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Cardiovascular Health In Adults with Type 1 Diabetes

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Abstract

Adults with type 1 diabetes (T1D) are at risk for cardiovascular (CV) disease. Managing CV risk is an important prevention strategy. The American Heart Association has defined 7 factors for ideal CV health.

The purpose of this 2016 secondary analysis was to assess the prevalence of 6 CV health factors in a sample of adults 18 (n=7153) in the T1D Exchange Clinic registry.

CV health factors include: hemoglobin A1c (HbA1c) < 7 %, BMI < 25kg/m², blood pressure < 120/80mmHg, total cholesterol < 200mg/dl, non-smoking, and physical activity 150 minutes/week. HbA1c < 7% was substituted for the AHA health factor of fasting blood glucose.

Frequencies of each factor were tabulated for the total sample and for each gender. Logistic regression examined variables associated with achievement of each CV health factor.

The mean age was 37.14 ± 17 years. Mean HbA1c was 7.9 ± 1.5 %, and duration was 19.5 ± 13.5 years. The majority (54%) were working full or part-time. Achievement of CV health factors in the whole sample ranged from 27% (HbA1c < 7%) to 94% nonsmoking. Achievement of some factors varied by gender. Common variables associated with several CV health factors included gender, education, employment, and T1D duration.

This young sample exhibited low levels of some CV health factors, especially HbA1c and physical activity. Providers need to routinely assess and advise on management of all CV risk factors to prevent this common diabetes complication.

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Keywords

cardiovascular disease; risk factors; type 1 diabetes

Introduction

Type 1 diabetes (T1D) affects about 1.25 million Americans and the majority (over 1 million) are adults age 20 years and above (Prime Group for JDRF, 2015). Self-management of diabetes is essential in preventing both acute and chronic complications (American Diabetes Association, 2014). Those with diabetes are more likely to die of cardiovascular disease (CVD) than from microvascular complications; (American Diabetes Association, 2014) indeed, well over half of adults > 65 years with diabetes (68%) will die of some form of heart disease (Mozaffarian et al., 2015).

The American Heart Association (AHA) has defined the concept of “ideal cardiovascular health” for adults (Lloyd-Jones et al., 2010). The basis for this concept, developed by an AHA Strategic Planning Task Force, includes three factors in health promotion and disease prevention: the importance of primordial prevention; the fact that CVD risk begins early in life; and the need to balance both population-level, and individual approaches to health promotion and disease prevention. This concept is defined by the presence of four health behaviors (nonsmoking, body mass index (BMI) < 25kg/m², physical activity at goal levels, and dietary habits consistent with current recommendations) and three health factors (untreated total cholesterol < 200mg/dL, untreated blood pressure <120/80mmHg, and a fasting blood glucose <100mg/dL). These metrics will be used to measure the achievement of the AHA Impact Goal of improving the cardiovascular health of all Americans and reducing death from CVD and stroke(Lloyd-Jones et al., 2010).

CVD events are not only more common in individuals with T1D as compared with those without diabetes, they occur earlier(de Ferranti et al., 2014). In a cohort of individuals with T1D (n=1,043), CVD contributed to about 10% of all deaths within the first 10 years of diagnosis of diabetes, but rose to 60% of all deaths after a duration of 20 years (Secrest, Becker, Kelsey, Laporte, & Orchard, 2010). Moreover, death rates (per 100,000 population) attributed to diabetes also vary with gender and race, with Black males having highest death rate (44.9), followed by Black females (35.8), White males (24.3) and finally White females (16.2) (Mozaffarian et al., 2015). These disparities in death rates may reflect the strong association between social and economic factors and CVD death (Greer, Schieb, Ritchey, George, & Casper, 2016) or an interaction between gender and socioeconomic status that raises the risk of CVD in women (Kavanagh et al., 2010). Therefore, although achieving ideal cardiovascular health may not be feasible in adults with T1D, attaining the best cardiovascular health possible may be more critical for them compared to age-matched people without diabetes. Health promotion efforts need to address all factors related to cardiovascular health, and the American Diabetes Association publishes annual standards of medical care that include CVD and risk management in the presence of diabetes (Welk, Blair, Wood, Jones, & Thompson, 2000). Adopting healthy lifestyle habits (regular physical

activity, healthy diet, non-smoking) has been associated with a better cardiometabolic profile in adults with T1D (Leroux et al., 2015).

Given that type 2 diabetes (T2D) represents 90–95% of cases of diabetes in adults (Mozaffarian et al., 2015), adults with T1D may be understudied as compared to adults with T2D. Additionally, the number of youth diagnosed with T1D is rising, and this trend will result in an increased prevalence of adults with this condition (Mozaffarian et al., 2015). With the heightened risk of CVD in this population, and the need for CVD risk modification, our purpose was to analyze the cardiovascular health in adults with T1D. We had two specific aims:

1. To describe and compare by gender four indices of cardiovascular health in a sample of adults with T1D: BMI < 25kg/m², 150 minutes/week of exercise, blood pressure < 120/80mmHg, and HbA1c < 7 %
2. To identify the sociodemographic, clinical, and diabetes-related variables associated with each cardiovascular health factor:
 - a. Variables associated with health behaviors (BMI, exercise)
 - b. Variables associated with health factors (blood pressure, and HbA1c)

Methods

We conducted a secondary cross-sectional analysis using data from the T1D Exchange Clinic registry, which included participants from 67 U.S.-based pediatric and adult endocrinology practices (Beck et al., 2012). Adults 18 years enrolled in the registry who had completed exercise self-report data (n=7153) were included in this study. Data were collected by questionnaire and medical record review at the time of enrollment in the registry. Appropriate Institutional Review Board approval was obtained for this secondary analysis.

Data Collection

Systolic and diastolic blood pressure, HbA1c, height and weight (for BMI calculation) were collected from medical record review. Self-reported exercise was assessed using a single question, “In a typical week, how many days do you spend at least 30 minutes doing any physical activities or exercises such as running, working out, yoga or Pilates, aerobics, sports, gardening, physical education in school or walking for exercise?” For the purpose of these analyses, ideal cardiovascular health factors were designated as follows: BMI < 25kg/m², exercise 150 minutes/week, untreated blood pressure < 120/80mmHg, and HbA1c < 7 %. These factors were based on the AHA’s guidelines for ideal cardiovascular health (Lloyd-Jones et al., 2010). Although 24% of the entire sample were on blood pressure medication, only participants who were not being treated for high blood pressure were included in the blood pressure analyses. HbA1c was substituted for fasting blood glucose given this was a population with T1D who would not be expected to have normal fasting blood glucose. HbA1c, along with patient self-monitoring of blood glucose, is the present standard for assessment of glycemic control, and a HbA1c level of < 7 % represents the

current guideline for medical care for diabetes (American Diabetes Association, 2015a). Furthermore, HbA1c is also strongly associated with CVD risk (Diabetes Control and Complications Trial (DCCT)-Epidemiology of Diabetes Interventions and Complications (EDIC) Research Group et al., 2016).

Statistical Analysis

Analyses were conducted with SAS version 9.2. Descriptive statistics and frequencies of each cardiovascular health factor were calculated for the entire sample (n=7153). Chi square and independent t-tests were used to compare adults who achieved each ideal factor and those who did not. Based on a review of the diabetes literature, the independent variables included in the bivariate analyses were chosen based on their potential to affect achievement of each cardiovascular health factor. Sociodemographic (e.g., age, gender, race/ethnicity, marital status, education, employment), clinical (e.g., general health, depressive symptoms as measured by the well-validated Patient Health Questionnaire-8 (PHQ-8)(Kroenke, Spitzer, Williams, & Lowe, 2010)) and diabetes-related variables (e.g., diabetes duration, number of blood glucose checks conducted each day, use of an insulin pump or continuous glucose monitoring, frequency of missed insulin doses, diabetes complications, episodes of severe hypoglycemia or diabetic ketoacidosis) that were found to be statistically significant ($p<.05$) in the bivariate analysis were included in the multivariate analysis. Stepwise multivariate logistic regression modeling was used to examine the variables independently associated with each cardiovascular health factor. Given the effect of multiple comparisons, the p-value for the four logistic regression was adjusted, and $p<.01$ was considered statistically significant. In the case of missing data on any variable, that observation was deleted from the analysis and only complete case analyses were conducted.

Results

Sample Characteristics

This sample of adults with T1D had a mean age of 37.14 ± 17 years. A majority was female (54%) and White non-Hispanic (89%). The mean duration of diabetes was 19.5 ± 13.5 years and HbA1c was 7.9 ± 1.5 %. Over half the participants were either overweight (37%) or obese (22%). The sample's mean systolic blood pressure was 121 ± 13.8 mmHg and diastolic blood pressure was 71.7 ± 9 mmHg. (Table 1).

Aim 1. The Cardiovascular Health of Adults with T1D

The achievement of each individual ideal health factor was calculated for the entire sample (n=7153) and for each gender (Table 2). The achievement of each goal ranged from 27% (HbA1c < 7%) to 42% (BMI<25kg/m²). Males had a significantly higher percentage of achievement than females in exercise (37% vs. 30%; $p<.0001$), whereas women had higher percentage in blood pressure achievement (54% vs. 37%; $p<.0001$).

Aim 2. Sociodemographic, Clinical, and Diabetes-related Variables Associated with Each Cardiovascular Health Factor

For each of the factors below, we report the variables independently associated with each of the health behaviors and health factors separately when analyzed with stepwise logistic regression.

a. Variables Associated with Health Behaviors (BMI, exercise)—Variables independently associated with having a BMI $\geq 25\text{kg/m}^2$ included employment, blood pressure, treatment for blood pressure, smoking, exercise, and duration of T1D (Table 3). Compared to being retired, those who worked full- or part-time were more likely to have a BMI $> 25\text{kg/m}^2$. Those who were being treated for high blood pressure also had higher odds of a BMI $\geq 25\text{kg/m}^2$.

Variables independently associated with exercising < 150 minutes/week included: gender, education, marital status, employment, depressive symptoms, blood glucose self-monitoring, and eating/drinking carbohydrate before exercise to prevent low blood sugar (Table 4). Females, vs. males, were more likely to exercise < 150 minutes/week. Those with higher levels of education, as compared to $<$ high school diploma, were more likely to exercise < 150 minutes/week, with a Bachelor degree having the higher odds. Compared to those who were retired, those who work full- or part-time, were disabled, laid off, on sick leave, or a homemaker, or were a student all had increased odds of exercising < 150 minutes/week. And compared to those who “always” ate or drank a carbohydrate before exercise to prevent a low blood sugar, those who did so less often were more likely to exercise < 150 minutes/week.

b. Variables Associated with Health Factors (blood pressure, and HbA1c)—Four variables were independently associated with blood pressure $\geq 120/80\text{mmHg}$: gender, total cholesterol levels, duration of T1D, and HbA1c (Table 5). Being a female was associated with lower odds of having a blood pressure $\geq 120/80\text{mmHg}$, which was consistent with more females achieving ideal blood pressure than males. Higher HbA1c and longer duration of T1D was associated with higher odds of having blood pressure $> 120/80\text{mmHg}$.

Variables independently associated with HbA1c $\geq 7\%$ included: education, employment, marital status, general health, insulin and blood glucose management, and duration of T1D (Table 6). Those with fair-poor self-reported general health were more likely to have a HbA1c $\geq 7\%$. Higher levels of education, as compared to $<$ high school diploma, were associated with lower odds of having a HbA1c $\geq 7\%$. Compared to the retired, those working full- or part-time were more likely to have a HbA1c $\geq 7\%$, as were students. Missing insulin doses was strongly associated with a HbA1c $\geq 7\%$, with those missing at least one dose per day, as compared to almost never, having the highest odds.

Discussion

In this secondary analysis of the T1D Exchange Clinic registry data, we examined the cardiovascular health of adults with T1D. In this relatively young sample, the level of

cardiovascular health varied. There was moderate achievement in blood pressure and BMI, but lower achievement in HbA1c, exercise. These findings are particularly worrisome in a population at high risk for CVD.

The primary aim of this study was to determine the prevalence cardiovascular health in adults with T1D. The prevalence of ideal cardiovascular health was also analyzed in adults with T1D in the Coronary Artery Calcification in T1D (CACTI) study (Alman, Maahs, Rewers, & Snell-Bergeon, 2014). In that sample (546 subjects with T1D and 631 subjects without T1D), no subjects met the criteria for all seven factors designated by the AHA, and the number of ideal factors achieved was lower in those with T1D as compared to those without T1D ($p<.001$). Furthermore, higher numbers of ideal health factors in adults with and without T1D were associated with decreased prevalence and progression of coronary artery calcification, a measure of subclinical CVD. Although CVD outcomes data were not collected in the T1D Exchange Clinic registry, the low prevalence of the composite factor of ideal cardiovascular health was comparable to this sample and may reflect a comparable risk of CVD.

Measurement of cardiovascular health is not only relevant in the adult population with T1D, but extends to younger age groups. Cardiovascular health was measured in a sample of adolescents with T1D ($n=190$; median age=15) using the AHA definitions (Alman et al., 2014). No subjects met all seven metrics for ideal cardiovascular health; only 2.1% met the definition of six metrics; and the majority met 3–4 metrics. Furthermore, meeting the physical activity goal was associated with reduced carotid artery intima-media thickness (a measure of atherosclerotic vascular disease), while meeting an increasing number of ideal cardiovascular health metrics was associated with decreased pulse wave velocity of the trunk (a measure of arterial stiffness). These results suggest that management of cardiovascular health in those with T1D may benefit from early assessment and treatment.

In these analyses, some gender differences were noted in the achievement of ideal cardiovascular health factors, with males less likely to achieve ideal blood pressure control as compared to females, and being female was associated with lower odds of having a blood pressure $\geq 120/80$ mmHg. These result parallel findings from another large cohort of adults with T1D ($n=1835$) and T2D ($n=13,516$). Males with T1D had significantly higher systolic and diastolic blood pressure than females with T1D (Collier, Ghosh, Hair, & Waugh, 2015). High blood pressure is consistently found to be a major risk factor for diabetes complications (Diabetes Control and Complications Trial (DCCT)-Epidemiology of Diabetes Interventions and Complications (EDIC) Research Group et al., 2016), and controlling it in all patients should be a priority. However, when the analysis of ideal blood pressure was conducted with all participants, including those being treated for high blood pressure (data not shown), those on blood pressure medication had more than double the risk of having a blood pressure $\geq 120/80$ mmHg. The association of blood pressure medication with adverse outcomes has been noted before. In a large population-based cohort, the use of blood pressure medication was strongly associated with an increased risk of atrial fibrillation (Vermond et al., 2015). Although the study authors do not discuss this relationship, others have suggested that the association between blood pressure medication and atrial fibrillation, or other adverse outcomes be fully explored prospectively (Onat, Simsek, & Akbas, 2016).

However, in contrast to our findings of no gender differences in achievement of BMI or HbA1c, Collier (2015) found that males with T1D had significantly lower BMI and HbA1c. Importantly, compared to the general population where females have lower risk of mortality from ischemic heart disease than males at all ages, an analysis of a large cohort of adults with T1D reveals no difference between females and males with T1D under the age of 40 years in ischemic heart disease mortality (Laing et al., 2003). Additionally, in our sample females were more likely to exercise <150 minutes/week, which is an important strategy in ameliorating cardiovascular risk.

In a recent meta-analysis (n=59,383) of the risk of all-cause mortality and vascular events in adults with T1D, females had a higher standardized mortality ratio (SMR) as compared to males in both incident coronary heart disease (SMR=2.54; 95% CI: 1.80 3.60; p<.0001) and CVD mortality (SMR=2.54; 95% CI: 1.80 3.60; p<.0001) (Huxley, Peters, Mishra, & Woodward, 2015). The authors speculate the increased mortality in females was related to greater cumulative exposure to hyperglycemia in females as compared to males. Indeed, in a study of children with T1D (n=151), females were twice as likely to be in poor glycemic control than males (Kim, Elmi, Henderson, Cogen, & Kaplowitz, 2012). However, in the current T1D Exchange sample, there was no significant difference between the genders in achievement of ideal HbA1c. Nevertheless, these findings underscore the need for aggressive treatment of all risk factors for both males and females with T1D.

The two cardiovascular health metrics that had the lowest levels of achievement were HbA1c and exercise. Variables common to both were level of education and employment. Those with higher levels of education were more likely to exercise < 5 days/week, which may reflect the type of time commitments at work. For example, compared to those who were retired, those who worked or were students were twice as likely to exercise < 5 days/week. Additionally, compared to those who retired, those who were worked or were students were more likely to have a HbA1c > 7%.

In these analyses, being treated for high blood pressure has the strongest association with having a BMI >25kg/m². This association has been noted in a large cohort of individuals without baseline hypertension (Kang et al., 2016). Over approximately three years of follow-up, obese individuals, as compared to the nonobese, had a stronger association with the development of hypertension. The authors suggest two potential mechanisms for this association were vascular dysfunction and the renin-angiotensin-aldosterone-system (RAAS) hyperactivation. However, this was not a sample with T1D. In a longitudinal study of adults with T1D, researchers found that after controlling for BMI, endothelial dysfunction was strongly associated with the development of hypertension (Sahakyan, Klein, Myers, Tsai, & Klein, 2010). Unfortunately, our data do not allow for a causal explanation of the association between these two risk factors for CVD.

In this sample, very few (7%) were active smokers, and being a smoker was associated with lower odds of having an elevated BMI. This contrasts with a sub-sample of adolescents with T1D (age 15–20 years), where a much larger percent (28.4%) were smokers, and smoking in the overall sample of adolescents (n=27,561; mean age=13.6 ±4.2) was associated with a poorer metabolic profile than nonsmokers, including a higher BMI (Hofer et al., 2009).

Regardless, smoking is an avoidable risk factor for CVD and should be a top priority for prevention of complications.

Limitations and Strengths

This secondary data analysis had several limitations. This dataset did not contain the exact measures of ideal cardiovascular health as defined by the AHA, and we were only able to analyze variables that closely reflected the AHA metrics. For example, we did not have dietary habits data to analyze as one of the seven factors of ideal cardiovascular health. The prevalence of overweight and obese participants may provide insight into their dietary habits, but dietary data would have allowed for an analysis of how well participants were following current recommended lifestyle modifications such as sodium and alcohol restriction, and fruit, vegetable and low-fat dairy consumption as a treatment strategy for managing CVD risk (American Diabetes Association, 2015b). Furthermore, the data on exercise was by self-report (indirect measure) and no direct measurement of exercise was collected to establish reliability or validity. On average, moderate correlations have been found between indirect and direct measures of physical activity (Kowalski, Rhodes, Naylor, Tuokko, & MacDonald, 2012). The substitution of HbA1c for fasting blood glucose data may be seen as a limitation. However, we believed the analysis of HbA1c was more appropriate for this population and provided valuable information about their risk for CVD. Despite these limitations, we identified high rates of cardiovascular risk factors in a large cohort of adults with T1D with both clinical and diabetes-related data, which offered insight into their cardiovascular risk.

Conclusion

The American Diabetes Association's current standards of medical care include guidelines for prevention and treatment of diabetes complications (American Diabetes Association, 2015a). Recommendations also include annual screening for the CVD risk factors (dyslipidemia, hypertension, smoking, positive family history of heart disease and the presence of albuminuria). Lifestyle interventions focused on weight loss (calorie reduction with increased physical activity) may be advised. HbA1c < 7% is recommended for most adults with diabetes. Although many of the components of ideal cardiovascular health are addressed in the standards of medical care, there may be a gap in the translation of these recommendations to patients, leading to poor cardiovascular health, and lower levels of optimal self-management as well. Monitoring each of these risk factors on a regular basis may reduce the burden of all comorbidities, particularly CVD, at both the individual and population level.

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Highlights

- Adults with type 1 diabetes are at increased risk of cardiovascular (CV) disease
- A low prevalence of HbA1c and physical activity at goal levels were noted
- Level of employment was related to achievement of several CV health factors
- Health promotion efforts by providers are needed to endorse CV health

Table 1

Sample Characteristics (n=7153*)

Characteristic	Mean $\pm$ SD or n (%)
Age	37.14 $\pm$ 17
Gender	
Female	3840 (54%)
Male	3313 (46%)
Race/Ethnicity	
White Non-Hispanic	6363 (89%)
Black Non-Hispanic	225 (3%)
Hispanic	348 (5%)
Other	217 (3%)
Marital status	
Single	3124 (44%)
Married	3142 (44%)
Living together	292 (4%)
Separated	72 (1%)
Divorced	363 (5%)
Other	109 (2%)
Education	
<High School diploma	319 (4%)
High School diploma/GED	3033 (43%)
Associate degree	558 (8%)
Bachelor degree	1908 (27%)
Graduate degree	1248 (18%)
Employment	
Student	1644 (23%)
Full or part time	3852 (54%)
Retired	603 (9%)
Other	974 (14%)
Annual income	
<25K	686 (10%)
25-<50K	1054 (15%)
50K-<100K	1940 (27%)
100K	1872 (26%)
Missing	1601 (22%)
Duration of type 1 diabetes (years)	19.5 $\pm$ 13.5
Age at type 1 diabetes diagnosis (years)	17.4 $\pm$ 13
Hemoglobin A1c	7.9 $\pm$ 1.5 % (62mmol/mol)
Systolic BP (mmHg)	121 $\pm$ 13.8
Diastolic BP (mmHg)	71.7 $\pm$ 9
Total Cholesterol (mg/dl)	171 $\pm$ 35

Characteristic	Mean ± SD or n (%)
Treated for hypertension	1743 (24%)
BMI (kg/m ²)	26.8 ± 5.1
Underweight (BMI <18.5 kg/m ²)	62 (1%)
Normal weight (BMI <25 kg/m ²)	2233 (41%)
Overweight (BMI ≥25 kg/m ²)	2010 (37%)
Obese (BMI ≥30 kg/m ²)	1200 (22%)
Depression PHQ-8 ≥10	635 (10%)
Smoking	
Yes	520 (7%)
No	6551 (92%)
Exercise	
0 days/week	848 (12%)
30 minutes 1–4 days/week	3928 (55%)
30 minutes ≥5 days/week	2377 (33%)

Note.

* Some sample sizes <7153 due to missing data;

BMI=body mass index; BP=blood pressure; GED=general education diploma; kg/m²=kilograms/meter²; mmHg=millimeters mercury; mg/dl=milligrams/deciliter; PA=physical activity; PHQ-8=patient health questionnaire-8; SD=standard deviation;

Table 2

Cardiovascular Health by Gender

Ideal Cardiovascular Health Factor	All n=7,153	Female 3,840 (54%)	Male 3,313 (46%)	P-value
Hemoglobin A1c < 7 %	1,820 (27%)	958 (26%)	862 (27%)	0.28
Exercise 150 minutes/week	2,377 (33%)	1,157 (30%)	1,220 (37%)	<.0001
Blood Pressure <120/80mmHg [*]	2319 (46%)	1,509 (54%)	810 (37%)	<.0001
Body Mass Index <25kg/m ²	2,295 (42%)	1,271 (43%)	1,024 (40%)	0.06

Note. Data presented as n (%); Sample sizes vary for each variable due to missing data;

^{*}
untreated blood pressure

Table 3Logistic Regression Analysis of Factors Associated with Body Mass Index $\geq 25\text{kg/m}^2$

Factor	Adjusted Odds Ratio	95% CI
Employment		
Retired	Reference	
Full- or part-time	1.6	1.2–2.1
Systolic BP (each 1-mm $\uparrow$)	1.02	1.01–1.02
Diastolic BP (each 1-mm $\uparrow$)	1.02	1.01–1.03
Treatment for HTN		
No	Reference	
Yes	2.2	1.8–2.7
Smoking		
No	Reference	
Yes	.54	.42–.70
Days/week exercise 30 min (each 1-day $\uparrow$)	.90	.88–.93

Note. BP=blood pressure; CI=confidence interval; HTN=hypertension;

Table 4

Logistic Regression Analysis of Factors Associated with Exercise < 150 minutes/week

Factor	Adjusted Odds Ratio	95% CI
Gender		
Male	Reference	
Female	1.3	1.1–1.5
Education		
<High school diploma	Reference	
Associate degree	1.5	1.2–2.4
Bachelor degree	1.8	1.4–2.8
Marital Status		
Married	Reference	
Single	.73	.62–.87
Employment		
Retired	Reference	
Full- or part-time	2.2	1.7–2.7
Disabled/Laid off/Sick leave/homemaker	1.6	1.2–2.1
Student	2.4	1.8–3.2
Depressive symptoms (each 1-point ↑ in PHQ-8)	1.04	1.02–1.06
Blood glucose checks/day (each 1-check ↑)	.95	.92–.97
Eat/drink carbohydrate to prevent low blood sugar		
Always	Reference	
Most of the time	1.4	1.1–1.8
Sometimes	1.8	1.4–2.3
Rarely	2.1	1.6–2.7
Never	1.8	1.4–2.5

Note. CI=confidence interval; PHQ=patient health questionnaire

Table 5

Logistic Regression Analysis of Factors Associated with Untreated Blood Pressure 120/80

Factor	Adjusted Odds Ratio	95% CI
Gender		
Male	Reference	
Female	.52	.43–.63
Total cholesterol	1.004	1.001–1.007
T1D duration (each 1-year ↑)	1.01	1.003–1.02
HbA1c (each 1% ↑)	1.1	1.03–1.17

Note. CI=confidence interval; HbA1c=hemoglobin A1c; T1D=type 1 diabetes

Table 6

Logistic Regression Analysis of Factors Associated with HbA1c 7%

Factor	Adjusted Odds Ratio	95% CI
Education		
< High school diploma	Reference	
Bachelor degree	.53	.34–.81
Master degree	.43	.27–.66
Professional or doctoral degree	.40	.25–.66
Employment		
Retired	Reference	
Full- or part-time	1.7	1.3–2.1
Student	1.7	1.2–2.4
Marital status		
Married	Reference	
Single	1.6	1.3–1.9
General health		
Good-excellent	Reference	
Fair-poor	1.6	1.2–2.1
Missed insulin dose		
Almost never	Reference	
< once/month	1.5	1.2–1.8
< once/week	2.2	1.8–2.8
1–2x/week	3.9	2.9–5.1
3–4x/week	4.2	2.7–6.4
5x/week	4.6	2.0–10.9
At least 1x/day	5.02	2.1–11.8
Blood glucose checks/day (each 1-check ↑)	.91	.88–.93
Use of continuous glucose monitor		
No	Reference	
Yes	.74	.6–.9
T1D duration (each 1-year ↑)	1.02	1.01–1.02

Note. CI=confidence intervals;T1D=type 1 diabetes