The Association of Depression with Diabetes Management among Urban American Indians/Alaska Natives in the United States, 2011

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Objective: To determine the relationship between depression and diabetes management among urban American Indians/Alaska Natives (AI/ANs).

Design: Retrospective, cross-sectional analysis of medical records.

Setting: 33 Urban Indian Health Organizations that participated in the Indian Health Service Diabetes Care and Outcomes Audit.

Patients: 3,741 AI/AN patient records.

Main Outcome Measures: Diabetes management outcomes, including HbA1c, smoking, BMI, systolic blood pressure, creatinine, total cholesterol, and receipt of preventive services.

Results: Individuals with depression and diabetes were 1.5 times more likely to smoke than individuals with diabetes but without depression (OR=1.51; 95% CI: 1.23, 1.86), controlling for age, sex, and facility. After adjustment, the geometric mean BMI in diabetes patients with depression was 3% higher than in patients without depression (β=.034; 95% CI: .011, .057).

Conclusions: Urban AI/ANs with diabetes and depression are more likely to smoke and have higher BMI than those with diabetes but without depression. These findings inform programmatic efforts to address the care of patients with both depression and diabetes. (*Ethn Dis*. 2015;25[1]:83–89)

Key Words: Diabetes Mellitus, Depression, North American Indians

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Introduction

Type 2 diabetes is a leading cause of morbidity and mortality among American Indians/Alaska Natives (AI/ANs).[1,2] AI/ANs are more than twice as likely to have diabetes than non-Hispanic Whites of similar age.[3] In 2009, the age-adjusted prevalence of diabetes was 16.1% among AI/ANs and 7.1% among non-Hispanic Whites in the United States.[2] Depression is common among individuals with diabetes, but particularly among AI/ANs with diabetes. The age-adjusted prevalence of major and minor depression among individuals with diabetes is 33.2% among AI/ANs and 15.3% among non-Hispanic Whites.[4]

Over the past half-century, AI/ANs have relocated from reservations into urban centers, both by choice and as a result of federal policy.[5] Currently, 71% of AI/ANs reside in urban areas.[6] These individuals left reservation lands for educational, employment, or housing opportunities, as well as through forced relocation and termination policies.[5,7,8] Although urban AI/AN health data are limited, what information does exist indicates substantial health disparities between urban AI/ANs and comparison urban populations. Urban AI/ANs carry a disproportionate burden of disease, including higher mortality from diabetes, unintentional injury, and chronic liver disease compared with the general population living in the same urban areas.[7] A downward trend from 1990 to 1999 seen in mortality rates for the general population is absent for urban AI/ANs, where rates have remained steady or increased over the same period.[7] Additionally, urban AI/ANs are nearly twice as likely as the general population to be poor, unemployed, and not have a college degree,[7] which likely exacerbate health disparities.

Although urban AI/ANs are a heterogeneous group that includes members or descendants of a variety of tribes, they share a common historical experience of population decimation, loss of lands, and destruction of language, religion, and culture.[9] The poor health and socioeconomic status of urban AI/ANs are shaped by the experience of historical trauma and the transfer of unresolved grief across generations.[10] Research among several reservations/reserves indicate that persistent thoughts of historical loss are associated with emotional responses including depression and anger.[11,12]

Access to culturally appropriate, comprehensive health care, including diabetes care, is critical to reducing rates of disease and death in this population. Yet after migrating into urban areas, AI/ANs often lose access to health care benefits that are available on reservation lands. While some urban AI/ANs travel back to their home reservations, others lack strong ties with tribal communities or are unable to travel long distances for health care. Urban Indian Health Organizations (UIHOs) are private, nonprofit corporations that serve AI/ANs in select cities by providing a range of health and social services, from referral services to full ambulatory care. Thirty-three UIHOs, funded in part under Title V of the Indian Health Care Improvement Act, receive limited grants and contracts from the Indian Health Service (IHS) to provide services to AI/ANs living in urban areas. Although the scope and delivery of health care services vary across UIHOs, almost all receive Special Diabetes Program for Indians (SDPI) funding from the IHS to support comprehensive diabetes care.

Congress established the SDPI in 1997 to reduce the burden of diabetes among AI/ANs.[13] This program provides funding to aid in the prevention and treatment of diabetes in AI/AN communities.

While genetics and lifestyle influence diabetes risk, the experience of stress and trauma early in life is also predictive of diabetes morbidity,[14,15] as is the interaction between genetics and stress in the environment.[16] Adverse events that occur during fetal development and early childhood are associated with an increased risk of physical and mental health issues.[14,17] These stressors can include poverty, abuse, racial discrimination, food insecurity, and others. Studies conducted in AI/AN communities found an association between self-reported diabetes and stress burden, such as childhood trauma and chronic racial discrimination,[15] and an association between depressive disorder and diabetes.[18] Considering the extensive history of trauma among AI/ANs, research on chronic disease in this population might benefit from exploring the complex relationship between disease and mental and emotional well being.

It has been well-documented that diabetes is associated with a higher risk of depression.[19] The co-morbidity of diabetes and depression is particularly challenging for clinicians, as the debilitating effects of depression may influence an individual's ability to successfully manage diabetes. To date, several studies have demonstrated that depression is associated with poor diabetes control among AI/ANs.[20–22] However, these studies focused on Hemoglobin A1c (HbA1c) as the primary measure of diabetes control, and little is known about the association between depression and other diabetes-related outcomes, including other clinical biomarkers (eg, blood pressure, creatinine, cholesterol), tobacco use, and the likelihood of receiving exercise and diet instruction, or other diabetes services (eg, foot, eye, or dental exams). Additionally, most studies of depression co-existing with diabetes among AI/ANs fail to include AI/ANs who reside in urban areas. The generalizability of findings from rural to urban communities may not be appropriate, given the differences in geography, lifestyle, and accessibility of cultural and health care resources between rural and urban areas.[8]

The purpose of our analysis was to assess the relationship of depression and diabetes management among urban AI/ANs who received care at UIHOs in 2011. A better understanding of the association of depression and diabetes management will allow health care providers, including UIHOs, to develop appropriate protocols that address the care and treatment of individuals with both depression and diabetes, and develop relevant clinical guidelines for successful diabetes management in this population. Our findings also will increase knowledge about the complex relationship between mental health and chronic disease among AI/ANs.

METHODS

The data for this analysis were obtained from the IHS 2011 Diabetes Care and Outcomes Audit (Diabetes Audit) performed at the UIHOs that participated in the 2011 Diabetes Audit. The Diabetes Audit is an annual sample of diabetes patient records from IHS, tribal, and urban health care facilities, and includes information about demographics and quality of care indicators.[13] The IHS developed the Diabetes Audit to assess and promote improvement in diabetes care and health outcomes for AI/AN people with diabetes. To participate in the Diabetes Audit, facilities submit data from their registry of AI/AN diabetes patients to the IHS Division of Diabetes Treatment and Prevention (DDTP) annually. Patient records are eligible for inclusion if they received diabetes health care services and had at least one primary care visit during the past 12 months. Facilities were instructed to exclude patients who met any of the following criteria: received primarily referral or contract care paid by the IHS; arranged other health care services with non-IHS monies; received most of their primary care at another IHS or tribal facility, lived in a jail or nursing home and received care at those institutions; attended a dialysis unit (if on-site dialysis was not available); had gestational diabetes; had pre-diabetes only; or had moved, died, or were not contactable after three contact attempts in 12 months.

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Some facilities audit all charts of eligible AI/AN patients with diabetes, while other facilities use a systematic random sampling scheme. The randomization and sampling methods used for the Diabetes Audit provide an estimate of performance for each facility within 10% of the true rate, with a power of more than 90%.[13] To conduct the Diabetes Audit, data for patients with diabetes are collected at each facility via manual chart review or by extracting data from electronic health record systems. For the manual Diabetes Audit, patient information from medical records is used to complete a paper Diabetes Audit form from which data are entered into a central database via the IHS WebAudit Data Entry tool. For the electronic Diabetes Audit, data is extracted from an electronic health record system directly into a data file, usually via the IHS Resource Patient Management System, which is then

uploaded to a central database via the WebAudit's Upload Data tool.

In 2011, 31 of the 33 UIHOs participated in the Diabetes Audit, in addition to two urban demonstration facilities in Oklahoma, for a total of 33 urban facilities and 3,741 patient records audited. These facilities are located in 18 states across the country, 23 (70%) of which are in the Pacific and Mountain regions. For this study, we included only those records with no missing data for the variables depression, age, sex, facility, BMI, HbA1c, diabetes duration, smoking, documentation of past year foot, eye, or dental exam, and past year diabetes, diet, and exercise education, leaving 3,390 records (90.6%) with complete data. Missing values for the outcomes of interest varied by facility, and patients with missing data were more likely to be younger, male, have a lower mean BMI, have a higher mean HbA1c, and were less likely to have a depression diagnosis than participants with non-missing values.

Our primary exposure was depression, as documented on the 2011 Diabetes Audit. Patients are considered having depression (yes/no) if it is documented in their medical record as an active problem or if it is the purpose of their visit during the Diabetes Audit period. Depression screening tools varied across UIHOs, and included the Patient Health Questionnaire (PHQ), Beck Depression Inventory (BDI), and the Center for Epidemiological Studies Depression Scale (CES-D). Outcomes included HbA1c (%); current smoking (yes/no); BMI (kg/m^2); mean systolic blood pressure (mm Hg); foot, eye, or dental exam during past year (yes/no); diet, exercise, or diabetes instruction during past year (yes/no); serum creatinine (mg/dL); and total cholesterol (mg/dL), as documented on the 2011 Diabetes Audit. Information on depression treatment is not collected in the Diabetes Audit so was not available for this analysis. The IHS National IRB reviewed and approved this study.

Statistics

Stata version 10.1 (Stata Corp, College Station, Texas) was used to perform all analyses. Multivariate linear and logistic regression models explored the relationship of depression with each of the above measures of diabetes management, using individuals with no depression as the referent group. Because data were combined from multiple facilities and because facilities sample differing proportions of their diabetes patients, a weighting procedure was applied to calculate accurate risk estimates for each regression model. For each analysis, odds ratios (95% CI) (categorical analyses) or beta coefficients (95% CI) (continuous analyses) were calculated, adjusting for potential confounders, including age, sex, facility (as depression and diabetes outcomes may vary by facility), and diabetes duration. Continuous variables (ie, BMI, mean systolic blood pressure, serum creatinine [mg/dL], and total cholesterol) were log transformed due to non-normality. For these outcomes, the beta coefficient is exponentiated to obtain a ratio of geometric means. Some UIHOs were missing a large percentage of patient data on systolic blood pressure, total cholesterol, and creatinine. As such, analyses for these outcomes excluded patients from UIHOs with $\geq$10% missing data for those variables.

We repeated all analyses separately for each Diabetes Audit year 2005–2010 to identify time trends in diabetes management. Additionally, because adolescents or the elderly may have different diabetes management profiles than young and middle-aged adults, we conducted additional analyses restricted to individuals aged 18–60 and 18–75 years.

RESULTS

Among the 3,390 individuals included in the analytic cohort for this report, 1,289 (38.0%) were male, and the mean age at the time of the diabetes audit was 53 years (range 13, 91) (Table 1). Mean BMI was 34.9 kg/m^2 (range 16.5, 73.0). Average diabetes duration was 7.4 years and mean HbA1c was 7.8%. Approximately 32% reported current smoking. A majority had documentation of receiving various types of diabetes care during the past year. Past year eye and dental exams were less frequently documented, with 48.2% and 27.6% of individuals having documentation of these exams in the past year, respectively.

In total, 28.5% (n=965) of the analytic cohort had documentation of a depression diagnosis. Compared with those without diagnosed depression, individuals with diagnosed depression were more likely to be younger, more likely to be female, had higher BMI, had slightly longer duration of diabetes, and were more likely to smoke than individuals without diagnosed depression. Additionally, individuals with diagnosed depression were more likely to have documentation of a foot or dental exam in the past year, and less likely to have documentation of past year diet instruction. There were no significant differences in HbA1c, past year eye exam, past year diabetes education, or past year exercise instruction according to diagnosed depression status.

Individuals with depression were 1.5 times more likely to smoke than individuals without documented depression (OR=1.51; 95% CI: 1.23, 1.86) after adjustment for age, sex, and facility (Table 2). The geometric mean BMI in patients with depression was 3% higher than in patients without depression after multivariate adjustment (β=.034; 95% CI: .011, .057). After adjustment, there was no significant association of depression status with HbA1c; systolic blood pressure; total cholesterol; creatinine; documentation of a foot, eye, or dental exam; or diet, exercise, or diabetes education. Further adjustment of these analyses for diabetes

Table 1. Characteristics of study participants according to depression status[a]

	Depression	No Depression	Total
n	965	2,425	3,390
Age, years	51.6 (10.8)	53.3 (13.1)	52.8 (12.5)
Sex, % male	29.1	41.6	38.0
BMI, kg/m^2	35.8 (8.2)	34.5 (7.7)	34.9 (7.8)
Normal	5.6	7.3	6.8
Overweight	18.2	23.5	22.0
Obese	76.2	69.3	71.2
HbA1c, %	7.8 (2.0)	7.8 (2.0)	7.8 (2.0)
<7%	44.5	46.1	45.6
7%–9.5%	37.2	35.8	36.2
>9.5%	18.3	18.1	18.2
Diabetes duration, years	8.0 (7.3)	7.2 (7.4)	7.4 (7.4)
<5 years	38.8	44.6	42.9
5–9.9 years	29.0	26.3	27.1
≥10 years	32.2	29.2	30.0
Current smoking	37.2	29.3	31.5
Foot exam, past year	72.5	68.4	69.6
Eye exam, past year	48.1	48.3	48.2
Dental exam, past year	29.0	27.0	27.6
Diabetes education, past year	84.9	85.1	85.0
Diet instruction, past year	73.9	75.9	75.3
Exercise instruction, past year	70.7	71.1	70.9

BMI, body mass index; HbA1c, glycosylated hemoglobin.
[a] Data are mean (SD) or %.

duration did not materially alter estimates of reported odds ratios or relative risks.

Restricting analyses to participants aged 18 to 75 years and aged 18 to 60 produced similar results to the entire cohort (data not shown). All analyses were repeated separately for Diabetes Audit years 2005–2010 and results were similar (data not shown).

Table 2. Factors related to diabetes management according to depression status (yes/no)[a]

Dichotomous Outcomes	OR[a]	95% CI	*P*
Current smoking	1.51	(1.23, 1.86)	<.001
Foot exam, past year	1.13	(.91, 1.40)	.28
Eye exam, past year	.85	(.70, 1.03)	.09
Dental exam, past year	.95	(.76, 1.18)	.63
Diet instruction, past year	.89	(.71, 1.12)	.32
Exercise instruction, past year	1.06	(.86, 1.31)	.59
Diabetes education, past year	.95	(.72, 1.25)	.69
Continuous Outcomes (All Log-Transformed)	**β Coefficient[a]**	**95% CI**	***P***
HbA1c	−.00000513	(−.022, .022)	1.00
BMI	.034	(.011, .057)	.003
Systolic blood pressure[b]	−.004	(−.014, .006)	.45
Total cholesterol[c]	−.005	(−.065, .055)	.87
Creatinine[d]	.017	(−.017, .051)	.32

BMI, body mass index; HbA1c, glycosylated hemoglobin.
[a] No depression, referent group; adjusts for age, sex, facility; weights were utilized to account for the different sampling schemes of each facility.
[b] Included 27 facilities; 2,991 patients.
[c] Included 13 facilities; 652 patients.
[d] Included 17 facilities; 2,473 patients.

Our analysis suggests that patients with diabetes and depression are more likely to smoke and have higher BMI than individuals with diabetes but no depression.

DISCUSSION

Our analysis suggests that patients with diabetes and depression are more likely to smoke and have higher BMI than individuals with diabetes but no depression. However, depression was not significantly associated with glycemic control or clinic-associated diabetes services, including receiving a past year foot, eye, or dental exam, or past year diet, exercise, or diabetes instruction.

The finding that the geometric mean BMI in patients with depression is 3% higher than in patients without depression is consistent with a previous study that indicated depression is associated with a 4% higher BMI among participants with diagnosed diabetes.[20] Due to the cross-sectional nature of this analysis, we are unable to make causal inference on the observed relationship. It is possible that the debilitating effects of depression promote weight gain, but it is also plausible that obesity may influence depression, or that there are factors that underlie depression, diabetes, and obesity.[23,24]

Observational studies have consistently shown a strong association between smoking and diabetes.[25,26] Our results indicate that depression was associated with increased likelihood of smoking, similar to a recent study that found that odds of depression diagnosis among AI/AN patients with diabetes was positively associated with substance use/dependence, including tobacco abuse.[27] However, similar to BMI, the causal nature of this finding is unclear.

It is possible that individuals with depression may be less motivated to quit smoking or use smoking as a means of self-medication.[28] Alternatively, it is possible that smoking promotes neurophysiology changes that increase the risk of depression.[29]

In our analysis, depression was not associated with HbA1c. A study among AI/AN primary care patients also found no association between depression presence and HbA1c.[27] This differs from previous studies that indicate AI/ANs with both depression and diabetes have worse glycemic control (higher HbA1c levels) than those with diabetes alone,[20,21] although these studies comprised population-based samples, while our analysis was based on a clinical population of urban AI/ANs. Those AI/ANs actively receiving care at UIHOs may be different from the general urban AI/AN population; those receiving care may be more health conscious and more likely to have good diabetes management compared with the general population. A recent study among AI/AN diabetic patients at a tribal health clinic demonstrated significant associations between depression symptoms and self-reported hyperglycemia, although HbA1c was not measured.[30] Additionally, several studies have shown that treatment of depression improves HbA1c,[31,32] and it is possible that patients with depression at UIHOs are receiving treatment, which may influence their diabetes management. Because information on treatment for depression was not ascertained as part of the Diabetes Audit, we were unable to determine if HbA1c differed according to depression treatment. The inability to distinguish controlled versus uncontrolled depression in our data makes it difficult to explore the impact of uncontrolled depression on diabetes management. Future studies that distinguish treated from untreated depression will help clarify these relationships.

In our analysis, we found no association between depression and the clinic-controlled markers of diabetes care, including past year receipt of a foot, eye, or dental exam, or diet, exercise, or diabetes education. To our knowledge, there are no studies assessing the relationship between receiving recommended diabetes related services and depression among AI/ANs with diabetes. We located one study that found that rural elder AI/ANs with depression were less likely to engage in some diabetes self-management activities, such as being physically active, and more likely to perform self-foot inspection, when compared with AI/ANs with diabetes, but not depression.[33]

Our study has several limitations. First, the measurement for depression was crude (dichotomous: yes/no) and not assessed in a standardized way across UIHOs. We also were unable to assess the impact of depression severity, depression treatment, or depression duration on diabetes management. While our study's prevalence of depression among diabetes patients is similar to other studies,[4] there also remains uncertainty about the sensitivity and cultural relevance of depression screening tools used with AI/AN individuals.[34,35] Second, because these data were cross-sectional, we were unable to make causal inference on the observed relationships. Third, UIHOs may refer out to other health care providers for some clinical services (eg, laboratory testing) and lack tracking systems for including these services in the patient's medical record; this contributes to missing data and varies greatly by facility. Because we did not have data on blood pressure, cholesterol, or creatinine for all participants, we had limited power to detect an association of depression with these biomarkers. Fourth, although we considered the potential of confounding by several variables, other non-measured factors may confound the association between depression and diabetes management, including other mental health diagnoses. Finally, the study population comprised AI/ANs who accessed clinical care in 2011 from a UIHO, and the findings may not be generalizable to other populations. Urban AI/ANs who lack consistent access to diabetes care may be more affected by co-occurring depression. AI/AN patients who seek care at UIHOs may have a stronger connection with their culture and therefore may be more likely to access the support resources of the local urban AI/AN community.

Our analysis has several strengths. To our knowledge, this is the only study of depression and diabetes management among a population of AI/ANs who reside in urban areas. Research on mental health issues, such as depression and its interaction with other health conditions, is critical to understanding disparities in diabetes morbidity among urban AI/ANs. Other strengths are the inclusion of participants from a broad age range, and the availability of Diabetes Audit data on several clinical and non-clinical characteristics, including biomarkers, health behaviors, receipt of recommended medical care, and receipt of clinical education.

Results of our study indicate that AI/ANs with both diabetes and depression who access UIHOs are more likely to smoke and have higher BMI compared with those without depression. While these findings suggest a need for programs that focus on weight loss and smoking cessation for AI/ANs with depression and diabetes, also critical is the incorporation of depression management into existing weight loss and smoking interventions. Integrated approaches to health management and health promotion that address several behavioral risk factors simultaneously (eg, smoking, stress management, and exercise) may be more effective than those that focus on a single factor.[16] Further, depression prevention and treatment efforts in AI/AN communities may benefit from awareness of current and past stressors that have happened in the lives of individuals as well as families and communities, and then to offer behavioral health services

which are congruous with the cultural worldview of each client they serve.[36,37]

Our study contributes to a small but critical literature on the health of urban AI/ANs, a population with a substantial burden of both depression and diabetes. In order to comprehensively understand these relationships, longitudinal data tracking both the development of depression and its long-term impact on diabetes management is needed. We intend for these findings to help inform programmatic efforts to address depression in diabetes care for urban AI/ANs.

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AUTHOR CONTRIBUTIONS

Design and concept of study: Knaster, Fretts
Acquisition of data: Knaster
Data analysis and interpretation: Knaster, Fretts, Phillips
Manuscript draft: Knaster, Fretts, Phillips
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