BMJ Open Diabetes Research & Care

Influence of depression on racial and ethnic disparities in diabetes control

Jessica Y Breland ,[1] Chi-Hong Tseng,[2,3] Joy Toyama,[2] Donna L Washington[2,3]

To cite: Breland JY, Tseng C-H, Toyama J, *et al*. Influence of depression on racial and ethnic disparities in diabetes control. *BMJ Open Diab Res Care* 2023;**11**:e003612. doi:10.1136/bmjdrc-2023-003612

► Additional supplemental material is published online only. To view, please visit the journal online (http://dx.doi.org/10.1136/bmjdrc-2023-003612).

Received 30 June 2023
Accepted 30 September 2023

[1]VA HSR&D Center for Innovation to Implementation, Menlo Park Division (152), VA Palo Alto Health Care System, Palo Alto, California, USA
[2]VA HSR&D Center for the Study of Healthcare Innovation, Implementation, and Policy, VA Greater Los Angeles Healthcare System, Los Angeles, California, USA
[3]Department of Medicine, David Geffen School of Medicine, Los Angeles, California, USA

Correspondence to
Dr Jessica Y Breland;
jessica.breland@va.gov

ABSTRACT

Introduction We tested the hypotheses that depression diagnoses influence racial and ethnic disparities in diabetes control and that mental health treatment moderates that relationship.

Research design and methods We created a national cohort of Veterans Health Administration (VHA) patients with diabetes using administrative data (n=815 067). Cross-sectional linear mixed effects regression models tested the hypothesized indirect effect of depression on poor diabetes control (glycosylated hemoglobin >9%) and tested whether mental health treatment (visits or antidepressant prescriptions) moderated the effect of depression (α=0.05). Results represent the percentage point difference in probability of poor diabetes control. Covariates included primary care visits, sex, age, and VHA facility.

Results Overall, 20% of the cohort had poor diabetes control and 22% had depression. Depression was more common among racial and ethnic minoritized groups. The probability of poor diabetes control was higher for most minoritized groups compared with White patients (largest difference: American Indian or Alaska Native patients, 5.2% (95% CI 4.3%, 6.0%)). The absolute value of the proportion of racial and ethnic disparities accounted for by depression ranged from 0.2% (for Hispanic patients) to 2.0% (for Asian patients), with similar effects when accounting for the moderating effect of mental health treatment. Patients with depression and 5+ mental health visits had a lower probability of poor diabetes control compared with those with fewer visits, regardless of antidepressant prescription status.

Conclusions The influence of depression on disparities in diabetes control was small. High rates of depression among people with diabetes, especially among those from racial and ethnic minoritized groups, highlight a need to ensure equitable and coordinated care for both conditions, as the effects of mental health treatment may extend to the control of physical health conditions.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ People from many racial and ethnic minoritized groups have worse diabetes control than non-Hispanic white people. Depression is associated with poor diabetes outcomes and may be more common among minoritized patients; however, to our knowledge no one has assessed the influence of depression on racial and ethnic disparities in diabetes control.

WHAT THIS STUDY ADDS

⇒ The goal of the present study was to test the hypothesis that depression diagnoses influence the relationship between race and ethnicity and diabetes control and to assess the possible moderating effect of mental health treatment. We found that depression diagnoses accounted for a small portion of racial and ethnic disparities in diabetes control, ranging from 0.2% (for Hispanic patients) to 2.0% (for Asian patients). We also found that patients with depression and 5+ mental health visits had a lower probability of poor diabetes control compared with those with fewer visits, regardless of antidepressant prescription status.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ High rates of depression among people with diabetes, especially among those from racial and ethnic minoritized groups, highlight a need to ensure equitable and coordinated care for both conditions, as the effects of mental health treatment may extend to the control of physical health conditions.

THE INFLUENCE OF DEPRESSION ON RACIAL AND ETHNIC DISPARITIES IN DIABETES CONTROL

Diabetes affects approximately 10% of the general US population[1] and nearly 25% of veterans using the Veterans Health Administration (VHA).[2] As with many chronic conditions, there are racial and ethnic disparities in diabetes outcomes. Among racial and ethnic minoritized populations, diabetes is more commonly associated with complications that can lead to reduced quality of life and premature mortality, such as visual impairment, end-stage renal disease, and cardiovascular disease.[3] Adequate diabetes control can prevent negative consequences associated with diabetes. However, people from racial and ethnic minoritized groups are more likely to have poor diabetes control, that is, glycosylated hemoglobin (HbA1c) above 9%, compared with non-Hispanic white (hereafter white) people.[3] Within the VHA, despite having access to an integrated healthcare system, non-Hispanic American Indian or Alaska Native, non-Hispanic Black or African-American (hereafter Black), and Hispanic or

Latina/Latino (hereafter Hispanic) VHA patients have worse diabetes control than white patients.[4 5]

Having a diagnosis of diabetes also increases risk for depression.[6] Depression comorbid with diabetes is associated with worse diabetes outcomes.[7 8] The relationship between diabetes and depression is related to a complex interplay of biological, behavioral, and social factors. Hypothalamic-pituitary-adrenal (HPA) axis and circadian rhythm dysregulation are present in both conditions.[7] The health behaviors required to manage diabetes could lead to depression via the stress caused by trying to find healthy food with limited resources[9] or through social withdrawal, perhaps related to the perception that food-related social events cannot be enjoyable. At the same time, depression is associated with non-adherence to diabetes self-care regimens,[10] perhaps due to the effect of diabetes distress on medication adherence[11] or other effects on self-management behaviors (eg, consuming high glycemic index comfort foods or engaging in limited physical activity).

Conversely, behavioral treatment for depression can improve diabetes outcomes,[12] perhaps by affecting the metabolic system, or by improved mood leading to the ability to overcome setbacks or missteps related to the self-management of diet, exercise, and medication adherence. The relationship between diabetes control and antidepressant medication is more complex. For some, antidepressant medication may increase the risk of new-onset type 2 diabetes,[13] whereas for others relief from depressive symptoms could improve diabetes self-management in similar ways to behavioral depression treatments.

Given that experiences of racism are associated with depression,[14] it might be expected that rates of depression would be higher among minoritized racial and ethnic groups. However, in the general US population, rates of depression vary across time and racial and ethnic group. Between 2015 and 2019, white and Hispanic people in the USA had the highest rates of depression (~8%) compared with 6% for Black people.[15] Earlier work suggests that Black people in the USA may have more severe depression and maybe be less likely to receive treatment.[16] In VHA, all groups of racial and ethnic minoritized patients, except Asian patients, have higher rates of depression diagnoses than white patients.[2] Although, Asian, Black, and Hispanic VHA primary care patients may be less likely to initiate treatment for depression than white VHA patients.[17] There are less data on racial and ethnic differences in depression rates among people with diabetes, with some studies suggesting that compared with white patients, there are lower rates of depression among Black patients, higher rates among Hispanic patients, or no differences when lumping all minoritized racial and ethnic groups into a single category.[18]

Given that depression is associated with poor diabetes outcomes and may be more common among minoritized patients, the goal of the present analyses was to test the hypothesis that depression diagnoses influence the relationship between race and ethnicity and diabetes control among VHA patients. Given that VHA provides comprehensive mental healthcare, which may positively affect diabetes control and may be less common among racial and ethnic minoritized patients, we also hypothesized that an interaction between depression diagnoses and mental health treatment might further be associated with the relationship between race and ethnicity and diabetes control. Improved understanding of the relationships among diabetes disparities and depression could identify ways to reduce disparities, such as improved coordination for diabetes and depression care, particularly in an integrated healthcare system like VHA.

RESEARCH DESIGN AND METHODS

The cohort and variables were defined using data from the VHA electronic health record (EHR; also known as the Corporate Data Warehouse) with an algorithm based on VA Office of Quality and Performance methods for diabetes quality measures. The cohort included VHA patients aged 75 years or younger who had type 1 or type 2 diabetes in fiscal year 2017 (FY17) based on International Classification of Diseases (ICD)-10 codes and/or prescriptions for diabetes medications (see online supplemental exhibits S1 and S2).

Variables

The primary outcome was poor diabetes control, defined as HbA1c) >9%.

The main independent variable represented race and ethnicity, defined with mutually exclusive groups—American Indian or Alaska Native, Asian, Black or African-American, Hispanic or Latino/Latina, Native Hawaiian or Other Pacific Islander, white, and unknown. Veterans with Hispanic ethnicity were included in the Hispanic group regardless of their race. As a result, all reported racial groups are non-Hispanic.

A three-level mental health diagnosis variable was defined based on mental health diagnoses in FY17 and was based on VHA's Women's Health Evaluation Initiative (WHEI) definitions.[19] Categories included depression, which was the mental health diagnosis of interest, mental health diagnoses other than depression, and no mental health diagnosis. Mental health diagnoses other than depression included those related to anxiety disorders, post-traumatic stress disorder, alcohol use disorders, drug use disorders, psychotic disorders, eating disorders, and personality disorders (full list available via WHEI Sourcebook[19]).

Number of mental health visits in FY17 included psychiatry, psychology, individual or group therapy, behavioral medicine, and substance use disorder treatment programs. This variable was also based on WHEI definitions.[19] Mental health visits were split into three groups: 0 visits, indicating no mental health visits; 1–4 visits; or 5+ visits.

Antidepressant prescriptions were assessed using VHA pharmacy data and represented whether a patient had at least one prescription for an antidepressant medication in the prior 2 years (ie, FY15–FY17). Included medications were based on those in VHA depression-related quality measures. A full list of medications is provided in online supplemental exhibit S3.

A mental health diagnosis-by-mental health treatment interaction term was collapsed into 10 categories to improve interpretability of results related to depression: people with no mental health diagnoses and no mental health treatment; people with depression diagnoses, no mental health visits and no antidepressant prescriptions; people with depression diagnoses, no mental health visits and antidepressant prescriptions; people with depression diagnoses, 1–4 mental health visits and no antidepressant prescriptions; people with depression diagnoses, 1–4 mental health visits and antidepressant prescriptions; people with depression diagnoses, 5+ mental health visits and no antidepressant prescriptions; people with depression diagnoses, 5+ mental health visits and antidepressant prescriptions; people with no mental health diagnoses, no mental health visits and antidepressant prescriptions; all other patients (ie, those with no depression diagnosis and any number of mental health visits, and those with only mental health diagnoses other than depression) with no antidepressant prescriptions; and all other patients with antidepressant prescriptions.

Additional covariates

Sex, which was a composite variable primarily representing biologic sex, but which can include self-reported gender (they were not separately defined in VHA EHR data in FY17). *Age*, based on date of birth, was coded into 5-year increments to account for the non-linear relationship between age and diabetes control, other than the youngest age group, which had a 6-year interval. *Number of primary care visits in FY17*, which included primary care received in general medical or women's health clinics, were split into four categories: 0 or 1 visits; 2–3 visits, 4 visits, or 5+ visits. These variables were based on WHEI definitions.[19]

Analyses

We specified three linear mixed effects regression models to quantify the hypothesized influence of depression on racial and ethnic disparities in diabetes control.[20] Linear mixed effects models are a practical and convenient analytical approach that can provide valid inference with a large sample size.[21] This approach to assessing the influence of depression, a form of mediation, accommodated the three-level mental health diagnosis variable, which would not have been possible with other approaches.[22] In addition, this approach improves interpretability as point estimates represent the percentage point change in probability of poor diabetes control. Therefore, we report all point estimates as percentages. The 95% CIs and p values were calculated for all models (α=0.05).[23]

Table 1 Cohort characteristics

Characteristic	N	%
Women	37 511	5
Men	777 556	95
Race/Ethnicity		
American Indian or Alaska Native	8169	1
Asian	7740	1
Black or African-American	176 765	22
Hispanic or Latino/Latina	57 766	7
Native Hawaiian or Other Pacific Islander	7115	<1
White	546 450	67
Unknown	11 062	1
Age (years)		
19–24	208	<1
25–29	1268	<1
30–34	4441	1
35–39	8337	1
40–44	15 238	2
45–49	35 135	4
50–54	54 161	7
55–59	89 780	11
60–64	131 001	16
65–69	288 581	35
70–75	186 917	23
Number of mental health visits in FY17		
0	559 472	69
1–4	150 192	18
5+	105 403	13
Antidepressant prescription	304 497	37
Number of primary care visits		
0–1	129 039	16
2	187 418	23
3–4	254 954	31
5+	243 656	30
Mental health diagnosis		
Depression diagnosis	182 624	22
Mental health diagnoses other than depression	134 780	17
No mental health diagnosis	497 663	61
Poor diabetes control	162 748	20

All percentages are row percentages. Poor diabetes control: HbA1c >9%. All racial groups are non-Hispanic.
FY17, fiscal year 2017; HbA1c, glycosylated hemoglobin.

All models included race and ethnicity, sex, age, and number of primary care visits. In addition, all models included the unique site identifier as a random effect for all VHA sites across the USA, where care could be

provided. Model 1, the base model, also included mental health visits and antidepressant prescriptions. Model 2 was the same as model 1, but with the addition of the mental health diagnosis variable. The difference between the race and ethnicity coefficients between model 1 and model 2 allowed us to assess the influence of depression diagnoses on diabetes control and to determine the percent of the direct effect accounted for by depression.[20] The final model, model 3, included the mental health diagnosis-by-mental health treatment interaction term. The difference between the race and ethnicity coefficients between model 1 and model 3 allowed us to quantify the influence of depression, depending on mental health treatment and represented a form of moderated mediation.[24] Our primary goal was to understand the influence of depression diagnoses on diabetes control. Therefore, our base model included all other available confounders that might affect outcomes so that in model 2 we could assess the unique association of depression diagnoses with diabetes control and in model 3 we could assess the unique influence of the depression diagnoses and mental health treatment in combination on diabetes control.

Data and resource availability

The datasets generated during and/or analyzed during the current study are not publicly available due to the potential for re-identification of data, but are available from the guarantor in a redacted form on reasonable request.

RESULTS

The cohort included 37 511 women and 777 556 men with diabetes. Overall, 20% of the cohort had poor diabetes control. Most patients in the cohort were white (67%) or Black (22%). A smaller proportion were Hispanic (7%), American Indian or Alaska Native (1%), Asian (1%), Native Hawaiian or Other Pacific Islander (<1%), or had unknown race and ethnicity (1%). The mean age was 63.5 years (SD 8.4). Additional details on cohort characteristics are provided in table 1.

Overall, 22% of the sample had a diagnosis of depression. Within racial and ethnic groups, Hispanic patients had the highest rate of depression diagnoses at 26% followed by American Indian or Alaska Native patients (25%), then byBlack patients (24%) and Native Hawaiian or Other Pacific Islander patients (24%). Those same groups had the highest proportion of patients with mental health visits and antidepressant prescriptions. For example, 38% of Hispanic patients had at least one mental health visit, the highest of any racial or ethnic group. Antidepressant prescriptions were highest among American Indian or Alaska Native patients (41%). Table 2 provides additional detail.

Table 3 provides results of regression models. First, we report on model 1, which tested the association between race and ethnicity and diabetes control, adjusting for age, sex, number of primary care visits, number of mental health visits, antidepressant prescriptions, and site. In this model, the probability of poor diabetes control was higher among patients from most racial and ethnic minoritized groups compared with white patients, including American Indian or Alaska Native patients (beta: 5.2% (95% CI 4.3% to 6.0%)), Black patients (2.1% (1.8% to 2.3%)), Hispanic patients (3.3% (2.9% to 3.7%)), Native Hawaiian or Other Pacific Islander patients (3.2% (2.3% to 4.1%)), and patients with unknown race and ethnicity (1.4% (0.7% to 2.1%)). Asian patients had a lower probability of poor diabetes control compared with white patients (−0.9% (−1.8% to −0.001%)).

Model 2 tested the association between race and ethnicity and diabetes control and, in addition to the variables in model 1, included mental health diagnoses. As seen in table 3, depression diagnoses were positively associated with poor diabetes control (beta: 0.3% (95% CI 0.003% to 0.6%)). As shown in table 4, the estimated influence of depression diagnoses in model 2 was statistically significant for all groups other than patients with unknown race or ethnicity, but very small. The absolute value of the influence of depression diagnoses ranged from 0.2% (for Hispanic patients) to 2.0% (for Asian patients) of the total effects of race and ethnicity on diabetes control.

Finally, model 3 (table 3) allowed us to test the hypothesis that the influence of depression on diabetes control was moderated by mental health treatment. In this model, the association between Asian race and diabetes control was no longer statistically significant. Results show a dose-response effect in which for people with depression diagnoses there was a positive association between poor diabetes control and no mental health visits or 1–4 mental health visits, regardless of whether the person had an antidepressant prescription. For example, the predicted probability of poor diabetes control was 2.1% higher among people with depression, 1–4 mental health visits and no antidepressant prescription (95% CI 1.4% to 2.7%) compared with people without depression or mental health treatment. Conversely, having a depression diagnosis and 5+ mental health visits was negatively associated with poor diabetes control for people with an antidepressant prescription (−2.2% (95% CI −2.5% to −1.8%)) and for people without an antidepressant prescription (−1.3% (−2.1% to −0.5)).

As shown in table 4, the absolute values of the estimated influence of depression diagnosis, with mental health treatment as a moderator, were statistically significant for Hispanic patients (0.7%), Native Hawaiian or Other Pacific Islander patients (0.4%), and patients with unknown race or ethnicity (2.6%) but represented a very small portion of the total effects of race and ethnicity on diabetes control.

Table 3 Differences in poor diabetes control associated with characteristics of VHA patients with diabetes in FY17, based on linear mixed effects regression models

	Model 1			Model 2			Model 3		
Independent variable	**%**	**95% CI**	**P value**	**%**	**95% CI**	**P value**	**%**	**95% CI**	**P value**
Race/Ethnicity (ref: white)									
American Indian or Alaska Native	5.2	4.3% to 6.0%	<0.0001	5.2	4.4% to 6.1%	<0.0001	5.2	4.3% to 6.0%	<0.0001
Asian	−0.9	−1.8% to −0.001%	0.0498	−0.9	−1.9% to −0.02%	0.0454	−0.9	−1.8% to −0.04%	0.0597
Black or African-American	2.1	1.8% to 2.3%	<0.0001	2.1	1.8% to 2.3%	<0.0001	2.1	1.8% to 2.3%	<0.0001
Hispanic or Latino/Latina	3.3	2.9% to 3.7%	<0.0001	3.3	2.9% to 3.7%	<0.0001	3.3	2.9% to 3.7%	<0.0001
Native Hawaiian or Other Pacific Islander	3.2	2.3% to 4.1%	<0.0001	3.2	2.3% to 4.1%	<0.0001	3.2	2.3% to 4.1%	<0.0001
Unknown	1.4	0.7% to 2.1%	0.0002	1.4	0.7% to 2.1%	0.0002	1.4	0.7% to 2.2%	0.0001
Number of mental health visits (ref: 0 visits)									
1–4	−0.5	−0.8% to −0.3%	<0.0001	−0.4	−0.7% to −0.1%	0.0124	–	–	–
5+	−3.4	−3.7% to −3.1%	<0.0001	−3.3	−3.7% to −3.0%	<0.0001	–	–	–
Antidepressant prescription (ref: no antidepressant prescription)	1.00	0.8% to 1.2%	<0.0001	0.9	0.7% to 1.1%	<0.0001	–	–	–
Mental health diagnosis (ref: no mental health diagnosis)									
Depression diagnosis	–	–	–	0.3	0.004% to 0.6%	0.0474	–	–	–
Other mental health diagnosis	–	–	–	−0.9%	−1.2% to −0.6%	<0.0001	–	–	–
Depression and mental health treatment (ref: no diagnosis and no treatment)									
Depression, no mental health visits, no antidepressant prescription	–	–	–	–	–	–	2.4	1.7% to 3.0%	<0.0001
Depression, no mental health visits, antidepressant prescription	–	–	–	–	–	–	1.9	1.3% to 2.4%	<0.0001
Depression, 1–4 mental health visits, no antidepressant prescription	–	–	–	–	–	–	2.1	1.4% to 2.7%	<0.0001
Depression, 1–4 mental health visits, antidepressant prescription	–	–	–	–	–	–	0.6	0.2% to 0.9%	0.0006
Depression, 5+ mental health visits, no antidepressant prescription	–	–	–	–	–	–	−1.3	−2.1% to −0.5%	0.0016
Depression, 5+ mental health visits, antidepressant prescription	–	–	–	–	–	–	−2.2	−2.5% to −1.8%	<0.0001
No mental health diagnosis, no mental health visits, antidepressant prescription	–	–	–	–	–	–	2.4	2.1% to 2.7%	<0.0001
Other patients, no antidepressant prescription*	–	–	–	–	–	–	−0.2	−0.5% to 0.1%	0.3124
Other patients, antidepressant prescription*	–	–	–	–	–	–	−1.1	−1.4% to −0.8%	<0.0001

All analyses were adjusted for sex, age, and number of primary care visits, with VHA facility identifier included as a random effect.
*Other patients include those with mental health diagnoses, other than depression, and any number of mental health visits (including zero), and patients without mental health diagnoses that have mental health visits.
FY17, fiscal year 17; Ref, reference group; VHA, Veterans Health Administration.

Table 4 Influence of depression diagnosis and mental health treatment on racial and ethnic disparities in poor diabetes control

Race/Ethnicity (ref: white)	Effect of depression*		Effect of depression×mental health treatment†	
	Influence of depression	% of total effect accounted for by depression	Influence of depression×mental health treatment	% of total effect accounted for by depression×mental health treatment
	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)
American Indian or Alaska Native	−0.02% (−0.03% to −0.01%)	−0.39% (−0.52% to −0.25%)	0.001% (−0.01% to 0.01%)	0.02% (−0.11% to 0.15%)
Asian	0.02% (0.01% to 0.03%)	2.00% (1.25% to 2.75%)	–	–
Black or African-American	−0.02% (−0.02% to −0.01%)	−0.92% (−1.16% to −0.68%)	0.003% (−0.002% to 0.01%)	0.15% (−0.09% to 0.38%)
Hispanic or Latino/Latina	−0.01% (−0.01% to −0.01%)	−0.24% (−0.32% to −0.17%)	−0.02% (−0.03% to −0.02%)	−0.70% (−0.77% to −0.62%)
Native Hawaiian or Other Pacific Islander	−0.02% (−0.02% to −0.01%)	−0.47% (−0.59% to −0.35%)	−0.01% (−0.02% to −0.01%)	−0.38% (−0.49% to −0.26%)
Unknown	−0.001% (−0.003% to 0.001%)	−0.07% (−0.22% to 0.07%)	−0.04% (−0.04% to −0.03%)	−2.63% (−2.78% to −2.49%)

All racial groups are non-Hispanic.
The association between Asian race and diabetes control (ie, the direct effect) was not statistically significant in model 3, so estimates of the influence of depression×mental health treatment on this association is not provided.
*Model 1–model 2.
†Model 1–model 3.
Ref, reference group.

DISCUSSION

Among a cohort of patients with diabetes, American Indian or Alaska Native, Black, Hispanic, and Native Hawaiian or Other Pacific Islander patients had a higher probability of poor diabetes control than white patients. Rates of depression diagnoses among these patients were higher than among white patients. Depression was associated with a higher probability of poor diabetes control. Depression had a slight, but statistically significant influence on racial and ethnic disparities in diabetes control, suggesting that a small part of the disparity in diabetes outcomes may be related to differences in rates of depression diagnoses across racial and ethnic groups. Finally, this association was moderated by mental health treatment such that having depression and four or fewer mental health visits was associated with a higher probability of poor diabetes control, but having depression and five or more mental health visits was associated with a lower probability of poor diabetes control, regardless of antidepressant medication prescriptions.

American Indian or Alaska Native patients had the largest disparities in diabetes control of any racial and ethnic minoritized group—the probability of poor diabetes control was roughly 5% higher for these patients than white patients. However, only 0.4% of that effect was related to depression, with an even smaller proportion when accounting for the moderating effect of mental health treatment, suggesting that differences in rates of depression are not a primary factor driving racial and ethnic disparities in diabetes control.

Nonetheless, the findings provide further support for the detrimental effect of depression on diabetes

Table 2 Depression diagnoses and mental health visits by race/ethnicity

Race/Ethnicity	Total	Depression diagnosis	Mental health visits			Antidepressant prescription
	N	%	0 visits (%)	1–4 visits (%)	5+ visits (%)	%
American Indian or Alaska Native	8169	25	66	20	14	41
Asian	7740	19	71	17	12	29
Black or African-American	176 765	24	63	20	17	37
Hispanic or Latino/Latina	57 766	26	62	22	16	40
Native Hawaiian or Other Pacific Islander	7115	24	64	21	15	39
White	546 450	22	71	18	11	38
Unknown	11 062	19	74	16	10	28

All percentages are row percentages; χ^2 tests of column differences were statistically significant at p<0.05. All racial groups are non-Hispanic.

outcomes[7 8 25] as depression diagnoses were associated with a higher likelihood of poor diabetes control, especially for people with few or no mental health visits. As such, focusing on undertreated depression, particularly ensuring access to mental health treatment visits, may be an important way to improve the health of people with diabetes and depression. This has special importance for people from racial and ethnic minoritized groups with depression who are often less likely to use mental health treatment than white people.[16 17]

The findings also offer important information on rates of depression diagnoses among patients with diabetes from racial and ethnic groups that are often left out of research, such as American Indian or Alaska Native and Native Hawaiian or Other Pacific Islander populations. Given that we found higher rates of depression diagnoses among these patients compared with white patients, future work must ensure their adequate representation. As in other work,[6 18] we found relatively high rates of depression among our cohort of patients with diabetes. At the same time, our findings also suggest that rates of depression diagnoses across racial and ethnic groups among patients with diabetes may differ from those in the general US population where Black people may have lower rates of depression than white people.[15] Additional work is needed to confirm these findings outside a veteran population.

Racial and ethnic health disparities in the USA have deep roots based on structural and systemic factors, including inequitable access to housing and healthcare.[26] Veterans using VHA have access to a national, integrated healthcare system, which includes housing support for some veterans, that should ameliorate some of these effects. However, we found racial and ethnic disparities in diabetes control remained for VHA patients, even after adjusting for depression and mental health treatment. Therefore, our findings offer additional support for the idea, described in a recent report to the US Congress, that medical and mental healthcare alone are insufficient to address disparities in diabetes outcomes.[27] The report suggested that addressing diabetes-related disparities will require new approaches that could include subsidies to farmers to grow healthier food, housing support, and paid parental leave. Such an approach may also address some of the shared mechanisms driving diabetes and depression as described by the International Conference of Depression and Diabetes, including poverty, unsafe neighborhoods, and childhood adversity.[7]

Specifically considering structural inequities and the relationship between diabetes and depression leads to additional hypotheses. It is possible that depression does not influence diabetes disparities if caused by diabetes-related changes in behavior that are unlikely to be related to structural racism, such as withdrawal from social gatherings. At the same time, it may be that depression will influence diabetes disparities if related to structural racism, such as HPA axis dysregulation due to the stress of living in an under-resourced neighborhood. These and similar hypotheses were not possible to test with our cross-sectional design based on VHA administrative data as the data cannot account for whether depression or diabetes occurred first, causes of depression, or underlying physiology. These hypotheses would be difficult to test even with longitudinal data collected as part of a study. However, the underlying idea that structural racism affects multiple facets of health across multiple domains is well documented[26] and could be accounted for in future work by including multidimensional measures of structural racism,[28] with special care to develop measures specific to veterans who have unique health profiles and, in the USA, unique access to medical and mental healthcare.

Other limitations include the use of depression diagnoses as opposed to symptoms of depression, which may have overestimated the effect of depression on diabetes control as the diagnosis may represent a history of depressive symptoms as opposed to current symptoms. Relying on ICD diagnoses cannot identify people who do not seek care at VHA or for whom providers do not assess or document depression. As a result, our analyses may underestimate the effect of depression on diabetes control, particularly given that Black, Hispanic, and Asian patients are less likely to receive depression diagnoses than white patients.[29] Although, this effect is attenuated by the fact that VHA is an integrated healthcare system with universal screening for depression, meaning that a patient would not have to seek mental healthcare to get a depression diagnosis. In addition, we did not have information on why people received mental health treatment or whether they received treatment outside VHA. Finally, results may not generalise outside VHA where people may have less comprehensive healthcare, although our use of VHA data allowed us to investigate the moderating effect of mental health treatment. Therefore, we believe the limitations of this work are outweighed by strengths, which include the large national cohort with access to medical and mental healthcare, and comprehensive race and ethnicity categories.

In conclusion, our results offer the novel finding that depression, particularly if undertreated, has a small influence on the association between race and ethnicity and diabetes control. The findings also support past work demonstrating that American Indian or Alaska Native, Black, Hispanic, and Native Hawaiian or Other Pacific Islander people and people without adequate depression treatment have a higher probability of poor diabetes control. High rates of depression among people with diabetes, especially among those from racial and ethnic minoritized groups, highlight a need to ensure equitable and coordinated care for both conditions as the effects of mental health treatment may extend to the control of physical health conditions. Given the small magnitude of the influence of depression on racial and ethnic disparities in diabetes control, a continued focus on identifying and reducing factors that drive disparities is necessary.

Contributors JYB: conceptualization; writing—original draft, reviewing, and editing. C-HT: methodology; writing—review and editing. JT: formal analysis; writing—review and editing. DLW: funding acquisition; methodology; conceptualization; project administration; writing—review and editing. DLW 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.

Funding This study was supported by a VA Health Services Research & Development Investigator Initiated Research Award (IIR 17-289).

Disclaimer The views presented in this manuscript represent those of the authors and not necessarily those of the Department of Veterans Affairs or the US government.

Competing interests None declared.

Patient consent for publication Not applicable.

Ethics approval The VA Greater Los Angeles Healthcare System Institutional Review Board approved this project (ID# 1615863), which included approval for a waiver of consent.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available on reasonable request. The datasets generated during and/or analyzed during the current study are not publicly available due to the potential for re-identification of data, but are available from the guarantor in a redacted form on reasonable request.

ORCID iD

Jessica Y Breland http://orcid.org/0000-0003-0024-3478

REFERENCES

1 Centers for Disease Control and Prevention. National Diabetes Statistics Report website, Available: https://www.cdc.gov/diabetes/data/statistics-report/index.html [Accessed 3 Nov 2022].
2 VA Office of Health Equity. National veteran health equity report—Fy2013 Washington, DC US Department of Veterans Affairs; 2016. Available: http://www.va.gov/healthequity/NVHER.asp [Accessed 3 Nov 2022].
3 Golden SH, Brown A, Cauley JA, *et al*. Health disparities in endocrine disorders: biological, clinical, and Nonclinical factors--an endocrine society scientific statement. *J Clin Endocrinol Metab* 2012;97:E1579–639.
4 Hunt KJ, Davis M, Pearce J, *et al*. Geographic and racial/ethnic variation in glycemic control and treatment in a national sample of veterans with diabetes. *Diabetes Care* 2020;43:2460–8.
5 Washington DL, Steers WN, Huynh AK, *et al*. Racial and ethnic disparities persist at veterans health administration patient-centered medical homes. *Health Aff (Millwood)* 2017;36:1086–94.
6 Hasan SS, Mamun AA, Clavarino AM, *et al*. Incidence and risk of depression associated with diabetes in adults: evidence from longitudinal studies. *Community Ment Health J* 2015;51:204–10.
7 Holt RIG, de Groot M, Lucki I, *et al*. NIDDK international conference report on diabetes and depression: current understanding and future directions. *Diabetes Care* 2014;37:2067–77.
8 Richardson LK, Egede LE, Mueller M, *et al*. Longitudinal effects of depression on glycemic control in veterans with type 2 diabetes. *Gen Hosp Psychiatry* 2008;30:509–14.
9 Breland JY, McAndrew LM, Gross RL, *et al*. Challenges to healthy eating for people with diabetes in a low-income, minority neighborhood. *Diabetes Care* 2013;36:2895–901.
10 Gonzalez JS, Peyrot M, McCarl LA, *et al*. Depression and diabetes treatment nonadherence: a meta-analysis. *Diabetes Care* 2008;31:2398–403.
11 Gonzalez JS, Kane NS, Binko DH, *et al*. Tangled up in blue: unraveling the links between emotional distress and treatment adherence in type 2 diabetes. *Diabetes Care* 2016;39:2182–9.
12 Uchendu C, Blake H. Effectiveness of cognitive-behavioural therapy on glycaemic control and psychological outcomes in adults with diabetes mellitus: a systematic review and meta-analysis of randomized controlled trials. *Diabet Med* 2017;34:328–39.
13 Wang Y, Liu D, Li X, *et al*. Antidepressants use and the risk of type 2 diabetes mellitus: a systematic review and meta-analysis. *J Affect Disord* 2021;287:41–53.
14 Paradies Y, Ben J, Denson N, *et al*. Racism as a determinant of health: a systematic review and meta-analysis. *PLoS One* 2015;10:e0138511.
15 Goodwin RD, Dierker LC, Wu M, *et al*. Trends in U.S. depression prevalence from 2015 to 2020 the widening treatment gap. *Am J Prev Med* 2022;63:726–33.
16 Williams DR, González HM, Neighbors H, *et al*. Prevalence and distribution of major depressive disorder in African Americans, Caribbean Blacks, and non-hispanic whites: results from the national survey of American life. *Arch Gen Psychiatry* 2007;64:305–15.
17 Waitzfelder B, Stewart C, Coleman KJ, *et al*. Treatment initiation for new episodes of depression in primary care settings. *J Gen Intern Med* 2018;33:1283–91.
18 Roy T, Lloyd CE. Epidemiology of depression and diabetes: a systematic review. *J Affect Disord* 2012;142 Suppl:S8–21.
19 Frayne SM, Phibbs CS, Saechao F, *et al*. Sourcebook: women veterans in the veterans health administration. In: *Longitudinal Trends in Sociodemographics, Utilization, Health Profile, and Geographic Distribution* . Women's Health Serv Veterans Health Adm Dep Veterans Aff, 2018: 4. 1–132.
20 VanderWeele TJ. Mediation analysis: a practitioner's guide. *Annu Rev Public Health* 2016;37:17–32.
21 Lumley T, Diehr P, Emerson S, *et al*. The importance of the normality assumption in large public health data SETS. *Annu Rev Public Health* 2002;23:151–69.
22 Baron RM, Kenny DA. The moderator-mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. *J Pers Soc Psychol* 1986;51:1173–82.
23 Saunders CT, Blume JD. A classical regression framework for mediation analysis: fitting one model to estimate mediation effects. *Biostatistics* 2018;19:514–28.
24 Preacher KJ, Rucker DD, Hayes AF. Addressing moderated mediation hypotheses: theory, methods, and applications. *Multivariate Behav Res* 2007;42:185–227.
25 Frayne SM, Halanych JH, Miller DR, *et al*. Disparities in diabetes care: impact of mental illness. *Arch Intern Med* 2005;165:2631–8.
26 Bailey ZD, Krieger N, Agénor M, *et al*. Structural racism and health inequities in the USA: evidence and interventions. *Lancet* 2017;389:1453–63.
27 health.gov. Report to Congress, Available: https://health.gov/about-odphp/committees-workgroups/national-clinical-care-commission/report-congress [Accessed 3 Nov 2022].
28 Chantarat T, Van Riper DC, Hardeman RR. The intricacy of structural racism measurement: a pilot development of a latent-class multidimensional measure. *EClinicalMedicine* 2021;40:101092.
29 Shao Z, Richie WD, Bailey RK. Racial and ethnic disparity in major depressive disorder. *J Racial Ethn Health Disparities* 2016;3:692–705.

Supplemental Material

Exhibit S1. ICD9 and ICD10 codes used to define a diabetes diagnosis

ICD9CM

357.2, 250.00, 250.01, 250.02, 250.03, 250.10, 250.11, 250.12, 250.13, 250.20, 250.21, 250.22, 250.23, 250.30, 250.31, 250.32, 250.33, 250.40, 250.41, 250.42, 250.43, 250.50, 250.51, 250.52, 250.53, 250.60, 250.61, 250.62, 250.63, 250.70, 250.71, 250.72, 250.73, 250.80, 250.81, 250.82, 250.83, 250.90, 250.91, 250.92, 250.93, 362.01, 362.02, 362.03, 362.04, 362.05, 362.06, 362.07, 366.41, 648.00, 648.01, 648.02, 648.03, 648.04

ICD10CM

E10.8, E10.9, E11.8, E11.9, E13.8, E13.9, E10.10, E10.11, E10.21, E10.22, E10.29, E10.36, E10.39, E10.40, E10.41, E10.42, E10.43, E10.44, E10.49, E10.51, E10.52, E10.59, E10.65, E10.69, E11.00, E11.01, E11.21, E11.22, E11.29, E11.36, E11.39, E11.40, E11.41, E11.42, E11.43, E11.44, E11.49, E11.51, E11.52, E11.59, E11.65, E11.69, E13.00, E13.01, E13.10, E13.11, E13.21, E13.22, E13.29, E13.36, E13.39, E13.40, E13.41, E13.42, E13.43, E13.44, E13.49, E13.51, E13.52, E13.59, E13.65, E13.69, O24.02, O24.03, O24.12, O24.13, O24.32, O24.33, O24.82, O24.83, E10.311, E10.319, E10.321, E10.329, E10.331, E10.339, E10.341, E10.349, E10.351, E10.359, E10.610, E10.618, E10.620, E10.621, E10.622, E10.628, E10.630, E10.638, E10.641, E10.649, E11.311, E11.319, E11.321, E11.329, E11.331, E11.339, E11.341, E11.349, E11.351, E11.359, E11.610, E11.618, E11.620, E11.621, E11.622, E11.628, E11.630, E11.638, E11.641, E11.649, E13.311, E13.319, E13.321, E13.329, E13.331, E13.339, E13.341, E13.349, E13.351, E13.359, E13.610, E13.618, E13.620, E13.621, E13.622, E13.628, E13.630, E13.638, E13.641, E13.649, O24.011, O24.012, O24.013, O24.019, O24.111, O24.112, O24.113, O24.119, O24.311, O24.312, O24.313, O24.319, O24.811, O24.812, O24.813, O24.819

Exhibit S2. Diabetes-related prescriptions

Note: list does not include metformin alone as it can be used to treat other conditions

- acarbose
- albiglutide
- alogliptin
- alogliptin-metFORMIN
- alogliptin-pioglitazone
- canagliflozin
- canagliflozin-metFORMIN
- chlorproPAMIDE
- dapagliflozin
- empagliflozin
- empagliflozin-metformin
- empaglifozin-linagliptin
- exenatide
- glimepiride
- glimepiride-pioglitazone
- glimepiride-rosiglitazone
- glipiZIDE
- glipiZIDE-metFORMIN
- glyBURIDE
- glyBURIDE-metFORMIN
- insulin
- linagliptin
- linagliptin-metFORMIN
- liraglutide
- metFORMIN-pioglitazone
- metFORMIN-repaglinide
- metFORMIN-rosiglitazone
- metFORMIN-saxagliptin
- metFORMIN-sitaGLIPtin
- miglitol
- nateglinide
- pioglitazone
- pramlintide
- repaglinide
- rosiglitazone
- saxagliptin
- sitaGLIPtin
- TOLAZamide
- TOLBUTamide

Exhibit S3. Antidepressant medications

Bupropion, Vilazodone, Vortioetine, Isocarboxazid, Selegiline, Phenelzine, Tranylcypromine, Nefazodone, Trazodone, Amitriptyline-chlordiazepoxide, Amitriptyline-perphenazine, Fluoxetine-olanzapine, Desvenlafaxine, Levomilnacipran, Venlafaxine, Duloxetine, Citalopram, Fluoxetine, Paroxetine, Escitalopram, Fluvoxamine, Sertraline, Maprotiline, Mirtazapine, Amitriptyline, Desipramine, Nortriptyline, Amoxapine, Doxepin (gt 6mg), Protriptyline, Clomipramine, Imipramine, Trimipramine