Social and Psychosocial Determinants of Health Associated With Uncontrolled Diabetes in a Federally Qualified Health Center Population

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ABSTRACT

Purpose. Many people with diabetes have difficulty achieving glycemic targets, and social and psychosocial determinants of health may influence their ability to obtain glycemic goals. The objective of this study was to identify characteristics independently associated with A1C >9% or untested A1C compared to those with A1C ≤9% at a federally qualified health center.

Methods. This retrospective cohort study included people with a diagnosis of diabetes, who were 18–89 years of age and had a medical evaluation from a primary care provider between 1 September 2016 and 31 August 2017. The primary outcome was to identify characteristics associated with an A1C >9% or untested A1C compared to those with an A1C ≤9%.

Results. Of 6,185 patients meeting inclusion criteria, 2,965 (48%) had uncontrolled A1C. In the uncontrolled A1C group, 1,549 patients (52%) were female, 1,296 (44%) preferred care in a language other than English (1,273 [43%] in Spanish), and 535 (18%) had a concurrent mental health diagnosis. Multivariable logistic regression of 4,774 patients with complete data revealed that poor appointment adherence (odds ratio [OR] 3.24, 95% CI 2.30–4.57) and/or a positive Patient Health Questionnaire-2 depression screen (OR 1.35, 95% CI 1.12–1.62) had an increased risk of being in the uncontrolled A1C group. Patients with a prescription for antidepressant medication were more likely to be in the controlled group.

Conclusion. Poor adherence to appointments and presence of depressive symptoms were associated with high A1C values. Interventions can be developed targeting these determinants to improve blood glucose levels.

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It is estimated that more than 30 million people in the United States are affected by diabetes, with rates of diabetes particularly high in rural and medically underserved areas (1,2). Federally qualified health centers (FQHCs) are safety-net health systems and clinics whose purpose is to provide primary care services to underserved urban and rural communities. According to data from the Healthcare Resources and Services Administration (HRSA), FQHCs provided care to 25.8 million patients in 2016, and ~14.3% of these patients had diabetes (3).

Salud Family Health Centers is an FQHC in Colorado with 15 service locations that provide care to patients typically identified as medically underserved (4). In 2016, Salud provided care to >76,600 patients, and 10,877 (14.2%) of them had diabetes (5). Approximately 40% of these patients with diabetes were considered to have poor glycemic control, defined by HRSA as an A1C >9% or untested (5). This was higher than the national rate of uncontrolled diabetes of 32.1% and the Colorado statewide rate of 37.9% in 2016 (3). *Healthy People*

2020, the United States population health initiative, aims to reduce the proportion of patients with diabetes with an A1C >9% to 16.2% by 2020 (6).

Improving the health of patients with diabetes goes beyond targeting A1C goals, and meeting glycemic targets may be dependent on improving other aspects of patients' health. A common framework for understanding holistic health care is the "health triangle," which presumes that balanced social, physical, and emotional and mental health are needed to improve overall health (7). Consistent with this model, the 2018 American Diabetes Association *Standards of Medical Care in Diabetes* recommended that providers "assess social context … and apply that information to treatment decisions" and that providers consistently assess the psychosocial health of patients with diabetes (8).

Social determinants of health (SDOH) are identified by the World Health Organization as a growing concern for chronic disease state management (9). SDOH are defined by the Centers for Disease Control and Prevention as conditions of living, learning, working, and leisure activities that may affect patients' health risks and outcomes (9). For example, one commonly identified social determinant of health is food insecurity, described by the U.S. Department of Agriculture on a spectrum ranging from reduced quality or variety of food to lack of consistent access to a sufficient amount of food (10). Food security is positively correlated with achieving glycemic goals, and patients with type 2 diabetes and food insecurity are more likely to be treated with insulin and to have an A1C >7% (11,12).

The third component of the "health triangle" is emotional and mental health, referred to here as "psychosocial health." Psychosocial determinants of health, or social factors that affect mental health or emotional well-being, affect chronic disease state management (13). Studies have found a bidirectional relationship between depression and poor glycemic control and development of diabetes (14). The presence of depression can negatively affect a person's ability to achieve diabetes targets, while development of diabetes complications can exacerbate symptoms of depression (14).

Whereas the long-term complications of hyperglycemia are established, specific SDOH and psychosocial health factors that predispose patients to having difficulty achieving A1C goals are not well defined (8). Salud regularly screens patients for SDOH and psychosocial health concerns. However, understanding the characteristics, risk factors, mental health, and SDOH would help with developing targeted and comprehensive population health strategies to improve A1C values. The objective of this research project was to identify the characteristics and social and psychosocial health factors independently associated with having an A1C >9% or untested A1C compared to those associated with an A1C ≤9%.

Methods

Study Design, Setting, and Population

This retrospective cohort study included patients with a diagnosis of diabetes who were 18–89 years of age and had at least one medical evaluation by a primary care provider at Salud Family Health Centers during the 12-month time frame from 1 September 2016 to 31 August 2017. Patients with a diagnosis of steroid-induced or gestational diabetes were excluded. Diagnoses used in these criteria were identified using *International Classification of Diseases*, 10th Revision (ICD-10), codes. This study was approved by the Colorado Multiple Institutional Review Board.

Data Collection

All A1Cs of included patients that were measured during the study period were collected. Each patient's highest A1C was defined as the index. If a patient had an index A1C >9% or no A1C tested during the study period, the A1C was categorized as "uncontrolled," whereas those with A1C values ≤9% were categorized as "controlled," using language consistent with HRSA clinical quality measures (3). Data were pulled from the time of the index event. If data were unavailable during the time of the index event, the latest datapoint for that variable during the study period was collected.

All data were extracted using Bridge-IT data-management software automated reports from the electronic medical record (EMR) (eClinical Works, Westborough, Mass.). A random sampling of records was manually reviewed to ensure accuracy of the data. Measures collected are listed in Table 1. Patients' age, sex, ethnicity, preferred language, insurance status, and education level were collected from the patient information section of the EMR, and BMIs were calculated from data in the EMR vitals section. Medication use was identified using documented active medications reconciled as "taking" or "continued" or "refilled" during the study time frame. Appointment adherence rates were calculated by dividing the number of completed patient visits by the total number of visits scheduled (including no-show, cancelled, or incomplete visits) during the study period. Poor adherence to appointments was defined as missing ≥20% of visits, consistent with other literature. Mental health diagnoses were extracted using ICD-10 codes. Annual Patient Health Questionnaire-2 (PHQ-2) screening results were collected, with a score ≥3 indicating the presence of depressive symptoms (15). Data for all other variables were part of a standard questionnaire embedded in the EMR and completed by Salud patients on an annual basis. Additional details are shown in Table 2.

Primary Outcome

In patients with diabetes, we aimed to determine patient-specific risk factors

TABLE 1. Patient Characteristics and Results of Univariate Analysis

	Uncontrolled (*N* = 2,965)	Controlled (*N* = 3,220)	*P**
Age in years, mean (SD)	56.1 (14.5)	55.8 (11.3)	0.362
Sex, *n* (%)			**<0.001**
Female	1,549 (52)	1,871 (58)	
Male	1,416 (48)	1,349 (42)	
Ethnicity, *n* (%)			**<0.001**
Hispanic or Latino	2,097 (71)	2,109 (65)	
Non-Hispanic or Latino	831 (28)	1,072 (33)	
Declined to report	30 (1.0)	39 (1.2)	
Preferred language, *n* (%)			0.512
English	1,278 (43)	1,623 (50)	
Non-English	1,297 (44)	1,591 (49)	
Not reported	390 (13)	6 (0.2)	
BMI, *n* (%)			**<0.001**
Nonobese (BMI < 30 kg/m^2)	1,238 (42)	1,165 (36)	
Obese (BMI ≥30 kg/m^2)	1,410 (48)	1,853 (58)	
Not reported	317 (11)	202 (6.3)	
Diabetes medications, *n* (%)			
Metformin	2,195 (74)	2,398 (75)	0.691
Other oral antidiabetics	1,304 (44)	908 (28)	**<0.001**
Insulin	1,485 (50)	654 (20)	**<0.001**
Other injectable antidiabetics	135 (4.6)	72 (2.2)	**<0.001**
Psychiatric medications, *n* (%)			
Antipsychotic	83 (2.8)	101 (3.4)	0.440
Antianxiety agent	18 (0.6)	39 (1.2)	**0.013**
Mood stabilizer	62 (2.1)	75 (2.3)	0.525
Antidepressant	651 (22)	852 (26)	**<0.001**
Visits with clinical pharmacist, *n* (%)			**<0.001**
One or more	325 (11)	107 (3.3)	
None	2,640 (89)	3,113 (97)	
Appointment adherence, *n* (%)			**<0.001**
Good: missed <20% of visits	1,373 (47)	1,706 (53)	
Poor: missed ≥20% of visits	1,592 (54)	1,514 (47)	
Education level, *n* (%)			0.533
High school graduate or college	886 (30)	1,194 (37)	
Less than high school graduate	1,064 (36)	1,381 (43)	
Not reported	1,015 (34)	645 (20)	
Self-perceived health literacy, *n* (%)			0.993
Good	2,020 (68)	2,598 (81)	
Poor	228 (7.7)	293 (9.1)	
Not reported	717 (24)	329 (10)	
Insurance status, *n* (%)			**0.038**
Insured	1,757 (59)	2,290 (71)	
Uninsured	733 (25)	844 (26)	
Not reported	475 (16)	86 (2.7)	

TABLE CONTINUED ON P. 148 →

independently associated with having an A1C >9% or no A1C tested during the study period compared patients with an A1C ≤9%.

Statistical Analysis

Univariate analyses were performed between the two groups using χ^2 for categorical variables and Student *t* test for continuous variables. Adjusted analyses were performed using multivariable regression with group set as the dependent variable and the patient characteristics listed in Table 1 entered as potential independent variables. Stepwise selection was used to identify the best-fitting model, weighting variables according to their contribution to the model according to the Akaike information criterion, and the proportion of missing data. Two-sided α was defined as 0.05, and results are presented as odds ratios (ORs) and 95% CIs. All analyses were conducted using SAS software version 9.4 (SAS Institute, Cary, N.C.).

Results

A total of 6,185 patients met the inclusion criteria. Of these, 3,220 (52%) were in the "controlled" A1C group, and 2,965 (48%) were in the "uncontrolled" A1C group (Table 1). The uncontrolled A1C group included 926 patients with no A1C test, which was ~15% of the total population. More than 50% of patients in both groups were female. The highest proportion of patients who identified as Hispanic or Latino were in the uncontrolled A1C group, and these patients made up 71% of this group. The controlled A1C group had a larger proportion of obese patients compared to the uncontrolled group (58 vs. 48%). Regarding diabetes medications, metformin use was similar between groups, with more frequent use of other antidiabetic agents and insulin in the uncontrolled A1C group (Figure 1). With psychiatric medications, a higher proportion of patients in the controlled A1C group were prescribed an antidepressant compared to the uncontrolled A1C group (26 vs. 22%, *P* <0.001) (Figure 2).

TABLE 1. Patient Characteristics and Results of Univariate Analysis, ***continued from p. 147***

	Uncontrolled (*N* = 2,965)	Controlled (*N* = 3,220)	*P**
Number of concurrent mental health diagnoses, *n* (%)			**0.045**
None	2,430 (82)	2,560 (80)	
1	401 (14)	503 (16)	
2 or more	134 (4.5)	157 (4.9)	
PHQ-2 score, *n* (%)			**0.003**
Negative	1,157 (39)	1,499 (47)	
Positive	301 (10)	298 (9.3)	
Not reported	1,507 (51)	1,423 (44)	
Self-perceived impact of physical or mental health on daily activities, *n* (%)			0.0564
Low (<2 weeks in the last month)	1,377 (46)	1,745 (54)	
High (>2 weeks in the last month)	208 (7.0)	279 (8.7)	
Not reported	1,380 (47)	1,196 (37)	
Family or friend support, *n* (%)			0.510
Positive	2,092 (71)	2,704 (84)	
Negative	42 (1.4)	62 (1.9)	
Not reported	831 (28)	454 (14)	
Food source, *n* (%)			**0.041**
Security	777 (26)	1,013 (31)	
Insecurity	80 (2.7)	74 (2.3)	
Not reported	2,108 (71)	2,133 (66)	

**Values in boldface type indicate statistical significance.*

TABLE 2. Psychosocial and SDOH Screening Questions

PHQ-2 score	
"Over the past 2 weeks, how often have you been bothered by any of the following problems? • Little interest or pleasure in doing things? • Feeling down, depressed, or hopeless?"	Options: not at all = 0, several days = 1, more than half the days = 2, nearly every day = 3 Score ≥3: positive Score 0–2: negative
Self-perceived health literacy	
"Do you feel confident when you read or fill out medical forms?"	Options: yes, no
Self-perceived impact of physical or mental health on daily activities	
"How many days in the last month did poor physical or mental health prevent you from doing your usual activities (self-care, work, play)?"	Options: less than 2 weeks (14 days), more than 2 weeks (14 days)
Family or friend support	
"Do you have family or friends you can rely on or ask for help?"	Options: always, often, sometimes, never
Food source insecurity	
"In the past 2 months, we worried whether our food would run out before we got to buy more."	Options: never true, sometimes true, often true, don't know

Multivariable analyses were performed on the 4,774 patients with complete data (Table 3). Patients with poor adherence to appointments during the study time frame were three times more likely to be in the uncontrolled A1C group (OR 3.24 [95% CI 2.30–4.57]). Another statistically significant predictor of being in the uncontrolled A1C group was a positive PHQ-2 screening result for depression (OR 1.35 [95% CI 1.12–1.62]). For the continuous variables of BMI and age, with each unit increase in BMI or year of age, the odds of being in the uncontrolled group decreased (OR 0.98 [95% CI 0.97–0.99]). Nonmodifiable risk factors with statistically significant results were Hispanic or Latino ethnicity (OR 1.29 [95% CI 1.13–1.47]) and female sex (OR 0.76 [95% CI 0.68–0.86]). For additional comparison between patients with an A1C ≤9%, those with an A1C >9%, and those with no A1C test done, see Supplementary Table S1.

Discussion

It is understood that social and psychosocial health factors may commonly affect the ability of patients with diabetes to achieve glycemic goals. However, the specific impact of these factors on a large, predominantly Hispanic, FQHC-treated population had not yet been explored (2). Defining individual characteristics associated with higher A1C values is essential in developing interventions to improve care for these patients.

This study found that patients who missed at least 20% of their scheduled clinic appointments were three times more likely to be in the uncontrolled A1C group. Reasons for missed visits were not known. These results are consistent with other studies showing that poor adherence to appointments negatively affects achievement of glycemic targets. In a study of 4,253 patients with diabetes in rural Virginia, for each 10% increase in missed appointments, the odds of having an A1C >9%

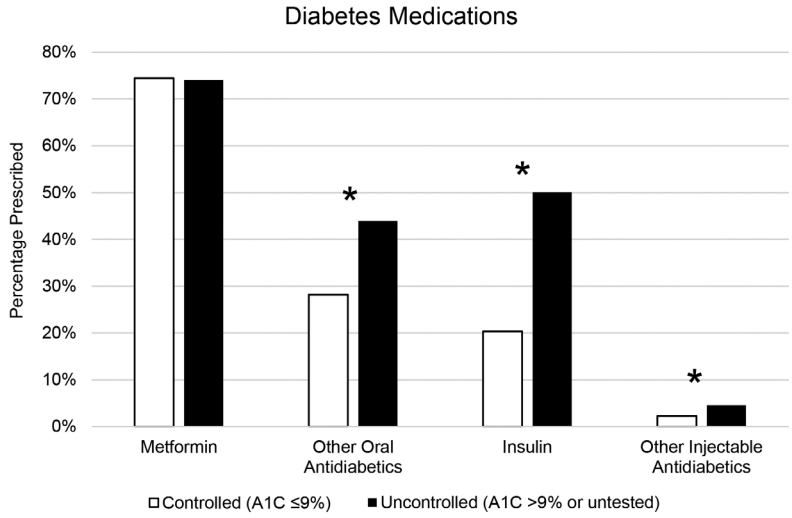

FIGURE 1. Percentage of patients prescribed diabetes medications in each group. *Indicates statistical significance (P <0.001).

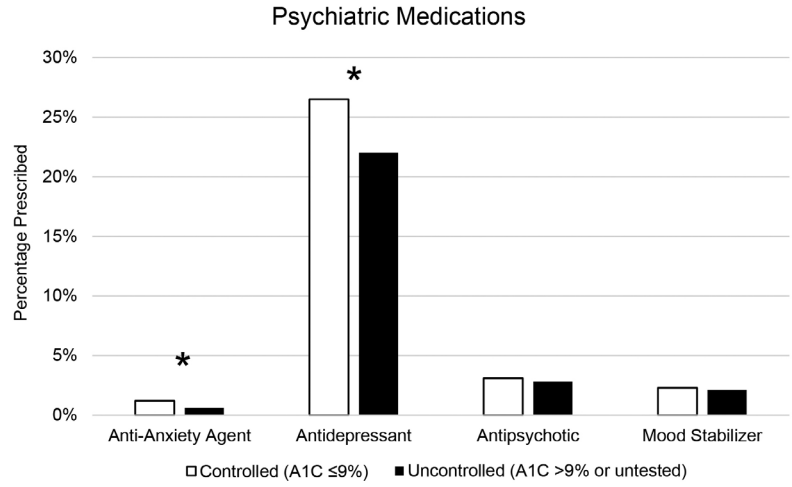

FIGURE 2. Percentage of patients prescribed psychiatric medications in each group. *Indicates statistical significance (P <0.05).

increased by 24% (15). Additional focus on patient-specific barriers to appointment adherence would allow for potential improvements in patient engagement and rate of clinic follow-up.

Psychological and disease-related distress have also been shown to affect patients' ability to achieve glycemic targets. The clinics in this study administer the PHQ-2 assessment tool annually to screen for depression (16). This is the first study to demonstrate an association between PHQ-2 screening results and A1C values. In this population, patients with a positive PHQ-2 were more likely to have an A1C >9% or untested A1C. This result indicates that even "possible depression" may be an independent risk factor for uncontrolled diabetes. Another study of 463 patients with type 2 diabetes found that diabetes distress (accounting for perceived burden of the diabetes regimen, interpersonal and provider-related distress, and emotional burden of the disease), but not depression, increased the risk of uncontrolled diabetes (17). Because this study did not find a relationship between number of mental health diagnoses and A1C results, patients with comorbid depression and other mental health symptoms of concern may be better identified by conducting more frequent screens and ensuring that additional diagnostic screens are completed when war-

TABLE 3. Results of Multivariable Analysis

Variable	OR (95% CI)	*P*
Poor appointment adherence (missing ≥20% of visits)	3.24 (2.30–4.57)	<0.001
Positive PHQ-2 screen for depression	1.35 (1.12–1.62)	<0.001
Hispanic or Latino versus non-Hispanic, non-Latino ethnicity	1.29 (1.13–1.47)	<0.001
Ethnicity refused or missing versus non-Hispanic, non-Latino ethnicity	0.99 (0.54–1.82)	0.9630
BMI	0.98 (0.97–0.99)	<0.001
Age	0.98 (0.98–0.99)	<0.001
Female sex	0.76 (0.68–0.86)	<0.001

*ORs shown represent the risk of being in the uncontrolled diabetes group (*n *=4,774). BMI and age are represented as continuous variables.*

ranted. This procedure would allow for a targeted, team-based approach that integrates support from behavioral health providers into patients' plans for meeting A1C goals.

Incorporating behavioral health providers on the care team and improving identification and treatment of depression may have further benefits to this patient population. In this study, a higher proportion of patients in the controlled A1C group were prescribed an antidepressant compared to the uncontrolled A1C group (26 vs. 22%, P <0.001). This was without controlling for a diagnosis of depression. This trend is consistent with results of a previous study, which found that patients with depression taking an antidepressant were twice as likely to achieve an A1C <7% than those experiencing depression without antidepressant medications (18). In patients with a diagnosis of depression and uncontrolled symptoms, adding an antidepressant medication could improve mood while also indirectly affecting patients' ability to achieve glycemic goals.

This study found that a larger proportion of patients in the controlled A1C group were obese compared to the uncontrolled A1C group (58 vs. 48%, P <0.001). Obesity is often thought to complicate the achievement of glycemic targets. Although these results seem to contradict this, the average BMI of patients in this study was 32 kg/m^2, and the majority of patients in the study were obese. Additionally, many patients with an A1C above goal may experience weight loss with extremely elevated glucose readings, which may obscure this result.

Age was another patient characteristic that had an effect on achievement of glycemic goals. With each year of age gained, the likelihood of being in the uncontrolled A1C group decreased. This result is consistent with what has been observed in another study of more than 318,000 Hispanic patients with type 2 diabetes that found that patients >65 years of age were more likely to achieve an A1C ≤7% than younger adult subgroups (19). These results indicate that achieving glycemic targets in younger and middle-aged adult populations may be more challenging, and using practice methods that cater to the needs of younger generations may help improve diabetes care in these patients.

This study has certain limitations. Data were extracted through automated reports from the EMR, and a random sampling of charts were reviewed to assess the accuracy of these data. However, results are limited by missing or incomplete data that may result from inconsistent documentation in the EMR. In patients without an A1C completed during the study period, demographic and social characteristics were collected from the most recent encounter. Although the goal was to ensure that all data were directly correlated to the time of the index A1C event, some patients without data that directly correlated to this time point were included to allow for the greatest amount of data to be evaluated. Patients without an A1C tested during the study period were considered to have uncontrolled diabetes. Although this may have affected these results, this categorization method is consistent with the way quality metrics in FQHCs are reported.

It is important to acknowledge that many medications for mental health may have multiple indications and that a prescription for a medication may not always indicate patient adherence to that medication. Some medications, such as benzodiazepines, were not included in our study due to the potential for "as needed" use and to avoid including prescriptions for one-time doses. Thus, the use of these medications and their effects on A1C may be underestimated.

Additionally, using positive PHQ-2 screenings can underestimate the actual prevalence of depression in our patient population and may not capture the degree to which emotional distress could contribute to poorly managed diabetes (20). Although depression may contribute, other psychosocial health factors such as anxiety, substance use disorder, or post-traumatic stress disorder could also impede management of chronic diseases (21,22). Therefore, the strength of psychosocial health as a predictor in this study is likely underestimated. Screening practices in these clinics are currently being revised to improve the frequency of screening and reduce reporting bias. It may also be prudent to consider the use of screening tools for other psychosocial health conditions in future studies to better understand the overlap between not meeting glycemic targets and mental health.

Conclusion

Poor adherence to appointments and a positive PHQ-2 result were associated with having uncontrolled A1C values (A1C >9% or untested A1C) in our FQHC population. Targeting patients who screen positive for possible depression on the PHQ-2 may improve access to necessary services and indirectly improve their ability to achieve glycemic goals. In addition, identifying and helping patients overcome barriers to appointment adherence may aid in reducing the proportion of patients with elevated or untested A1C values.

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Duality of Interest

No potential conflicts of interest relevant to this article were reported.

Author Contributions

J.R. and E.R.K. researched data, wrote the manuscript, contributed to discussion, and edited the manuscript. S.J.B., J.L.P., and J.J.S. researched data, contributed to discussion, and edited the manuscript. E.R.K. is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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