Psychosocial Factors Predicting Healthcare Usage in Young Adults with Youth-Onset Type 2 Diabetes: The TODAY2 *i*Count Observational Study

Paula M. Trief, PhD[1] , *Diane Uschner, PhD[2], Barbara J. Anderson, PhD[3], Hui Wen, MPH[2], Jane D. Bulger, MS[4], and Ruth S. Weinstock, MD, PhD[4]*

[1]Department of Psychiatry and Behavioral Sciences, State University of New York Upstate Medical University, NY, Syracuse, USA; [2]The Biostatistics Center, George Washington University, Washington, DC, USA; [3]Department of Pediatrics-Psychology, Baylor College of Medicine, Houston, TX, USA; [4]Department of Medicine, State University of New York Upstate Medical University, NY, Syracuse, USA

ABSTRACT

BACKGROUND: Established diabetes care ("diabetes home") and regular healthcare visits are important to achieve optimal health. Nothing is known about psychosocial factors that predict healthcare usage (HCU) in young adults with youth-onset type 2 diabetes, at risk for early complications.

OBJECTIVE: To identify psychosocial predictors of HCU in the Treatment Options for type 2 Diabetes in Adolescents and Youth (TODAY2) cohort.

DESIGN: Longitudinal, measured at T1 (baseline) and T2 (1 year later). Logistic and linear regressions, adjusted for potential confounders, identified predictors of sub-optimal HCU (defined as no diabetes home, 0 visits for routine care, or ≥ 1 urgent care visit in prior 6 months).

PARTICIPANTS: $N = 366$ TODAY2 participants with T1 and T2 data (381 consented). Mean age $= 26.0$ years, 67.8% female, 37.7% non-Hispanic Black, 35.8% Hispanic, 20.2% non-Hispanic white, 6.3% "other," mean HbA1c $= 9.4\%$.

MAIN MEASURES: HCU survey; reliable and valid measures of diabetes self-efficacy, depressive symptoms, anxiety symptoms, diabetes distress, beliefs about medicines, diabetes attitudes, material need insecurities, self-management support.

KEY RESULTS: 25.4% had no diabetes home, 23.7% had 0 routine care visits, 46% had ≥ 1 urgent care visit (prior 6 months). Beliefs in the necessity of (adjusted odds ratio [OR] $= 1.28$; 95% confidence interval [CI] $= 1.12, 1.46$, $p < 0.001$), and concerns about (OR $= 1.29$; CI $= 1.08, 1.54$, $p = 0.004$), diabetes medicines, and its negative psychosocial impacts (OR $= 1.57$; CI $= 1.04, 2.38$, $p = 0.03$), predicted higher odds of having a diabetes home at T2. Beliefs that medicines are harmful predicted lower odds of a diabetes home (OR $= 0.56$; CI $= 0.37, 0.85$, $p = 0.006$). Necessity beliefs (OR $= 1.2$; CI $= 1.06, 1.36$, $p = 0.004$), and self-management support (OR $= 1.5$; CI $= 1.08, 2.07$, $p = 0.01$) predicted higher odds of having ≥ 1 diabetes care visit, harm beliefs predicted lower odds (OR $= 0.6$; CI $= 0.41, 0.88$, $p = 0.01$).

CONCLUSIONS: Sub-optimal healthcare usage, common in young adults with youth-onset type 2 diabetes, is predicted by beliefs about medicines, diabetes impact, and self-management support. We must address these factors to help this vulnerable group establish stable diabetes care.

KEY WORDS: type 2 diabetes; young adults; healthcare usage; psychology; social determinants of health.

There has been a marked increase in incidence and prevalence of youth-onset type 2 diabetes (T2D, diagnosed before 18 years of age).[1] Compared to adult-onset T2D, youth-onset T2D is associated with poorer health outcomes, including shorter time to onset of complications, and greater number of complications.[2] The majority of those with youth-onset T2D are poor and members of racial/ethnic minority groups, groups with consistently poorer health outcomes.[3,4]

Regular attention from one's medical team is needed to support self-management (medications, lifestyle). In young adults with type 1 diabetes, care is often disrupted when moving from pediatric healthcare systems, this disruption results in poorer health.[5] The Search for Diabetes in Youth Study (SEARCH), studying healthcare usage of young adults with youth-onset T2D, compared usage when they were < 18 years to usage as young adults (18–25 years). SEARCH found 29% did not transfer from pediatric to adult care providers, 15% had no usual diabetes care provider. Also, those who transferred and those who had no care, had a higher likelihood of poor glycemic control.[6]

TODAY (Treatment Options for Diabetes in Adolescents and Youth Study), an intervention trial, enrolled a large, diverse cohort of youth with T2D.[7] TODAY2 was a follow-up, observational study extending into young adulthood. Annual assessments included interviewer-administered healthcare usage questions. TODAY2 and SEARCH investigators (combined data) reported that, in TODAY2/SEARCH cohorts, 13.3%/18.4% lacked healthcare coverage, 26.6%/21.9% had no usual diabetes care provider ("diabetes home"), and 26.4%/19.5% had not seen

any diabetes care provider in the prior 6 months. Those with T2D were more likely than those with T1D to lack a diabetes home, lack healthcare coverage, and have fewer diabetes care visits.[8]

Nothing is known about psychosocial factors that may predict suboptimal healthcare usage in young adults with youth-onset T2D. Identifying risk factors is key to successful intervention. Psychological (e.g., diabetes distress) and social (e.g., material need insecurities) factors are consistently associated with poor diabetes outcomes, and disproportionately affect poor, minority individuals.[3] Our objectives were to assess the prevalence of, and individual factors predictive of, suboptimal healthcare usage in young adults with youth-onset T2D, defining "suboptimal" as lacking a usual diabetes care provider, and having no routine diabetes care visits, or having ≥ 1 urgent care visit, in the prior 6 months.

METHODS
TODAY, TODAY2, *i*Count

Fifteen U.S. centers recruited youth and adolescents ($N=699$) to participate in TODAY if they were 10 to < 18 years old, diagnosed with T2D (American Diabetes Association 2002 criteria) < 2 years, with body mass index ≥ 85th percentile, negative islet cell autoantibodies, and fasting C-peptide > 0.6 ng/mL. They were randomized to one of three treatments (metformin, metformin + rosiglitazone, metformin + lifestyle intervention) and followed for 2–6 years (2004–2011) to assess treatment effects on primary (time-to-treatment-failure) and secondary (e.g., complications) outcomes.[7] After TODAY, 572 participants enrolled in TODAY2, an observational follow-up study. They received care in their communities, no medications were provided, and underwent annual assessments (2014–2020). [See Supplementary Appendix for details about TODAY and TODAY2. TODAY/TODAY2 publications at https://scholar.google.com/citations?hl=en&user=dgbLBa4AAAAJ].

*i*Count, a TODAY2 ancillary study (7/2017–2/2019), included independent data collection and access to TODAY2 data. TODAY2 participants aged 19–31 years were recruited at TODAY2 annual visits (T1 = *i*Count baseline visit), written informed consent included permission to access TODAY2 data. All other assessments (e.g. HbA1c, complications/comorbidities) were performed per TODAY2 protocols.[7] TODAY, TODAY2 and *i*Count were approved by Institutional Review Boards at 15 centers (IRB approval #1032847 at primary institution). Participants received financial compensation for assessment time.

MEASURES
Healthcare Usage Survey

TODAY and SEARCH jointly developed an interviewer-directed survey to assess healthcare usage and coverage. Questions were adapted from the Household Component of the Medical Expenditure Panel Survey (MEPS).[9,10] We analyzed data from 4 queries that were part of MEPS, administered at 2 annual visits, one year apart. Respondents were asked if they have a usual source of care for diabetes treatment ("diabetes home"), and how often they visited their diabetes provider, and went to a walk-in/urgent care facility, in the prior 6 months. Finally, they were asked if they had health care coverage (public or commercial coverage, and limited coverage through the Indian Health Service or Urban Indian Health Centers or tribal health programs) in the previous year.

Psychosocial Measures

Participants completed psychosocial questionnaires at *i*Count enrollment visits (T1) and subsequent 1-year TODAY2 annual visits (T2). We categorize constructs as "psychological" (individually focused) or "social" (focused on relationships and societal factors). All measures have shown excellent reliability and validity (see references for each measure). Some were developed specifically for, others used routinely with, persons with diabetes.

Psychological Measures.

1. Beliefs about Medicines Questionnaire (BMQ).[11] Two 5-item scales (range: 5–25) measure beliefs in the "necessity" of (e.g., "My medicines protect me from getting worse"), and "concerns" about (e.g., "I worry about the long-term effects of my medicines"), diabetes medicines. Two 4-item scales (range: 4–20) measure beliefs that, in general, medicines are "overused" (e.g., "Doctors use too many medicines") or "harmful" (e.g., "Medicines do more harm than good.")
2. Diabetes Self-Efficacy Scale (DSES).[12] The 8-item DSES measures how confident one is in their ability to perform various self-care behaviors (range: 8–80).
3. Diabetes Attitudes Scale (DAS).[13] The 33-item DAS measures attitudes toward diabetes. To decrease assessment burden, we used 3 of the 5 subscales (range:1–5): perceived seriousness of diabetes, its psychosocial impact, and attitudes toward patient autonomy.
4. Patient Health Questionnaire-8 (PHQ-8).[14] The 8-item PHQ-8 measures the presence and severity of depressive symptoms in the prior 2 weeks (range: 0–20). Widely used to screen for major depressive disorder, a positive screening score is PHQ-8 ≥ 10,[15] or "moderate-to-severe depressive symptoms."
5. Generalized Anxiety Disorders Questionnaire-7 (GAD-7).[16] The 7-item GAD-7 measures the presence/severity of anxiety disorder symptoms in the prior 2 weeks (range: 0–21). Recommended to screen for anxiety disorders,[17] a positive screening score is GAD-7 ≥ 10, or "moderate-to-severe anxiety symptoms."

6. Problem Areas in Diabetes Scale (PAID-5).[18] The 5-item PAID-5 measures diabetes-related emotional distress (range: 0–20). It lists common diabetes-related concerns, respondents indicate the degree to which each is currently a problem; ≥ 8 defines "high" diabetes distress.

Social Measures.

1. Material Needs Insecurities Survey (MNIS).[19] Comprised of validated measures of selected material need insecurities/social determinants of health, respondents indicate whether each need was met/not met due to cost in the prior 12 months. MNIS subscales assessed food, housing, and medication insecurities. We added lack of healthcare coverage as a fourth insecurity.
2. Chronic Illness Resources Survey (CIRS).[20,21] The 22-item CIRS measures multi-level self-management support provided by family/friends, one's neighborhood, and larger community (range: 1–5). It lists resources that support self-care. Respondents indicate the extent to which they have used each resource in the prior 6 months.

Statistical Analyses

For descriptive purposes, data are summarized with means/standard deviations (continuous variables) and percentages (categorical variables). Outcomes of interest were having a diabetes home (Yes/No), number of diabetes care office visits (0 vs. ≥ 1) and number of urgent care visits (0 vs. ≥ 1) in prior 6 months. To determine the marginal associations of each factor with each outcome, we performed two sample t-tests and chi-square tests. Multivariable logistic regression models were performed to assess the association of psychosocial measures at T1 with the probability of each outcome at T2, adjusting for potential confounders. Covariates for the multivariable regression analyses were selected based on univariate analyses. For "having a diabetes home," we adjusted for T1-healthcare coverage status. For "number of diabetes care office visits," we adjusted for number of comorbidities/complications, diabetes in nuclear family and T1-healthcare coverage status. For "number of urgent care visits," we adjusted for gender, race/ethnicity, and T1-annual income. All analyses were exploratory. Data are presented as mean + SD, unless noted and were performed using SAS 9.4 (SAS Institute Inc, Cary, North Carolina).

RESULTS

Participants Of 572 TODAY2 participants, 411 were eligible for *i*Count (based on age) and were approached at annual visits. Of these, 381 consented to participate in *i*Count (30 or 7.3% refused). All enrollees completed the healthcare usage

Table 1 Participant Characteristics at T1 (Baseline)

Characteristic	T1 ($n = 366$)
Age (years)	26.0 ± 2.5
Gender	
Female	248 (67.8)
Male	118 (32.2)
Race/Ethnicity	
Hispanic	131 (35.8)
Black, non-Hispanic	138 (37.7)
White, non-Hispanic	74 (20.2)
Other	23 (6.3)
Education	
No high school diploma	34 (9.3)
High school or trade school	250 (68.3)
Associate's degree or higher	82 (22.4)
Annual Income	
Up to $34,999	281 (82.9)
$35,000 or greater	58 (17.1)
Employment Status	
Employed or student	280 (76.5)
Unemployed/Disabled	86 (23.5)
BMI (kg/m^2)	36.4 ± 8.5
Diabetes Duration (years)	12.4 ± 1.5
HbA1c (%)	9.4 ± 2.8
No. of Comorbidities/Complications	2.5 ± 1.4
Diabetes in Nuclear Family (yes)	215 (59.9)
Health Care Coverage Status	
No Healthcare Coverage	51 (13.9)
Have Healthcare Coverage	315 (86.1)
Routine Care for Diabetes *	
No	93 (25.4)
Yes	272 (74.3)
Number of routinely scheduled visits	
0 visits	69 (25.4)
≥ 1 visits	203 (74.6)
Number of urgent care visits	
0 visits	197 (54.0)
≥ 1 visits	168 (46.0)

Data are presented as mean $\pm$ SD or n (%). "Other" in Race/Ethnicity includes American Indian and non-Hispanic Asian. * One participant responded "refuse/do not know" at baseline visit

(HCU) survey at baseline (T1). Of these, 366 also completed it at follow-up (T2); they comprise the analysis group. It includes 248 (67.8%) females, 131 (35.8%) Hispanics, 138 (37.7%) non-Hispanic Blacks, 74 (20.2%) non-Hispanic whites, and 23 (6.3%) from "other" racial/ethnic groups (American Indian, non-Hispanic Asian). Mean age was 26.0 ± 2.5 years, mean diabetes duration was 12.4 ± 1.5 years, and mean HbA1c $= 9.4 \pm 2.8\%$. (Table 1:other participant characteristics; Table 2: T1 psychosocial data). Compared to those without T2 HCU data, the analysis group had higher BMI (36.4 ± 8.5 kg/m^2 vs. 32.9 ± 5.4 kg/m^2, $p = 0.03$, data not shown), but was otherwise similar.

Participant Factors Associated with Healthcare Usage: Unadjusted Analyses

1. Usual diabetes care provider: Approximately 25.4% did not have a usual place (e.g. doctor's office, clinic) for rou-

Table 2 Psychosocial Characteristics at T1 (Baseline)

	T1 ($n = 366$)
Psychological Factors	
Diabetes Attitudes Scale (DAS)	
Seriousness of diabetes	4.0 ± 0.5
Psychosocial impact of diabetes	4.0 ± 0.6
Attitude toward patient autonomy	3.7 ± 0.5
Beliefs about Medicines (BMQ)	
Specific Beliefs-Necessity	13.0 ± 9.3
Specific Beliefs-Concerns	9.6 ± 7.3
General Beliefs-Harm	9.6 ± 3.0
General Beliefs-Overuse	10.1 ± 3.2
Diabetes Self-Efficacy (DSES)	54.1 ± 16.3
Diabetes Distress (PAID)	4.7 ± 4.8
High Diabetes Distress (PAID ≥ 8)	89 (24.3)
Depression Score (PHQ8)	3.3 ± 4.4
Depression Symptoms (PHQ8)	
None-to-mild depression symptoms	322 (89.4)
Moderate-to-severe depression symptoms	38 (10.6)
Anxiety Score (GAD7)	2.5 ± 4.0
Anxiety Symptoms (GAD7)	
None-to-mild anxiety symptoms	335 (93.1)
Moderate-to-severe anxiety symptoms	25 (6.9)
Social Factors	
Chronic Illness Resources Survey (CIRS)	2.6 ± 0.7
Material Need Insecurity Survey (MNIS)	
Medication Insecurity (yes)	66 (34.7)
Food Insecurity (yes)	139 (45.1)
Housing Insecurity (yes)	101 (27.6)
Healthcare Coverage Insecurity (yes)	51 (13.9)
Reported ≥ 1 insecurity* (yes)	218 (74.2)
Reported ≥ 2 insecurities (yes)	98 (31.3)

Data are presented as mean $\pm$ SD or n (%). * Included those who had missing Medication insecurity but had reported one or more food, housing or healthcare coverage insecurities

tine diabetes care. A higher percentage of those lacking a diabetes home, vs. those with one, lacked healthcare coverage (33.3% vs. 6.5%, $p < 0.001$). Therefore, we adjusted for healthcare coverage status in prospective analyses when having a diabetes home was the outcome. (Table 3)

2. Number of diabetes care office visits: A higher percentage of those with 0 visits vs. those with ≥ 1 visit, lacked healthcare coverage (23.7% vs. 7.0%, $p < 0.001$). A smaller percentage of those with 0 visits had a family member with diabetes (53.7% vs. 64.3%, $p = 0.04$). The group with 0 visits had a smaller mean number of complications/comorbidities (2.3 ± 1.4 vs. 2.6 ± 1.3, $p = 0.03$). Therefore, we adjusted for healthcare coverage, number of comorbidities/complications, and diabetes in nuclear family in prospective analyses when number of diabetes care office visits was the outcome. (Table 4)

3. Number of urgent care visits: A higher percentage of those with ≥ 1 urgent care visit, vs. those with 0 visits, were female (74.3% vs. 63.7%, $p = 0.04$), with income < \$35 K (92.0% vs. 75.6%, $p = 0.001$). Also, a higher percentage were members of "other" racial/ethnic groups (overall $p = 0.002$). Therefore, we adjusted for gender, income and race/ethnicity in prospective analyses when number of urgent care visits was the outcome.

(Table 5) We note that those with ≥ 1 urgent care visit were not more likely to lack a diabetes care provider nor to have 0 routine visits (Tables 3, 4, and 5).

Psychosocial Factors Associated with Healthcare Usage- Unadjusted Analyses

1. Diabetes home: Those lacking a diabetes home, vs. those with one, had lower DAS-psychosocial impact scores (3.9 ± 0.6 vs. 4.0 ± 0.6, $p = 0.02$), i.e., described less psychosocial impact of diabetes on quality-of-life. They had lower BMQ "necessity beliefs" (9.04 ± 9.0 vs. 14.5 ± 8.8, $p < 0.001$) and "concerns" (6.9 ± 7.4 vs. 10.6 ± 6.9, $p < 0.001$) scores, and higher "harm" (10.4 ± 3.2 vs. 9.3 ± 2.6, $p = 0.003$) and "overuse" (10.6 ± 3.3 vs. 9.8 ± 3.1, $p = 0.04$) scores. They had lower CIRS-self-management support scores (2.4 ± 0.7 vs. 2.6 ± 0.7, $p = 0.02$), a higher percentage reported ≥ 2 need insecurities (MNIS; 41.8% vs. 27.8%, $p = 0.02$) and lacked healthcare coverage. (Table 3)

2. Number of diabetes care office visits: Those who had no routine diabetes care visits, vs. those with ≥ 1 visit, had lower BMQ-necessity beliefs (10.6 ± 9.6 vs. 14.7 ± 8.7, $p < 0.001$) and concerns (8.1 ± 7.6 vs. 10.6 ± 6.9, $p = 0.001$) scores, and higher harm scores (10.2 ± 3.1 vs. 9.2 ± 2.9, $p = 0.002$). They had lower CIRS-self-management support scores (2.5 ± 0.7 vs. 2.7 ± 0.7, $p = 0.005$), and a higher percentage lacked healthcare coverage. (Table 4)

3. Number of urgent care visits: Those who had ≥ 1 urgent care visit had higher BMQ-necessity beliefs scores (14.3 ± 9.0 vs. 12.2 ± 9.4, $p = 0.04$). (Table 5)

T1 Psychosocial Factors Predicting T2 Healthcare Usage (Table 6)

1. Diabetes home: After adjustment, diabetes attitudes (DAS-psychosocial impact scores), and beliefs about medicines (BMQ-necessity beliefs, concerns, and harm scores) at T1, predicted odds of having a diabetes home at T2. Specifically, every 1-point higher DAS-psychosocial impact score predicted 1.57 times higher odds of having a diabetes home ($p = 0.03$). Every 5-point higher BMQ-necessity beliefs score predicted 1.28 times higher odds ($p < 0.001$), and BMQ-concerns score, 1.29 times higher odds ($p = 0.004$), of having a diabetes home. Every 5-point higher BMQ-harm score predicted 44% lower odds of having a diabetes home.

2. Number of diabetes care office visits: After adjustment, BMQ-necessity and harm beliefs, and CIRS-self-management support scores at T1, predicted having at least 1 diabetes care office visit (prior 6 months)

Table 3 Comparisons of Participant Characteristics at T1 for Healthcare Usage Outcome – Have Usual Diabetes Care Provider ("Diabetes Home")

Characteristic	Have Usual Diabetes Care Provider ($n = 365$)		
	No ($n = 102$)	Yes ($n = 263$)	*p*-value*
Age (years)	26.0 ± 2.4	26.0 ± 2.5	0.99
Female	69 (67.7)	178 (67.7)	0.99
Race/Ethnicity			0.86
Hispanic	36 (35.3)	95 (36.1)	
Black, non-Hispanic	41 (40.2)	96 (36.5)	
White, non-Hispanic	20 (19.6)	54 (20.5)	
Other	5 (4.9)	18 (6.8)	
Education			0.07
No high school diploma	12 (11.8)	22 (8.4)	
High school or trade school	75 (73.5)	174 (66.2)	
Associate's degree or higher	15 (14.7)	67 (25.5)	
Annual Income			0.31
Up to $34,999	81 (86.2)	199 (81.6)	
$35,000 or greater	13 (13.8)	45 (18.4)	
Employment Status			0.58
Employed or student	80 (78.4)	199 (75.7)	
Unemployed/Disabled	22 (21.6)	64 (24.3)	
BMI (kg/m^2)	35.7 ± 8.0	36.7 ± 8.7	0.31
Diabetes duration (years)	12.3 ± 1.3	12.4 ± 1.6	0.45
HbA1c (%)	9.2 ± 3.0	9.5 ± 2.7	0.47
No. of Comorbidities/Complications	2.3 ± 1.4	2.5 ± 1.3	0.13
Diabetes in nuclear family (yes)	55 (55)	160 (62.0)	0.22
Health Care Coverage Status			**<0.001**
No Healthcare Coverage	34 (33.3)	17 (6.5)	
Have Healthcare Coverage	68 (66.7)	246 (93.5)	
Number of routine diabetes care visits			**<0.0001**
0 visit	24 (55.8)	45 (19.6)	
≥1 visit	19 (44.2)	184 (80.4)	
Number of urgent care visits			0.65
0 visit	57 (55.9)	140 (53.2)	
≥1 visit	45 (44.1)	123 (46.8)	
Psychological Factors			
Diabetes Attitudes Scale (DAS)			
Seriousness of diabetes	4.0 ± 0.6	4.1 ± 0.5	0.16
Psychosocial impact of diabetes	3.9 ± 0.6	4.0 ± 0.6	**0.02**
Attitude toward patient autonomy	3.7 ± 0.6	3.7 ± 0.5	0.75
Beliefs about Medicines (BMQ)			
Specific Beliefs-Necessity	9.0 ± 9.4	14.5 ± 8.8	**<0.001**
Specific Beliefs-Concerns	6.9 ± 7.4	10.6 ± 6.9	**<0.001**
General Beliefs-Harm	10.4 ± 3.2	9.3 ± 2.6	**0.003**
General Beliefs-Overuse	10.6 ± 3.3	9.8 ± 3.1	**0.04**
Diabetes Self-Efficacy (DSES)	54.3 ± 17.9	54.1 ± 15.6	0.93
Diabetes Distress (PAID)	4.2 ± 4.9	4.9 ± 4.7	0.19
High Diabetes Distress (PAID ≥ 8)	22 (21.6)	66 (25.1)	0.48
Depression Score (PHQ8)	3.6 ± 4.9	3.4 ± 4.2	0.41
Depression Symptoms (PHQ8)			0.36
None-to-mild depression symptoms	87 (87.0)	234 (90.4)	
Moderate-to-severe depression symptoms	13 (13.0)	25 (9.6)	
Anxiety Score (GAD7)	2.8 ± 4.5	2.4 ± 3.8	0.39
Anxiety Symptoms (GAD7)			0.63
None-to-mild anxiety symptoms	92 (92.0)	242 (93.4)	
Moderate-to-severe anxiety symptoms	8 (8.0)	17 (6.6)	
Social Factors			
Chronic Illness Resources Survey (CIRS)	2.4 ± 0.7	2.6 ± 0.7	**0.02**
Material Need Insecurity Survey (MNIS)			
Medication Insecurity (yes)	11 (31.4)	55 (35.5)	0.65
Food Insecurity (yes)	44 (51.2)	94 (42.5)	0.17
Housing Insecurity (yes)	29 (28.4)	72 (27.4)	0.84
Healthcare Coverage Insecurity (yes)	34 (33.3)	17 (6.5)	**<0.001**
Reported ≥ 1 insecurity† (yes)	67 (81.2)	148 (71.2)	0.08
Reported ≥ 2 insecurities (yes)	33 (41.8)	65 (27.8)	**0.02**

Data are presented as mean ± SD or n (%). "Other" in Race/Ethnicity includes American Indian and non-Hispanic Asian. * Groups were compared on these characteristic variables using t-test (continuous) and Chi-Square test (categorical). † Included those who had missing medication insecurity but had reported one or more food, housing or healthcare coverage insecurities. Significant *p*-values are bolded

Table 4 Comparisons of Participant Characteristics at T1 for Healthcare Usage Outcome – Number of Routine Diabetes Care Visits

Characteristic	Number of Routine Diabetes Care Visits (n = 366)		
	0 visits (n = 152)	**≥ 1 visits (n = 214)**	**p-value***
Age (years)	26.0 ± 2.5	25.9 ± 2.5	0.76
Female	105 (69.1)	143 (66.8)	0.65
Race/Ethnicity			0.73
Hispanic	55 (36.2)	76 (35.5)	
Black, non-Hispanic	58 (38.2)	80 (37.4)	
White, non-Hispanic	32 (21.0)	42 (19.6)	
Other	7 (4.6)	16 (7.5)	
Education			0.54
No high school diploma	17 (11.2)	17 (7.9)	
High school or trade school	103 (67.8)	147 (68.7)	
Associate's degree or higher	32 (21.0)	50 (23.4)	
Annual Income			0.39
Up to $34,999	119 (85.0)	162 (81.4)	
$35,000 or greater	21 (15.0)	37 (18.6)	
Employment Status			0.15
Employed or student	122 (80.3)	158 (73.8)	
Unemployed/Disabled	30 (19.7)	56 (26.2)	
BMI (kg/m^2)	36.6 ± 9.0	36.3 ± 8.2	0.75
Diabetes Duration (years)	12.4 ± 1.4	12.4 ± 1.6	0.84
HbA1c (%)	9.0 ± 3.0	9.6 ± 2.7	0.06
No. of Comorbidities/Complications	2.3 ± 1.4	2.6 ± 1.3	0.03
Diabetes in Nuclear Family (yes)	80 (53.7)	135 (64.3)	**0.04**
Health Care Status			**< 0.001**
No Healthcare Coverage	36 (23.7)	15 (7.0)	
Have Healthcare Coverage	116 (76.3)	199 (93.0)	
Have usual diabetes care provider			**< 0.0001**
Yes	68 (44.7)	189 (88.3)	
No	83 (54.6)	25 (11.7)	
Number of urgent care visits			0.08
0 visit	90 (59.2)	107 (50.0)	
≥ 1 visit	62 (40.8)	107 (50.0)	
Psychological Factors			
Diabetes Attitudes Scale (DAS)			
Seriousness of diabetes	4.0 ± 0.6	4.0 ± 0.5	0.57
Psychosocial impact of diabetes	3.9 ± 0.6	4.0 ± 0.6	0.12
Attitude toward patient autonomy	3.7 ± 0.5	3.7 ± 0.5	0.51
Beliefs about Medicines (BMQ)			
Specific Beliefs-Necessity	10.6 ± 9.6	14.7 ± 8.7	**< 0.001**
Specific Beliefs-Concerns	8.1 ± 7.6	10.6 ± 6.9	**0.001**
General Beliefs-Harm	10.2 ± 3.1	9.2 ± 2.9	**0.002**
General Beliefs-Overuse	10.4 ± 3.1	9.8 ± 3.2	0.11
Diabetes Self-Efficacy (DSES)	54.6 ± 17.0	53.8 ± 15.8	0.67
Diabetes Distress (PAID)	4.7 ± 5.0	4.7 ± 4.6	0.99
High Diabetes Distress (PAID ≥ 8)	39 (25.7)	50 (23.4)	0.61
Depression Score (PHQ8)	3.5 ± 4.7	3.1 ± 4.1	0.36
Depression Symptoms (PHQ8)			0.15
None-to-mild depression symptoms	130 (86.7)	192 (91.4)	
Moderate-to-severe depression symptoms	20 (13.3)	18 (8.6)	
Anxiety Score (GAD7)	2.7 ± 4.3	2.3 ± 3.8	0.34
Anxiety Symptoms (GAD7)			0.81
None-to-mild anxiety symptoms	139 (92.7)	196 (93.3)	
Moderate-to-severe anxiety symptoms	11 (7.3)	14 (6.7)	
Social Factors			
Chronic Illness Resources Survey (CIRS)	2.5 ± 0.7	2.7 ± 0.7	**0.005**
Material Need Insecurity Survey (MNIS)			
Medication Insecurity (yes)	21 (32.8)	45 (35.7)	0.69
Food Insecurity (yes)	66 (51.6)	73 (40.6)	0.06
Housing Insecurity (yes)	42 (27.6)	59 (27.6)	0.99
Healthcare Coverage Insecurity (yes)	36 (23.7)	15 (7.0)	**< 0.001**
Reported ≥ 1 insecurity† (yes)	101 (78.9)	117 (70.5)	0.10
Reported ≥ 2 insecurities (yes)	45 (37.8)	53 (27.3)	0.05

Data are presented as mean ± SD or n (%). "Other" in Race/Ethnicity includes American Indian and non-Hispanic Asian. * Groups were compared on these characteristic variables using t-test (continuous) and Chi-Square test (categorical). † Included those who had missing medication insecurity but had reported one or more food, housing or healthcare coverage insecurities. Significant *p*-values are bolded

Table 5 Comparisons of Participant Characteristics at T1 for Healthcare Usage Outcome – Number of Urgent Care Visits

Characteristic	Number of Urgent Care Visits ($n = 366$)		
	0 visits ($n = 226$)	≥ 1 visits ($n = 140$)	*p*-value*
Age (years)	26.2 ± 2.5	25.7 ± 2.5	0.09
Female	144 (63.7)	104 (74.3)	**0.04**
Race/Ethnicity			0.002
Hispanic	89 (39.4)	42 (30.0)	
Black, non-Hispanic	83 (36.7)	55 (39.3)	
White, non-Hispanic	48 (21.2)	26 (18.6)	
Other	6 (2.7)	17 (12.1)	
Education			0.18
No high school diploma	18 (8.0)	16 (11.4)	
High school or trade school	151 (66.8)	99 (70.7)	
Associate's degree or higher	57 (25.2)	25 (17.9)	
Annual Income			**0.001**
Up to $34,999	166 (75.6)	115 (92.0)	
$35,000 or greater	48 (22.4)	10 (8.0)	
Employment Status			0.07
Employed or student	180 (79.6)	100 (71.4)	
Unemployed/Disabled	46 (20.4)	40 (28.6)	
BMI (kg/m^2)	36.1 ± 8.0	36.9 ± 9.2	0.40
Diabetes Duration (years)	12.5 ± 1.6	12.3 ± 1.5	0.32
HbA1c (%)	9.2 ± 2.7	9.7 ± 3.0	0.09
No. of Comorbidities/Complications	2.4 ± 1.4	2.5 ± 1.4	0.44
Diabetes in Nuclear Family (yes)	135 (60.8)	80 (58.4)	0.65
Health Care Status			0.16
No Healthcare Coverage	36 (15.9)	15 (10.7)	
Have Healthcare Coverage	190 (84.1)	125 (89.3)	
Number of routine diabetes care visits			0.24
0 visit	46 (27.9)	23 (21.5)	
≥ 1 visit	119 (72.1)	84 (78.5)	
Have usual diabetes care provider			0.31
Yes	165 (73.0)	107 (76.4)	
No	61 (27.0)	32 (22.9)	
Psychological Factors			
Diabetes Attitudes Scale (DAS)			
Seriousness of diabetes	4.0 ± 0.5	4.0 ± 0.5	0.67
Psychosocial impact of diabetes	4.0 ± 0.6	4.0 ± 0.6	0.69
Attitude toward patient autonomy	3.7 ± 0.5	3.7 ± 0.6	0.43
Beliefs about Medicines (BMQ)			
Specific Beliefs-Necessity	12.2 ± 9.4	14.3 ± 9.0	**0.04**
Specific Beliefs-Concerns	9.1 ± 7.3	10.4 ± 7.2	0.09
General Beliefs-Harm	9.7 ± 3.0	9.5 ± 3.0	0.43
General Beliefs-Overuse	10.2 ± 3.2	9.8 ± 3.1	0.17
Diabetes Self-Efficacy (DSES)	55.2 ± 14.8	52.4 ± 18.3	0.12
Diabetes Distress (PAID)	4.7 ± 5.1	4.8 ± 4.3	0.89
High Diabetes Distress (PAID ≥ 8)	57 (25.2)	32 (22.9)	0.61
Depression Score (PHQ8)	3.0 ± 4.1	3.8 ± 4.8	0.10
Depression Symptoms (PHQ8)			0.24
None-to-mild depression symptoms	201 (91.0)	121 (87.1)	
Moderate-to-severe depression symptoms	20 (9.0)	18 (12.9)	
Anxiety Score (GAD7)	2.3 ± 3.7	2.7 ± 4.5	0.38
Anxiety Symptoms (GAD7)			0.32
None-to-mild anxiety symptoms	208 (94.1)	127 (91.4)	
Moderate-to-severe anxiety symptoms	13 (5.9)	12 (8.6)	
Social Factors			
Chronic Illness Resources Survey (CIRS)	2.6 ± 0.7	2.6 ± 0.7	0.70
Material Need Insecurity Survey (MNIS)			
Medication Insecurity (yes)	42 (38.2)	24 (30.0)	0.24
Food Insecurity (yes)	83 (43.5)	56 (47.9)	0.45
Housing Insecurity (yes)	57 (25.2)	44 (31.4)	0.20
Healthcare Coverage Insecurity (yes)	36 (15.9)	15 (10.7)	0.16
Reported ≥ 1 insecurity† (yes)	138 (76.2)	80 (70.8)	0.30
Reported ≥ 2 insecurities (yes)	57 (30.3)	41 (32.8)	0.64

Data are presented as mean ± SD or n (%). "Other" in Race/Ethnicity includes American Indian and non-Hispanic Asian. * Groups were compared on these characteristic variables using t-test (continuous) and Chi-Square test (categorical). † Included those who had missing medication insecurity but had reported one or more food, housing or healthcare coverage insecurities. Significant *p*-values are bolded

Table 6 Psychosocial Factors at T1 as Predictors of Health Care Usage at T2: Adjusted Odds Ratios

Multivariable Analyses

	Have Usual Diabetes Care Provider (n = 365)			Have at least 1 Diabetes Care Visits (n = 366)		
	OR	95% CI	*p*-value*	OR	95% CI	*p*-value†
Psychological Factors						
Diabetes Attitudes Scale (DAS)						
Seriousness of diabetes	1.35	0.86,2.11	0.19	0.95	0.63,1.44	0.82
Psychosocial impact of diabetes	1.57	1.04,2.38	**0.03**	1.15	0.79,1.68	0.46
Attitude toward patient autonomy	0.85	0.53,1.34	0.48	0.85	0.56,1.30	0.45
Beliefs about Medicines (BMQ) ‡						
Specific Beliefs-Necessity	1.28	1.12,1.46	**< 0.001**	1.20	1.06,1.36	**0.004**
Specific Beliefs-Concerns	1.29	1.08,1.54	**0.004**	1.17	1.00,1.37	0.05
General Beliefs-Harm	0.56	0.37,0.85	**0.006**	0.60	0.41,0.88	**0.01**
General Beliefs-Overuse	0.71	0.48,1.04	0.08	0.82	0.58,1.16	0.26
Diabetes Self-Efficacy (DSES) ‡	1.01	0.94,1.09	0.81	1.00	0.94,1.07	0.97
Diabetes Distress (PAID)	1.04	0.99,1.09	0.17	0.98	0.94,1.03	0.49
High Diabetes Distress (PAID ≥ 8)	1.34	0.74,2.42	0.33	0.76	0.45,1.27	0.29
Depression Symptoms (PHQ8)						
Moderate-to-severe vs None-to-mild	0.83	0.38,1.81	0.65	0.56	0.27,1.17	0.12
Anxiety Symptoms (GAD7)						
Moderate-to-severe vs None-to-mild	0.75	0.30,1.90	0.55	0.87	0.37,2.07	0.75
Social Factors						
Chronic Illness Resources Survey (CIRS)	1.39	0.97,1.98	0.07	1.50	1.08,2.07	**0.01**
Material Need Insecurity Survey (MNIS)						
Medication Insecurity (yes)	1.82	0.73,4.52	0.20	1.24	0.62,2.46	0.54
Food Insecurity (yes)	0.95	0.55,1.63	0.84	0.74	0.45,1.20	0.22
Housing Insecurity (yes)	0.97	0.56,1.67	0.92	0.91	0.55,1.49	0.71
Healthcare Coverage Insecurity (yes)	-	-	-	-	-	-
Reported ≥ 1 insecurity § (yes)	1.00	0.51,1.94	1.00	0.79	0.44,1.41	0.43
Reported ≥ 2 insecurities (yes)	1.08	0.56,2.07	0.82	0.88	0.50,1.55	0.67

The adjusted logistic regression model (probability of having routine diabetes care provider) estimates the routine care for diabetes groups (Y/N) at T2 as a function of the psychosocial factors adjusting for healthcare coverage status at T1. † The adjusted logistic regression model (probability of having at least 1 routinely scheduled visit) estimates the number of routinely scheduled visits groups (0 vs. ≥ 1) at T2 as a function of the psychosocial factors adjusting for diabetes in nuclear family., No. of comorbidities/cComplications, and healthcare coverage status at T1. ‡ Regression coefficients for BMQ and DSES reflect a 5-point increase, other coefficients reflect a 1-point increase. § Included those who had missing medication insecurity but reported one or more food, housing or healthcare coverage insecurities. Significant *p*-values are bolded

at T2. Specifically, every 5-point higher BMQ-necessity beliefs score predicted 1.20 times higher odds ($p = 0.004$), while every 5-point higher BMQ-harm score predicted 40% lower odds ($p = 0.001$), of having ≥ 1 visit. Every 1-point higher CIRS-self management support score predicted 1.50 times higher odds of having ≥ 1 visit ($p = 0.01$).

3. Number of urgent care visits: After adjustment, none of the psychosocial factors predicted number of urgent care visits.

SUMMARY AND DISCUSSION

This is the first longitudinal assessment of psychosocial predictors of healthcare utilization in young adults with youth-onset T2D. We defined "optimal"(i.e., acceptable, stable) diabetes care conservatively, i.e., having a diabetes home, having at least 1 routine diabetes care visit, or no urgent care visits, in the prior 6 months. More than a quarter of participants did not have a stable source of diabetes care. Establishing consistent

care is especially important as a majority of TODAY Study youth required insulin within 2 years of diagnosis.[7]

Participants reporting that diabetes had a greater psychosocial impact on their quality of life, who had greater belief that diabetes medicines are necessary, less belief that medicines, in general, are harmful, but more concerns about them, were significantly more likely to have a diabetes home one year later. Similarly, greater belief that diabetes medicines are necessary and less belief that medicines, in general, are harmful, predicted having at least 1 office visit in the prior 6 months, as did having more self-management support. It is striking that even small absolute differences on surveys affected the odds of suboptimal healthcare usage. These data highlight the importance of attitudes, beliefs about medicines, and support in establishing and using care from diabetes providers. While limited healthcare access, due to structural systemic barriers and/or cost, certainly serve as significant barriers to optimal care, our data suggest it is also important to identify and assess potential psychosocial barriers to care.

Our TODAY/SEARCH colleagues reported that neither lack of healthcare coverage nor having a diabetes home were

associated with HbA1c in those with T2D (they were associated for those with T1D), and described the influence of healthcare usage and coverage on HbA1c as "muddled".[8] They note this may reflect disease management that is insufficiently aggressive, or that those with high HbA1c might be scheduled for more frequent office visits.

We have previously reported that medication adherence is poor in young adults with youth-onset T2D, and that beliefs about medicines (e.g., concerns about adverse effects, dependence, overuse) and social determinants were associated with poor medication adherence.[22,23] Previous TODAY/TODAY2 publications also highlight poor glycemic control in this vulnerable population[24,25]; in the cohort studied here, mean HbA1c was 9.4%. These data identify a need to focus on attitudes and beliefs to improve healthcare utilization. Given the early disease onset and high rate of complications in this group, seeing a diabetes care provider regularly to address glycemic control, as well as other risk factors for diabetes-related complications, is critical to achieving and maintaining overall health.

In TODAY2, participants were asked why they did not have a diabetes home. Reasons included no healthcare coverage, not knowing where to get care, belief that they seldom or never "get sick," and cost,[8] barriers that must be addressed. Our data lead to several other recommendations. If providers and family foster beliefs that diabetes medicines are necessary, address concerns about them, and build on beliefs that medicines, in general, are not harmful, the person may be more likely to seek and use a diabetes home. Beliefs about medicines have been found to be associated with medication adherence across chronic conditions[26] and in the TODAY2 cohort.[22,23] Our data support the "Necessity/Concerns Framework" applied to medication adherence, which posits that medication adherence is determined, to some extent, by the individual's belief that medicines are necessary to treat disease balanced against concerns about using medicines.[26] To our knowledge, this is the first paper to look at the role these beliefs may play in establishing, and using, a diabetes home. Also, providers can encourage the individual to recognize the impact diabetes has on their quality of life, and the importance of accessing support from family, friends and community, to enhance their likelihood of seeking and using a diabetes home.

We hypothesized that other factors (unmet material needs, depression) would predict having and using a diabetes home, this was not supported. However, the sample was quite homogeneous (the majority of participants were poor yet had healthcare coverage), with a small percent with high depression/anxiety scores, this may have limited our ability to find relationships that may exist.

Strengths Data were longitudinal, and could identify predictors of healthcare usage over time. The TODAY2 cohort is a well-described, diverse group of young adults with youth-onset T2D. We used well-validated psychosocial measures, although not developed for youth-onset T2D.

Limitations Lacking claims data, healthcare usage was assessed by self-report, accuracy may have been affected by inaccurate recall. We did not measure other psychosocial factors that may affect healthcare usage (e.g., health literacy, stress). The cohort had been involved in TODAY for many years, a group without that support may have had different outcomes.

In conclusion, beliefs about medicines, experiencing a significant psychosocial impact of diabetes, and feeling supported in one's self-management, were significant predictors of having and using a diabetes home. Results extend the reach of the Necessity/Concerns Framework applied to understanding medication adherence to the role these beliefs may play in accessing stable diabetes care. Given poor outcomes and high rates of early complications in young adults with youth-onset T2D,[24] we must identify and overcome barriers to establishing stable diabetes care as a foundation supporting healthier physical, behavioral and emotional health.

Corresponding Author: *Paula M. Trief, PhD; Department of Psychiatry and Behavioral Sciences, State University of New York Upstate Medical University, NY, Syracuse, USA (e-mail: triefp@upstate.edu).*

REFERENCES

1. **Tamborlane WV, Klingensmith G**. Crisis in care: Limited treatment options for type 2 diabetes in adolescents and youth. Diabetes Care. 2013;36:1777-1778.
2. **Al-Saeed AH, Constantino MI, Molyneaux L, et al**. An inverse relationship between age of type 2 diabetes onset and complication risk and

mortality: the impact of youth-onset type 2 diabetes. Diabetes Care. 2016;39:823-829.

3. **Agarwal S, Hilliard M, Butler A**. Disparities in care delivery and outcomes in young adults with diabetes. Curr Diabetes Rep. 2018;18:65.

4. **Evans M, Williams W, Graces J, Shim R, Tishkoff S**. Race in medicine-genetic variation, social categories, and paths to health equity. New Engl J Med. 2021;385:e45.

5. **Peters A, Laffel LMB**. American Diabetes Association Transitions Working Group. Diabetes care for emerging adults: recommendations for transition from pediatric to adult diabetes care systems. A position statement of the American Diabetes Association with representation by the American College of Osteopathic Family Physicians. Diabetes Care. 2011;34:477–485.

6. **Agarwal S, Raymond JK, Isom S, et al**. Transfer from paediatric to adult care for young adults with type 2 diabetes: the SEARCH for Diabetes in Youth Study. Diabet Med. 2018;35:504–512.

7. **TODAY Study Group**. A clinical trial to maintain glycemic control in youth with type 2 diabetes. N Eng J Med. 2012;366:2247-2256.

8. **Pihoker C, Braffett BH, Songer TJ, et al**. Barriers to care, healthcare utilization, and health and economic outcomes in youth with type 1 and type 2 diabetes enrolled in SEARCH and TODAY. (Under review).

9. MEPS-HC Panel Design and Collection Process [Internet]. Rockville, MD: Agency for Healthcare Research and Quality [updated November 2019]. Available from: https://meps.ahrq.gov/mepsweb/survey_comp/hc_data_collection.jsp. Accessed 1 Nov 2022

10. Questionnaire sections for Rounds 1–5 [Internet]. Rockville, MD: Agency for Healthcare Research and Quality [updated November 2019]. Available from: https://meps.ahrq.gov/survey_comp/hc_ques_sections.jsp. Accessed 1 Nov 2022

11. **Horne, R, Weinman J, Hankins M**. The Beliefs About Medicines Questionnaire: The development and evaluation of a new method for assessing the cognitive representation of medication. Psychol Health. 1999;14:1-24.

12. **Ritter PL, Lorig K, Laurent DD**. Characteristics of the Spanish- and English-language Self-Efficacy to Manage Diabetes scales. Diabetes Educ. 2016;42:167-177.

13. **Anderson RM, Fitzgerald JT, Funnell MM, Gruppen LD**. The third version of the Diabetes Attitudes Scale. Diabetes Care. 1998;21:1403-1407.

14. **Kroenke K, Strine TW, Spitzer RL, Williams JBW, Berry JT, Mokdad AH**. The PHQ-8 as a measure of current depression in the general population. J Affect Disord Rep. 2009;114:163-173.

15. **Corson K, Gerrity MS, Dobscha SK**. Screening for depression and suicidality in a VA primary care setting: 2 items are better than 1 item. Am J Manag Care. 2004;10(11 Pt 2):839-845.

16. **Spitzer RL, Kroenke K, Williams JB, Löwe B**. A brief measure for assessing generalized anxiety disorder: the GAD-7. Arch Intern Med. 2006;166:1092-1097.

17. **Swinson RP**. The GAD-7 scale was accurate for diagnosing generalised anxiety disorder. Evid Based Med. 2006;11:184.

18. **McGuire BE, Morrison TG, Hermanns S, et al**. Short-form measures of diabetes-related emotional distress: The Problem Areas in Diabetes Scale (PAID)-5 and PAID-1. Diabetologia. 2010;53:66-69.

19. **Berkowitz SA, Meigs JB, DeWalt D, et al**. Material need insecurities, control of diabetes mellitus, and use of health care resources: Results of the Measuring Economic Insecurity in Diabetes study. JAMA Intern Med. 2015;175:257-265.

20. **Glasgow RE, Strycker LA, Toobert DJ, Eakin EG**. A social-ecologic approach to assessing support for disease self-management: The Chronic Illness Resources Survey. J Behav Med. 2000;23:559-583.

21. **Glasgow RD, Toobert DJ, Barrera Jr. M, Strycker LA**. The Chronic Illness Resources Survey: Cross validation and sensitivity to intervention. Health Educ Res. 2005;20:402-408.

22. **Trief PM, Kalichman SC, Wang D, et al**. Medication adherence in young adults with youth-onset type 2 diabetes: *i*Count, an observational study. Diabetes Res Clin Pract. 2022;184:109216.

23. **Trief PM, Kalichman S, Uschner D, et al**. Association of psychosocial factors with medication adherence in emerging adults with youth-onset type 2 diabetes: The *i*Count Study. Pediatric Diabetes 2022;23(8):1695-1706.

24. **TODAY Study Group, Bjornstad P, Drews KL, et al**. Long-Term Complications in Youth-Onset Type 2 Diabetes. N Engl J Med. 2021;385:416–426.

25. **Zeitler P, El Ghormli L, Arslanian S, et al**. Deterioration of glycemic control in youth-onset type 2 diabetes: what are the early and late predictors? J Clin Endocrinol Metab. 2022;107(8):e3384-e3394.

26. **Horne R, Chapman SCE, Parham R, Freemantle N, Forbes A, Cooper V**. Understanding patients' adherence-related beliefs about medicines prescribed for long-term conditions: A meta-analytic review of the Necessity-Concerns Framework. PLoS ONE. 2013;8:e80633.