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A Longitudinal Examination of Hope and Optimism and Their Role in Type 1 Diabetes in Youths

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Abstract

Objectives To test the longitudinal associations between hope and optimism and health outcomes (i.e., HbA1c and self-monitored blood glucose [SMBG]) among youths with Type 1 diabetes mellitus (T1DM) over a 6-month period. **Methods** A total of 110 participants (aged 10–16 years) completed study measures at Time 1, and 81 completed measures at Time 2. Analyses examined hope and optimism as predictors of change in health outcomes, and examined SMBG as a mediator of the relationship between hope and optimism, and HbA1c. **Results** Change in hope, but not optimism, was associated with change in SMBG and HbA1c. Change in SMBG mediated the relationship between change in hope and HbA1c, but not between optimism and HbA1c. **Conclusions** It may be beneficial to assess hope in pediatric T1DM patients to identify youths who may be at risk for poor diabetes management, and to test the benefit of hope-based intervention efforts in clinical studies.

Type 1 diabetes mellitus (T1DM) is one of the most common chronic illnesses in youth, with recent estimates indicating that >18,000 youths are newly diagnosed with T1DM every year (Centers for Disease Control and Prevention [CDC], 2014). Youths with T1DM are at risk for adverse physiological outcomes including ketoacidosis, hypoglycemia, and hyperglycemia (Melendez-Ramirez, Richards, & Cefalu, 2010), and for a number of long-term complications such as heart disease, stroke, and kidney failure (Atkinson, Eisenbarth, & Michels, 2014). For individuals with Type 1 diabetes, the risk of death is approximately 3.5 times higher than the general population (Lind et al., 2014).

Beyond these potential negative physiological sequelae, T1DM is also related to a variety of negative psychological states and long-term mental health problems for some children and adolescents. For example, youths with T1DM are more likely than their peers to be diagnosed with depressive disorders, anxiety disorders, and adjustment disorders, and are more likely to have peer relationship difficulties and problems in their family environment (Fogel & Weissberg-Benchell, 2010; Northam, Matthews,

Anderson, Cameron, & Werther, 2005). These psychosocial problems may also lead to increased health care utilization and missed school or work (e.g., parents taking off to transport their children), contributing to increased health care costs and financial burden related to T1DM (Tao & Taylor, 2010).

Although the challenges of T1DM can negatively affect some youths, many achieve biopsychosocial outcomes in the face of such adversity that are equal to—or in excess of—typical developmental milestones, demonstrating a process known as resilience (Masten, 2001). Consistent with the diabetes resilience model proposed by Hilliard, Harris and Weissberg-Benchell (2012), individual factors that are nonspecific to diabetes can play an important role in diabetes-specific health behaviors and outcomes, and the identification of individual factors that promote resilience is important to research in this area. Hope represents one individual factor that may be associated with health behavior and outcomes among youths with T1DM, similar to findings from other areas of child and adolescent health (Berg, Rapoff, Snyder, & Belmont, 2007; Germann et al., 2015; Maikranz, Steele, Dreyer, Stratman, & Bovaird, 2007; Van Allen & Steele, 2012). As originally theorized by Snyder et al. (1991), hope theory refers to an individual's energy and planning toward goal attainment, and is composed of two interactive components: pathways and agency. *Pathways* represent the routes individuals select to achieve their desired goals (i.e., the means to an end). *Agency* refers to an individual's goal-directed energy, intention, and persistence (i.e., motivation to set and complete goals). In the diabetes literature, Lloyd and colleagues (2009) reported a significant association between hope, regimen adherence, and glycemic control (HbA1c) in a sample consisting exclusively of adolescents, and found that hope mediated the relationship between parenting characteristics and adolescents' adherence and glycemic control.

The role of optimism in pediatric psychology has also been examined, and has been hypothesized as another individual construct that may promote resilience and positive health outcomes in T1DM (Hilliard et al., 2012). In contrast to the goal-achievement focus of hope theory, optimism represents a construct describing an individual's general expectancy for good rather than bad outcomes in their life (Scheier & Carver, 1985). In research involving youths, Mannix and colleagues (2009) found support for an association between optimism and health-related outcomes among adolescents and emerging adults with cancer. Among adolescents with T1DM, Wright (1997) reported that optimism was associated with diabetes-specific psychological adjustment, adherence, and metabolic control.

Although hope and optimism share some conceptual overlap, researchers have noted various theoretical and empirical differences between each construct. For example, Snyder (2002) noted that hope theory is distinct from optimism through the measurement of, and equal weight given to, an individual's pathways; that is, hope theory intends to assess one's capacity to select appropriate routes and overcome barriers to goals rather than just one's confidence in a positive outcome (i.e., optimism, as described by Scheier & Carver, 1985). Among university students, Bailey, Eng, Frisch, and Snyder (2007) reported that hope was a stronger predictor of life satisfaction compared with optimism, and Magaletta and Oliver (1999) found that hope accounted for unique variance in subjective well-being beyond optimism. Nonetheless, few studies have directly compared these constructs in youth, particularly in the context of health behavior.

The present study is designed to build on the abovementioned research regarding hope and optimism in a number of ways. First, previous studies have incorporated these constructs individually within the pediatric literature but have not compared them directly, which precludes testing whether one construct explains more variance in health outcomes. Thus, this study will test the differential associations of hope and optimism to multiple diabetes-specific health outcomes in a pediatric sample. Second, previous research on hope and optimism in the pediatric literature has primarily been conducted using cross-sectional designs. Generalizations and inferences are limited from cross-sectional designs because these designs do not allow researchers to test for the temporal stability of associations between predictors and health measures, and they are less reliable at identifying potentially important predictors of change in outcomes when compared with longitudinal designs. The present study was designed to address these limitations by prospectively examining the associations between hope and optimism with health outcomes in a sample of youths with T1DM, including an examination of associations between change in hope/optimism and change in health-related variables. Moreover, previous researchers (Lloyd et al., 2009; Wright, 1997) have not tested the indirect effect of the relations between hope and optimism and HbA1c through a potential mediator, such as one's frequency of self-monitored blood glucose (SMBG). Thus, the present study will include a mediation model to examine a potential mechanism of relations between hope and optimism and HbA1c.

Given that published studies have found a significant association between each construct and health outcomes (Lloyd et al., 2009; Wright, 1997), and previous research does not provide a justification for an incremental association with health outcomes from either of these constructs, our first hypothesis was that hope and optimism scores would be significantly

associated with youths' SMBG and HbA1c, cross-sectionally. Our second hypothesis was that hope and optimism scores at baseline—and change in these variables between time points—would be significantly associated with change in youths' SMBG and HbA1c at Time 2. Finally, we hypothesized that hope and optimism would have significant indirect effects on HbA1c through frequency of SMBG in residual change mediation models.

Methods

Participant Recruitment

Parent–youth dyads were eligible to participate if youths were between 10 and 16 years old, youths had been diagnosed with T1DM for at least 6 months, and the family was English speaking. Families were excluded if youths had a diagnosis of developmental delay (i.e., autism, cerebral palsy, or mental retardation) and if youths or parents reported hospitalization within the last year for a psychological disorder. Study personnel recruited participants (parent and youth dyads) from the Pediatric Diabetes Center at the University of Kansas Medical Center, through an affiliated office in central Kansas, and at the Diabetes Center at Children's Mercy Hospital (Kansas City, MO).

Procedure

Study aims and procedures were approved by all the affiliated institutional review boards. Dyads who consented to participate were asked to sign an informed consent and assent form, and were informed that this study involved completing study measures and providing HbA1c and SMBG data at two time points (baseline [Time 1] and 6-month follow-up [Time 2]). Although the study was designed to obtain Time 2 data after 6 months, the mean time between assessments was 7.4 months ($SD = 1.9$). Originally, researchers obtained dyads' email addresses during clinic visits following assent/consent from clinic personnel, and subsequently emailed participants instructions for accessing a secured Internet study site to complete the assessment battery. However, among the first 29 participants recruited in this manner, 5 participants did not complete study measures. Thus, to improve participant response, study personnel recruited participants to complete the web-based study measures using iPads while they were present in clinics for scheduled visits. Youths' HbA1c and a measure of youths' frequency of self-monitoring for blood glucose (SMBG) were obtained from their medical chart. At Time 2, all dyads were asked to complete the assessment battery and study personnel gathered blood glucose meter data and HbA1c data via a second chart review. Parents and youth were each compensated $25 for both assessment time points completed. The data used for study analyses were abstracted from a larger study designed to examine associations between psychosocial factors and T1DM outcomes.

Participants

Of the 125 dyads who completed consent/assent at Time 1, 110 youths with T1DM and a custodial parent completed study measures and provided HbA1c and SMBG data. The majority of youths at Time 1 were male ($N = 60$; 54.5%), White ($N = 98$; 89.1%), approximately 14 years old ($M = 13.6$, $SD = 1.87$), and had been diagnosed with diabetes for an average of 5.6 years ($SD = 3.63$). Eighty-one participants completed study measures and provided HbA1c and SMBG data at the follow-up visit (Time 2). Again, the majority of these youths were male ($N = 42$; 51.9%), White ($N = 72$; 92.3%), approximately 14 years old ($M = 14.18$, $SD = 1.87$), and had been diagnosed with diabetes for an average of 6.2 years ($SD = 3.61$). Twenty-nine participants were lost to follow-up for a variety of reasons, including relocation of the family, unavailability of research assistants at follow-up appointments, study refusal, and not scheduling a follow-up visit before study conclusion. Study analyses indicated that there were no differences between participants who completed Time 2 data and those who did not, with respect to demographic characteristics, hope and optimism scores, HbA1c, and SMBG data. Table I details demographic information and scores on primary study measures for the sample at each time point.

Measures

Hope

The Children's Hope Scale (CHS; Snyder et al., 1997) is a six-item self-report measure designed for 8–16-year-olds. It uses a 6-point Likert-type scale ranging from "None of the time" to "All of the time." The CHS is divided into three items that measure agency and three items that measure pathways. Example items include "I think the things I have done in the past will help me in the future" (agency) and "I can think of many ways to get the things in life that are most important to me" (pathways). A higher total score reflects greater overall hope. Cronbach's alpha for this study was .76.

Optimism

The revised Life Orientation Test (LOT-R; Scheier, Carver, & Bridges, 1994) is a 10-item measure (six optimism items plus four filler items) of dispositional optimism (e.g., "In uncertain times, I usually expect the best"). Respondents rate the extent of their agreement to items using a 5-point Likert-type scale ranging

Table I. Demographic Characteristics and Participants' Scores on Study Measures by Assessment Point

	Mean ± *SD* or *n* (%)	
	Baseline (Time 1)	6-month follow-up (Time 2)
N	110	81
Child age (years)	13.6 (1.87)	14.18 (1.87)
Male child gender	60 (54.5%)	42 (51.9%)
Child ethnicity		
White‘	98 (89.1%)	72 (88.9%)
Black	3 (2.7%)	2 (2.5%)
Hispanic	1 (0.9%)	1 (1.2%)
Asian	0 (0%)	0 (0%)
Native American	0 (0%)	0 (0%)
Mixed	3 (2.7%)	3 (3.7%)
Other	1 (0.9%)	0 (0%)
Did not answer	4 (3.6%)	3 (3.7%)
Disease duration (years)	5.60 (3.63)	6.21 (3.61)
Time between assessments (months)	N/A	7.35 (1.93)
Insulin pump regimen	97 (88%)	72 (89%)
Multiple daily injections regimen	13 (12%)	9 (11%)
Hollingshead Index	46.56 (10.27)	46.25 (10.54)
Marital status		
Married	82 (74.5%)	60 (74%)
Single	8 (7.4%)	6 (7.4%)
Divorced	13 (11.8%)	10 (12.3%)
Engaged/living with	3 (2.7%)	2 (2.5%)
Separated	2 (1.8%)	1 (1.2%)
Widowed	2 (1.8%)	2 (2.5%)
Hope scores (CHS)	27.00 (4.50)	27.70 (4.80)
Optimism scores (LOT-R)	15.60 (4.79)	15.73 (4.82)
HbA1c	9.14 (2.17)	8.65 (1.53)
SMBG (total checks over 14 days, with a range in this sample of 3–165)	54.77 (31.81)	54.12 (30.42)

Note. CHS = Children's Hope Scale; LOT-R = Life Orientation Test; SMBG = self-monitored blood glucose.

from 0 (*strongly disagree*) to 4 (*strongly agree*). Higher scores on the LOT-R indicate greater optimism. Cronbach's alpha for the LOT-R was .83.

Glycated Hemoglobin (HbA1c)

This is a proxy measure of patients' average blood glucose levels over about 3 months (American Diabetes Association, 2015). Similar point-of-care machines were used across sites (Bayer DCA 2000, TOSOH-G8, and Bio-Rad In2it), and youths had their HbA1c measured on the same machine at Time 1 and Time 2. The research team obtained participants' HbA1c values via chart review.

Frequency of SMBG

Frequency of SMBG is a proxy measure of adherence, and refers to the number of blood glucose checks completed by youths in a 14-day period, converted to an average daily amount. Previous research has demonstrated an association between the frequency of SMBG and glycemic control (i.e., HbA1c; Anderson, Ho, Brackett, Finkelstein, & Laffel, 1997). These data are obtained during clinic visits by downloading the blood glucose values recorded in the youth's blood glucose meters. Research personnel obtained the SMBG data via chart review.

Statistical Analyses

To identify potential model covariates, Pearson correlations and independent *t* tests were used to examine the relationship between demographic/disease variables (i.e., child age, gender, ethnicity, disease duration) and scores on study measures at Time 1 and Time 2. Age was positively and significantly associated with HbA1c at Time 1 ($r = .316$, $p < .01$) and Time 2 ($r = .225$, $p < .05$), and was included in study analyses as a covariate.

All study analyses were performed in MPlus (Muthén & Muthén, 2010). Multiple imputation, with $M = 100$ imputed data sets, was used to address missing data in all analyses. Pearson correlations were conducted, to test the study hypothesis that hope and optimism would be associated with health outcomes. Further, hierarchical regressions were conducted to examine whether hope and optimism (at Time 1) were predictors of change in SMBG and HbA1c from Time 1 to Time 2. Next, hierarchical multiple regressions were used to conduct residual change analyses, which is a method of examining whether there is an association between the changes in variables of interest across two time points. An analysis of this kind is potentially beneficial because previous studies have shown that change in hope is associated with change in outcomes

(Germann et al., 2015; Van Allen & Steele, 2012), which may be a better model of the relations between study constructs than the initial regression analyses proposed. Specifically, we examined the associations between change in hope and optimism, and change in study outcomes. Residual change variables were calculated by regressing Time 2 values of each variable onto baseline values, and using the residual change values in subsequent regressions. This method of residualized change analysis adjusts for baseline differences in each variable and does not require the statistical power necessary for latent change analyses (MacKinnon, 2008).

Finally, given that adherence has been shown to mediate associations between study variables and HbA1c in previous studies and SMBG is often conceptualized as a proxy for adherence (Helgeson, Honcharuk, Becker, Escobar, & Siminerio, 2011) mediation models were examined for study variables. Each mediation analysis tested the indirect effect of study variables on HbA1c, through the proposed mediator SMBG. Mediation analyses used bias-corrected bootstrap confidence intervals (based on $k = 500$ bootstrap samples) of the indirect effect. In addition, two-wave change scores for each variable were used in mediation analyses to avoid limitations associated with arbitrarily selecting either Time 1 or Time 2 values for analyses (MacKinnon, 2008). A 95% confidence interval of the indirect effect is provided from the bootstrapped sampling distribution (Preacher & Hayes, 2004); when the 95% confidence interval does not include zero, the indirect effect is considered statistically significant (Preacher & Hayes, 2004).

Results

Consistent with the first study hypothesis, correlation analyses revealed that hope and optimism were significantly associated with SMBG and HbA1c at each time point (see Table II). Results partially supported the second study hypothesis: Time 1 hope and optimism were not significant predictors of change in HbA1c or SMBG between Time 1 and Time 2, but residual change analyses indicated that change in hope (but not change in optimism) was a significant predictor of change in both HbA1c ($b = -0.16$, $SE = 0.08$, $p < .05$) and SMBG ($b = 0.16$, $SE = 0.08$, $p < .05$). More information related to regression analyses can be found in Table III.

Finally, the hypothesized mediation models were tested. A significant indirect effect was found for frequency of SMBG in the relation between hope and HbA1c, such that the association between increases in hope and decreases in HbA1c was partially explained by increases in frequency of SMBG ($b = -0.041$, $SE = 0.019$, $p < .05$). Results from the bias-corrected bootstrapping analysis were also significant (95% CI for bootstrap of indirect effect $= -0.078$ to -0.0036). Although the b path of the mediation model was not significant, the proportion of the effect of hope on HbA1c accounted for by frequency of SMBG was $-0.041/-0.169 = 0.24$ (MacKinnon, 2008), suggesting that SMBG frequency accounted for 24% of the variance in the effect of hope on HbA1c in a residual change mediation analysis. There was no significant indirect effect found for a mediation model that included optimism. Figure 1 provides coefficient estimates of direct and indirect effects.

Discussion

Results supported the study hypothesis regarding associations between hope and optimism and health outcomes cross-sectionally, and partially supported residual change and mediation hypotheses. Only changes in hope—and not optimism—were associated with changes in both HbA1c and frequency of SMBG between Time 1 and Time 2. Moreover, analyses supported a longitudinal residual change mediation model that included frequency of SMBG as a mediator of the relationship between children's self-reported hope and their HbA1c, but did not support a similar mediation model that included optimism.

Results from longitudinal change models and mediation analyses suggest that hope may be an important factor in youths' glycemic control. The current results are consistent with Lloyd et al. (2009) investigation examining the role of hope among adolescents with T1DM, and expanded on this work by testing longitudinal associations and incorporating school-aged children as well as adolescents. Testing these associations across a broader age-range provides support for the consistency of these findings across multiple developmental periods.

Further, the present results are consistent with numerous published studies, establishing an association between hope (as measured by the CHS) and health outcomes in multiple pediatric chronic illnesses (Berg et al., 2007; Maikranz et al., 2007; Van Allen & Steele, 2012). Similar to these previous studies, the present study found that changes in hope were associated with changes in frequency of SMBG and with HbA1c. These results suggest that interpretations of hope as a trait construct that predicts changes in health outcomes over time may not be accurate in all contexts, and that the associations between hope and health outcomes over time may depend on a related change in each. The present study also supported hope's indirect effect on HbA1c through adherence (i.e., frequency of SMBG) in a longitudinal residual change mediation. Therefore, some of the association

Table II. Hierarchical Multiple Regression Analyses With Change in Hope and Optimism Scores From Baseline to Postintervention Predicting Change in HbA1c and SMBG (in Bold Below)

Dependent variable and block	B	*SE* B	β	ΔR^2
A1C (Time 2)				
Step 1 (A1C at Time 1)	0.425	0.059	0.616	0.446**
Step 2 (Age at Time 1)	0.055	0.070	0.077	0.008
Step 3 (Residual change in hope)	−0.056	0.027	−0.161	0.028*
A1C (Time 2)				
Step 1 (A1C at Time 1)	0.455	0.061	0.658	0.448**
Step 2 (Age at Time 1)	0.047	0.068	0.065	0.014
Step 2 (Residual change in optimism)	0.009	0.034	0.024	0.003
SMBG (Time 2)				
Step 1 (SMBG at Time 1)	0.577	0.081	0.609	0.454**
Step 2 (Age at Time 1)	−0.029	0.024	−0.100	0.012
Step 2 (Residual change in hope)	0.022	0.010	0.157	0.025*
SMBG (Time 2)				
Step 1 (SMBG at Time 1)	0.622	0.075	0.648	0.462**
Step 2 (Age at Time 1)	−0.026	0.024	−0.091	−0.006
Step 2 (Residual change in optimism)	0.007	0.015	0.045	0.007

Note. Change in study variables represents residual change associated with regression analyses.
*$p \leq .05$; **$p \leq .01$.

Table III. Bivariate Correlations Between Study Variables

Study variable	1	2	3	4	5	6	7	8
1. $Hope_{T1}$	1							
2. $Hope_{T2}$	.47**	1						
3. $Optimism_{T1}$	.47**	.33*	1					
4. $Optimism_{T2}$	.25**	.43**	.62**	1				
5. $SMBG_{T1}$	.27**	.32**	.33**	.16	1			
6. $SMBG_{T2}$	.20	.35**	.31**	.21	.68**	1		
7. $HbA1c_{T1}$	−.37**	−.35**	−.29**	−.15	−.51**	−.50**	1	
8. $HbA1c_{T2}$	−.25**	−.37**	−.33**	−.17	−.36**	−.44**	.68**	1

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

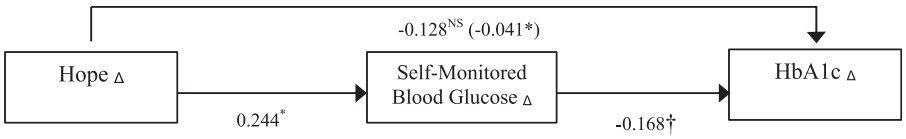

Figure 1. Residual change in self-monitored blood glucose mediates the relation between residual change in hope and HbA1c.

Note. Unstandardized coefficients outside of parentheses represent the direct effects of each path, and those inside the parentheses represent the indirect effect on the criterion through the proposed mediator. *$p < .05$, †$p = .07$, NS = not significant, Δ is used to denote that the variable is a residual change score between Time 1 and Time 2 assessments.

between change in hope and change in HbA1c can be explained by how hope influences blood-glucose monitoring: youths who report increases in hope also had increases in their number of blood glucose checks, and are more likely to have a reduction in HbA1c as a result. Given that hope is a goal-oriented construct that is theorized to measure one's persistence and planning related to goal attainment, study findings are conceptually intuitive—youths who are more motivated, goal-focused, and capable of overcoming obstacles to diabetes care, are more likely to manage their diabetes effectively.

In contrast to findings related to hope, longitudinal regression analyses, residual change analyses, and residual change mediation analyses did not reveal statistically significant associations between optimism and either frequency of SMBG or HbA1c. This finding is consistent with current literature, as no other study could be identified through a literature search that reported a significant direct effect of optimism on HbA1c using longitudinal data. It may be the case that general positive expectations are not a powerful influence on diabetes management, especially change in one's management, because they do not necessarily predict action.

This investigation contributes to the growing literature aimed at distinguishing hope and optimism, and the impact of these constructs on individual functioning. Some (e.g., Tennen, Affleck, & Tennen, 2002) have questioned whether hope is distinct from optimism and whether it contributes uniquely to the field. Nonetheless, various investigations have found hope to predict outcomes equal to, or better than, optimism (Bailey et al., 2007; Magaletta & Oliver, 1999; Snyder, 2002). When study results related to hope and optimism are considered together, they suggest that hope may have a greater impact on youths' glycemic control in comparison with optimism, arguing for hope and optimism as distinct constructs. Theoretically, hope may have a greater impact on diabetes management because it purports to assess how one engages in goal-directed behavior and maintains energy throughout a goal pursuit, rather than simply assessing one's outcome expectancies. Stated simply, diabetes management is onerous enough that it requires considerable cognitive and emotional resources, and hope theory may be more closely related to those resources than optimism.

Although not included as a variable in the model, it is important to briefly draw a distinction between hope and self-efficacy, as these constructs may also be perceived as similar. Snyder (2002) differentiated hope from self-efficacy primarily through its distinction between "can" and "will." Hope is hypothesized to measure one's intention to start and achieve a goal (will), while self-efficacy is just a measure of one's ability to complete the goal (can). Hope also captures a person's persistence to complete a goal while self-efficacy primarily focuses on a person's perceived ability to complete the goal irrespective of any potential obstacles to goal completion. Nonetheless, comparisons between self-efficacy and hope may be beneficial for future studies in the T1DM literature.

Results of the current study are similar to previous research, demonstrating that changes in hope are temporally associated with changes in health outcomes (e.g., physical activity; Van Allen & Steele, 2012). Nonetheless, no study to date has tested the benefit of incorporating hope theory into pediatric behavioral health interventions. Instead, previous studies have reported changes in hope for children and adolescents receiving residential and outpatient psychotherapy (McNeal et al., 2006; Weis & Ash, 2009), but these studies were not specifically designed to increase hope through targeted intervention. Although these studies do not support a directional relationship between hope and treatment outcomes, other hope-based interventions have demonstrated success in adult populations (Berg, Snyder, & Hamilton, 2008; Cheavens, Feldman, Gum, Michael, & Snyder, 2006). Within the health context specifically, Berg and colleagues (2008) reported significant increases in hope among females, and significant increases in pain tolerance for all participants, following a brief hope intervention for a cold pressor task. Nonetheless, future research is needed to examine hope-based interventions in chronic illness populations, which involve long-term challenges and sustained coping efforts.

Clinical Implications

If observational research continues to support an association between hope and health outcomes among youths with T1DM, it may be beneficial to consider incorporating hope-based treatment components into future T1DM intervention efforts. Hope-based interventions help youths identify important life goals and strategies to achieve those goals, maintain the motivation necessary to pursue their goals (health related or not), and identify potential barriers to goal-attainment as well as potential solutions to such obstacles. Nonetheless, experimental designs are needed to determine whether changes in hope directly result in improvements to adherence or HbA1c. If future longitudinal and intervention studies indicate that hope has a significant, consistent, and stable effect on HbA1c, then clinicians should also consider measuring hope in clinic-based psychosocial screenings to help identify new patients who may be at risk for poor metabolic control. Conceivably, those high-risk patients would benefit the most from hope-based interventions.

Limitations

Results of the current study should be considered within the context of a single study with methodological and statistical limitations. For example, although longitudinal change models were supported, the inherent weaknesses of regression analyses still apply to interpretations of this finding (e.g., measurement error could not be controlled for during analyses). Nonetheless, these regression analyses provide some initial support of a prospective relationship between hope and diabetes outcomes, and are consistent with a previous study, indicating that longitudinal change models are a better representation of the relationship between hope and health behavior (Van Allen & Steele, 2012). Like Van Allen and Steele (2012), however, analyses included data from only two time points, which limited directional interpretations of results. The 6-month period between assessments also may have limited the variability of study measures, and future studies may benefit from a longer assessment interval. In addition, although SMBG may serve as a proxy of adherence, it is not a comprehensive measure of adherence. Other behaviors are important to T1DM treatment regimens, which may not be

assessed via SMBG (e.g., insulin use, diet). Thus, study results may not generalize to more comprehensive assessments of adherence in future research studies, or in clinic settings.

The generalizability of study findings are also restricted by the limited diversity of participants' self-reported ethnicity. Approximately 89% of parents in the study identified their child as non-Hispanic White. However, current estimates suggest that approximately 75% of youths with T1DM are non-Hispanic White (Mayer-Davis et al., 2009). Thus, future studies should examine the relationship between hope and optimism and SMBG and HbA1c in a more ethnically diverse sample. Additionally, although the present study compared the contributions of two related constructs (hope and optimism) with T1DM outcomes, other related constructs (e.g., self-efficacy) were not included in this study and may play an important role in T1DM. Finally, data collection of study measures using electronic tablets had not been validated before this study, and thus may not generalize to other investigations.

Conclusion

Overall, this study adds to the pediatric diabetes literature by demonstrating an association between changes in hope and changes in HbA1c and frequency of SMBG prospectively over approximately 6 months, and by showing that hope had significant indirect effects on HbA1c, through frequency of SMBG, in residual change mediation models. These results provide partial support for study hypotheses and suggest that hope may be an important factor for future clinical studies in youths with T1DM. However, future research should test longitudinal associations using three time points over a longer period to allow for more tenable interpretations of mediation models and directional inferences. If observational research continues to find significant associations between hope and diabetes outcomes, it may be helpful to include a measure of hope in clinical screenings and incorporate hope-based therapy within psychological interventions for patients with T1DM.

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