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Psychosocial and behavioral correlates of A1C and quality of life among young adults with diabetes

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Abstract

Purpose: The purpose of this study was to evaluate relationships between behavioral and psychosocial constructs, A1C, and diabetes-related quality of life (DQoL) among low-socioeconomic status, ethnically diverse young adults with diabetes.

Methods: Using baseline data of 81 participants in the Resilient, Empowered, Active Living (REAL) randomized controlled trial, behavioral, cognitive, affective, and experiential variables were correlated with A1C and DQoL, while adjusting for demographic characteristics, and these relationships were examined for potential effect modification.

Results: The data indicate that depressive symptoms and satisfaction with daily activities are associated with both A1C and DQoL, while diabetes knowledge and participation in daily activities are associated with neither A1C nor DQoL. Two constructs, diabetes distress and life satisfaction, were associated with DQoL and were unrelated to A1C, while two constructs, self-monitoring of blood glucose and medication adherence, were associated with A1C but were unrelated to DQoL. These relationships were largely unchanged by adjusting for demographic characteristics, while numerous effect modifications were found.

Conclusion: The data suggest that when tailoring interventions, depressive symptoms and satisfaction with daily activities may be particularly fruitful intervention targets, as they represent modifiable risk factors that are associated with both A1C and DQoL.

Keywords

Diabetes mellitus; Hemoglobin A, glycosylated; Health-related quality of life; Healthy lifestyle; Health behaviors; Occupational therapy

Elevated blood glucose, typically measured through A1C, has been definitively linked to development of disabling complications of diabetes.^{1, 2} As such, maintaining blood glucose levels at near-normal levels is the hallmark of diabetes treatment.³ Clinical trials of educational and lifestyle interventions, as well as drug therapies, thus commonly employ A1C as a primary outcome given its sensitivity to change and association with events and conditions that are relevant to individuals with diabetes and their healthcare providers. A1C is affected by a complex constellation of physiological, behavioral, and psychosocial influences, making diabetes management a complex undertaking. For the purpose of this paper, four broad categories of potential influences on A1C were identified: behavioral (specific actions), affective (moods and emotional states), cognitive (thoughts and mental processes), and experiential (engagement in life situations).

In terms of health behaviors, medication adherence is consistently associated with lower A1C in both Type 1 and Type 2 diabetes.^{4, 5} Self-monitoring of blood glucose (SMBG) is strongly associated with reduced A1C in Type 1 diabetes,⁶ as well as in Type 2 diabetes when paired with timely and appropriate feedback.⁷ A broad range of affective factors have also been shown to be related to A1C among individuals with both Type 1 and Type 2 diabetes, including diabetes-specific emotional distress^{8, 9} and depressive symptoms.^{10, 11} The impact of cognitive factors on A1C, including self-efficacy, problem-solving, and diabetes-related knowledge, are also well-known.^{12–14} Perhaps less well-understood are the impact of experiential constructs on diabetes management. To examine how life experiences affect diabetes management, both stressful life events as well as participation in daily life activities were examined. While stressful life events have been shown to be associated with medication nonadherence¹⁵ and A1C,¹⁶ daily activity participation is a relatively novel construct in diabetes research, and its relationship with health and well-being in this population is largely unknown. Daily activity participation includes people's ability to engage in daily life activities, such as household activities, attending school or work, and leisure activities and is typically assessed in occupation therapy for conditions that contribute to physical or cognitive disabilities. While diabetes notably produces few acute symptoms, hypo- and hyperglycemic episodes, and daily self-management tasks have the potential to interfere with participation in daily life activities.¹⁷

Beyond A1C, the challenges faced by those living with a chronic disease requiring complex management may negatively influence quality of life (QoL) through time required for self-management activities, interruptions or limitations to daily living activities, stress regarding perceived ability to reach disease management goals, and coping with complications.¹⁸ Diabetes-dependent QoL (DQoL) refers to the specific ways in which diabetes affects QoL, independent of other influences such as socioeconomic conditions or overall health status. While both glycemic control and QoL are arguably the principal objectives of diabetes intervention, the relationship between these two constructs are not necessarily

straightforward; interventions that improve one may have positive, neutral, or detrimental effects on the other. Thus, identifying and clarifying which behavioral, cognitive, affective, and experiential factors are associated with A1C and DQoL, and for which particular populations, may lead to the identification of intervention targets that improve both DQoL and A1C.

There is a particularly urgent need to identify such intervention targets among populations at the highest risk for poor health outcomes and poor quality of life. Among individuals with diabetes, young adulthood is widely recognized as one of the most challenging developmental phases with respect both to glycemic control and quality of life. Furthermore, young adults with low socioeconomic status (SES) and who are from underrepresented racial/ethnic minority groups have higher A1C and higher complication rates as compared to more advantaged populations.^{19, 20} Among individuals with Type 1 diabetes, A1C values are highest at age 19, with an average of 9.2% (77 mmol/mol);¹⁹ A1C values are similar among young adults with Type 2 diabetes.²¹ Psychosocial well-being is also similar among young adults with Type 1 and Type 2 diabetes,²² and poorer than their same-age peers without diabetes and other age groups with diabetes; over one-third experience mental health challenges including depression, anxiety, or eating disorders.^{22–24}

Methods.

The Resilient, Empowered, Active Living (REAL) Diabetes Study was a randomized controlled trial of an occupational therapy lifestyle intervention which aimed to improve A1C and psychosocial well-being among low-SES, ethnically diverse young adults with Type 1 or Type 2 diabetes.²⁵ In the current analyses, baseline data from the REAL Diabetes Study are used to investigate relationships between A1C, DQoL, and behavioral, cognitive, affective and experiential constructs which may be associated with A1C and DQoL. In addition, demographic and clinical variables (diabetes type, gender, ethnicity, nativity, and recruitment site) were analyzed as potential effect modifiers or confounders of the associations between A1C and DQoL and each of the behavioral, cognitive, affective and experiential variables. Effect modification occurs when an association between two variables is different depending on the value of a third variable (the effect modifier). In these cases, it is important to present results separately according to the value of the effect modifier since the overall association between the variables is, by definition of effect modification, unrepresentative of the effect in the subgroups. In contrast, confounding occurs when the confounding variable is related to both of the variables of interest and exaggerates or obscures the true relationship of the variables. Adjustment for confounding allows for subgroups to be combined for the presentation of results. Since it is important to present stratified results when there is effect modification, associations were checked first for potential effect modification and then for confounding.

The REAL study methodology has been described previously.²⁵ In brief, 81 young adults age 18–30, from low-SES backgrounds, with Type 1 or Type 2 diabetes, and an A1C level 8.0% (64 mmol/mol), were randomly assigned to receive either the REAL intervention (a community-based occupational therapist-led diabetes management intervention) or an attention control condition (packet of standardized educational materials and follow-up

phone calls) over 6 months. Participants completed a battery of psychometric assessments and point-of-care A1C measurements at baseline and post-intervention, as well as a medical chart review at baseline. The current exploration is a supplementary analysis of only the baseline data from the REAL clinical trial. The goal was to explore how demographic and psychosocial variables may be related to A1C and DQoL before the effects (if any) of the trial intervention. The study was approved by the University of Southern California Institutional Review Board and all participants provided informed consent prior to completing study procedures.

Measures.

The current analyses include baseline data for the 81 participants enrolled in this trial. A1C was measured using the Axis-Shield Afinion point-of-care assay²⁶ during each participant's baseline testing session, which occurred at the participant's home or another place of his or her preference. In instances when the assessors could not obtain a baseline A1C measurement through point-of-care assay (e.g. due to equipment malfunction), they utilized the most recent measurement of A1C recorded in the participant's medical records within 4 weeks prior to baseline testing. Statistical analyses were done for all participants and, for sensitivity analyses, were repeated excluding those participants who had A1C values accessed from their medical records.

Diabetes-dependent quality of life (DQoL) was evaluated using the Audit of Diabetes Dependent Quality of Life (ADDQoL), a 19-item instrument which includes social, physical and emotional domains.²⁷ Each item is rated in terms of the perceived impact of diabetes on that life domain (either positive or negative), weighted by the importance of that domain to the individual's overall quality of life; higher total scores indicate better DQoL.

The behavioral, affective, cognitive, and experiential factors analyzed, and their measurement instruments, were as follows: Diabetes self-care behaviors were evaluated using the Summary of Diabetes Self-Care Activities.²⁸ Specifically, SMBG was evaluated using the question: *On how many of the last seven days did you test your blood sugar the number of times recommended by your health care provider?* Medication adherence was evaluated using the mean of the following question(s), as appropriate: *On how many of the last seven days did you take your recommended insulin injection/number of diabetes pills?* Diabetes-related emotional distress (diabetes distress) was evaluated using the 5-item Problem Areas in Diabetes-Short Form (PAID-5; Cronbach $\alpha=0.83-0.86$).²⁹ Each item is rated on a 5-point scale from 0=*Not a problem* to 4=*Serious problem*, items are summed, and higher scores indicate higher levels of diabetes-related stress. Depressive symptom severity was assessed using the Patient Health Questionnaire-8 (PHQ-8; Cronbach $\alpha=0.86-0.89$).³⁰ Each item is rated on a 4-point scale from 0=*Not at all* to 3=*Nearly every day*, items are summed, and higher scores indicate higher levels of depressive symptoms. Life satisfaction/global subjective well-being was evaluated using the 5-item Satisfaction with Life Scale (SWLS; Cronbach $\alpha=0.87$).³¹ Each item is rated on a 7-point scale from 1=*Strongly disagree* to 7=*Strongly agree*, items are summed, and higher scores indicate greater satisfaction with life. Diabetes-related self-efficacy was evaluated using the 8-item Diabetes Empowerment Scale-Short Form (DES-SF; Cronbach $\alpha=0.85$).³² Each item is

rated on a 5-point scale from 1=*Strongly disagree* to 5=*Strongly agree*, items are averaged, and higher scores indicate greater feelings of self-efficacy in relation to diabetes. Diabetes-related problem-solving was evaluated using the Diabetes Problem-Solving Interview (DPSI; Cronbach $\alpha=0.77$).³³ A structured interview probes for problem-solving strategies for nine scenarios related to SMBG, stress management, and medication adherence. Ratings for each situation range from 1= *Very poor strategy* to 5=*Excellent strategy*, ratings are averaged, and higher scores indicate better problem solving related to diabetes. Diabetes knowledge was evaluated using the 24-item Diabetes Knowledge Questionnaire (DKQ-24; Cronbach $\alpha=0.78$).³⁴ One point is scored for each correct answer. Exposure to stressful life events was evaluated using a life event checklist, including 24 items compiled from childhood trauma and life event checklists.^{35–38} One point is scored for each event checked so that higher scores indicate higher exposure to past stressful life events.

Objective and subjective domains of participation, or “involvement in formal or informal everyday activities,”³⁹ were evaluated using the 26-item Participation Objective, Participation Subjective (POPS; Cronbach $\alpha=0.43$ for objective and 0.70 for subjective participation) scale.⁴⁰ This measure evaluates both the frequency of participation (*objective participation*) across five domains of activities: household activities, productive activities (work/school/volunteering), transportation, leisure, and social activities, as well as the individual’s satisfaction with participation (*participation satisfaction*). Scoring uses a complex algorithm where participant z-scores are calculated for each item according to the means and standard deviations calculated for the sample, i.e., in this case, the REAL sample. Briefly, z-scores are weighted by the participant’s rating of the importance of the activity to them and averaged to obtain the objective participation score. Higher objective participation scores indicate higher levels of participation in activities that are important to the participant. Participation satisfaction is calculated using the participant’s assessment of whether they would prefer more, less, or the same amount of each type of activity, and their rating of the importance of that activity to them. Higher scores indicate that the participant is doing closer to the desired level of each activity.

Demographic and clinical characteristics including diabetes type, sex, ethnicity, country of origin, and recruitment site were assessed as potential effect modifiers and confounders, and analyses were adjusted accordingly.

Statistical Analyses.

The purpose of the analyses was to explore behavioral, affective, cognitive and experiential factors that may influence the important diabetes-related outcomes of A1C and DQoL, rather than to propose a parsimonious model that predicts either of these outcomes and which would be highly variable according to covariates in the model. Thus, rather than conducting a multivariate analysis, each psychosocial variable was tested separately from the others. Furthermore, given the exploratory nature of this study, results are presented without control for multiple comparisons. Although multiple comparison adjustments are often necessary to adjust for comparisons made as part of a global null hypothesis, in exploratory analyses such as are presented in this paper, results are typically presented without multiple comparison adjustments.

All analyses were performed using SAS for Windows, version 9.4, SAS Institute, Inc., Cary, NC. As data in this study generally were not normally distributed, nonparametric statistical methods were used. Descriptive statistics are presented using n (%) or median (interquartile range). Univariate correlations of each psychosocial variable with A1C and with DQoL were calculated using Spearman correlation. Wilcoxon rank sum tests were used to test for differences in A1C and in DQoL by each of the potential effect modifiers. Each potential effect modifier was tested for modification of the Spearman correlation of A1C and DQoL with each psychosocial variable using Fisher r -to- z transformation tests. Correlations were stratified by any statistically significant ($P<0.05$) effect modifiers. Associations of A1C and DQoL with each psychosocial variable (stratified by effect modifiers as appropriate) were adjusted for diabetes type, gender, Latino ethnicity, country of origin, recruitment site, age, and duration of diabetes in one model, and then further adjusted for measures of SMBG and medication adherence in another model.

Results.

The REAL sample has been characterized in detail previously.²⁵ In brief, the 81 participants enrolled in the REAL study were 22.6 ± 3.5 years old, 63% female, 78% Latino, 75% with Type 1 diabetes, and 26% not born in the United States. Participants had a low socioeconomic level effected by the inclusion criteria. Six participants had A1C accessed from medical records and were compared to the 75 participants with point-of-care measures of A1C on all of the variables shown in Table 1. SMBG was the only variable which differed significantly between the groups; higher levels of glucose monitoring were reported by those whose A1C was accessed from medical records. All statistics were run separately for the full study sample and excluding the six participants with medical record results for A1C. All results were similar and only the full sample results are presented herein. Table 1 shows the baseline measures for the sample overall and stratified by diabetes type. Mean A1C did not differ by diabetes type. However, participants with Type 2 diabetes were more likely to be immigrants and to report lower medication adherence, diabetes-related self-efficacy and problem-solving. With respect to the other potential effect modifiers (gender, ethnicity, country of origin, and recruitment site), significant between-group differences included the following: more social media and fewer clinic recruits among females; lower participation satisfaction among Latinos; higher life satisfaction among immigrants; and higher diabetes knowledge and participation satisfaction, and lower medication adherence among social media recruits compared to clinic recruits.

Table 2 shows univariate associations of demographic variables with A1C and DQoL. The only significant association was between age and DQoL, in which older participants had lower DQoL ($r=-0.24$, $P=0.03$). Table 3 shows Spearman correlation coefficients for A1C and DQoL with each of the behavioral, affective, cognitive and experiential variables. Significance levels are included for the unadjusted model, the model after adjusting for demographic variables only, and the model after adjusting for demographic variables and self-care behaviors (SMBG and medication adherence). In the unadjusted model, SMBG and medication adherence were associated with lower A1C (SMBG $r=-0.33$, $P=0.003$; medication adherence $r=-0.26$, $P=0.02$), and remained associated after adjusting for all demographic variables ($r=-0.33$, $P=0.01$ and $r=-0.22$, $P=0.06$, respectively, data not shown).

A1C was also associated with depressive symptoms ($r=0.27$, $P=0.02$) and participation satisfaction ($r=-0.23$, $P=0.04$). With respect to DQoL, life satisfaction ($r=0.23$, $P=0.04$) and participation satisfaction ($r=0.24$, $P=0.03$) were positively associated with DQoL, whereas diabetes-related distress ($r=-0.46$, $P<0.0001$), depressive symptoms ($r=-0.39$, $P=0.0003$), and stressful life events ($r=-0.31$, $P=0.005$) were associated with lower DQoL.

There were numerous statistically significant correlations among the behavioral and psychosocial variables. Unsurprisingly, SMBG and medication adherence were correlated ($r=0.47$, $p<0.0001$; data not shown). However, neither of the significant psychosocial correlates of A1C (depressive symptoms and participation satisfaction) were associated with either SMBG or medication adherence, and their associations with A1C remained significant after adjustment for SMBG and medication adherence (Table 3). The only statistically significant associations between the behavioral and psychosocial measures were for problem solving with SMBG ($r=0.31$, $P=0.005$) and for objective participation with medication adherence ($r=0.24$, $P=0.03$); (data not shown).

Effect Modification.

An analysis of effect modifications revealed several instances where the relationships between psychosocial variables and A1C or DQoL were different for different demographic or clinical subgroups. Figure 1 summarizes statistically significant effect modifications for the associations of behavioral and psychosocial variables with A1C and DQoL. As shown in Table 3, participation satisfaction was associated with lower A1C in people with Type 1 diabetes but not Type 2 diabetes ($r=-0.37$ Type 1, $r=0.22$ Type 2; p -interaction=0.03). Greater exposure to stressful life events was associated with higher A1C in people with Type 1 diabetes, but lower A1C in those with Type 2 diabetes ($r=0.28$ Type 1, $r=-0.45$ Type 2; p -interaction=0.005). Life satisfaction was significantly associated with DQoL in people with Type 1 diabetes but not Type 2 diabetes ($r=0.34$, $r=-0.19$ respectively; p -interaction=0.05). There was an inverse relationship between self-efficacy and A1C among immigrants, but not US-born participants ($r=-0.52$, $r=0.00$ respectively; p -interaction=0.03), and a relationship between life satisfaction and DQoL among US-born, but not immigrant participants ($r=0.32$, $r=-0.21$ respectively; p -interaction=0.04). There was an inverse relationship between medication adherence and A1C among social media/mass mailing-recruited participants, but not clinic-recruited participants ($r=-0.46$, $r=-0.03$ respectively; p -interaction=0.05). Finally, gender modified the relationship between diabetes-related problem solving and DQoL (P -interaction=0.01), with problem solving being associated with DQoL among men ($r=0.41$) but not women ($r=-0.13$).

The majority of these associations remained significant after adjusting for demographics and diabetes self-care behaviors, with the exception of the relationship between diabetes self-efficacy and A1C among immigrants and the relationships between stressful life events, participation satisfaction, and A1C among participants with Type 2 diabetes. After adjusting for demographic and self-care variables, there were no longer significant relationships between self-efficacy and A1C among immigrants ($P=0.28$), or between stressful life events and A1C among participants with Type 2 diabetes ($P=0.17$). However, after adjusting for demographic and self-care variables, there was a significant relationship between

participation satisfaction and A1C among participants with Type 2 diabetes ($P=0.04$). Each of these analyses involves a very small subset of the study sample ($n=21$ immigrants or $n=20$ with Type 2 diabetes) and consequently adjusting for a large number of covariates makes the models very unstable.

Except as previously noted, the significance of these interactions, as well as the associations of SMBG and depressive symptoms with A1C, were minimally changed by adjustment for multiple covariates. Notably, A1C and SMBG were negatively correlated regardless of diabetes type, with no statistically significant effect modification. However, the relationship was only statistically significant in those with Type 1 diabetes due to a larger sample size as well as a stronger relationship ($r=-0.38$ in Type 1, $r=-0.23$ in Type 2; data not shown).

Discussion.

This analysis investigated the associations of A1C and DQoL with behavioral, affective, cognitive and experiential constructs in a group of 81, mostly Latino, young adults with diabetes. Three constructs: depressive symptoms, stressful life events, and participation satisfaction were associated with both A1C and DQoL in this sample. Notably, the association of stressful life events with DQoL is positive in those with type 1 diabetes and negative in those with Type 2 diabetes. Diabetes distress and life satisfaction were associated with DQoL but not A1C, while medication adherence and SMBG were associated with A1C but not DQoL. Although medication adherence appeared to only be related to A1C among social media-recruited participants, with no relationship among clinic-recruited participants, this finding may be due to a ceiling effect among clinic-recruited participants, 78% of whom (vs. 46% of social media-recruited participants) reported full medication adherence. Thus, little variation in adherence among clinic-recruited participants makes it difficult to establish any association between medication adherence and other constructs within this subgroup.

Although directionality of cause and effect cannot be ascertained from cross-sectional analyses, these findings provide insights appropriate for further investigation, as they may be relevant to tailoring interventions to address DQoL, A1C, or both. In reviewing both the magnitude of associations (correlation coefficients) and their significance levels, the data suggest that interventions may have the greatest impact on A1C if they target SMBG, medication adherence, depressive symptoms, and participation satisfaction. Conversely, interventions may have the greatest impact on DQoL if they target life satisfaction, diabetes distress, depressive symptoms, and participation satisfaction. Although stressful life events were associated with lower DQoL, this construct is specific to past life events and thus is not subject to modification. Clinicians should be aware, however, that such past events may still affect DQoL.

In exploring possibilities for intervention development, this study sheds light on important clinical and demographic attributes that may modify relationships between potential behavioral and psychosocial intervention targets, and important diabetes-related outcomes. For example, the data suggest that diabetes-related problem solving is related to DQoL among men, but not women, and diabetes self-efficacy is related to A1C among immigrants, but not US-born, individuals with diabetes. The potential for effect modification is extremely

important in planning clinical interventions. Resources for delivering complex interventions are limited, so targeting the most effective treatment modalities for each patient is imperative. The findings of effect modification should be considered provisional until confirmed by future research. Nevertheless, the discovery of three relationships being modified by diabetes type underscores the potential for substantial relational differences between these two strata.

The construct of participation satisfaction merits attention as it is both novel within the diabetes literature, and was significantly associated with both A1C and DQoL in the sample. Thus, it represents an untapped and potentially fruitful domain for further research and clinical interventions. Participation may be broadly understood as the extent to which individuals are able to take part in desired activities and life roles within their current environment. Although participation has been evaluated as a key outcome among populations with diverse health conditions including physical disabilities, chronic conditions, mental health disorders, intellectual and developmental disabilities, and communication disorders, it has been largely neglected as an outcome of interest in diabetes care.^{41–43} This study suggests that the subjective dimension of participation in particular – that is, how satisfied a person is with their level of participation in life activities they perceive as important – is relevant to both glycemic control and diabetes-related quality of life. Diabetes self-care tasks, such as SMBG and taking medications, are embedded within individuals' everyday life activities, such as mealtimes, social and leisure activities, and attending work and school. It seems reasonable, given the many ways in which diabetes self-care intersects with everyday activities, that an individual's level of satisfaction with the orchestration of their daily life activities has implications for their ability to manage diabetes effectively as well as how diabetes affects their quality of life.

The fact that many psychosocial variables were significantly associated with DQoL and A1C is not surprising. Perhaps more interesting are the factors which were unrelated to DQoL or A1C, including diabetes knowledge, diabetes self-efficacy and objective participation. While objective participation is a relatively novel construct to be evaluated in diabetes care, diabetes-related knowledge and self-efficacy are well-established, extensively researched constructs within diabetes care, and have been found to be associated with self-care behaviors and A1C in a variety of populations.^{12, 13, 44} Although the participants' diabetes knowledge scores were somewhat higher than other published research utilizing the same measure,^{13, 45} they did not exhibit a ceiling effect, and their diabetes self-efficacy scores were similar to others reported in the literature.^{46, 47} Given that there have been few studies conducted specifically among low-SES, ethnically diverse young adults with diabetes, the findings suggest that they may differ from other populations with diabetes in terms of the psychosocial constructs most relevant to their A1C and DQoL.

Limitations.

The participants in the study are not a representative sample of young adults with diabetes. Their overall health and well-being was, according to several measures, poorer than that reported in other recent studies of young adults with diabetes. Their average A1C was approximately 2% (22 mmol/mol) higher than that of 18–25 year olds enrolled in the Type 1

Diabetes Exchange and other recent studies of young adults with diabetes,^{19, 48} and 27.2% reported clinically significant depressive symptoms (PHQ-10), in contrast to rates of 10–12% reported in other recent studies among adolescents and young adults with diabetes.^{23, 24} Thus, the findings may not generalize to the broader population of young adults with diabetes. Furthermore, in this study, several potential effect modifiers for the associations between A1C and psychosocial factors were considered. Nevertheless, there are potentially many unmeasured factors that may also affect these associations. Furthermore, with the relatively small sample size, some important effect modifiers may have been missed. In particular, there is evidence that race/ethnicity may be important in these associations, but the sample had few non-Latinos and therefore dichotomized race/ethnicity as Latino/non-Latino, which may mask important differences among non-Latino populations.

Implications for Diabetes Educators.

Overall, this study contributes to knowledge regarding associations between health behaviors and psychosocial constructs, A1C, and diabetes-related quality of life. Furthermore, it helps to clarify how these relationships differ among population subgroups characterized by different clinical and demographic attributes. Although preliminary and in need of further study, these findings may potentially be useful in tailoring diabetes education to impact both health and quality of life outcomes among various populations.

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Figure 1.
Correlations and 95% Confidence Intervals by Subgroups

Table 1.

REAL Baseline Sample Characteristics; median (IQR) or N(%)

Characteristic	Total	Diabetes Type	
		Type 1	Type 2
Total N	81	61	20
Demographic			
Female gender	51 (63)	40 (66)	11 (55)
Latino ethnicity	63 (78)	45 (74)	18 (90)
Immigrant [*]	21 (26)	12 (20)	9 (45)
Social media recruit	40 (49)	28 (46)	12 (60)
Outcomes			
A1C %	10.4 [9.4, 11.7]	10.1 [9.3, 11.4]	11.4 [9.7, 12.7]
Mmol/mol	90 [79, 104]	87 [78, 101]	101 [83, 115]
Diabetes-related quality of life (<i>range: -9 to +1</i>)	-2.42 [-3.68, -1.16]	-2.44 [-4.00, -1.13]	-2.11 [-3.54, -1.38]
Behavioral			
Glucose monitoring (<i>range: 0-7</i>)	4.00 [0.00, 6.00]	4.00 [1.00, 6.00]	1.50 [0.00, 4.50]
Medication adherence [†] (<i>range: 0-7</i>)	7.00 [5.00, 7.00]	7.00 [6.00, 7.00]	5.50 [4.00, 7.00]
Affective			
Life satisfaction (<i>range: 5-35</i>)	20.00 [15.00, 26.00]	20.00 [15.00, 26.00]	20.00 [13.50, 26.00]
Diabetes distress (<i>range: 0-20</i>)	10.00 [4.00, 14.00]	9.00 [4.00, 14.00]	11.50 [7.50, 14.00]
Depressive symptoms (<i>range: 0-27</i>)	5.00 [3.00, 10.00]	6.00 [3.00, 10.00]	4.50 [3.00, 10.50]
Cognitive			
Diabetes-related self-efficacy [*] (<i>range: 8-40</i>)	32.00 [28.00, 36.00]	32.00 [29.00, 36.00]	28.00 [25.00, 33.50]
Diabetes knowledge (<i>range: 0-24</i>)	19.00 [16.00, 21.00]	19.00 [17.00, 21.00]	18.00 [15.00, 20.00]
Problem-solving [*] (<i>range: 1-5</i>)	3.78 [3.33, 4.00]	3.78 [3.44, 4.11]	3.44 [2.89, 3.89]
Experiential			
Objective participation (<i>range: weighted z-scores -3 to 3</i>)	-0.09 [-0.25, 0.13]	-0.01 [-0.25, 0.15]	-0.18 [-0.26, -0.03]
Participation satisfaction (<i>range: -4 to +4</i>)	-0.05 [-0.58, 0.44]	-0.01 [-0.58, 0.46]	-0.17 [-0.91, 0.30]
Stressful life events (<i>range: 0-24</i>)	4.00 [3.00, 7.00]	4.00 [2.00, 6.26]	4.50 [3.00, 7.00]

^{*} Wilcoxon rank sum test or Fisher exact test $P < 0.05$ for difference by diabetes type at baseline

[†] Wilcoxon rank sum test $P < 0.01$ for difference by diabetes type at baseline

Table 2.

REAL Baseline Univariate Associations with A1C and DQoL

Characteristic	A1C			DQoL	
	Median (IQR), %	Median (IQR), mmol/mol	<i>P</i> -value (Wilcoxon rank sum test)	Median (IQR)	<i>P</i> -value (Wilcoxon rank sum test)
Gender					
Male	10.2 [9.5, 11.6]	88 [80, 103]	0.88	−2.06 [−3.63, −1.28]	0.26
Female	10.4 [9.3, 11.7]	90 [78, 104]		−2.68 [−4.32, −1.13]	
Birthplace					
US	10.6 [9.4, 12.1]	92 [79, 109]	0.17	−2.52 [−3.87, −1.13]	0.37
Other	10.1 [9.3, 11.4]	87 [78, 101]		−2.16 [−2.84, −1.28]	
Ethnicity					
Latino	10.7 [8.7, 12.1]	93 [72, 109]	0.95	−3.54 [−4.95, −2.06]	0.07
Other	10.3 [9.4, 11.7]	89 [79, 104]		−2.35 [−3.63, −1.11]	
Recruitment					
Clinic	10.4 [9.5, 11.4]	90 [80, 101]	0.72	−2.11 [−3.50, −1.13]	0.10
Social media	10.5 [9.2, 12.5]	91 [77, 113]		−2.92 [−4.43, −1.35]	
Diabetes type					
Type 1	10.1 [9.3, 11.4]	87 [78, 101]	0.12	−2.44 [−4.00, −1.13]	0.59
Type 2	11.4 [9.7, 12.7]	101 [83, 115]		−2.11 [−3.54, −1.38]	
	A1C		DQoL		
	Spearman correlation coefficient	<i>P</i> -value	Spearman correlation coefficient	<i>P</i> -value	
Age	−0.09	0.42	−0.24	0.03	
Diabetes duration	−0.06	0.61	−0.01	0.95	

Table 3.

Correlates of A1C and DQoL

Psychosocial and Behavioral Factor	Correlation Coefficient	P-value [*]	P-value [†]	P-value [‡]
Association with A1C				
DQoL	−0.14	0.20	0.17	0.08
<u>Behavioral</u>				
SMBG	−0.33	0.003	0.01	--
Medication adherence	−0.26	0.02	0.06	--
In-clinic recruit	−0.03	0.85	0.47	--
Social media/mass mailing recruit	−0.46	0.003	0.01	--
<u>Affective</u>				
Life satisfaction	−0.04	0.71	0.97	1.00
Diabetes distress	0.19	0.09	0.07	0.07
Depressive symptoms	0.27	0.02	0.01	0.02
<u>Cognitive</u>				
Diabetes self-efficacy	−0.11	0.32	0.58	0.57
Immigrant	−0.52	0.02	0.12	0.28
US Born	−0.00	0.98	0.89	0.78
Problem solving	−0.08	0.46	0.81	0.54
Diabetes knowledge	−0.14	0.21	0.35	0.28
<u>Experiential</u>				
Objective participation	0.09	0.43	0.23	0.09
Participation satisfaction	−0.23	0.04	0.08	0.03
Type 1 diabetes	−0.37	0.004	0.01	0.002
Type 2 diabetes	0.22	0.35	0.07	0.04
Stressful life events	0.12	0.29	0.25	0.28
Type 1 diabetes	0.28	0.03	0.01	0.01
Type 2 diabetes	−0.45	0.05	0.39	0.17
Association with DQoL				
<u>Behavioral</u>				
SMBG	−0.07	0.53	0.20	--
Medication adherence	0.08	0.49	0.88	--
<u>Affective</u>				
Life satisfaction	0.23	0.04	0.04	0.03
Type 1 diabetes	0.34	0.01	0.01	0.01
Type 2 diabetes	−0.19	0.42	0.26	0.28
Immigrant	−0.21	0.35	0.86	0.61
US Born	0.32	0.01	0.02	0.02
Diabetes distress	−0.46	<0.0001	<0.0001	<0.0001
Depressive symptoms	−0.39	0.0003	0.0003	0.0002
<u>Cognitive</u>				
Diabetes self-efficacy	0.01	0.96	0.92	0.72

Psychosocial and Behavioral Factor	Correlation Coefficient	<i>P</i> -value [*]	<i>P</i> -value [†]	<i>P</i> -value [‡]
Problem solving	0.06	0.60	0.25	0.09
Male	0.41	0.03	0.07	0.06
Female	−0.13	0.35	0.89	0.60
Diabetes knowledge	−0.08	0.50	0.97	0.91
<u>Experiential</u>				
Objective participation	−0.15	0.19	0.62	0.53
Participation satisfaction	0.24	0.03	0.01	0.01
Stressful life events	−0.31	0.005	0.005	0.005

^{*} Unadjusted

[†] Adjusted for diabetes type, gender, Latino ethnicity, immigrant status, recruitment, age, and duration of diabetes

[‡] Adjusted for diabetes type, gender, Latino ethnicity, immigrant status, recruitment, age, duration of diabetes, glucose management, and medication adherence