Adherence and Glycemic Control among Hispanic Youth with Type 1 Diabetes: Role of Family Involvement and Acculturation

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Objective   To assess whether family involvement and acculturation were related to adherence and glycemic control among Hispanic youth with type 1 diabetes (T1D).   **Methods**   Hispanic youth with T1D ($n = 111$; M age $= 13.33$; 53% female) and parents completed questionnaires that assessed diabetes-related family involvement (distribution of responsibility for diabetes, family support for diabetes), acculturation (linguistic acculturation, generational status), and adherence. HbA1c levels indexed glycemic control.   **Results**   Better adherence was associated with less adolescent independent responsibility, more family support for diabetes, and more recent immigration (fewer generations of the family living in US). Family support mediated the relationship between responsibility and adherence. Better glycemic control was associated with higher levels of parental education and adherence.   **Conclusions**   Family support for diabetes is important for adherence among Hispanic youth with T1D. Research should examine aspects of recent immigration that contribute to better adherence and the impact of supportive interventions on diabetes care.

Key words   diabetes; adolescents; youth; acculturation; family; social support; adherence; glycemic control; Hispanic.

Hispanics represent the fastest growing minority group in the US and one-third of the Hispanic population is under age 18 (US Census, 2007). Yet, the health of this population is understudied (Flores et al., 2002). Especially understudied are Hispanic youth with chronic illnesses such as type 1 diabetes (T1D). Recent estimates suggest the incidence of T1D among Hispanic youth aged 10–19 years of age is 13.8 per 100,000 (Lawrence et al., 2009) and Hispanic youth with T1D often have poor glycemic control (Davis et al., 2001; Delamater et al., 1999; Gallegos-Macias, Macias, Kaufman, Skipper, & Kalishman, 2003). Understanding factors that contribute to better adherence in this population is important, as higher levels of adherence are associated with better glycemic control (e.g., Anderson, Ho, Brackett, Finkelstein, & Laffel, 1997), which, in turn, delays the onset of complications, such as renal disease (Diabetes Control and Complications Trial Research Group, 1994). The present study is the first to examine the associations between both family and acculturation factors and diabetes

management within a diverse group of Hispanic youths with T1D.

Family involvement, measured by diabetes-specific family responsibility allocation and family support for diabetes care, was chosen as a focus of this study given both the importance of family in Hispanic culture and the importance of family involvement in the existing diabetes outcome literature. In Hispanic culture, the term *familismo* represents and emphasizes the importance of family relationships and collective ownership of obligations (Lopez, 2006; Miville, 2006; Roosa, Morgan-Lopez, Cree, & Specter, 2002) and this emphasis may have implications for Hispanic youths' diabetes care. Among non-Hispanic youth with T1D, family involvement has been important for adherence and control (e.g., Grey, Boland, Yu, Sullivan-Bolyai, & Tamborlane, 1998). Specifically, higher levels of youth responsibility for diabetes tasks (or low levels of parental responsibility) have been associated with poorer adherence and control (Anderson, Auslander, Jung, Miller, & Santiago, 1990; Anderson et al., 1997). In addition,

higher levels of family support for diabetes care have been associated with better treatment adherence among youth with T1D (e.g., Grey et al., 1998; La Greca et al., 1995; La Greca & Bearman, 2002; Skinner, John, & Hampson, 2000).

While there is consistent evidence that family variables contribute to better adherence and control among nonminority youth with T1D, it is unknown if similar relations exist among Hispanic youth with T1D. As such, healthcare providers have little information to guide effective interventions for these youths. Therefore, the present study examined whether responsibility (i.e., high adolescent or low parental responsibility) and family support for diabetes care were independently related to adherence and glycemic control among Hispanic youth with T1D. This study focused on youths 10–17 years of age because difficulties with adherence and glycemic control are common in this age group (e.g., Harris et al., 2000; La Greca, Follansbee, & Skyler, 1990).

Furthermore, we examined whether family support mediated the relationship between youth responsibility and adherence. Although youths with high levels of responsibility for self-care have been found to have poorer adherence, as noted above, the mechanism underlying this relationship is unclear. One possibility is that as youths become more responsible for their own diabetes care, family members become less involved and less supportive of disease-management (e.g., they listen less frequently to diabetes-related concerns). A decrease in diabetes-specific family support may in turn be deleterious to youths' treatment adherence. The present study explored this possibility.

Another key variable examined in this study was acculturation, which refers to the changes that occur in individuals as a result of contact with a different culture (Berry, Poortinga, Segall, & Dasen, 2002). Hispanic youths in the US vary in the number of generations their families have been in the country (Malone, Baluja, Costanzo, & Davis, 2003) and in their adaptation to and adoption of mainstream US culture. Particular aspects of acculturation, such as linguistic acculturation and generational status, could be important for diabetes care and control among Hispanic youth with T1D. Specifically, among Hispanics, low linguistic acculturation has been associated with both positive health behaviors (e.g., less smoking among youths; Epstein, Botvin, & Diaz, 1998) and risks of negative health outcomes (e.g., increased risk for peripheral neuropathy among adults with type 2 diabetes; Mainous et al., 2006). In this study, we reasoned that lower linguistic acculturation might be associated with poorer adherence and glycemic control among Hispanic youth with T1D,

perhaps because low linguistic acculturation might interfere with learning and understanding diabetes management tasks.

In contrast, more recent generational status (suggesting less acculturation to US culture) might be associated with better treatment adherence and control. We reasoned this because traditional Hispanic culture places an emphasis on respecting authority and professionals (e.g., Paniagua, 2005) which might lead to more referential attitudes toward healthcare providers and thus to better adherence and control. To our knowledge, the associations between acculturation and adherence and control have not been examined in pediatric diabetes populations, despite the fact that recent reviews have highlighted the importance of understanding ethnic differences that affect the treatment adherence of minority youth (e.g., Quittner, Modi, Lemanek, Levers-Landis, & Rapoff, 2008). As a first step in this direction, the present study examined whether specific aspects of acculturation (linguistic acculturation and generational status) were directly related to adherence and control among youth with T1D.

In summary, the overall goal of this study was to evaluate how family involvement and acculturation variables were related to adherence and glycemic control among Hispanic youth with T1D. Specifically, it was expected that: (a) less youth independent responsibility for diabetes care and more diabetes-related family support would be associated with better treatment adherence and glycemic control; (b) family support for diabetes care would mediate the relationship between responsibility and treatment adherence; and (c) greater linguistic acculturation and more recent generational status would be associated with better adherence and glycemic control.

Method
Participants

Participants were 111 Hispanic youths with T1D, ages 10–17 years ($M = 13.33$ years, $SD = 2.82$; 53% girls) and their primary caregivers (83% mothers; 14% fathers; 3% other guardian). (The "other" category was composed of one stepmother, one stepfather, and one grandmother who were primary caregivers with legal guardianship.) On average, youths had T1D for 6.15 years ($SD = 3.61$) and were on a variety of regimens including two or fewer daily injections (45%), three or more injections (28%), and insulin pump therapy (27%).

The sample consisted of Hispanic families that came from a wide range of geographical locations, education levels, and financial means. Maternal and paternal countries of origin (respectively) were: the continental US

(23%; 11%), Puerto Rico (5%; 5%), Cuba (38%; 45%), Central America (14%; 6%), South America (12%; 14%), and other Caribbean areas (7%; 5%). Parents who immigrated to the US had lived in this country from 2 to 47 years. Most caregiver participants (83%) were bilingual; 4% spoke only English and 13% spoke only Spanish. Parents' education also varied; on the Hollingshead Scale, the mean of parents' education fell between a four (high school education) and a five (some college education, but <4 years). Annual income of families ranged from $2040 to over $80,000, with a median of $40,000. All participating youth spoke English; most also spoke Spanish (92%).

Procedure

The current study was part of a larger study of youth with T1D. Inclusion criteria consisted of: a diagnosis of T1D for at least 1 year, receipt of primary T1D care at the recruitment site, presence of a caregiver willing to participate, ability of youth to speak and read English, and ability of caregiver to speak and read either English or Spanish. Youth with developmental disabilities, other chronic medical conditions requiring a treatment regimen, or serious psychiatric disorders, as determined by parent/healthcare provider report or medical records, were excluded. All caregiver materials (i.e., consent forms, demographic information interview, and questionnaires assessing responsibility for diabetes care and youths' treatment adherence) were translated and made available to participants in both English and Spanish.

Of 205 eligible participants, 38 (18%) refused. The most frequent reason for refusal was that the child "did not feel like it." Of the youth who agreed to participate in the larger study, 120 (71.4%) were Hispanic and were included in the present study. Nine of these participants (7.5%) did not complete the main study measures, leaving data from 111 youth–parent dyads for final analyses. This subsample of 111 Hispanic youth and caregivers included youth recruited at two diabetes treatment sites, a university-based endocrinology clinic and a children's hospital, during routine appointments for medical care.

For all participants, parents signed informed consent in either English or Spanish and youths signed assent forms in English. To promote confidentiality, interviews were administered to youths and parents separately and away from the healthcare teams. Members of the research team were available throughout the study visit to read questionnaires aloud to youths and caregivers with low reading abilities. HbA$_{1c}$ levels were obtained from medical charts.

The study was approved by the Institutional Review Board (IRB) at the university and at participating hospitals/clinics; procedures were in accordance with APA ethical standards. All research personnel, including research assistants, were trained in study procedures and certified in human protections by the Collaborative Institutional Training Initiative.

Measures

Translation of Caregiver Measures

Prior to the start of the study, all caregiver measures were translated into Spanish via an iterative backwards and forwards translation procedure (Brislin, 1970). Translations were conducted by two bilingual doctoral students in psychology and a bilingual child psychologist; they represented Cuban and Latin American backgrounds and all had considerable background in research with youths with T1D. Measures were also reviewed by a certified, IRB-approved language translator for additional clarification and refinement. Internal consistencies of the completed caregiver responsibility and adherence measures were similar in English and Spanish, and are noted below.

Demographic Information

Caregiver reports were used to index parental education, income, single-parent status, and the birthplace of youths and caregivers (to determine generational status). Caregiver and youth reports were used to classify whether youths identified as Hispanic.

Acculturation

Two different measures of acculturation were used: linguistic acculturation and generational status. Youths' linguistic acculturation was assessed through five questions on the *Acculturation, Habits and Interests Multicultural Scale for Adolescents Acculturation Scale* (AHIMSA) (Unger et al., 2002), which had initially been derived from the *Brief Acculturation Scale for Hispanics* (Norris, Ford, & Bova, 1996). Youth answered questions regarding the language they generally use to speak, read, speak at home, think in, and speak with friends. Responses were rated on a Likert scale ranging from 1 (another language only) to 5 (English only). Scores were averaged across items, with higher scores indicating greater facility and use of the English language. In this study, the internal consistency was 0.74.

Generational status was based on information provided by parents/caretakers (in the demographics interview) about the youths' and parents' birthplaces. As in other studies (e.g., Popkin & Udry, 1998), higher generational status reflected a greater number of generations the family has been in the US, or greater number of generations removed from immigration: first generation

(1) referred to youths born outside the continental US; second generation (2) referred to youths born in the US with at least one parent who had been born outside the US; and third generation (3) referred to families with US-born youths and parents. Also in line with previous acculturation studies (Popkin & Udry, 1998), youths born in Puerto Rico were considered first generation in this study despite being US citizens.

Family Involvement

In this study, family involvement was assessed by two variables: the youths' level of responsibility for diabetes management tasks (with higher youth independent responsibility reflecting lower family involvement); and the degree of family support for diabetes care. Specifically, the *Diabetes Family Responsibility Questionnaire* (DFRQ) (Anderson et al., 1990) was used to assess the number of independent diabetes management tasks for which youth were responsible, and this measure was completed by youths and parents. The 17 DFRQ items included daily management tasks (e.g., remembering when blood glucose or urine should be tested) as well as occasional management tasks (e.g., scheduling doctor appointments). Respondents indicated the current level of responsibility the youth or parent had for each of the 17 diabetes tasks, with 1 = parent(s) take or initiate responsibility for this almost all of the time, 2 = both share responsibility for this about equally, and 3 = child takes or initiates responsibility for this almost all of the time. The number of tasks for which the "youth was independently responsible" was determined by averaging the number of 3s reported by youths and by parents. There was high internal consistency for the youth report ($\alpha = 0.78$) as well as caregiver report in both English ($\alpha = 0.84$) and Spanish ($\alpha = 0.70$). For the 42 parents who completed the Spanish translation of the DFRQ, preliminary analyses support the validity of the scale. Correlations between the parents' ratings (in Spanish) of youths' independent responsibility were related to older youth age ($r = .28$, $p < .05$), less family support for diabetes care ($r = -.31$, $p < .03$), and lower treatment adherence ($r = -.36$, $p < .01$); all associations were in the expected directions. Overall, caregiver and youth reports of "youth independent responsibility" were significantly correlated ($r = .44$, $p < .001$). Thus, we conducted analyses with the average of the youth and parent scores; however, analyses conducted with each score separately yielded similar results. The average number of "youth independent responsibility" items could range from 0 to 17; in the present sample the range was from 0 to 12.

Family support for diabetes care was assessed with the *Diabetes Social Support Questionnaire-Family* (DSSQ-Fa) (La Greca & Bearman, 2002). Youths reported how often family members performed diabetes-related supportive behaviors for 13 items that are rated for frequency (0 = never to 5 = at least once a day) and supportiveness (–1 = unhelpful, 0 = neutral, 3 = very supportive). The frequency and supportiveness ratings were multiplied for each item and then summed across items; scores per item could range from –5 to 15 with higher scores representing greater family support for diabetes care. Research supports the reliability and validity of the DSSQ-Fa (La Greca & Bearman, 2002). There was high internal consistency across the 13 DSSQ-FA items ($\alpha = .91$) in this study.

Although both the DSSQ-Fa and the DFRQ contain items that reflect aspects of diabetes management, there is little content overlap across the measures and the rating scales, as the two measures differ substantially. For example, although both measures address eating-related aspects of diabetes care, the DFRQ asks who is responsible for deciding what the child will eat, whereas the DSSQ-Fa asks how often family members encourage the child to eat the right foods and how supportive that behavior is. In addition, the DSSQ-Fa contains several questions about emotional support for diabetes (e.g., encouragement; understanding when things go wrong; listening to concerns) that are not represented on the DFRQ.

Adherence

Participants completed the youth and parent versions of the *Diabetes Self-Management Profile* (DSMP; Harris et al., 2000), respectively. The DSMP is a semi-structured interview that assesses adherence by rating what the youth does for diabetes care as compared to ideal diabetes management. The subscales measure management of hypoglycemia, blood glucose testing, insulin administration, eating plans, and insulin-dose adjustment. Each answer has an assigned point value, with a greater number of points indicating more meticulous self- management; the maximum total score that could be obtained was 88.

Internal consistency in this sample (youth $\alpha = .74$, parent English forms $\alpha = .75$, parent Spanish forms $\alpha = 0.79$) was comparable to that reported by Harris et al. (2000) ($\alpha = .76$ for both parent and youth administration). Several investigators have provided support for the validity of the DSMP with English-speaking youth and parents (e.g., Harris et al., 2000; Lewin et al., 2005). For the 42 parents in this study who completed the Spanish translation of the DSMP, preliminary analyses also support the validity of the scale. For example,

correlations between the parents' ratings (in Spanish) of adherence and youths' reports were significant ($r = .65$, $p < .001$). In addition, parents' reports (in Spanish) of adherence were related to lower (i.e., better) HbA_{1c} levels ($r = -.43$, $p < .005$), and less youth independent responsibility for diabetes care ($r = -.36$, $p < .01$), as would be expected.

Overall, youth and parent total scores were strongly correlated ($r = .67$, $p < .001$) and displayed similar patterns of relationships with respect to responsibility, social support, and glycemic control. Thus, the average of the parent and youth total score on the DSMP was used to index adherence in the analyses.

Glycemic Control

HbA_{1c} levels taken within 6 weeks of participation indexed glycemic control. HbA_{1c} reflects average glycemia in the past 2–3 months and is considered the best estimate of glycemic control (Nathan, Singer, Hurxthal, & Goodson, 1984). Lower numbers indicate better glycemic control. Across the study sites, different HbA_{1c} assays were used; thus, HbA_{1c} levels were converted to standard scores so that they could be analyzed and compared across participants. Specifically, following procedures in other studies (e.g., Nansel et al., 2007), the upper limit of normal (ULN) was identified for each lab (typically 6.0 or 6.3), and this number was subtracted from the participant's HbA_{1c} value; the result was then divided by the lab's ULN.

Results
Preliminary Analyses

Prior to the main analyses, means were computed for all variables (see Table I). On average, youths' linguistic acculturation was 3.77, which is between "equal usage of English and another language" and "mostly English." The majority of youths were of second-generation status ($M = 1.94$); most were the children of immigrants (79.3%), a minority were the first generation to immigrate to the US (13.5%) and the rest were third generation or higher (7.2%). On average, youths were independently responsible for 4 of the 17 diabetes management tasks (on the DFRQ) and reported moderate levels of support from family members for diabetes care (on the DSSQ-Fa). Youths had moderate levels of adherence, similar to levels reported by Harris and colleagues (2000). Youths' standardized mean HbA_{1c} level was 2.9, which is almost 3 standard deviations above normal, or comparable to a value of 8.9 for a lab where 6 represents the upper limit of normal. Thus, HbA_1 values reflect relatively poor glycemic

Table I. Means (SDs) for Primary Study Measures

Variable	Mean	SD	Range
Acculturation			
Linguistic acculturation	3.77	0.67	1.8–5.0
Generational status	1.94	0.45	1.0–3.0
Family Involvement			
Youth independent responsibility (DFRQ)	3.73	2.60	0–11.5
Family support for diabetes care (DSSQ-Fa)	118.60	50.13	0–195.0
Adherence			
Average of youth and parent report (DSMP)	56.23	10.79	27.5–75.0
Glycemic control			
Standardized HbA1c	2.90	2.16	4.2–15.4

DFRQ, *Diabetes Family Responsibility Questionnaire*; DSSQ-Fa, *Diabetes Social Support Questionnaire-Family Version*; DSMP, *Diabetes Self-Management Profile*.

control, but are comparable to levels reported for Hispanic and Caucasian youth (8.3–8.8) (Anderson et al., 2002; Auslander, Thompson, Dreitzer, White, & Santiago, 1997; Gallegos-Macias et al., 2003).

Correlations among key study variables were also examined (see Table II). Youth independent responsibility for diabetes care was associated with less family support for diabetes care, lower levels of adherence, and older age. In contrast, family support was related to higher levels of youth adherence. Lower linguistic acculturation (i.e., less frequent use of English) was associated with more recent generational status (i.e., fewer generations in the US); more recent generational status was associated with better treatment adherence. Finally, greater treatment adherence was related to better (i.e., lower) HbA1c levels.

Acculturation and Family Involvement as Predictors of Adherence

Hierarchical linear regression was used to evaluate the independent associations of the key study variables with adherence. Demographic and control variables (age, parental education, and single-parent status) were entered on the first step of the regression analysis, followed in subsequent steps by linguistic acculturation, generational status, youth independent responsibility for diabetes (on the DFRQ), and family support for diabetes (on the DSSQ-Fa; see Table III). Demographic variables, more recent generational status, lower youth independent responsibility for diabetes care, and greater family support for diabetes each contributed significant incremental variance to the prediction of higher treatment adherence (see Steps 1–5). Controlling for all variables (final step;

Table II. Correlations among Study Measures

Variable	2	3	4	5	6	7	8
1. Youth independent responsibility (DFRQ)	−.46**	.07	−.01	−.28**	.06	.25**	.02
2. Family support for diabetes (DSSQ)		−.06	−.01	.35**	−.00	−.14	.06
3. Linguistic acculturation			.37**	−.07	.12	.05	−.07
4. Generational status				−.24*	.20	−.02	−.17
5. Adherence – average of youth and parent (DSMP)					−.42**	−.15	.22*
6. HbA1c						.13	−.39**
7. Youth age							−.09
8. Parental education							

*p < .05, **p < .01.

DFRQ = Diabetes Family Responsibility Questionnaire; DSSQ-Fa = Diabetes Social Support Questionnaire-Family Version; DSMP = Diabetes Self-Management Profile.

Table III. Hierarchical Regression Analyses Predicting Adolescents' Treatment Adherence

Variables	β	B	SE	ΔR^2 for Step	F Step
Step 1 – Demographics				.09	3.49*
Age	−.12	−.46	.36		
Parent education	.18	1.75	.9		
Single parent	−.16	−3.40	2.03		
Step 2 – Linguistic acculturation	−.03	−.52	1.50	0	.12
Step 3 – Generational status	−.20*	−4.86	2.40	.03	4.10*
Step 4 – Youth responsibility	−.26**	−1.08	.39	.06	7.93**
Step 5 – Family support for diabetes				.06	7.62**
Age	−.07	−.25	.34		
Parent education	.15	1.45	.85		
Single parent	−.10	−2.20	1.94		
Linguistic acculturation	.06	1.02	1.49		
Generational status	−.22*	−5.17	2.26		
Youth responsibility	−.14	−.56	.42		
Family support	.27**	.06	.02		

*p < . 05, **p < . 01.

Final model F (7, 103) = 4.71, p < .001, total $R^2 = 0.24$.

bottom of Table III), only lower (more recent) generational status and higher family support for diabetes care remained significant. The final model explained 24.2% of the variance in youths' adherence (F (7, 103) = 4.71, $p < .001$).

Next, family support for diabetes was tested as a mediator between youth independent responsibility and treatment adherence, using procedures described by Holmbeck (1997). Controlling for demographic variables, youth independent responsibility was found to be a significant predictor of lower family support ($\beta = -.49$, $p < .001$). The previous regression analyses indicated that the hypothesized mediator (family support for diabetes) was significantly associated with the dependent variable (adherence) (Step 5, Table III). The predictor (youth independent responsibility) was significantly associated with the dependent variable (adherence) without the control of the mediator (family support for diabetes) (see Step 4, Table II) and was no longer significant once the mediator (family support for diabetes) was controlled (see Step 5, Table III). Thus, family support for diabetes appeared to mediate the relationship between youth independent responsibility and adherence. In other words, it appeared that youth with more independent responsibility for diabetes care were less adherent to treatment because they had less support from their family members for their diabetes care.

Acculturation and Family Involvement as Predictors of Glycemic Control

A similar set of regression analyses was conducted with glycemic control as the outcome measure (see Table IV). Acculturation variables and family involvement did not predict youths' glycemic control. In the final regression, youths whose parents had higher educational levels ($\beta = -.26$) and better adherence ($\beta = -.37$) had better glycemic control (i.e., lower HbA1c levels).

Discussion

Recent attention has highlighted the need to understand the mechanisms by which cultural factors influence health (e.g., Barakat, 2008; Flores et al., 2002; McQuaid, 2008). Until now, however, healthcare providers have had little information about factors associated with treatment adherence and glycemic control among Hispanic youth with T1D. The results of the present study highlight the importance of perceived family support for diabetes and recent generational status in understanding the adherence of this population, as discussed below.

Table IV. Hierarchical Regression Analyses Predicting Glycemic Control

Variables	β	B	SE	ΔR^2 for Step	F Step
Step 1—Demographics				.19	6.74**
Age	.07	.06	.08		
Parent education	−.35**	−.70	.20		
Single parent	.17	.72	.41		
Step 2—Linguistic acculturation	.04	−.13	.34	0	.14
Step 3—Generational status	.15	.71	.51	.02	1.98
Step 4—Youth responsibility	.01	.01	.08	0	.01
Step 5—Family support for diabetes	.02	0	.01	0	.05
Step 6—Adherence				.09	10.72**
Age	.07	.06	.08		
Parent education	−.26**	−.53	.20		
Single parent	.07	.31	.42		
Linguistic acculturation	.02	.07	.35		
Generational status	.05	.25	.51		
Youth independent responsibility	−.01	−.00	.09		
Family support	.17	.01	.01		
Adherence	−.37**	−.07	.02		

$*p < .05$, $**p < .01$.
Final model $F (8, 84) = 4.39$, $p < .001$, total $R^2 = 0.30$.

Family Involvement for Diabetes Care

A large body of empirical studies with varied methodologies suggests the importance of family involvement in diabetes care (Wysocki & Greco, 2006). The current study extends these findings by demonstrating that family involvement is important among Hispanic youth with T1D as well.

Furthermore, family support for diabetes care mediated the relationship between youth responsibility and adherence, suggesting that youth with more independent diabetes-care responsibilities have poorer treatment adherence because they also have less family support for their diabetes care. Although it is developmentally appropriate and necessary for youths to gradually assume responsibility for diabetes care (La Greca et al., 1990), this transition needs to be done in a way that does not sacrifice family support for their disease management.

As this study was cross-sectional, we could not evaluate causal pathways between family support and youths' treatment adherence. Thus, it is possible that family members find it easier to be supportive when youth are more adherent to their regimens. Alternatively, it may be the case that family support has an important influence on youth adherence. This latter interpretation suggests that

enhancing family support for diabetes management (or at least ensuring that it does not decline) as youth take on greater responsibility for self care may be a way of promoting treatment adherence. Future research might examine whether tailoring interventions to include traditional Hispanic values of shared family care and shared family obligations are effective for improving treatment adherence among Hispanic youths with T1D. Healthcare providers might assess the specific family behaviors that Hispanic youths find supportive and find ways to increase the frequency of these behaviors (La Greca et al., 1995).

Acculturation

To our knowledge, this is the first study to examine aspects of acculturation as they pertain to Hispanic youth's diabetes management. Youths with more recent generational status had better treatment adherence than those who had been in the US for more generations. Results mirror findings from studies in other health domains that suggest that less acculturation is associated with better health behaviors, such as less smoking (e.g., Epstein et al., 1998). The next important step in this line of research will be to examine the mechanisms that underlie this relationship. For example, perhaps more recent generational status is associated with greater respect for medical staff, which in turn might lead to greater motivation to adhere to medical recommendations. Additionally, it is possible that nonadherence is a risk-taking behavior associated with increased acculturation to US culture; other studies have found a link between increased acculturation and risky health behaviors (e.g., smoking) among Hispanic youths (e.g., Epstein et al., 1998). Further research that examines potential pathways is important and desirable.

In contrast to generational status, the other acculturation measure, youths' linguistic acculturation, was unrelated to treatment adherence (although it was related to less recent generational status). This suggests that language acculturation may not play a significant role in diabetes management for Hispanic youths, although caution is warranted in interpreting these findings. First, youths in the current sample all spoke some English. Second, families in this study had access to Spanish-speaking healthcare providers and lived in an area with a high concentration of Hispanic residents and Spanish speakers (US Census, 2008). Thus, low linguistic acculturation may not be as critical in geographic areas where multilingual healthcare teams are available. Future studies that include youth with more diverse linguistic abilities and who reside in less culturally diverse rural and urban areas may find that linguistic acculturation is important for treatment management in Hispanic youth with T1D.

Glycemic Control

In the present study, acculturation and family involvement were not related to youths' glycemic control. However, parent and youth reports of adherence showed good concordance, and were significantly related to glycemic control. This finding extends previous research documenting a relationship between adherence and glycemic control conducted primarily with non-Hispanic populations (e.g., Ellis et al., 2007; Harris et al., 2000). Given the relatively poor levels of glycemic control observed for the Hispanic youths in this study, developing interventions to improve treatment adherence in this population would appear to be critical.

In addition, higher levels of parental education were associated with better glycemic control. The processes that underlie this relationship are unclear, but warrant further study. For example, it is possible that more educated parents have better health literacy (e.g., Sanders, Thompson, & Wilkinson, 2007); thus, complex aspects of the diabetes treatment regimen, such as counting carbohydrates and adjusting insulin dosages might be easier to perform for parents with higher education levels.

In general, myriad and complex factors contribute to glycemic control among youths with T1D (e.g., Wysocki et al., 1996). Further study of the processes that contribute to better glycemic control will be important for informing healthcare providers regarding potential avenues for improving diabetes care among Hispanic youths.

Limitations

Despite the positive contributions of the present study, several limitations should be considered in interpreting the findings and guiding research. First, Spanish translations of measures of diabetes responsibility and adherence were used with about 40% of the parents. These translated measures allowed us to focus on an understudied Hispanic youth population and one benefit is that we now have preliminary psychometric data on the translated measures (Hsin, 2007; Valenzuela et al., 2008) that may facilitate research on Hispanic youth with T1D. However, further research that replicates and extends the psychometric properties of these translated measures would be desirable. In addition, we did not have sufficient statistical power to test differences across the Hispanic/Latino subgroups, which may be of interest in the future.

Second, although the caregiver measures were translated into Spanish, the youth measures were not. It is unclear whether having Spanish translations of our measures would have affected the results; a review of our study records indicated that <5% of potential participants were excluded because the youth did not speak English. In our experience, most if not all school-aged Hispanic youth in the local community speak and read English. However, if resources allow, it would be useful to translate the youth measures as well.

Third, this study focused on Hispanic youths living in South Florida, a unique region with a high concentration of Hispanics and Spanish-speaking medical providers. Thus, it is possible that acculturation variables, particularly linguistic acculturation, might have different relations with health outcomes in areas of the country where there is less cultural and language diversity. Furthermore, there was a lack of Mexican-American backgrounds represented in the sample such that conclusions may not generalize to this population.

Fourth, the study combined youth and parent reports of adherence and of youth independent responsibility. This was done because the parent and youth variables were significantly correlated, and because analyses conducted with each score separately yielded similar results. Still, it should be noted that parents and youths may have different perspectives on diabetes care.

Fifth, although the present study incorporated information from multiple informants (youths and parents), some concerns have been raised about self-report measures of adherence, as they may overestimate adherence (e.g., Quittner et al., 2008). The inclusion of 24-h recall or diary measures would be useful in future studies, as would an examination of individual facets of adherence rather than overall adherence levels.

Finally, the cross-sectional design of the present study precludes an evaluation of causal paths between the variables of interest. Research that examines the likely bidirectional influences between family support for diabetes care and youths' adherence and disease control would be valuable, as well as studies of the utility of family-based interventions.

Conclusion

In summary, this study extends prior work in diabetes by evaluating a sample of diverse Hispanic youth with T1D. Results emphasize the importance of family support for diabetes care among Hispanic youth with T1D and raise questions about how youths' generational status plays a role in treatment adherence. Further research is needed that identifies specific aspects of recent immigration that contribute to better adherence, examines the potential bidirectional interplay between family support and adherence, and evaluates interventions to enhance family support in this population.

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References

Anderson, B. J., Auslander, W. F., Jung, K. C., Miller, J. P., & Santiago, J. V. (1990). Assessing family sharing of diabetes responsibilities. *Journal of Pediatric Psychology, 15*, 477–491.

Anderson, B. J., 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. *The Journal of Pediatrics, 130*, 257–265.

Anderson, B. J., Vangsness, L., Connell, A., Butler, D., Goebel-Fabbri, A., & Laffel, L. M. B. (2002). Family conflict, adherence, and glycaemic control in youth with short duration Type 1 diabetes. *Diabetic Medicine, 19*, 635–642.

Auslander, W. F., Thompson, S. J., Dreitzer, D., White, N. H., & Santiago, J. V. (1997). Disparity in glycemic control and adherence between African-American and caucasian youths with diabetes. *Diabetes Care, 20*, 1569–1575.

Barakat, L. (2008). Editorial: *Journal of Pediatric Psychology Statement of Purpose*—Section on Family Influences and Adaptation. *Journal of Pediatric Psychology, 33*, 26–30.

Berry, J. W., Poortinga, Y. H., Segall, M. H., & Dasen, P. R. (2002). *Cross-cultural psychology: Research and applications*. New York: Cambridge University Press.

Brislin, R. (1970). Back translation for cross-cultural research. *Journal of Cross-Cultural Psychology, I*, 185–216.

Davis, C., Delamater, A. M., Shaw, K. H., La Greca, A. M., Eidson, M., Perez-Rodriguez, J. E., et al. (2001). Brief report: Parenting styles, regimen adherence, and glycemic control in 3- to 10-year-old children with diabetes. *Journal of Pediatric Psychology, 26*, 123–129.

Delamater, A. M., Shaw, K. H., Applegate, E. B., Pratt, I. A., Eidson, M., Lancelotta, G. X., et al. (1999). Risk for metabolic control problems in minority youth with diabetes. *Diabetes Care, 22*, 700–705.

Diabetes Control and Complications Trial Research Group. (1994). Effect of intensive diabetes treatment on the development and progression of long-term complications in adolescents with insulin-dependent diabetes mellitus: Diabetes Control and Complications Trial. *Journal of Pediatrics, 125*, 177–188.

Ellis, D. A., Podolski, C.-L., Frey, M. A., Naar-King, S., Wang, B., & Moltz, K. (2007). The role of parental monitoring in adolescent health outcomes: Impact on Regimen adherence in youth with type 1 diabetes. *Journal of Pediatric Psychology, 32*, 907–917.

Epstein, J. A., Botvin, G. J., & Diaz, T. (1998). Linguistic acculturation and gender effects on smoking among Hispanic youth. *Preventive Medicine, 27*, 583–589.

Flores, G., Fuentes-Afflick, E., Barbot, O., Carter-Pokras, O., Claudio, L., Lara, M., et al. (2002). The health of Latino children: Urgent priorities, unanswered questions, and a research agenda. *Journal of the American Medical Association, 288*, 82–90.

Gallegos-Macias, A., Macias, S., Kaufman, E., Skipper, B., & Kalishman, N. (2003). Relationship between glycemic control, ethnicity and socioeconomic status in Hispanic and white non-Hispanic youths with type 1 diabetes mellitus. *Pediatric Diabetes, 4*, 19–23.

Grey, M., Boland, E., Yu, C., Sullivan-Bolyai, S., & Tamborlane, W. (1998). Personal and family factors associated with quality of life in adolescents with diabetes. *Diabetes Care, 21*, 909–914.

Harris, M. A., Wysocki, T., Sadler, M., Wilkinson, K., Harvey, L. M., Buckloh, L. M., et al. (2000). Validation of a structured interview for the assessment of diabetes self-management. *Diabetes Care, 23*, 1301–1304.

Holmbeck, G. N. (1997). Toward terminological, conceptual, and statistical clarity in the study of mediators and moderators: Examples from the child-clinical and pediatric psychology literatures. *Journal of Consulting and Clinical Psychology, 65*, 599–610.

Hsin, O., La Greca, A. M., Valenzuela, J., Moine, C., & Delamater, A. (2007). Paper presented at the

American Psychological Association Annual Convention. *Measuring adherence in Hispanic adolescents with type 1 diabetes*. San Francisco: August.

La Greca, A. M., Auslander, W. F., Greco, P., Spetter, D., Fisher, E. B. Jr., & Santiago, J. V. (1995). I get by with a little help from my family and friends: Adolescents' support for diabetes care. *Journal of Pediatric Psychology, 20*, 449–476.

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*, 665–676.

La Greca, A. M., Follansbee, D., & Skyler, J. S. (1990). Developmental and behavioral aspects of diabetes management in youngsters. *Journal of Child Health Care, 19*, 132–139.

Lawrence, J. M., Mayer-Davis, E. J., Reynolds, K., Beyer, J., Pettitt, D. J., Ralph B. D'Agostino, J., et al. (2009). Diabetes in Hispanic American youth: Prevalence, incidence, demographics, and clinical characteristics: the SEARCH for Diabetes in Youth Study. *Diabetes Care, 32*, S123–S132.

Lewin, A. B., Storch, E. A., Geffken, G. R., Heidgerken, A. D., Williams, L. B., & Silverstein, J. H. (2005). Further examination of a structured adherence interview of diabetes for children, adolescents, and parents. *Children's Health Care, 34*, 149–164.

Lopez, T. (2006). Familismo. In Y. Jackson (Ed.), *Encyclopedia of multicultural psychology* (pp. 211). Thousand Oaks: Sage.

Mainous, A. G., Majeed, A., Koopman, R. J., Baker, R., Everett, C. J., Tilley, B. C., et al. (2006). Acculturation and diabetes among Hispanics: Evidence from the 1999-2002 National Health and Nutrition Examination Survey. *Public Health Reports, 121*, 60–66.

Malone, N., Baluja, K. F., Costanzo, J. M., & Davis, C. J. (2003). The foreign-born population: 2000 (U.S. Census 2000 brief). *Retrieved from* http://www. census.gov/prod/2003pubs/c2kbr-34.pdf.

McQuaid, E. (2008). Introduction to Special Issue: *Journal of Pediatric Psychology* Statement of Purpose—Special Section on Diversity and Health Care Disparities. *Journal of Pediatric Psychology, 33*, 22–25.

Miville, M. (2006). Hispanic Americans. In Y. Jackson (Ed.), *Encyclopedia of multicultural psychology* (pp. 224). Thousand Oaks: Sage.

Nansel, T., Iannotti, R., Simons-Morton, B., Cox, C., Plotnick, L., Clark, L., et al. (2007). Diabetes personal trainer outcomes: Short-term and 1-year outcomes of a diabetes personal trainer intervention among youth with type 1 diabetes. *Diabetes Care, 30*, 2471–2477.

Nathan, D. M., Singer, D. E., Hurxthal, K., & Goodson, J. D. (1984). The clinical information value of the glycosolated hemoglobin assay. *New England Journal of Medicine, 310*, 341–346.

Norris, A. E., Ford, K., & Bova, C. A. (1996). Psychometrics of a Brief Acculturation Scale for Hispanics in a probability sample of urban Hispanic adolescents and young adults. *Hispanic Journal of Behavioral Sciences, 18*, 29–38.

Paniagua, F. A. (2005). *Assessing and treating culturally diverse clients: A practical guide* (3rd ed.). Thousand Oaks: Sage.

Popkin, B. M., & Udry, J. R. (1998). Adolescent obesity increases significantly in second and third generation U.S. Immigrants: The National Longitudinal Study of Adolescent Health. *The Journal of Nutrition, 128*, 701–706.

Quittner, A. L., Modi, A. C., Lemanek, K. L., Levers-Landis, C. E., & Rapoff, M. A. (2008). Evidence-based assessment of adherence to medical treatments in pediatric psychology. *Journal of Pediatric Psychology, 33*, 916–936.

Roosa, M. W., Morgan-Lopez, A. A., Cree, W. K., & Specter, M. M. (2002). Ethnic culture, poverty, and context: Sources of influence on Latino families and children. In J. M. Contreras, K. A. Kems, & A. M. Neal-Barnett (Eds.), *Latino children and families in the United States* (pp. 27). Westport: Praeger Publishers.

Sanders, L. M., Thompson, V. T., & Wilkinson, J. D. (2007). Caregiver health literacy and the use of child health services. *Pediatrics, 119*, e86–e92.

Skinner, T. C., John, M., & Hampson, S. E. (2000). Social support and personal models of diabetes as predictors of self-care and well-being: A longitudinal study of adolescents with diabetes. *Journal of Pediatric Psychology, 25*, 257–267.

U.S. Census. (2007). Minority population tops 100 million. *Retrieved June 1, 2007 from* http:// www.census.gov/Press-Release/www/releases/ archives/population/010048.html.

U.S. Census. (2008). State and county quickfacts. *Retrieved May 1, 2008 from* http://quickfacts.census.gov/qfd/ states/12/12086.html.

Unger, J. B., Gallaher, P., Shakib, S., Ritt-Olson, A., Palmer, P., & Johnson, C. A. (2002). The AHIMSA Acculturation Scale: A new measure of acculturation for adolescents in a multicultural society. *Journal of Early Adolescence, 22*, 225–251.

Valenzuela, J., Castro, M., Hsin, O., Moine, C., La Greca, A. M., & Delamater, A. (2008, April). *Psychometric findings for a Spanish translation of the Diabetes Self Management Profile (DSMP)*. Miami Beach: Paper presented at the National Conference in Child Health Psychology.

Wysocki, T., Taylor, A., Hough, B. S., Linscheid, T. R., Yeates, K. O., & A., N. J. (1996). Deviation from developmentally appropriate self-care autonomy. Association with diabetes outcomes. *Diabetes Care, 19*, 112–125.