Diabetes-Specific and General Life Stress and Glycemic Outcomes in Emerging Adults With Type 1 Diabetes: Is Race/Ethnicity a Moderator?

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Abstract

Objective This study examines whether race/ethnicity moderates relationships of (a) diabetes stress and general life stressors with (b) diabetes outcomes of glycemic control and diabetic ketoacidosis (DKA) among emerging adults (aged 18–25 years) with type 1 diabetes (T1D). **Method** Using a T1D Exchange Registry sample of non-Hispanic White, African American, and Hispanic emerging adults ($N = 3,440$), multiple group analyses were used to determine whether race/ethnicity moderates the relationships between stress and diabetes outcomes. **Results** The relationships between the two stress types and glycemic control did not differ between African American and non-Hispanic Whites. However, as compared with non-Hispanic Whites, the association between higher diabetes-specific stress and poorer glycemic control was significantly stronger for Hispanics, and Hispanics had poorer glycemic control when they experienced a relatively fewer number of general life stressors than non-Hispanic Whites. The relationships between the type of stress (diabetes-specific and general stress) and DKA did not differ across racial/ethnic groups. **Conclusions** Future research should evaluate possible mechanisms that contribute to the different relationships of stress with glycemic control among Hispanics compared with non-Hispanic Whites.

Key words: diabetic ketoacidosis; glycemic control; race/ethnicity; stress; type 1 diabetes.

Research conducted among children and older adults with type 1 diabetes (T1D) has well documented the negative effects of high rates of diabetes-specific stress and general life stress on diabetes outcomes, and specifically, the contribution of these stressors to negative outcomes of suboptimal glycemic control and higher rates of diabetes complications (Hagger, Hendrieckx, Sturt, Skinner, & Speight, 2016; Hilliard et al., 2016). *General life stress* consists of common life events that are not specific to managing diabetes but can

contribute to disruption in an individual's life (Rahe & Arthur, 1978), whereas *diabetes-specific stress* refers to the unique emotional burdens related to managing the severe, demanding chronic condition (Gonzalez, Fisher, & Polonsky, 2011). Biopsychosocial models specify that high levels of stress reduce treatment adherence in T1D, and thereby, contribute to poor diabetes health outcomes (Peyrot, McMurry, & Kruger, 1999). Chronic high stress levels might also lead to poor outcomes in T1D

through direct disruption in physiological and biological functioning (Hilliard et al., 2016). Research that examines stress and diabetes health outcomes among subsets of the population with T1D who are vulnerable to negative health effects of stress is necessary to develop and deliver targeted interventions that reduce the risk for poor glycemic outcomes and complications.

Emerging adulthood (ages 18–25 years) is a developmental period that is vulnerable to increased stress for most (Arnett, 2007), and may be especially challenging for people with a demanding chronic condition such as T1D. Arnett's (2007) theory of emerging adulthood specified that this unique developmental period is marked by exploration and instability, which can contribute to increased stress (Arnett, 2007). Because emerging adulthood is a period of many transitions and changes, most emerging adults typically experience elevated levels of general life stress and instability stemming from myriad sources such as transitions to and within the workforce, frequent changes in residences, concerns about job stability and financial worries (Arnett, 2001, 2007). Unique sources of stress for emerging adults with T1D include changes in family and social support for diabetes management and transitions between diabetes health care providers (Monaghan, Helgeson, & Wiebe, 2015). Such changes co-occur with poor glycemic control that often peaks during emerging adulthood (Wood et al., 2013), which is troubling given that sustained poor glycemic control contributes to diabetes complications such as chronic kidney failure (Bash, Selvin, Steffes, Coresh, & Astor, 2008). It is possible that the instability of the emerging adulthood period may amplify the negative impact of stress on diabetes outcomes. Yet, in contrast to the literature on children and older adults, few studies that focus on emerging adults with T1D have addressed the critical issues of stress and glycemic control outcomes (Hagger et al., 2016). Thus, targeted research with emerging adults who have T1D is needed to determine whether diabetes-specific and general stress experienced during this developmental period are associated with diabetes outcomes. Such research can help researchers and practitioners understand whether stress is an important target for reduction to improve glycemic outcomes during the vulnerable period of emerging adulthood.

Other understudied groups that experience poorer glycemic control are racial/ethnic minorities with T1D (Willi et al., 2015). Although little empirical research has focused on emerging adulthood among racial/ethnic minorities, research suggested that as compared with non-Hispanic Whites, minorities perceive during this period that they have reached adulthood, which is marked by becoming self-reliant (Arnett, 2003). Among emerging adults with T1D, the reduced

reliance on others may limit opportunities for minorities to access social supports that may buffer the impact of stress on diabetes outcomes.

Indeed, models of racial/ethnic health disparities (Shonkoff, Boyce, & McEwen, 2009; Sternthal, Slopen, & Williams, 2011) suggest the need to understand the associations between stress and glycemic outcomes across diverse racial/ethnic groups of emerging adults with T1D. Research has consistently shown disparities in glycemic control and rates of diabetic ketoacidosis (DKA) among African Americans and Hispanics (Petitti et al., 2009; Willi et al., 2015) (DKA is one serious complication of diabetes that occurs when the body produces high levels of blood acids called ketones; Umpierrez & Kitabchi, 2003). In models of health disparities, stress is a central contributor to disparate health outcomes such as glycemic control and DKA (Shonkoff et al., 2009; Sternthal, Slopen, & Williams, 2011). Yet, the stress mechanism is not well understood, leaving unanswered questions regarding how stress may contribute to poor diabetes health outcomes among racial/ethnic minority groups. The few studies that have examined the role of stress among diverse racial/ethnic groups with diabetes have been conducted among adults with type 2 diabetes. These studies have suggested that racial/ethnic differences exist in the strength of the associations between stress and diabetes outcomes, and such differences contribute to poorer diabetes outcomes among some minority groups. For example, in a study of adults with type 2 diabetes, participant self-reports of greater levels of general life stressors were related to poorer perceived quality of life among African American adults but not their Hispanic counterparts (Shallcross et al., 2015). In another study, higher diabetes-specific stress was related to poorer glycemic control among Hispanic adult participants but not African American participants (Spencer et al., 2006). Although these studies suggest that stress differentially impacts diabetes outcomes among various racial/ethnic groups with type 2 diabetes, similar studies have not been conducted using samples with T1D.

A better understanding of the associations between stress (i.e., diabetes-specific and general stress) among emerging adults with T1D from diverse racial/ethnic groups is an important first step toward (a) identifying whether stress is an important contributor to disparities in glycemic control and DKA during the developmental period of emerging adulthood, and (b) determining whether stress is an important target for reduction to improve glycemic control and decrease DKA in emerging adulthood. Thus, to address current gaps in the literature, the current study focused on a racially/ethnically diverse sample of emerging adults (aged 18–25 years) with T1D to inform the development and delivery of tailored stress-reduction

interventions to emerging adults with T1D diabetes. The present study aimed to determine whether race/ethnicity moderates associations of (a) diabetes-specific stress and general life stress with (b) diabetes outcomes of glycemic control (as measured by glycosylated hemoglobin [HbA1c]) and DKA. We hypothesized that both types of stress would have stronger associations with diabetes outcomes in racial/ethnic minority groups as compared with non-Hispanic Whites.

Method

Study Design and Participants

This study includes data from emerging adults (ages 18–25 years) who participated in the Type 1 Diabetes Exchange Clinic Registry (hereafter, the T1D Registry). The T1D Registry is a prospective data repository in which data were gathered from a network of clinical centers that diagnose and care for individuals with T1D. Data collection for the T1D Registry includes participant surveys and extraction of clinical data from medical records. The objective of the T1D Registry is to provide a database of important information on individuals with T1D in the United States. For the current study, the T1D Registry database was accessed online (www.t1dexchange.org), and this study included data from participants who enrolled in the T1D Registry between September 1, 2010 and August 1, 2012. During that enrollment period, the T1D Registry enrolled 25,762 new participants from 68 U.S. sites. For this study, the sample was restricted to participants between ages 18 and 25 years who self-identified as non-Hispanic White, Black/African American (hereafter, African American), or Hispanic/Latino (hereafter, Hispanic); were diagnosed with T1D; and had an HbA1c level recorded within 6 months of data collection. Potential participants were excluded if their HbA1c was <5.8% or they had been diagnosed with diabetes <12 months before T1D Registry enrollment. These exclusion criteria were implemented to minimize overlap with individuals in the “honeymoon” period, which is the period shortly after T1D diagnosis when insulin needs are minimal (because the pancreas is still able to produce some quantity of insulin) and patients may have normal or near-normal blood glucose while taking little or no additional insulin (Abdul-Rasoul, Habib, & Al-Khouly, 2006).

Measures

Demographic Characteristics

When participants enrolled with the T1D Registry, they completed a demographic survey providing their gender, age, duration of diabetes (calculated by year of diagnosis minus year of survey administration),

current insulin regimen, and insurance coverage. Insulin regimen was reported using three categories: continuous subcutaneous insulin infusion (insulin pump), multiple daily injections, or fixed dose. Responses regarding insurance coverage were dichotomized as *private/military* versus *public/none*. For this study, insurance status was conceptualized as a proxy for socioeconomic status.

Stress

Perceived level of stress was self-reported by participants at T1D Registry enrollment. Diabetes-specific and general life stress were measured and handled separately in all analyses given evidence of different associations of each type of stress with diabetes outcomes in other age-groups with diabetes (Hilliard et al., 2016).

Diabetes-Specific Stress

Participants' diabetes-specific stress was assessed through one question on the T1D Registry enrollment survey: “In general, how often do you feel stressed by your diabetes?” Original response options used a 5-point Likert scale ranging from *never* (= 1) to *always* (= 5). The distribution of responses was skewed, and therefore, we recoded this variable using a 3-point scale: *never/rarely* (= 1), *sometimes* (= 2), and *often/always* (= 3).

General Life Stressors

General life stress was assessed with one survey question: “In the last year, have you experienced a major change in your life situation that caused you to feel ‘stressed’ or have a physical, mental, or emotional response for an extended period of time?” If the participant indicated *yes*, then he or she selected specific stressors experienced from a list of 17 stressors such as death of a family member or household financial problems. General life stressors were summed and then categorized on a 4-point scale: *no stressors* (= 0), *one stressor* (= 1), *two to three stressors* (= 2), and *four or more stressors* (= 3) (Middlebrooks & Audage, 2008).

Glycosylated Hemoglobin

The T1D Registry data set reported participants' HbA1c levels as either laboratory-verified or point-of-care. We included both values as was done in previous research using the T1D Registry (Clements et al., 2016).

Diabetic Ketoacidosis

The incidence of DKA was determined using participant self-reports to the question “In the past 12 months, about how many times have you experienced any of the following events? Hospitalization

overnight for DKA (do not include hospitalization at diagnosis).” Participants indicated the number of hospital admissions for DKA that had occurred in the past year. DKA incidence was recoded as a dichotomous variable: *no incidents* (=0) or *one or more incidents* (=1).

Statistical Analyses

Statistical analyses were conducted using Mplus 7.11 ([Computer Software], Los Angeles). (Muthen and Muthen 2013) Descriptive statistics were performed to summarize demographic characteristics, stress, HbA1c, and DKA. Two multiple group analyses were conducted. The first multiple group analysis examined whether race/ethnicity moderated the relationship between the two types of stress (diabetes-specific and general) and HbA1c. The second analysis examined whether race/ethnicity moderated the relationship between each type of stress and DKA (Bowen & Guo, 2012; Kline, 2015). Both stress variables were included simultaneously, and all analyses included the covariates *insurance status* and *insulin regimen*. Notably, we also examined models that included covariates for *gender*, *age*, *duration of diabetes*, *insulin regimen*, and *insurance status* given previous research that documented an association between these variables and both HbA1c and DKA (Drotar et al., 2013; Johns, Faulkner, & Quinn, 2008). However, including the variables *gender*, *age*, and *duration of diabetes* resulted in poor model fit; therefore, our analyses included only the variables for *insurance status* and *insulin regimen*.

To determine whether moderation was present, we first compared nested models in which parameters were freely estimated across the three racial/ethnic groups with a model that constrained parameters across groups. Second, we then compared nested models to determine which of the racial/ethnic groups was demonstrating moderation: one set of nested models compared African American emerging adults with their non-Hispanic White counterparts; the second set of nested models compared Hispanic emerging adults with their non-Hispanic White counterparts; the third set of nested models compared African American emerging adults with their Hispanic counterparts (Muthén, 2012). In the third step, nested models were constructed to identify whether the moderation effect involved one or both types of stress. In this third step, models with a free parameter were compared with models with a parameter constrained but equal across the race/ethnic groups. This analysis tested for significant differences in the nested models predicting HbA1c and DKA. Specifically, a significant Satorra-Bentler chi-square adjustment statistic and a significant result from the chi-square difference test with non-normal data (DIFFTEST) option in Mplus (Kieseppä, 2003) determined a significant difference in nested models

predicting HbA1c and DKA, respectively. Model fit was evaluated based on the following conventional criteria (West, Taylor, & Wu, 2014): root mean square error of approximation (RMSEA) point estimate and upper confidence interval (CI) below 0.06; Tucker-Lewis index (TLI) and confirmatory fit index (CFI) values of ≥ 0.95 ; standardized root mean residual (SRMR) values of ≤ 0.05 (Byrne, 1998; Diamantopoulos & Siguaw, 2000), and weighted root mean square residual (WRMR) values of ≤ 0.90 . Maximum likelihood estimation with robust standard errors and weighted least squares with mean and variance adjustment estimation were used in models to predict HbA1c and DKA, respectively, to account for sample size imbalance across racial/ethnic groups (Hox & Maas, 2001). To handle missing data, we used the full information maximum likelihood method and added the variances of the covariates into the model.

Results

Characteristics of the Study Sample

Table I contains demographic characteristics of the entire study sample ($N = 3,440$). Approximately 85% were non-Hispanic Whites, 5% were African American, and 10% were Hispanic. Average age of participants was 21 years ($SD = 2.22$). The majority of the sample reported using a pump as their insulin regimen (54%), private/military insurance (74%), and no DKA admissions (90%). The average HbA1c among the sample was 8.5% ($SD = 1.76$). Approximately one-third of the sample reported experiencing two or more general life stressors during the past 12 months, and 63% reported *often* or *always* experiencing diabetes-specific stress. Table I also shows that compared with non-Hispanic Whites, greater proportions of African Americans reported multiple daily injections or a fixed dose as their insulin regimen, public/no insurance, often/always experiencing diabetes-specific stress, and one or more hospitalization for DKA. Further, compared with non-Hispanic Whites, greater proportions of Hispanics reported multiple daily injections as their insulin regimen, public/no insurance, four or more general life stressors, often/always experiencing diabetes-specific stress, and one or more hospitalization for DKA. HbA1c was also higher for African Americans and Hispanics compared with non-Hispanic Whites.

Race/Ethnicity as Moderator of the Associations Between Stress and HbA1c

Results from multiple group analysis comparing nested models to predict HbA1c indicated that moderation might be present ($\Delta\chi^2 = 31.48$, $\Delta df = 16$; $p < .05$). No differences were found between non-Hispanic Whites and African Americans ($\chi^2 = 9.62$,

Table I. Participant Characteristics for the Overall Sample and Racial/Ethnic Groups

Characteristic	Overall (<i>n</i> = 3,440)	Non-Hispanic White (<i>n</i> = 2,920)	African American (<i>n</i> = 163)	Hispanic (<i>n</i> = 357)
Gender (% female)	49	48	51	52
Mean age, years (mean, <i>SD</i>)	20.8 ± 2.2	20.9 ± 2.2	20.4 ± 1.9*	20.3 ± 2.1*
Duration, years (mean, <i>SD</i>)	10.7 ± 5.2	10.98 ± 5.3	9.7 ± 4.5*	9.10 ± 4.7*
Insulin regimen (%):				
Pump use	54	57	21*	31*
Multiple daily injections	41	38	59*	64*
Fixed dose	5	5	20*	5
Insurance (%)				
Private/military	74	78	40	48
Public/none	26	22	60*	52*
General life stressors (%)				
0 General life stressors	54	55	50	49*
1 General life stressor	14	13	15	14
2–3 General life stressors	20	20	20	20
≥4 General life stressors	13	12	15	17*
Diabetes-specific stress (%)				
Never/rarely	37	38	26*	31
Sometimes	40	40	32*	41
Often/always	23	22	42*	28*
HbA1c (mean, <i>SD</i>)	8.5 ± 1.7	8.4 ± 1.6	10.3 ± 2.3*	9.1 ± 2.0*
Diabetic ketoacidosis (%)				
0 hospital admissions	90	91	74	87
1 or more hospital admissions	10	9	26*	13*

Note. HbA1c = glycosylated hemoglobin.

*Indicates racial/ethnic group is significantly different than non-Hispanic Whites at $p < .05$.

$\Delta df = 8$; $p = .29$). Conversely, results indicated the possibility of moderation when comparing non-Hispanic Whites with Hispanic emerging adults ($\chi^2 = 22.41$, $\Delta df = 8$; $p < .05$). Individual model paths showed significant differences for diabetes-specific stress and general life stress (all p -values $< .05$; see Table II). The fully constrained model had good fit (RMSEA = 0.022 [90% CI = 0.013, 0.030]; CFI = 0.908; TLI = 0.964; and SRMR = 0.27), and the final model which allowed free path estimation for non-Hispanic Whites and Hispanics also had good fit (RMSEA = 0.017 [90% CI = 0.002, 0.027]; CFI = 0.959; TLI = 0.978; and SRMR = 0.19). This final model did not include the African American group because the group did not differ from non-Hispanic Whites or Hispanics in their associations between stress and glycemic control (Muthén, 2012).

As shown in Table II, often experiencing diabetes-specific stress (i.e., *often* response) was associated with an increase in HbA1c for all racial/ethnic groups compared with not experiencing diabetes stress (i.e., *never* response). This association was significantly stronger for Hispanics ($\beta = 1.68$) compared with non-Hispanic Whites ($\beta = 1.03$).

Similarly, as compared with experiencing no life stressors, experiencing one or more general life stressors was associated with higher HbA1c. Yet, the number of general life stressors associated with higher HbA1c differed for Hispanic emerging adults as compared with non-Hispanic White emerging adults.

For non-Hispanic White emerging adults, as compared with experiencing no stressors, experiencing four or more stressors was associated with higher HbA1c, whereas for Hispanics, higher HbA1c was associated with experiencing three stressors.

Race/Ethnicity as Moderator of the Associations Between Stress and DKA

Results comparing nested models that predicted DKA indicated that moderation was not present ($\Delta\chi^2 = 25.194$, $\Delta df = 22$; $p < .29$). Overall, the final model that allowed parameters to be freely estimated across all three racial/ethnic groups indicated poor model fit: RMSEA = 0.012 (90% CI = 0.000, 0.022); CFI = 0.70; TLI = 0.66; and WRMR = 1.64.

The probit regression coefficient (Table II) indicated for all racial/ethnic groups that as compared with never experiencing diabetes-specific stress, frequently (i.e., *often*) experiencing diabetes-specific stress was associated with having one or more DKA episode. Similarly, as compared with not experiencing any general life stressors, experiencing four or more sources of general stress in the past 12 months was associated with having one or more DKA episode.

Discussion

This study of a large, nationwide cohort of emerging adults with T1D replicates and extends previous

Table II. Race as a Moderator for the Effect of Diabetes-Specific Stress and General Life Stressors on HbA1c and DKA

Variable	HbA1c							DKA	
	All race/ethnic groups		Non-Hispanic White		Hispanic		<i>p</i> value	All race/ethnic groups	
	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>		<i>B</i>	<i>SE</i>
Diabetes-specific stress (ref: never/rarely)									
Sometimes	0.33**	0.06	0.31**	0.06	0.35	0.2	0.01	0.34**	0.08
Often	1.11**	0.08	1.03**	0.09	1.68**	0.27	0.02	0.64**	0.09
General life stress (ref: none)									
1	−0.03	0.08	−0.04	0.09	0.19	0.27	0.03	0.1	0.1
2 or 3	0.14*	0.07	0.11	0.08	0.46*	0.22	0.02	0.08	0.09
≥ 4	0.35**	0.10	0.35**	0.11	0.53	0.32	0.04	0.45**	0.09
Insurance (ref: private/military)									
Public/no insurance	0.42**	0.08	0.35**	0.09	0.77**	0.22	0.02	0.39**	0.13
Insulin regimen (ref: pump)									
Multiple daily injections	0.36**	0.06	0.32**	0.06	0.75**	0.18	0.02	0.46	0.64
Fixed dose	0.38**	0.14	0.31*	0.15	1.17*	0.52	0.02	0.89	0.81

Note. HbA1c = glycosylated hemoglobin, DKA = diabetic ketoacidosis. The column listing *p*-values reflects differences between non-Hispanic Whites and Hispanics.

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

research. Prior research has examined levels of diabetes-specific stress among relatively small samples of emerging adults with T1D and reported a substantial percentage of this population experienced high levels of diabetes-specific stress (Hagger et al., 2016; Hilliard et al., 2016). The current findings indicate that in a large racially/ethnically diverse sample from clinics in geographically different areas, a substantial proportion of emerging adults had also recently experienced important general life stressors. One-third of the sample reported experiencing two or more recent general life stressors, and more than half of the sample reported a high frequency of diabetes-specific stress. Moreover, both types of stress were related to glycemic control and DKA. To our knowledge, this is the first study to demonstrate associations of general life stress with glycemic control and DKA among emerging adults with T1D. These findings bolster the American Diabetes Association (2016) guidelines that recommend including measures of both diabetes-related stress and general life stressors in clinical settings during psychosocial screening for T1D.

This is the first study to examine and demonstrate that some associations between stress and glycemic control are not uniform across racial/ethnic groups. These findings are consistent with data from adults with type 2 diabetes demonstrating racial/ethnic differences in associations of stress with quality of life and glycemic control (Shallcross et al., 2015; Spencer et al., 2006). The findings also indicate future research should aim to identify factors that contribute to ethnic differences in associations between diabetes-specific stress and glycemic control among Hispanic and non-Hispanic Whites to inform interventions that can reduce disparities in glycemic control during the vulnerable period of

emerging adulthood. Hispanic emerging adults are more likely to endorse that they have reached adulthood, which is often conceptualized as having greater self-reliance and more concern for obligations toward others (Arnett, 2003). Therefore, it may be valuable to evaluate whether self-reliance, concern for obligations toward others, or other milestones of adulthood contribute to differences in the associations of diabetes-specific stress with glycemic control among Hispanics compared with non-Hispanic Whites. Low family socioeconomic status background and becoming parents in their 20s are contextual factors that contribute to the higher proportion of Hispanics who endorse that they have reached adulthood (Arnett, 2003). Thus, interventions that teach stress management strategies, and that emphasize the value of meeting obligations to others and self-reliance in financial or parenting domains may be culturally relevant components to integrate in behavioral interventions targeting glycemic disparities among Hispanic emerging adults with T1D.

Results also showed that Hispanic emerging adults have higher HbA1c when they experienced a relatively fewer number of general life stressors than do non-Hispanic Whites. This finding suggests future research is needed to determine the predictive validity of screening tools that assess general life stressors across racially/ethnically diverse emerging adults with T1D. Such screening tools might be more sensitive with a lower cutoff when implemented among Hispanic emerging adults to more accurately identify those who are at risk for poor glycemic control. Given the American Diabetes Association recommendations to integrate more psychosocial screening in clinics, these data could inform implementation decisions for clinics with diverse patient populations.

The study results did not support the hypothesis that the associations of diabetes stress and general stress with DKA incidence would be stronger for African American and Hispanics. Results indicated that both types of stress were associated with DKA incidence across racial/ethnic groups. This may be owing to the low rate of DKA, or may suggest other more proximal factors explain the disparity in DKA. Given associations between stress and DKA across racial/ethnic groups, routine assessment and interventions that address both general and diabetes-specific stress in clinical settings to intervene with emerging adults at risk for DKA would appear to be beneficial for racially/ethnically diverse groups.

Limitations and Considerations

We were unable to examine whether participants with missing HbA1c or DKA data differed from those with complete data. Less than 1% of the sample had missing data, which not only permitted analyses of a large, well-characterized national sample but also permitted this work to extend beyond previous studies conducted with smaller samples examining stress and diabetes outcomes. Because this study relied on cross-sectional data, the directionality of the associations cannot be determined; however, a bidirectional association is likely between diabetes outcomes and diabetes-related stress, and to a lesser degree, with recent general life stressors. For example, having chronic poor glycemic control or frequent DKA admissions likely contributes to diabetes-related stress, which in turn, likely increases the difficulty of making behavioral or treatment changes that would improve these outcomes. It is also possible that a greater number of general life stressors hinders optimal diabetes management and leads to poor outcomes, and that suboptimal diabetes outcomes interfere with life activities (e.g., employment, social relationships) that may result in greater general life stressors. Longitudinal data are needed to disentangle these potential relations and identify important targets for intervention. Given the observational nature of this study, the underlying mechanisms that may contribute to racial/ethnic differences in the associations of stress and diabetes outcomes are still unclear and future research should address this gap to inform the development of interventions. Examination of specific general life stressors was beyond the scope of this study, and aspects of diabetes-specific stress were not captured; therefore, this study could evaluate only overall indices of general life stressors and diabetes-specific stress. A final limitation was the one-item measure of general stress. This study is a secondary analysis of existing data that allows for hypothesis-generating preliminary findings that can inform future research with more rigorous measures of stress. A multiple-item measure with

strong psychometric properties would have strengthened the rigor of the methods.

In summary, the results confirm and extend previous findings of associations between elevated stress and poor diabetes outcomes in samples that include diverse racial/ethnic groups. Moreover, associations between elevated stress and poor glycemic control are not the same for Hispanic emerging adults compared with non-Hispanic Whites. These findings lay the groundwork for the development of targeted and tailored interventions to improve glycemic control among Hispanic emerging adults with T1D—a group with persistent and troubling disparities in diabetes outcomes (Willi et al., 2015).

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