasing adherence. For example, based on the results of this study, it would be meaningful to investigate the role of a hope-based intervention for youth with T1DM, especially those with problems with adherence. Early work has shown that hope-based interventions can improve positive outcomes; for example, in a group of psychiatric inpatients, a hope-based intervention showed increased trait (as opposed to state) hope and decreased hopelessness compared to a control group (Steen, 2004). Hope could also be incorporated into already existing interventions. For example, as Weis (2010) suggested, hope-based therapeutic components can focus on psychoeducation about hope theory and creating meaningful goals, which is often already part of existing interventions, but can be made more explicit for these purposes. It would also be

meaningful to investigate the role of interventions focused on increasing executive functioning in an effort to improve adherence and depression. Much like interventions for children and adolescence with ADHD, involving parents in interventions to improve executive functioning would be critical. For example, parents could help the child with check-lists, reminders, and following routines that help with adherence. In addition, aspects of the parent-adolescent teamwork intervention (Anderson et al., 1999), which emphasizes family involvement in diabetes care, could be incorporated into cognitive behavioral treatment (CBT) for depression. This would be especially helpful for parents of older children or adolescence, who may tend toward becoming less involved in treatment as the child ages. It would be best if this took place in conjunction with efforts to increase hope, as the current study suggests that the best adherence may occur at the intersection of high hope and high executive functioning.

This study also provides helpful insight into the complex role of depressive symptoms in this population. Results suggest that it may be helpful to focus on maintaining or increasing executive functioning in an effort to potentially prevent depressive symptoms, prevent worsening of symptoms, or to alleviate symptoms. Furthermore, research often focuses on risk factors for developing depression, rather than positive variables that can protect against adverse psychological outcomes. By investigating the positive construct of hope in conjunction with executive functioning as they relate to depressive symptoms, the results from this study could provide useful information for developing prevention and treatment methods for depression in this high-risk population.

Future research could include investigation into these relationships in a longitudinal design with a larger sample size in order to increase power. It would also be helpful to use multimodal data gathering methods whenever it is practical in order to increase validity, such as including both self-and parent-reports of adherence and depression. Future researchers should consider controlling for the use of a CGM and focusing on development and testing of more reliable methods of measuring adherence.

Conclusion

This study investigated the important and emerging role of hope in diabetes-related health outcomes, including adherence, glycemic control, and depressive symptoms in youth with T1DM. Hope appears to be significant in the relationship with executive functioning and adherence, which has important implications for increasing adherence to a complex diabetes treatment regimen. Future work should focus on using larger sample sizes and refining the use of blood glucose monitoring as a form of measuring adherence. The results from this study may provide helpful information for professionals working with youth with T1DM and suggests promising avenues toward increasing positive outcomes in this at-risk group.

Table 1

Demographic and Disease Characteristics

Characteristic		
Mean Youth Age (SD)	14	(1.9)
Mean Years Since Diagnosis (SD)	6.94	(3.88)
Use of diabetes technology (%)		
CGM[1]	17	(27)
Pump[2]	38	(58.5)
Neither CGM or pump[1]	27	(42.9)
Youth Sex (%)		
Female	27	(40)
Male	40	(60)
Parent/Caregiver Respondent (%)[3]		
Mother	56	(86.2)
Father	7	(10.8)
Legal Guardian	2	(3.1)
Family Race/Ethnicity (%)[2]		
White, non-Hispanic	46	(71.8)
Black	8	(12.5)
African American	6	(9.4)
Hispanic or Latino	3	(4.7)
Other	1	(1.6)
Family Income (%)[2]		
<$20,000	9	(14.1)
$20,000-$50,000	19	(29.7)
$50,000-$80,000	15	(23.4)
$80,000-$100,000	5	(7.8)
$100,000-$200,000	15	(23.4)
$200,000-$500,000	0	(0)
>$500,000	1	(1.6)
Parent Education (%)[3]		
Some high school or middle school education	3	(4.6)
High school graduate or equivalent	12	(18.5)
Some college or professional training	26	(40)
Bachelor's degree/4-year college degree	17	(26.2)
Some post graduate level training	1	(1.5)
Masters degree	5	(7.7)
Doctoral degree	1	(1.5)
Family Structure (%)[3]		
Married	38	(58.5)
Divorced	9	(13.8)
Single	12	(18.5)
Widowed	2	(3.1)
Cohabitating	4	(6.2)

Note: n=67 unless otherwise noted. [1]*n*=63; [2]*n*=64; [3]*n*=65

Table 2

Descriptive statistics for primary study variables

Questionnaire	*M*	*(SD)*	Sample Range	Reference Range
Parent Report Measures				
D-REF[1]	67.06	(26.36)	36-130	0-144
Child Report Measures				
SMFQ	3.48	(3.97)	0-14	0-26
CASH	37.63	(8.67)	20-54	9-54
SCI-R	54.94	(8.4)	27-75	15-75
T1DM Characteristics				
A1c	9.62	(2.01)	6.3-14	5-14
# Checks[1]	4.11	(2.02)	0.7-9	Undefined

Note: n=67 unless otherwise noted. D-REF = Delis Rating of Executive Functions, SMFQ = Short Mood and Feelings Questionnaire, SCI = Self Care Inventory, # Checks = average number of daily glucose checks.

[1] *n*=65

Table 3

Bivariate Correlations

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1. Age	-											
2. Gender	.07	-										
3. Parental Ed	-.04	-.08	-									
4. Hope	.13	-.12	.24	-								
5. Agency	.04	-.16	.11	.83***	-							
6. Pathways	.14	-.15	.27*	.83***	.49***	-						
7. Goals	.14	.00	.23	.86***	.61***	.58***	-					
8. EF	-.05	-.07	-.06	-.31*	-.29*	-.24	-.24	-				
9. A1c	-.01	.29*	-.26*	-.31*	-.35**	-.18	-.25*	.17	-			
10. Adherence	-.03	-.19	.08	.38**	.41*	.29*	.25*	-.01	-.32**	-		
11. # Checks	-.23	.00	.24	-.03	.01	-.13	.07	.18	-.49***	.28*	-	
12. Depression	-.05	.20	-.15	-.24*	-.33**	-.09	-.19	.36**	.07	-.20	.08	-

Note: Parental Ed = Parental Education; EF = executive dysfunction; A1c = hemoglobin A1c, with lower scores representing worse glycemic control; Adherence = self-report of adherence on SCI-R; # Checks = average number of daily glucose checks

$*p \leq .05$; $**p \leq .01$; $***p \leq .001$

Table 4

Multiple linear regression statistics for adherence and A1c

Model	Predictor		R^2	F	ΔR^2	$B(SE)$	β	t	p
Adherence	Step 1		.16	5.87	.16				
		Hope				3.56 (1.04)**	.42	3.42	.001
		EF				.99 (1.04)	.12	.95	.345
	Step 2		.26	7.35	.10				
		Hope				3.67 (.98)***	.43	3.74	.000
		EF				.56 (.10)	.07	.56	.577
		Hope x EF				-2.56 (.86)**	-.30	-2.97	.004
# Checks	Step 1		.03	.99	.03				
		Hope				-.04 (.26)	-.02	-.14	.887
		EF				.34 (.26)	.17	1.29	.203
	Step 2		.07	1.40	.04				
		Hope				-.02 (.26)	-.01	-.09	.931
		EF				.28 (.26)	.14	1.06	.291
		Hope x EF				-.33 (.23)	-.17	-1.48	.145
A1c	Step 1		.14	5.09	.14				
		Education				-.48 (.24)	-.24	-1.99	.051
		Gender				.56 (.24)*	.28	2.34	.023
	Step 2		.20	3.86	.06				
		Education				-.37 (.24)	-.18	-1.53	.132
		Gender				.52 (.24)*	.26	2.19	.032
		Hope				-.40 (.26)	-.20	-1.55	.126
		EF				.24 (.25)	.12	.97	.338
	Step 3		.21	3.11	.01				
		Education				-.34 (.25)	-.17	-1.36	.179
		Gender				.52 (.24)*	.25	2.15	.036
		Hope				-.41 (.26)	-.20	-1.59	.117
		EF				.26 (.25)	.13	1.029	.308
		Hope x EF				.12 (.22)	.06	.56	.581

Notes: EF = executive dysfunction, # Checks = average number of daily glucose checks, A1c = hemoglobin A1c. Adherence = total score from SCI-R.

$*p \leq .05$; $**p \leq .01$; $***p \leq .001$

Table 5

Multiple linear regression statistics for depression

Model	Predictor	R^2	F	ΔR^2	$B(SE)$	β	t	p
Depression	Step 1	.15	5.47	.15				
	Hope				-.55 (.49)	-.14	-1.12	.267
	EF				1.29 (.50)*	.32	2.61	.011
	Step 2	.19	4.82	.04				
	Hope				-.59 (.49)	-.15	-1.21	.232
	EF				1.42 (.49)**	.35	2.89	.005
	Hope x EF				.75 (.43)	.19	1.77	.082
Depression w/ Gender	Step 1	.04	2.74	.04				
	Gender				.80 (.48)	.20	1.66	.102
	Step 2	.20	5.02	.16				
	Gender				.90 (.47)	.22	1.91	.061
	Hope				-.38 (.49)	-.09	-.77	.444
	EF				1.41 (.49)**	.35	2.89	.005
	Step 3	.23	4.59	.03				
	Gender				.85 (.46)	.21	1.84	.071
	Hope				-.42 (.48)	-.10	-.86	.391
	EF				1.53 (.49)**	.38	3.14	.003
	Hope x EF				.71 (.42)	.18	1.69	.096

Notes: EF = executive dysfunction

$*p \leq .05$; $**p \leq .01$; $***p \leq .001$

Figure 1

The interaction of hope and executive functioning in predicting self-reported adherence.

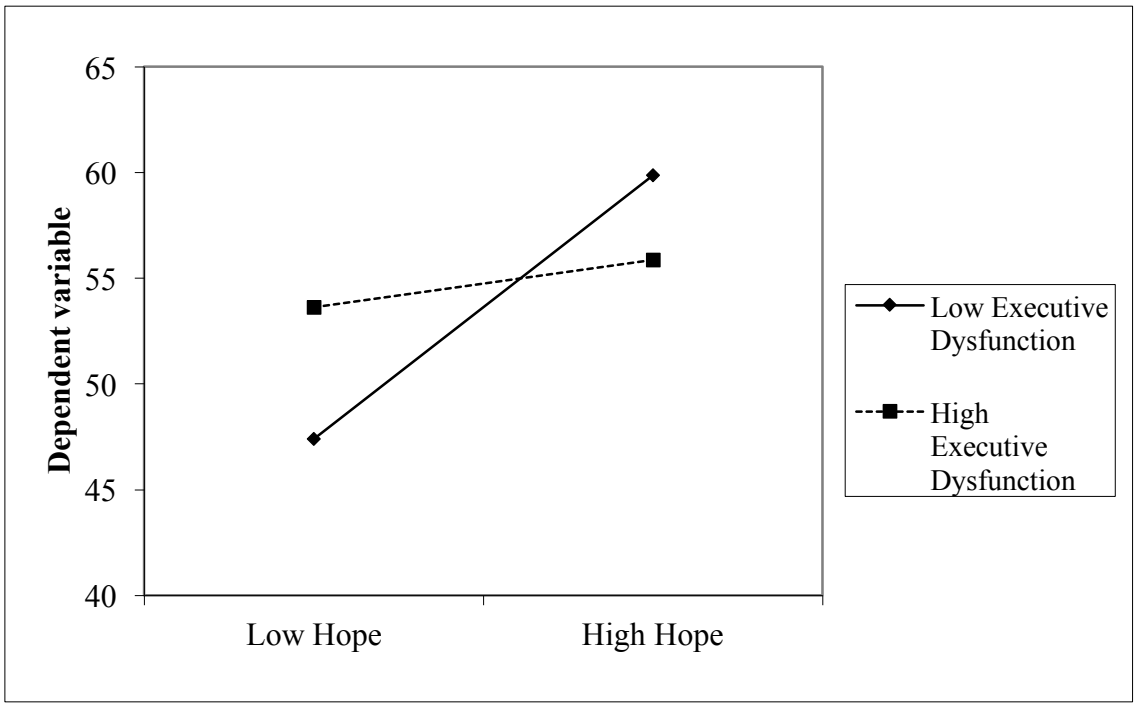

Figure 1. The interaction of hope and executive functioning in explaining self-reported adherence from the SCI-R. High hope and low executive dysfunction predicted better adherence. Low hope and low executive dysfunction predicted lower adherence.

References

Anderson, B., Ho, J., Brackett, J., Finkelstein, D., & Laffel, L. (1997). Parental involvement in diabetes management tasks: relationships to blood glucose monitoring adherence and metabolic control in young adolescents with insulin-dependent diabetes mellitus. *Journal of Pediatrics, 130*(2), 257-265

Angold, A., Costello, E. J., Messer, S. C., Pickles, A., Winder, F., & Silver, D. (1995). Development of a short questionnaire for use in epidemiological studies of depression in children and adolescents. *International Journal of Methods in Psychiatric Research, 5*, 237-249.

Bagner, M. F., Eillismd, L. B., Geffken, G. R., Silverstein, J. H., & Storch, E. A. (2007). Type 1 diabetes in youth: the relationship between adherence and executive functioning. *Children's Healthcare, 36*(2), 169-179.

Bailey, T. C., Eng, W., Frisch, M. B., & Snyder, C. R. (2007). Hope and optimism as related to life satisfaction. *The Journal of Positive Psychology, 2*, 168–175.

Barnum, D. D., Snyder, C. R., Rapoff, M. A., Mani, M. M., & Thompson, R. (1998). Hope and social support in the psychological adjustment of children who have survived burn injuries and matched controls. Children's Health Care, 27, 15-30

Baune, B. T., Czira, M. E., Smith, A. L., Mitchell, D., & Sinnamon, G. (2012). Neuropsychological performance in a sample of 13–25 year olds with a history of non psychotic major depressive disorder. *Journal of Affective Disorders, 141*, 441–448.

Bobrow, E. S., AvRuskin, T. W., & Siller, J. (1985). Mother-daughter interaction and adherence to diabetes regimens. *Diabetes Care, 8*(2), 146-151.

Brooks, B. L., Iverson, G. L., Sherman, E. M. S., & Roberge, M. C. (2010). Identifying cognitive problems in children and adolescents with depression using computerized neuropsychological testing. *Applied Neuropsychology, 17*, 37–43.

Buchberger, B., Huppertz, H., Krabbe, L., Lux, B., Mattivi, J. T., & Siafarikas, A. (2016). Symptoms of depression and anxiety in youth with type 1 diabetes: A systematic review and meta-analysis. *Psychoneuroendocrinology, 70*, 70-84.

Centers for Disease Control and Prevention. (2017). National Diabetes Statistics Report. Retrieved from https://www.cdc.gov/diabetes/pdfs/data/statistics/national-diabetesstatistics-report.pdf

Chang, E. (2003). A critical appraisal and extension of hope theory in middle-aged men and women: Is it important to distinguish agency and pathways components? *Journal of Social and Clinical Psychology, 22*(2), 121-143.

Chang, E. C., DeSimone, S. L. (2001). The influence of hope on appraisals, coping, and dysphoria: A test of hope theory. *Journal of Social and Clinical Psychology, 20*(2), 117-129.

Connolly, S. L., Wagner, C. A., Shapero, B. G., Pendergast, L. L., Abramson, L. Y., & Alloy, L. B. (2014). Rumination prospectively predicts executive functioning impairments in adolescents. *Journal of Behavioral Therapy and Experimental Psychiatry, 45*, 46-56.

Davis, C. L., Delamater, A. M., Shaw, K. H., La Greca, A. M., Eidson, M. S., Perez-Rodriguez, J. E., & Nemery, R. (2001). Brief report: Parenting styles, regimen adherence, and glycemic control in 4- to 10-year-old children with diabetes. *Journal of Pediatric Psychology, 26*(2), 123-129.

Delis, D. C. (2012). *Delis rating of executive functioning*. Bloomington, MN: Pearson.

Demeyer, I., De Lissnyder, E., Koster, E. H., & De Raedt, R. (2012). Rumination mediates the relationship between impaired cognitive control for emotional information and depressive symptoms: A prospective study in remitted depressed adults. *Behaviour Research and Therapy, 50*(5), 292–297.

Dickson, K. S., Ciesla, J. A., & Zelic, K. (2016). The role of executive functioning in adolescent rumination and depression. *Cognitive Therapy Research, 41*, 62-72.

Elliott, T. R., Witty, T. E., Herrick, S., & Hoffman, J. T. (1991). Negotiating reality after physical loss: Hope, depression, and disability. Journal of Personality and Social Psychology, 61, 608-613.

Garrison, W. T., Biggs, D., & Williams, K. (1990). Temperament characteristics and clinical outcomes in young children with diabetes mellitus. *Child Psychology & Psychiatry & Allied Disciplines*, *31*(7), 1079-1088.

Gioia, G. A., Isquith, P. K., Guy, S. C., & Kenworthy, L. (2000). Behavior Rating Inventory of Executive Function. *Child Neuropsychology, 6,* 235–238.

Graziano, P. A., Geffken, G. R., Williams, L. B., Lewin, A. B., Duke, D. C., Storch, E. A., & Silverstein, J. H. (2011). Gender differences in the relationship between parental report of self-regulation skills and adolescents' management of type 1 diabetes. *Pediatric Diabetes, 12*, 410-418.

Grey, M., Whittemore, R., & Tambolane, W. V. (2002). Depression in type 1 diabetes in children: natural history and correlates. *Journal of Psychosomatic Research, 53*, 907-911.

Helgeson, V. S., Reynolds, K. A., Siminerio, L., Escobar, O., & Becker, D. (2008). Parent and adolescent distribution of responsibility for diabetes self-care: links to health outcomes. *Journal of Pediatric Psychology, 33*(5), 497-508.

Holmbeck, G. N. (2002). Post-hoc probing of significant moderational and mediational effects in studies of pediatric populations. *Journal of pediatric psychology, 27*(1), 87-96.

Hood KK, Huestis S, Maher A, Butler D, Volkening L, Laffel LM. (2006). Depressive symptoms in children and adolescents with type 1 diabetes: association with diabetes specific characteristics. *Diabetes Care, 29*, 1389–1391.

Hood, K. K., Peterson, C. M., Rohan, J. M., & Drotar, D. (2009). Association between adherence and glycemic control in pediatric type 1 diabetes: a meta-analysis. *Pediatrics, 124*(6), 1171-1179.

Jaser, S. S., Whittemore, R., Ambrosino, J., Lindemann, E., Grey, M. (2008). Mediators of depressive symptoms in children with type 1 diabetes and their mothers. *Journal of Pediatric Psychology, 33*, 509-519.

Klimkeit, E. I., Tonge, B., Bradshaw, J. L., Melvin, G. A., & Gould, K. (2011). Neuropsychological deficits in adolescent unipolar depression. *Archives of Clinical Neuropsychology, 26*, 662-676.

Kovacs, M., Goldston, D., Obrosky, D. S., & Bonar, L. K. (1997). Psychiatric disorders in youth with IDDM: Rates and risk factors. *Diabetes Care, 20*, 36–44.

Kovacs, M., Goldston, D., Obrosky, D. S., & Drash, A. (1997). Major depressive disorder in youths with IDDM. *Diabetes Care 20*, 45–51.

Kovacs, M., Goldston, D., Obrosky, S., & Iyengar, S. (1992). Prevalence and predictors

of pervasive noncompliance with medical treatment among youths with insulin-dependent diabetes mellitus. *Journal of the American Academy of Child and Adolescent Psychiatry, 31*(6), 1112-1119.

Kruger, G. H. J. (2011). Executive functioning and positive psychological characteristics: A replication and extension. *Psychological Reports, 108*(2), 477-486.

Kwok, S. Y. C. L., Gu, M., & Kit, K. T. K. (2016). Positive psychology intervention to alleviate child depression and increase life satisfaction: A randomized clinical trial. *Research on Social Work Practice, 26*(4), 350-361

La Greca, A. M., Swales, T., Klemp, S., Madigan, S. (1988). Self care behaviors among adolescents with diabetes. In Ninth Annual Sessions of the Society of Behavioral Medicine (p. A42) Baltimore, MD: Society of Behavioral Medicine.

La Greca, A. M., & Bearman, K. J. (2002). The diabetes social support questionnaire-family version: evaluating adolescents' diabetes-specific support from family members. *Journal of Pediatric Psychology, 27*(8), 665-676.

Lawrence, J. M., Standiford, D. A., Loots, B., et al. (2006). Prevalence and correlates of depressed mood among youth with diabetes: The SEARCH for Diabetes in Youth Study. *Pediatrics, 117,* 1348–1358.

Lloyd, S. M., Cantell, M., Pacaud, D., Crawford, S., & Dewey, D. (2009). Brief report: Hope, perceived maternal empathy, medical regimen adherence, and glycemic control in adolescents with type 1 diabetes. *Journal of Pediatric Psychology, 34,*(9), 1025-1029.

Maalouf, F. T., Brent, D., Clark, L., Tavitian, L., McHugh, R. M., Sahakian, B. J., & Phillips, M. L. (2011). Neurocognitive impairment in adolescent major depressive

disorder: state vs. trait illness markers. *Journal of Affective Disorders, 133*, 625–632.

Magaletta, P. R., & Oliver, J. M. (1999). The hope construct, will and ways: Their relative relations with self-efficacy, optimism, and general well-being. *Journal of Clinical Psychology, 55*, 539–551.

McGrady, M. E., & Hood, K. K. (2010). Depressive symptoms in adolescents with type 1 diabetes: Associations with longitudinal outcomes**.** *Diabetes Research and Clinical Practice, 88*(3), 35-37.

McNally, K., Rohan, J., Pendley, J. S., Delamater, A., & Drotar, D. (2010). Executive functioning, treatment adherence, and glycemic control in children with type 1 diabetes. *Diabetes Care, 33*(6), 1159-1162.

Perez, K. M., Patel, N. J., Lord, J. H., Savin, K. L., Monzon, A. D., Whittemore, R., & Jaser, S. S. (2017) Executive functioning in adolescents with type 1 diabetes: Relationship to adherence, glycemic control, and psychosocial outcomes. *Journal of Pediatric Psychology, 42*(6), 626-646.

Pettitt, D., Talton, J., Dabelea, D., Divers, J., Imperatore, G., Lawrence, J., et al. (2014). Prevalence of diabetes in U.S. youth in 2009: the SEARCH for Diabetes in Youth Study. *Diabetes Care*, *37*(2), 402–408.

Rand, K. L. (2009). Hope and optimism: latent structures and influences on grade expectancy and academic performance. *Journal of Personality, 77*(1), 231-260.

Rewers, A., Chase, H.P., Mackenzie, T., Walravens, P., Roback, M., Rewers, M., Hamman, R.F., & Klingensmith, G. (2002). Predictors of acute complications in children with type 1 diabetes. *JAMA, 287*, 2511–2518.

Rueter, J. A. (2014). The assessment of executive functioning using the delis rating of executive functions (D-REF). In S. Goldstein and J.A. Naglieri (Eds.), *Handbook of Executive Functioning*, (367-377). New York: Springer Science and Business Media.

Santos, F. R. M., Sigulem, D., Areco, K. C. N., Gabbay, M. A. L., Dib, S. A., & Bernardo, V. (2015). Hope matters to the glycemic control of adolescents and young adults with type 1 diabetes. *Journal of Health Psychology, 20*(5), 681-689.

Scheier, M. F., & Carver, C. S. (1985). Optimism, coping, and health: Assessment and implications of generalized outcome expectancies. *Health Psychology, 4*, 219–247.

Sears, K. L. (2007). *The relationship between hope, executive function, behavioral/emotional strengths and school functioning in 5th and 6th grade students* (Doctoral dissertation). Retrieved from OhioLINK Electronic Theses and Dissertations Center.

Smith, L. B., Kugler, B. B., Lewin, A. B., Duke, D. C., Storch, E. A., & Geffkin, G. R. (2014). Executive functioning, parenting stress, and family factors as predictors of diabetes management in pediatric patients with type 1 diabetes using intensive regimens. *Children's Health Care, 43*, 234-252.

Snyder, C. R. (2002). Hope theory: Rainbows in the mind. *Psychological Inquiry, 13*(4), 249-275.

Snyder, C. R., Harris, C., Anderson, J. R., Holleran, S. A., Irving, L. M., Sigmon, S. T., Yoshinobu, L., Gibb, J., Langelle, C., & Harney, P. (1991). The will and the

ways: Development and validation of an individual-differences measure of hope. *Journal of Personality and Social Psychology, 60*, 570-585

Snyder, C. R., Sympson, S. C., Michael, S. T., & Cheavens, J. (2001). Optimism and hope constructs: Variants on a positive expectancy theme. In E. C. Chang (Ed.), *Optimism and pessimism, Implications for theory, research, and practice* (pp. 101-105). Washington, D.C.: American Psychological Association.

Snyder, H. R. (2013). Major depressive disorder is associated with broad impairments on neuropsychological measures of executive function: A meta-analysis and review. *Psychological Bulletin, 139*, 81.

Stewart, S. M., Rao, U., Emslie, G. J., Klein, D., & White, P. C. (2005). Depressive symptoms predict hospitalization for adolescents with type 1 diabetes mellitus. *Pediatrics, 115*(5), 1315-1319.

Thimm, J. C., Holte, A., Brennan, T., & Wang, C. E. A. (2013). Hope and expectancies for future events in depression. *Frontiers in Psychology, 4*(470), 1-6.

Van Allen, J., Poppert, K. M., Seegan, P. L., & Steele, R. G. (2014). Development and validation of the child and adolescent scale of hope (CASH): A pilot test among adolescents. Unpublished Poster: Texas Tech University & University of Kansas.

Van Allen, J., Seegan, P. L., Haslam, A., & Steele, R. G. (2016). Hope mediates the relationship between depression and quality of life among youths enrolled in a family-based pediatric obesity intervention. *Children's Health Care, 45*(4), 441-454.

Van Allen, J., Steele, R G., Nelson, M. B., Peugh, J., Egan, A., Clements, M., & Patton, S. R. (2016). A longitudinal examination of hope and optimism and their role in type 1 diabetes in youths. *Journal of Pediatric Psychology, 41*(7), 741-749.

Vieth, A. Z., Hagglund, K. J., Clay, D. L., Frank, R. G., Thayer, J. F., Johnson, J. C., & Goldstein, D. E. (1997). The contribution of hope and affectivity to diabetes-related disability: An exploratory study. *Journal of Clinical Psychology in Medical Settings, 4*(1), 65-77.

Vilgis, V., Silk, T. J., & Vance, A. (2015). Executive function and attention in children and adolescents with depressive disorders: a systematic review. *European Adolescent and Child Psychiatry, 24*, 365-384.

Whittemore, R., Kanner, S., Singleton, S., Hamrin, V., Chiu J, Grey M. (2002). Correlates of depressive symptoms in adolescents with type 1 diabetes. *Pediatric Diabetes, 3*, 135-143.

Wong, S. S., & Lim, T. (2009). Hope versus optimism in Singaporean adolescents: Contributions to depression and life satisfaction. *Personality and Individual Differences, 46*, 648-652.

Wysocki, T., Buckloh, L. M., & Greco, P. (2009). The psychological context of diabetes mellitus in youths. In M. C. Roberts & R. G. Steele (Eds.), *Handbook of pediatric psychology* (287-302). New York: Guilford Press.

Zetsche, U., & Joormann, J. (2011). Components of interference control predict depressive symptoms and rumination crosssectionally and at six-months follow-up. *Journal of Behavior Therapy and Experimental Psychiatry, 42*(1), 65 -73.