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Demographic and Clinical Correlates of Diabetes-Related Quality of Life among Youth with Type 1 Diabetes

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Abstract

Objectives—To evaluate the reliability and cluster structure of the Pediatric Quality of Life Inventory Type 1 Diabetes Module 3.0 (PedsQL-T1DM) and associated subscales and to explore the associations between PedsQL-T1DM total score and demographic and clinical characteristics and clinical indicators among a large racially/ethnically diverse cohort of youth with type 1 diabetes.

Study design—Principal components analysis was conducted on responses from the PedsQL-T1DM child self-report forms completed by SEARCH for Diabetes in Youth study participants aged ≥5 years. Multivariate linear regression models were fit to examine the associations among PedsQL-T1DM total score, demographic and clinical characteristics, and clinical indicators.

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Preliminary results of this study were presented at the European Association for the Study of Diabetes Annual Meeting, Vienna, Austria, September 30, 2009 and the International Association of Pediatric and Adolescent Diabetes (ISPAD) Meeting, Miami, Florida, October 20, 2011.

The authors declare no conflicts of interest.

Results—The sample comprised 2602 youth with a mean age of 13.6 ± 4.1 years and a mean T1DM duration of 62.1 ± 47.0 months. Principal components analysis did not support the 5 existing PedsQL-T1DM subscales. In multivariate analyses, the PedsQL-T1DM total score was negatively and significantly associated with younger age (5–7 years), female sex, receiving insulin by injection (vs pump), having parents without a college degree, Medic-aid/Medicare insurance, and having a comorbid medical condition. Youth with poor glycemic control based on their age-specific hemoglobin A1c target values and those with depressive symptoms had significantly lower PedsQL-T1DM scores than their counterparts with good control and no or limited depressive symptoms.

Conclusion—This study has identified sociodemographic and clinical characteristics of youth with T1DM more likely to experience poor diabetes-specific quality of life. The association of lower PedsQL-T1DM scores with depressive symptoms and poor glycemic control is especially concerning and may be the focus of future interventions and studies.

Children and adolescents with type 1 diabetes mellitus (T1DM) face many challenges, including the usual stressors encountered during these developmental periods, as well as the additional physical and emotional stressors associated with having and managing their diabetes.[1,2] Health-related quality of life (HRQOL) is a measure of the extent to which a medical condition influences the physical and psychosocial well being of an individual.[2] A major goal of diabetes care for youth and their families is good daily diabetes management without a reduction in HRQOL. HRQOL also serves as an outcome measure in clinical trials of diabetes treatments and interventions.[3–5] Previous reports indicate that youth with T1DM have a lower general quality of life compared with youth without diabetes.[6] The SEARCH Study has reported that being on Medicaid, receiving insulin injections (vs using an insulin pump), having poor glycemic control (>9%), and having medical comorbidities were all independently associated with lower general HRQOL in youth with T1DM.[7]

Diabetes-specific HRQOL provides a snapshot of an individual's perception of T1DM symptoms and treatment, as well as worries and communication issues specific to having T1DM. One diabetes-specific measure of HRQOL, the Pediatric Quality of Life Inventory Type 1 Diabetes Module 3.0 (PedsQL-T1DM),[6] was developed based on 237 youth with T1DM and includes a total score and 5 subscale scores. The Cronbach α coefficient and construct validity were reported for the total score and subscale scores in the original study, but the statistical analyses possibly used to verify the sub-scales were not reported.[6] The present study had 3 objectives: (1) to evaluate the reliability and cluster structure of the PedsQL-T1DM total and subscale scores; (2) identify demographic and clinical characteristics associated with diabetes-specific HRQOL; and (3) explore the associations between diabetes-specific HRQOL and selected clinical indicators, including depressive symptoms, glycemic control, episodes of diabetic ketoacidosis (DKA), hypoglycemia, hospitalizations, and emergency department (ED) visits, among a large, racially/ethnically diverse cohort of youth with T1DM.

Methods

SEARCH is a multicenter study that in 2001 began conducting population-based ascertainment of youth diagnosed with T1DM at age <20 years.[8] SEARCH recruited youth

from 4 geographically defined populations, Indian Health Service beneficiaries from 4 American Indian populations, and enrollees in several managed health care plans. Institutional review board(s) for each site approved the study protocol. All registered cases were asked to complete a brief initial survey; survey respondents were invited to a research visit. During this visit, informed consent and assent (when the individual with T1DM was aged <18 years) was obtained, questionnaires were administered, and physical measurements and fasting blood samples were obtained from metabolically stable participants (ie, no episodes of DKA during the previous month) after a minimum fast of 8 hours overnight.

All youth aged ≥5 years at the study visit were invited to complete the PedsQL-T1DM.[6] The PedsQL-T1DM is a 27-item multidimensional instrument developed to assess HRQOL specifically related to diabetes for use in children with T1DM. Age-specific child self-report forms for age groups 5–7, 8–12, 13–18, and ≥19 years were either read to the child or given to the child to read, depending on his or her reading skills. A total score and 5 subscale scores (diabetes symptoms, treatment barriers, treatment adherence, worry, and communication) can be calculated. Scores range from 0 to 100; higher scores indicate better HRQOL.

Age is based on age at the study visit and categorized based on the age-specific PedsQL-T1DM forms. Race/ethnicity is self-reported, using the standard census questions and categorized as Hispanic if of Hispanic ethnicity, by race if non-Hispanic, and as other/unknown race/ethnicity if multiple races or no race/ethnicity is reported. Highest level of parental education was based on the parent with the most education. Health insurance was categorized as private insurance, state/federally funded, other (including Indian Health Service, student health clinics, military, or other/unknown sources), or none.

Type of diabetes was based on the physician's clinical diagnosis. Medical comorbid conditions included asthma, kidney disease, celiac disease, hypertension, and polycystic ovarian syndrome based on self or parental report. Body mass index (BMI) was calculated using height/weight measurements obtained at the study visit. Age- and sex-specific percentiles for BMI *z*-scores were assessed using Centers for Disease Control and Prevention algorithms based on their 2000 growth charts.[9,10] Youth with a BMI *z*-score ≥95th percentile were categorized as obese, those with BMI *z*-score in the 85th to <95th percentile as overweight, those with BMI *z*-score >15th to <85th percentile as healthy weight, and those with BMI *z*-score <15th percentile as underweight.[11] Diabetes treatment was categorized as insulin injections <3 times/day, injections ≥3 times/day, or use of an insulin pump.

Glycemic control was based on glycated hemoglobin (HbA1c) measured in whole blood with an automated nonporous ion-exchange high-performance liquid chromatography system (model G-7; Tosoh Bioscience, Montgomeryville, Pennsylvania). To examine the association between diabetes-specific HRQOL and glycemic control, HbA1c values were categorized using the American Diabetes Association–recommended age-specific cutpoints for good control (<8.5% for age <6 years, <8.0% for age 6–12 years, <7.5% for age 13–18 years, and <7.0% for age ≥19 years).[12] Poor control was defined as >9.5% regardless of age,

based on the Diabetes Control and Complications Trial adolescent control group documenting risk for complications,[13] and intermediate control was defined as an HbA1c between those 2 values. Participants or their parents/guardians reported acute health care utilization (number of hospitalizations and ED visits for any reason) and acute complications (number of severe hypoglycemia and DKA episodes in the previous 6 months). To ensure that HbA1c was reflective of a period after the initial treatment regimen was established, and that hospitalizations and ED visits did not include those around the time of diagnosis, the sample was restricted to youth with diabetes of at least 1 year's duration. The presence of depressive symptoms was assessed for youth aged ≥10 years using the Center for Epidemiologic Studies Depression (CES-D) scale.[14] CES-D scores can range from 0 to 60 and are categorized as 0–15, none/minimal depressive symptoms; 16–23, mild depressive symptoms; or 24–60, moderate/severe depressive symptoms.[15–17]

Of the 4203 youths aged ≥5 years who completed a study visit from the prevalent 2001 and incident 2002–2005 cohorts, 1601 youth were excluded (for not having T1DM, not taking insulin, not having HbA1c measurements, or having diabetes duration <12 months), resulting in a sample of 2602 youth. The analysis of PedsQL-T1DM and depressive symptoms was limited to youth aged ≥10 years (n = 2027), because only these youth completed the CES-D scale.

Statistical Analyses

Cronbach's α was used to assess the internal consistency and reliability of total and subscale scores, as described by Varni et al.[6] Principal components analysis (PCA) using the SAS VARCLUS procedure (SAS Institute, Cary, North Carolina) was used to separate PedsQL-T1DM items into disjoint clusters.[18] The algorithm was constrained to produce only 5 clusters to determine whether they corresponded with the 5 originally published subscales[6] and then repeated to determine the actual number of clusters required to explain 60% and 80% of the total variance. Squared correlations between each variable and its assigned cluster (R^2_O), as well as between each variable and its next nearest cluster (R^2_N), were computed. The ratio $(1–R^2_O)/(1–R^2_N)$ is reported as a measure of cluster fit, where smaller values of this ratio indicate well-separated clusters.

ANOVA F-tests were used to test for unadjusted differences in mean total score by categorical demographic characteristics, clinical characteristics, and clinical indicators. Pearson correlation coefficients were calculated for the PedsQL-T1DM total score and HbA1c and CES-D scores. A multivariate linear regression model was fit to examine the independent associations between demographic and clinical characteristics and the PedsQL-T1DM total score. Then separate multiple linear regression models were fit for each clinical indicator to determine an associate with PedsQL-T1DM total score, after adjustment for demographic and clinical characteristics. Although no minimum clinically important difference (MCID) has been reported for the PedsQL-T1DM 3.0,[6] the differences for the Pediatric Quality of Life Inventory 4.0 Generic Core Scales is 4.5 points,[19] so we considered this the reference value. All analyses were performed with SAS version 9.2 (SAS Institute).

Results

The study sample comprised 2602 youth (mean age, 13.6 ± 4.1 years) who had T1DM for a mean duration of 62.1 ± 47.0 months and had a mean HbA1c value of 8.5% ± 1.6%. Three-quarters were non-Hispanic white, 50% were male, and ≈80% had a parent with at least some college education and were privately insured. Approximately half of the youth in the cohort used multiple daily insulin injections, and 22% used an insulin pump.

PedsQL-T1DM Scale Reliability and PCA

The Cronbach α coefficient for the PedsQL-T1DM total score was ≥0.80 for all age groups (Table I), exceeding the threshold of 0.70 for scale reliability.[20] Individual subscale score coefficients were more variable. The orthoblique PCA assuming 5 clusters explained only 42.7% of the total variation in PedsQL-T1DM item responses, and the items did not load on the predesignated subscales (Table II; available at www.jpeds.com). Eleven clusters were required to explain at least 60% of the variance, and 18 clusters were required to explain at least 80% of the variance (data not shown). Given these findings, we conducted the remainder of the analyses using just the PedsQL-T1DM total score.

Demographic and Clinical Characteristics and PedsQL-T1DM

We observed significant variability in the PedsQL-T1DM total score by participants' demographic and clinical characteristics (Table III). The PedsQL-T1DM total score was significantly associated with all demographic characteristics and with all clinical characteristics except diabetes duration. Because a statistical interaction was reported for sex and age category for the PedsQL generic scores,[7] we examined mean total scores by age category and sex and found minimal sex differences for 5- to 7-year olds and 8- to 12-year-olds (data not shown), with lower scores for adolescent (aged 13–18 years) females compared with males (females, 72.2 ± 13.2 years; males, 76.1 ± 11.9 years; $P < .001$) and young adults (≥19 years; females, 67.3 ± 14.0 years; males, 73.2 ± 12.8 years; $P < .001$).

Most demographic and clinical characteristics remained associated with PedsQL-T1DM total score in the multivariate model. Females aged 5–7 years whose parents had less than a college degree and who had Medicaid/Medicare insurance had the lowest PedsQL-T1DM scores. In addition, youth who took insulin by injection (vs a pump), and those with a medical comorbidity had lower PedsQL-T1DM total scores. The statistical interaction between age and sex persisted after adjustment for other demographic and clinical variables in the multivariate analysis (data not show), but had minimal impact on the other covariates in the model. Age was the sole variable to demonstrate both a statistically significant difference and an MCID for the PedsQL-T1DM total score.

Clinical Indicators and PedsQL-T1DM

Both HbA1c and CES-D scores were modestly correlated with PedsQL-T1DM total score ($r = -0.232$ and -0.568, respectively; $P < .0001$ for both). The magnitude of the correlation between HbA1c and PedsQL-T1DM total score varied by age category: 5–7 years, $r = -0.096$; 8–12 years, $r = -0.198$; 13–18 years, $r = -0.303$; ≥19 years, $r = -0.230$. The PedsQL-T1DM total score was associated with all clinical indicators in the unadjusted and

multivariate models (Table IV). The strongest association was observed between PedsQL-T1DM total score and depressive symptoms. Compared with youth with minimal or no depressive symptoms, youth with mild depressive symptoms had a 10.8-point lower average total score, and those with moderate/severe depressive symptoms had a 19.2-point lower average total score ($P < .0001$ for both). Compared with youth with good glycemic control, youth with intermediate control had 3.2-point lower average total score, and those with poor control had a 7.0-point lower average total score ($P < .0001$ for both). Episodes of hypoglycemia and DKA demonstrated similar patterns, but the magnitudes of the differences were much less pronounced than those for depression or glycemic control.

Discussion

We found that the 5 original subscales of the PedsQL-T1DM module were not supported by our PCA. A 5-cluster solution explained only ~43% of the total variation among item responses. Our conclusions are consistent with those of Nansel et al,[21] who conducted a similar analysis on responses from 447 youth with T1DM using PCA with a promax rotation and concluded that the PedsQL-T1DM total score, but not the original subscales, was the most appropriate unit for analysis. Their 5-factor structure differed from our 5-cluster solution, perhaps because of differences in analytic approaches or study populations. Varni et al[6] used focus groups, cognitive interviews, and field testing to develop this module, but to the best of our knowledge did not conduct PCA or any other similar analyses to confirm the statistical properties of their subscales.

Our study found significant independent associations between PedsQL-T1DM total score and demographic and clinical characteristics in a large, diverse cohort of youth with T1DM. The largest differences by demographic characteristics were those observed by age group, with the youngest children having the lowest total scores. There are only 3 response options for children aged 5–7 years, compared with 5 for children aged 8 years and older, a difference that might have contributed to some of the differences in scores by age. Females also tended to have lower HRQOL than males, with sex differences emerging in the teenage years, a finding consistent with that reported by Hoey et al from the multinational Hvidøre Study.[22] The differences in PedsQL-T1DM mean total score by race/ethnicity were not statistically significant after adjustment for other characteristics, likely due in part to the relatively small number of Native American youth included in the study (n = 18).

No significant differences in HRQOL by BMI category were seen after adjusting for other demographic and clinical characteristics for either diabetes-specific HRQOL or generic HRQOL, as reported previously.[7] In contrast, the Hvidøre Study Group reported that greater BMI was associated with poorer diabetes-specific HRQOL in more than 2000 adolescents with T1DM assessed using the Diabetes Quality of Life Questionnaire.[22,23] Schwimmer et al[24] found that severely-obese youth (mean BMI, 34.7) had much lower HRQOL scores compared with healthy-weight children, having scores similar to children with cancer, and Williams et al[25] reported smaller but significant differences in HRQOL across weight groups in a community sample. Our findings may suggest that in this US-based cohort, being overweight or obese in addition to having T1DM is not associated with the same reduction in HRQOL seen in otherwise healthy children. We also observed minimal

differences in HRQOL for children with comorbid medical conditions, suggesting that the PedsQL-T1DM is less sensitive to differences in HRQOL not related to diabetes.

Among the clinical indicators, the strongest association was with depressive symptoms in youth aged ≥10 years. The PedsQL-T1DM total score was 20 points lower in youth with moderate/severe depressive symptoms compared with youth with no or minimal symptoms. Given that both HRQOL and depression are psychological constructs, this finding is not unexpected. The negative correlation between the CES-D and the PedsQL-T1DM scores was moderately high ($r = -0.57$) and consistent with that reported by Nansel et al ($r = -0.54$).[21]

We found a dose-response relationship between glycemic control and PedsQL-T1DM score, with the highest scores in youth with good control. HbA1c and the PedsQL-T1DM total score were modestly negatively correlated ($r = -0.232$), slightly less so than reported by Ingerski et al ($r = -0.28$),[26] but more so than reported by Nansel et al ($r = -0.08$ and -0.09).[21] Varni et al[6] found no significant correlation. The Hvidøre Study found an association between lower mean HbA1c value and better HRQOL,[22] and Hassan et al[27] also reported an inverse association between PedsQL-T1DM total score and HbA1c. It is possible that persons with higher HRQOL, which we found to be associated with markers of better socioeconomic status (ie, having private insurance, higher parental education, being on an insulin pump), might have more resources to aid in achieving good control, but we cannot infer a causal association from cross-sectional data.

Given our large sample, the issue of statistical versus clinical significance should be addressed. In most cases, statistical differences in demographic data and clinical characteristics did not achieve the MCID for the total score that was recommended for the PedsQL generic scale except as previously noted for age, whereas the differences for depression and glycemic control categories exceeded these thresholds.

Although other measures of psychological distress might be associated with HRQOL, these measures are not included in the SEARCH study protocol. Similarly, we did not evaluate issues related to family relationships, which also might be associated with HRQOL in youth with T1DM.[28] The cross-sectional nature of these data precluded us from examining the direction of associations between variables of interest, such as whether lower HRQOL drives poorer glycemic control and elevated depressive symptomatology, or vice versa. In addition, we were unable to assess temporal trends, such as whether HRQOL increases from childhood to adolescence and then declines in later adolescence. Despite extensive efforts to optimize recruitment, older youth were less likely to participate in the study visit than those diagnosed at younger ages.[29] The majority of youth in these analyses were insured privately or through government-funded programs. Even though these results might not be generalizable to uninsured youth, the majority of youth with T1DM will be eligible for insurance under subsidized programs if they cannot afford private insurance.

Major strengths of the present study include the use of a validated measure of diabetes-specific HRQOL, as well as extensive clinical and demographic measures in a large diverse cohort of more than 2500 US youth with T1DM. The smaller number of Asian, Pacific

Islander, and Native American youth in this analysis is consistent with the lower prevalence of T1DM in these groups compared with other racial/ethnic groups.[30]

The findings of this study highlight demographic and clinical characteristics of youth with T1DM who are more likely to experience poor diabetes-specific HRQOL. Our data also suggest that in the presence of lower diabetes-specific HRQOL, a number of indicators of poor clinical functioning also may be affected, most importantly increased depressive symptoms and poor glycemic control. These findings are important for clinicians and researchers alike who are providing clinical care or conducting studies of demographically diverse youth with T1DM. In the clinical setting, poor glycemic control can be readily identified using laboratory test results, but depressive symptoms and poor or worsening diabetes-specific HRQOL might not be. Our findings suggest that in the presence of poor glycemic control, screening for depressive symptoms or poor diabetes-specific HRQOL may be warranted. In addition, clinic-based strategies aimed at preventing the development and/or worsening of diabetes-specific HRQOL also may benefit from the inclusion of strategies for reducing depressive symptoms. Future research studies should investigate whether these interventions may ultimately promote better disease management, subsequently improving glycemic control for this pediatric population.

Acknowledgments

Funding information is available at www.jpeds.com (Appendix 2). The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

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Glossary

BMI	Body mass index
CES-D	Center for Epidemiologic Studies Depressionl
DKA	Diabetic ketoacidosis
ED	Emergency department
HbA1c	Glycated hemoglobin
HRQOL	Health-related quality of life
MCID	Minimum clinically important difference
PCA	Principal components analysis
PedsQL-T1DM	Pediatric Quality of Life Inventory Type 1 Diabetes Mellitus
T1DM	Type 1 diabetes mellitus

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Appendix 1

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Appendix 2

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Table I

Standardized Cronbach α values for PedsQL-T1DM total and subscale scores by age category

Scale	Total (n = 2602)	5–7 years (n = 286)	8–12 years (n = 892)	13–18 years (n = 1135)	≥19 years (n = 289)
Diabetes symptoms	0.78	0.64	0.79	0.79	0.84
Treatment barriers	0.56	0.51	0.57	0.59	0.54
Treatment adherence	0.59	0.55	0.55	0.62	0.65
Worry	0.71	0.72	0.72	0.68	0.70
Communication	0.90	0.71	0.91	0.93	0.85
Total score	0.85	0.80	0.86	0.86	0.89

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Table II

Identification of 5 clusters using oblique principal component cluster analysis on the PedsQL-T1DM individual item responses from 2602 youth with type 1 diabetes

	Squared correlation of items with assigned cluster (R^2_O)					
Original subscale items	**Cluster 1**	**Cluster 2**	**Cluster 3**	**Cluster 4**	**Cluster 5**	**Cluster fit: $(1-R^2_O)/(1-R^2_N)$***
Diabetes symptoms						
Feeling hungry			0.397			0.631
Feeling thirsty			0.512			0.522
Having to go to the bathroom often			0.435			0.623
Stomach aches			0.400			0.649
Headaches			0.308			0.731
Going low					0.445	0.579
Feeling tired or fatigued			0.352			0.704
Getting shaky					0.606	0.430
Getting sweaty					0.487	0.572
Problems sleeping			0.378			0.690
Problems with getting irritable			0.342			0.731
Treatment barriers						
Needle pain	0.200					0.860
Getting embarrassed by diabetes	0.250					0.828
Arguing with parents about diabetes	0.259					0.783
Sticking with diabetes care	0.409					0.580
Treatment adherence						
Testing blood glucose	0.352					0.694
Problems taking insulin	0.168					0.857
Problems with exercise	0.254					0.825
Problems tracking carbohydrates	0.333					0.732
Problems wearing ID	0.050					0.959
Problems carrying fast-acting carbohydrates	0.351					0.681
Problems eating snacks	0.212					0.824
Worry						

Original subscale items	Squared correlation of items with assigned cluster (R^2_O)					Cluster fit: $(1-R^2_O)/(1-R^2_N)$*
	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	
Worry about going low				0.542		0.514
Worry about medical treatments				0.682		0.380
Worry about complications				0.688		0.400
Communication						
Telling doctors how I feel		0.857				0.158
Problem asking doctors questions		0.866				0.144
Problems explaining illness to others		0.770				0.250
Number in cluster	11	3	8	3	3	-
Variation explained by cluster	2.918	2.492	3.124	1.891	1.540	-

ID, identification.

Total variation explained = 11.966; proportion = 0.427.

*Smaller values of this ratio indicate well-separated clusters.

Table III

Characteristics of study sample and associations between demographic and clinical characteristics and mean PedsQL-T1DM total scores for youth aged ≥5 years with T1DM for at least 1 year (n = 2602)

		PedsQL-DM total score		Results from the multivariate linear regression model		
	All youth (n = 2602), n (%)for total sample	**Mean (SD)**	***P* value* unadjusted**	**β**	**95% CI**	***P* value for variable in model**
Demographic characteristics						
Age category, years			<.0001			<.0001
5–7	286 (11.0)	69.0 (13.7)		−7.66	−9.40 to −5.92	
8–12	892 (34.3)	76.8 (13.5)		Reference		
13–18	1135 (43.6)	74.2 (12.7)		−2.77	−3.94 to −1.60	
≥19 years	289 (11.1)	70.3 (13.7)		−6.27	−8.13 to −4.41	
Sex			<.0001			<.0001
Male	1301 (50.0)	75.5 (12.8)		Reference		
Female	1301 (50.0)	72.6 (13.9)		−2.88	−3.88 to −1.87	
Race/ethnicity			<.0001			.1797
Non-Hispanic white	1957 (75.2)	74.8 (13.0)		Reference		
Hispanic	309 (11.9)	71.9 (14.3)		−1.43	−3.08 to 0.23	
Black	178 (6.8)	71.4 (14.5)		−1.02	−3.09 to 1.05	
Asian/Pacific Islander	44 (1.7)	74.0 (14.6)		1.30	−2.60 to 5.20	
Native American	18 (0.7)	66.7 (18.3)		−6.25	−12.60 to 0.10	
Other/unknown	96 (3.7)	73.3 (14.4)		0.47	−2.21 to 3.16	
Highest parental education			<.0001			.0232
<High school graduate	112 (4.3)	71.6 (16.2)		0.97	−1.81 to 3.76	
High school graduate or GED	433 (16.7)	73.3 (13.6)		Reference		
Some college	861 (33.2)	75.8 (12.6)		0.53	−0.99 to 2.04	
≥Bachelor degree	1184 (45.7)	71.8 (14.2)		2.03	0.51 to 3.54	
Health insurance			<.0001			.0004
Private	2088 (80.4)	75.0 (12.9)		Reference		
Medicaid/medicare	422 (16.3)	70.2 (14.2)		−3.09	−4.60 to −1.59	
Other	42 (1.6)	74.5 (15.5)		0.55	−3.51 to 4.60	
None	45 (1.7)	68.8 (16.5)		−3.39	−7.30 to 0.51	

		PedsQL-DM total score		Results from the multivariate linear regression model		
	All youth (n = 2602), n (%)for total sample	**Mean (SD)**	***P* value* unadjusted**	**β**	**95% CI**	***P* value for variable in model**
Clinical characteristics						
Diabetes duration			.7116			.6669
1 year to <3 years	993 (38.2)	74.3 (13.8)		Reference		
3 years to <6 years	712 (27.4)	74.1 (13.8)		−0.49	−1.75 to 0.77	
≥6 years	897 (34.5)	73.8 (12.8)		−0.50	−1.78 to 0.78	
Diabetes treatment			<.0001			<.0001
Insulin <3 times/day	767 (29.5)	73.2 (13.6)		−3.21	−4.68 to −1.72	
Insulin ≥3 times/day	1261 (48.5)	73.2 (13.9)		−3.41	−4.73 to −2.09	
Insulin pump	574 (22.1)	77.2 (11.8)		Reference		
BMI percentile category†			.0337			.2785
Obese	301 (11.6)	73.4 (14.3)		−0.38	−1.99 to 1.23	
Overweight	571 (21.9)	73.4 (13.6)		−0.53	−1.78 to 0.72	
Healthy weight	1612 (62.0)	74.6 (13.4)		Reference		
Underweight	118 (4.5)	71.7 (11.8)		−2.33	−4.78 to 0.12	
Medical comorbidity‡			.0198			.0468
Yes	548 (21.1)	72.9 (13.7)		−1.26	−2.50 to −0.02	
No	2054 (78.9)	74.4 (13.4)		Reference		

GED, General Education Diploma.

Percentages might not add up to 100% because of rounding.

** P* values compare the distribution of total score by strata of demographic and clinical characteristics using ANOVA.

†BMI is based on measured height and weight at the study visit; youth with a BMI *z*-score ≥95th percentile were categorized as obese, 85th to <95th percentiles as overweight, >15th percentile to <85th percentile as healthy weight, and <15th percentile as underweight.

‡Medical comorbidities included asthma, kidney disease, celiac disease, hypertension, or polycystic ovarian syndrome based on self or parental report.

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Table IV

Mean PedsQL-T1DM total score and unadjusted and adjusted associations with clinical indicators for youth aged ≥5 years with T1DM for at least 1 year (n = 2602)

			Unadjusted			Adjusted*		
All youth (n = 2602), % in each category	**Total score, mean (SD)**		**β**	**95% CI**	***P* value**	**β**	**95% CI**	***P* value**
Glycemic control category†								
Good	32.3	77.4 (12.8)	-	-	-	-	-	-
Intermediate	47.6	73.9 (13.0)	−3.47	−4.62 to −2.31	<.0001	−3.15	−4.32 to −1.99	<.0001
Poor	20.1	69.1 (14.1)	−8.32	−9.75 to −6.88	<.0001	−6.98	−8.54 to −5.43	<.0001
Hypoglycemic episodes in past 6 months								
0	88.1	74.3 (13.5)	-	-	-	-	-	-
1	6.6	74.3 (12.5)	−0.01	−2.10 to 2.07	.9890	1.16	−0.88 to 3.19	.2646
≥2	5.3	69.7 (14.0)	−4.59	−6.90 to −2.28	.0001	−3.66	−5.90 to −1.43	.0013
Hospitalizations in past 6 months								
0	93.3	74.5 (13.3)	-	-	-	-	-	-
1	5.0	70.2 (14.0)	−4.27	−6.62 to −1.92	.0004	−2.50	−4.81 to −0.19	.0342
≥2	1.7	62.7 (11.6)	−11.81	−15.84 to −7.78	<.0001	−8.22	−12.16 to −4.29	<.0001
ED visits in past 6 months								
0	79.6	74.9 (13.1)	-	-	-	-	-	-
1	15.4	72.0 (14.0)	−2.90	−4.32 to −1.47	<.0001	−1.75	−3.15 to −0.36	.0140
≥2	5.0	66.8 (15.1)	−8.10	−10.47 to −5.73	<.0001	−5.34	−7.69 to −3.00	<.0001
DKA episodes in past 6 months								
0	88.2	74.5 (13.2)	-	-	-	-	-	-
1	7.2	71.3 (15.2)	−3.21	−5.21 to −1.22	.0016	−2.82	−4.77 to −0.87	.0046
≥2	4.6	70.1 (14.3)	−4.37	−6.84 to −1.91	.0005	−3.60	−6.00 to −1.20	.0033
Depressive symptom category‡								
None/minimal	81.1	77.2 (11.4)	-	-	-	-	-	-
Mild	12.2	65.9 (12.1)	−11.29	−12.85 to −9.73	<.0001	−10.81	−12.35 to −9.27	<.0001
Moderate/severe	6.7	56.5 (14.2)	−20.71	−22.77 to −18.66	<.0001	−19.18	−21.24 to −17.12	<.0001

* Each model is adjusted for age group, sex, race/ethnicity, parental education, health insurance status, duration of diabetes, insulin treatment, BMI category, and presence of any comorbidity.

† Good control is defined as 7.5%–8.5% at age <6 years, <8.0% for age 6–12 years, <7.5% for age 13–18 years, and <7.0% for age >19 years; poor control was defined as >9.5% regardless of age; and intermediate control is between these 2 values.

‡ The CES-D scale was administered to respondents aged ≥10 years at the time of the study visit (n = 2027).