Depression and Type 2 Diabetes among Alaska Native Primary Care Patients

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Objectives: To assess whether type 2 diabetes mellitus (DM2) and DM2 complications are associated with presence and severity of depression among Alaska Native and American Indian people (AN/AIs).

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

Setting: Southcentral Foundation Primary Care Center (SCF-PCC) in Anchorage, Alaska.

Participants: Total of 23,529 AN/AI adults.

Primary Outcome Measures: Patient Health Questionnaire (PHQ) scores (0–9 negative, 10–14 mild, 15–19 moderate, 20+ severe) and DSM-IV depression diagnosis.

Results: DM2 prevalence was 6% (n=1,526). Of those with DM2, 19% (n=292) had one or more DM2 complications and average HbA1c was 7.1%. Prevalence of depression diagnosis was similar between AN/AIs with and without DM2 (P=.124). Among those screened for depression (n=12,280), there were similar rates of PHQ severity between those without and with DM2; respectively 4% (n=452) vs 4% (n=42) mild, 4% (n=404) vs 3% (n=29) moderate, and 4% (n=354) vs 4% (n=38) severe. In multivariable logistic regression, DM2 was not associated with PHQ severity (OR 1.02, 95% CI 0.81–1.27) or depression diagnosis (OR 1.27, 95% CI 1.00–1.62). Increased odds of depression and higher depression severity were associated with female sex, younger age, being unmarried, substance abuse/dependence, and increased ambulatory visits. Depression was associated with number of other chronic conditions among AN/AIs with DM2 but not with number of complications.

Conclusions: Presence and severity of depression among AN/AI primary care patients was not significantly associated with DM2 nor DM2 complications, despite a slightly higher rate of depression diagnosis among those with DM2. (*Ethn Dis*. 2013;23[1]:56–64)

Key Words: Depression, Type 2 Diabetes Mellitus, Primary Care, North American Indians

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Introduction

In 2000, it was estimated type 2 diabetes mellitus (DM2) affected 2.8% of people worldwide and 17.7 million people in the United States with US rates expected to surpass 30.3 million by 2030.[1] The burden of DM2 is greater among Alaska Native/American Indian people (AN/AIs) than non-Hispanic White people,[2] with prevalence variability across AI tribes and AN regions. Within Alaska, fivefold prevalence variation exists with a low of 23.9/1,000 in the south-west to 109.5/1,000 in the south-east. The prevalence of DM2 is increasing faster among ANs than the US population (1.7% in 1985 to 4.8% in 2006 vs 2.9% to 5.6% nationally).[3,4] Some complications of DM2 (eg, cerebrovascular disease) also are disproportionately greater among AN/AIs.[5]

Depression is common, affecting over 13 million American adults annually.[6] One in six people experience a depressive episode during their lifetime.[6,7] Only 50% who meet diagnostic criteria are treated, resulting in substantial suffering, disability, and health care costs.[7,8] Rates are similar among AN/AIs[9–11] or higher[12] than the US population. However, small sample sizes, limited funds for treatment and research, and racial misclassification limit generalizability of results specific to AN/AIs.[4]

Depression is associated with DM2 in two ways. First, depression is associated with the presence or development of DM2. Depression is 60%–100% more common in adults with DM2 than those without.[13–15] Conversely, depression is associated with 20%–40% increased risk of developing DM2.[16,17] Researchers have not established causality and continue to debate whether the association is due to DM2, its complications, or the effect of concomitant physical conditions.[18–20]

Second, among those with DM2, depression is associated with increased morbidity and mortality. Co-morbid depression is associated with poorer glycemic control, complications (eg, retinopathy, neuropathy), increased health care costs, and functional impairment.[20,21] Individuals with DM2 may also be at increased risk of recurrence of depression.[13–15,22]

Few studies have examined the association between depression and DM2 among AN/AIs, with conflicting results. American Indians with DM2 had higher rates of depression than those without DM2 in the Strong Heart Study[23] while no significant differences were found among members of one AI tribe.[19] A positive correlation between poor glycemic control and depression has been detected in AN/AIs.[23] In addition to being limited in number, these studies had a predominance of AIs with limited representation of ANs.

We examined whether DM2 or DM2 complications were associated with the presence and for severity of

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depression. Addressing this aim is important among AN/AIs, where DM2 is on the rise in this diverse and understudied population.

METHODS

This study took place in Anchorage, Alaska at the Southcentral Foundation Primary Care Center (SCF-PCC) where prepaid primary care services are provided to approximately 45,000 AN/AIs. Care is provided within a patient-centered medical home model where AN/AIs identify a primary care provider (PCP) who leads an integrated, multidisciplinary primary care team (PCT). Annual screening for depression with the Patient Health Questionnaire (PHQ) by PCTs has occurred since 2001 with quality assurance indicating roughly 40%–50% current with annual screening. As part of routine primary care, there are several reasons some patients are missed in screening, including the presence of competing health care needs, staff capacity at the time of visit, patient refusal, migration between urban and rural Alaska, or sporadic service utilization. In addition to primary care, tertiary and specialty care services, including a DM specialty clinic, are provided at the Alaska Native Medical Center, comanaged by SCF and the Alaska Native Tribal Health Consortium (ANTHC).

Study Design and Procedures

The Alaska Area Institutional Review Board, SCF, and ANTHC approved this study and a limited dataset agreement was signed with SCF and ANTHC. We conducted retrospective, cross-sectional analysis of information from the electronic medical record (EMR), for AN/AIs who met eligibility criteria (≥one visit to SCF-PCC between July 1, 2006 and June 30, 2008, and aged ≥18 as of July 1, 2006). We calculated all variables as presence or count of occurrences over the study period, except PHQ scores and hemoglobin A1c (HbA1c) measurements for which we queried all values.

Dependent Variables

We queried diagnoses of DM2 (ICD-9 codes 250.x0 or 250.x2) along with chronic conditions of liver disease, heart disease, hypertension, pulmonary disease, renal disease, tobacco abuse, alcohol abuse/dependence, and drug abuse/dependence. Other clinical information included number of ambulatory visits, inpatient stays, and antidepressant medication dispensation. Demographic information included sex, age, and marital status.

For AN/AIs with DM2, DM2-specific variables included insulin and oral DM2 medications; average HbA1c; and DM2 complications including nephropathy, ophthalmic complications, neuropathy, gangrene, or hypoglycemia.

Independent Variables

Depression was examined with two outcomes. First, we assessed PHQ scores among those who were screened (~52%). The PHQ assesses the nine symptoms of DSM-IV major depression according to presence and severity over the previous two weeks (0=not at all, 1=several days, 2=more than half the days, and 3=almost every day).[9,24] Scores of ≥10 are considered positive and are further differentiated by severity (10–14 mild, 15–19 moderate, 20–27 severe). Some were screened multiple times, so all analyses were repeated using minimum, average, and maximum score as outcome. Results were not significantly different, thus only analysis using the maximum score is presented.

Second, for the entire population, we examined presence of the following DSM-IV depression diagnoses: episodic mood disorder (ICD-9 codes 296.0–296.9), dysthymic disorder (300.40), adjustment disorder with depressed mood (309.00), adjustment disorder with mixed anxiety and depressed mood (309.28), or depressive disorder not otherwise specified (311.0).

STATISTICS

SAS version 9.2 (Cary, NC) was used, and P under 5% were considered significant. We performed univariable analyses using the chi-square test for categorical variables and the Kruskal-Wallis test for continuous variables. Next, we utilized multivariable ordinal and binary logistic regression for PHQ scores and depression diagnosis, respectively. As not all patients received screening, inverse propensity score weighting was utilized in multivariable analysis of PHQ scores to adjust for characteristics associated with receipt of screening. Significant interactions were included. Finally, we utilized multivariable logistic regression to investigate associations of DM2-specific factors (DM2 complications, DM2 medication dispensation, and average HbA1c) with both depression outcomes (tables not shown).

RESULTS

Between July 2006 and June 2008, 23,543 unique AN/AI adults had one or more visit to the SCF-PCC. We excluded 14 (.06%) individuals who were dispensed insulin or oral diabetes medication, but had no DM2 diagnosis. Over half (52%) received PHQ screening with higher screening rates among those who were female, under age 50, married, with physical disorder(s) (including DM2), tobacco abuse diagnosis, increased ambulatory visits, and decreased inpatient stays (data not shown, all $P<.001$). Approximately 6% had DM2 and 5% had depression diagnosis with no significant association between DM2 and depression diagnosis (Table 1). Of those with DM2, 224 (15%) had one DM2 complication and 68 (4%) had more than one (data not shown). Approximately 10% of those with DM2 had no HbA1c measurement

Table 1. Descriptive statistics for total sample and stratified by depression diagnosis[a]

	Total Sample *N*=23529		Depression Diagnosis[a]				
			Not Present *n*=22352 (95%)		Present *n*=1177 (5%)		
	n	%	*n*	%	*n*	%	*P*[b]
Type 2 DM							
Present	1526	6	1437	6	89	8	.124
Absent	22003	94	20915	94	1088	92	
Demographic factors							
Sex							
Male	9230	39	8922	40	308	26	<.001
Female	14299	61	13430	60	869	74	
Age[c]							
18–29 years	8073	34	7648	34	425	36	<.001
30–39 years	4718	20	4419	20	299	25	
40–49 years	4906	21	4629	21	277	24	
≥50 years	5832	25	5656	25	176	15	
Marital status (319 missing)							
Single	13072	56	12379	56	693	28	<.001
Separated/divorced/ widowed	2270	10	2114	10	156	13	
Married/domestic partner	7868	34	7543	34	325	59	
Clinical factors							
Total number of other chronic conditions[d]							
None	16886	72	16093	72	793	67	.002
1	5351	23	5036	23	315	27	
≥2	1292	5	1223	5	69	6	
Antidepressant medication							
Absent	19941	85	19414	87	526	45	<.001
Present	3588	15	2937	13	651	55	
Tobacco abuse							
Absent	17146	73	16435	74	711	60	<.001
Present	6383	27	5917	26	466	40	
Alcohol abuse/dependence							
Absent	19914	85	19130	86	784	67	<.001
Present	3615	15	3222	14	393	33	
Drug abuse/dependence							
Absent	21888	93	21014	94	874	74	<.001
Present	1641	7	1338	6	303	26	
Inpatient stays							
None	19486	83	18573	83	913	78	<.001
At least one	4043	17	3779	17	264	22	
Number of ambulatory visits							
1	3914	17	3836	17	78	7	<.001
2–5	9402	40	9071	41	331	28	
6–10	5303	23	5030	23	273	23	
≥11	4910	21	4415	20	495	42	

[a] ICD-9 codes 296.0–296.9, 300.40, 309.00, 309.28, or 311.0.
[b] Approximate chi-square test of proportions *P*.
[c] As of July 1, 2006.
[d] Includes hypertension, heart, liver, renal, and pulmonary diseases.

over the study period and more than one third (n=517) had an average HbA1c greater than 7%. There was no significant difference in HbA1c levels for those with depression diagnosis (n=69, mean=7.1%, standard deviation (SD)=1.6% and those without (n=1288, mean=7.1%, SD=1.4%, P=.265, data not shown).

Depression severity according to the PHQ score did not vary significantly by presence of DM2 (Table 2). The average score for AN/AIs with DM2 was 2.2 (SD=5.6) compared to 2.4 (SD=5.9) for AN/AIs without. Score distributions were heavily skewed with 81% scoring zero. There were significant univariable associations with depression severity across all other factors, excluding number of other chronic conditions. Among AN/AIs with DM2, severity was not associated with HbA1c (P=.271) with means 7.1% (SD=1.4%), 7.0%, (SD=1.6%), 6.7% (SD=1.2%), and 7.1% (SD=1.9%) for negative, mild, moderate, and severe depression, respectively (data not shown).

Given missing marital status, 91 (1%) were excluded from multivariable analysis of PHQ severity (Table 3). DM2 was not associated with PHQ severity. Female sex, tobacco, alcohol, drug abuse/dependence, and increased ambulatory visits were associated with higher depression severity. Older and married people were less likely to score in higher PHQ categories.

In multivariable analysis restricted to people with DM2 and including DM2-specific clinical variables, odds of higher depression severity increased with number of other chronic conditions (n=882, odds ratio (OR)=1.43, 95% confidence interval (CI)=1.03–1.98), female sex (OR=2.05, CI=1.21–3.45), and alcohol abuse/dependence (OR=2.30, CI=1.21–4.40). DM2-specific clinical factors were not significantly associated with PHQ severity (DM2 complications present OR=.56, CI=.29–1.10; DM2 medication dispensation OR=.84, CI=.50–1.41; or average HbA1c OR=1.04, CI=.88–1.24) (data not shown).

Given missing values for marital status, 319 (1%) patients were excluded from multivariable analysis of depression diagnosis (Table 4). DM2 was not associated with depression diagnosis presence. Odds of depression diagnosis increased with female sex, age of 30–39, being unmarried, substance abuse/dependence, and increased ambulatory visits.

In the DM2-specific model (n=1356), odds of depression diagnosis increased with alcohol diagnosis (OR=2.35, CI=1.21–4.55) and ambulatory visits (≥11 vs 1; OR=9.08, CI=1.20–68.74). There were no significant associations with depression diagnosis among the following: number of chronic conditions (OR=1.06, CI=.73–1.55), presence of DM2 complications (OR=.73, CI=.36–1.50), DM2 medication dispensation (OR=−.82, CI=.45–1.50), and average HbA1c (OR=1.06, CI=.87–1.29) (data not shown).

There were differences between AN/AIs with and without DM2. Significantly more AN/AIs with DM2 were screened with the PHQ (66% vs 51%, with DM2 versus without, respectively; P<.001). Among AN/AIs without DM2, more females than males received PHQ screening (53% vs 48%, respectively, P<.001); while among those with DM2 there was not a significant difference (65% vs 67%, respectively, P=.327). Additionally, AN/AIs with DM2 were more likely to have an anti-depressant dispensed compared to AN/AIs without (26% vs 15%, P<.001) (data not shown).

In our study with AN/AIs, DM2 was not significantly associated with depression diagnosis nor PHQ severity.

DISCUSSION

In our study with AN/AIs, DM2 was not significantly associated with depression diagnosis nor PHQ severity. It should be noted that while prevalence of depression diagnosis was similar between people with and without DM2, when adjusted for other demographic and clinical factors, there was borderline significance (P=.055) indicating a trend towards increased depression diagnosis among people with DM2. However, there were no associations between depression presence or severity and DM2 complications, DM2 medications, or HbA1c levels. Depression was associated with sex, age, marital status, substance abuse/dependence, and ambulatory visits. Among AN/AIs with DM2, depression was associated with a number of other chronic conditions.

Our findings contradict other studies where odds of depression in people with DM2 are twice that of those without.[13,15] However, people with DM2 often differ from those without on other clinical variables associated with an increased risk of depression (eg, sex, age, marital status).[15,25] In other words, associations between depression and DM2 may be attributable to factors other than DM2 itself. Other investigators also found little evidence that DM2 increased the risk of depression after accounting for co-morbid chronic diseases and DM2 complications.[18,26] In the AI literature, Sahota did not find an association between DM2 and PHQ depression in one tribe.[19]

Our results also contradict a more robust finding of increasing number of complications and poorer glycemic control in the face of co-occurring DM2 and depression. For instance, AIs in the Strong Heart Study who experienced severe depression were associated with HbA1c levels almost a full point higher compared to those experiencing mild, moderate, or no depression.[23]

Table 2. Descriptive statistics by depression severity (*n*=12,280)

	PHQ Depression Score Category[a]								
	None		Mild		Moderate		Severe		
	n	%	*n*	%	*n*	%	*n*	%	*P*[b]
Overall	10,783	88	494	4	513	4	490	4	n/a
Type 2 DM									
Present	891	89	42	4	29	3	38	4	.200
Absent	9892	88	452	4	484	4	452	4	
Depression diagnosis									
Present	503	61	81	10	109	13	136	16	<.001
Absent	10280	90	413	4	404	4	354	3	
Demographic factors									
Sex									
Male	4144	91	137	3	138	3	119	3	<.001
Female	6639	86	357	5	375	5	371	5	
Age[c]									
18–29 years	3574	87	172	4	190	5	185	4	<.001
30–39 years	2218	86	116	5	123	5	112	4	
40–49 years	2345	88	114	4	115	4	102	4	
≥50 years	2646	91	92	3	85	3	91	3	
Marital status (91 missing)									
Single	5827	87	303	5	302	4	290	4	<.001
Separated/divorced/widowed	982	86	47	4	54	5	64	6	
Married/domestic partner	3892	90	143	3	154	4	131	3	
Clinical factors									
Total number of other chronic conditions[d]									
None	6927	88	325	4	336	4	329	4	.613
1	3070	88	141	4	137	4	130	4	
≥2	786	89	28	3	40	5	31	4	
Antidepressant medication									
Absent	9009	93	276	3	257	3	188	2	<.001
Present	1774	70	218	9	256	10	302	12	
Tobacco abuse									
Absent	7762	89	316	4	305	4	291	3	<.001
Present	3021	84	178	5	208	6	199	6	
Alcohol abuse/dependence									
Absent	9181	89	372	4	365	4	342	3	<.001
Present	1602	79	122	6	148	7	148	7	
Drug abuse/dependence									
Absent	10078	89	421	4	435	4	383	3	<.001
Present	705	73	73	8	78	8	107	11	
Inpatient stays									
None	8974	88	399	4	401	4	395	4	.007
At least one	1809	86	95	5	112	5	95	5	
Ambulatory visits									
1	841	93	28	3	16	2	17	2	<.001
2–5	3799	91	137	3	136	3	115	3	
6–10	2992	88	139	4	147	4	124	4	
≥11	3151	83	190	5	214	6	234	6	

[a] Patient Health Questionnaire (PHQ) scores (0–9 negative, 10–14 mild, 15–19 moderate, ≥20 severe).
[b] Approximate chi-square test of proportions *P*.
[c] As of July 1, 2006.
[d] Includes hypertension, heart, liver, renal, and pulmonary diseases.

Table 3. Weighted[a] multivariable ordinal logistic regression[b] on PHQ depression severity category[c] (*n*=12,189)

	Estimate	Standard Error	Wald X^2 *P*	Odds Ratio	Confidence Interval
Diabetic status (ref. no type 2 DM)	.048	.128	.708	1.05	.82–1.35
Demographic factors					
Sex (ref. male)	.519	.068	<.001	1.68	1.47–1.92
Age[d] (ref. 18–29 years)			<.001		
30–39 years	.043	.078		1.09[e]	.90–1.33
40–49 years	−.012	.068		.89[e]	.72–1.09
≥50 years	−.330	.067		.83[e]	.66–1.05
Marital status (ref. single)			<.001		
Married/domestic partner	−.238	.054		.97[f]	.77–1.23
Separated/divorced/widowed	.228	.074		2.10[f]	1.22–3.59
Other clinical factors					
Number of other chronic conditions[g]	−.079	.057	.165	.92	.83–1.03
Tobacco abuse	.425	.076	<.001	1.53[h]	1.32–1.78
Alcohol abuse/dependence	.769	.099	<.001	2.16[i]	1.78–2.62
Drug abuse/dependence	1.022	.123	<.001	2.78[j]	2.18–3.54
Number of inpatient stays	−.018	.041	.662	.98	.91–1.06
Number of ambulatory visits (ref.1)			<.001		
2–5	−.156	.049		1.25	1.02–1.53
6–10	.106	.053		1.62	1.31–2.01
≥11	.427	.054		2.24	1.80–2.78
Interactions					
Tobacco x alcohol abuse/dependence	−.301	.146	.039		
Tobacco x drug abuse/dependence	−.629	.180	<.001		
Marital status x age			.018		
Married/domestic partner x 30–39	.161	.095			
Married/domestic partner x 40–49	.069	.087			
Married/domestic partner x ≥50	−.201	.088			
Separated/divorced/widow x 30–39	−.262	.139			
Separated/divorced/widow x 40–49	−.014	.116			
Separated/divorced/widow x ≥50	.002	.100			

[a] Using inverse propensity score weights. The propensity score is the estimated probability of being screened given all variables.
[b] Assumption of proportional odds not rejected (*P*=.131).
[c] Per score on the Patient Health Questionnaire (0–9 negative, 10–14 mild, 15–19 moderate, ≥20 severe).
[d] As of July 1, 2006.
[e] Marital status of single. Odds ratios for status of married/domestic partner are .94 (.70–1.26), .81 (.60–1.09), and .45 (.32–.63) for 30–39, 40–49, and ≥50 years, respectively, vs 18–29 years. Similarly, odds ratios for status of separated/divorced/widowed are .45 (.22–.92), .55 (.29–1.03), and .41 (.23–.73).
[f] At age 18–29 years. Odds ratio for 30–39 years are .83 (.64–1.08) and .87 (.53–1.43) for marital of married/domestic partner and separated/divorced/widowed, respectively, vs single. Similarly, odds ratios for 40–49 years are .88 (.67–1.16) and 1.30 (.88–1.91), and odds ratios for ≥50 years are .52 (.38–.72) and 1.02 (.75–1.39).
[g] Includes hypertension, liver, heart, pulmonary, or renal disease.
[h] No alcohol and no drug abuse/dependence. Odds ratio with alcohol abuse/dependence 1.13 (.87–1.47), drug abuse/dependence .82 (.57–1.16), and both alcohol and drug .60 (.43–.84).
[i] No tobacco abuse. Odds ratio with tobacco abuse 1.60 (1.29–1.98).
[j] No tobacco abuse. Odds ratio with tobacco abuse 1.48 (1.14–1.93).

There are several possible reasons for our lack of association. First, our population may vary significantly from others. For instance, the prevalence of DM2 amongst AN/AIs included was quite low (6%) compared to other studies (eg, 24% in Strong Heart[23]). Roughly 40% of women and more than 50% of men also scored positive for depression on the CES-D in the Strong Heart study[23] compared to 12% scoring positive on the PHQ in our study. Our study also included primary care patients rather than a community-based sample, and the patient-centered medical home model theoretically could have led to earlier detection and intervention for DM2 and depression. In fact, a significantly higher proportion of AN/AIs with DM2 were prescribed antidepressants than AN/AIs without. While the reasons for this are unknown, it is possible that there is a propensity for PCPs or patients to consider antidepressants in the presence of DM2. As indicated earlier, few AN/AI studies exist and most studies have a predominance of AIs with limited representation of ANs.

Thus, biological and psychosocial contributors to DM2 and/or depression may vary from other populations studied. Cross-cultural validity of depression screeners amongst AN/AIs may vary due to cultural beliefs about mental illness, labeling of emotions, and language differences.[27,28] The PHQ has

Table 4. Multivariable Logistic Regression on Depression Diagnosis[a] (*n*=23,210)

	Estimate	Standard Error	Wald X^2 *P*	Odds Ratio	Confidence Interval
Diabetic status (ref. no type 2 DM)	.239	.125	.055	1.27	1.00–1.62
Demographic factors					
Sex (ref. male)	.512	.072	<.001	1.67	1.45–1.92
Age[b] (ref. 18–29 years)			<.001		
30–39 years	.322	.056		1.09	.93–1.29
40–49 years	.089	.056		.87	.73–1.03
≥50 years	−.645	.071		.42	.34–.51
Marital status (ref. single)			<.001		
Married/domestic partner	−.200	.051		.94	.81–1.09
Separated/divorced/widowed	.338	.066		1.61	1.31–1.97
Other clinical factors					
Number of other chronic conditions[c]	.044	.056	.427	1.05	.94–1.17
Tobacco abuse	.184	.068	.007	1.20	1.05–1.37
Alcohol abuse/dependence	.855	.085	<.001	2.35[d]	1.99–2.78
Drug abuse/dependence	1.656	.129	<.001	5.86[e]	3.13–10.98
Number of inpatient stays	−.010	.052	.853	.99[f]	.89–1.10
Number of ambulatory visits (ref. 1)			<.001		
2–5	−.270	.063		1.47[g]	1.12–1.95
6–10	.153	.065		2.25[g]	1.69–3.00
≥11	.776	.061		4.20[g]	3.17–5.56
Interactions					
Alcohol x drug abuse/dependence	−.570	.157	<.001		
Inpatient stays x drug abuse/dependence	−.298	.093	.001		
Ambulatory visits x drug abuse/dependence			.025		
2–5 visits	.301	.138			
6–10 visits	−.239	.152			
≥11 visits	−.175	.127			

[a] ICD-9 codes 296.0–296.9, 300.40, 309.00, 309.28, or 311.0.
[b] As of July 1, 2006.
[c] Includes hypertension, liver, heart, pulmonary, or renal disease.
[d] No drug abuse/dependence. Odds ratio with drug abuse/dependence is 1.33 (1.03–1.73).
[e] No alcohol abuse/dependence, no inpatient stays, and one ambulatory visit. With no alcohol abuse/dependence and no inpatient stays, the odds ratios are 7.08 (5.19–9.65), 4.12 (2.87–5.93), and 4.40 (3.33–5.81) for 2–5, 6–10, and ≥11 ambulatory visits, respectively. Similarly, with alcohol abuse/dependence and no inpatient stays, odds ratios are 3.32 (1.75–6.31), 4.01 (2.88–5.58), 2.33 (1.62–3.37), and 2.49 (1.84–3.36) for one, 2–5, 6–10, and ≥11 ambulatory visits, respectively. Odds ratios decrease with increased inpatient stays.
[f] No drug abuse/dependence. With drug abuse/dependence, odds ratio is .74 (.63–.86).
[g] No drug abuse/dependence. With drug abuse/dependence, odds ratios are 1.78 (.97–3.25), 1.58 (.85–2.96), and 3.15 (1.75–5.68) for 2–5, 6–10, and ≥11 ambulatory visits, respectively.

been used in other AN/AI studies[29] and validated in one AI study.[9] The association of higher PHQ scores with female sex, single status, substance abuse/dependence, service use, and other chronic conditions in our study is consistent with other depression-related studies.[6,15,30–32] However, a comprehensive assessment of PHQ reliability, validity, and performance in AN/AIs has not been completed.

Other limitations of our cross-sectional study deserve mention. Timing related to depression diagnosis, purpose of dispensation, and patient adherence for antidepressants is unknown. For example, antidepressants are sometimes dispensed to treat health issues other than depression such as anxiety, pain, sleep disorders, or tobacco cessation. Socioeconomic information (eg, income, education) was not available; some variables related to health status like blood pressure, Body Mass Index, lipid levels, and urine micro albumin were not included; and the reliability and consistency of ICD-9 coding in the EMR is unknown. Specifically, sensitivity of depression diagnosis is unknown, and there has been observed PCP variability in depression screening and diagnosis in a previous SCF-PCC study.[33] However, we utilized both indicators of depression available in the EMR, PHQ score and depression diagnosis, to maximize identification of individuals experiencing depression. Finally, given unobserved variables, inverse propensity score weighting may not fully account for individuals who are not screened and thus not included in the analysis of PHQ depression severity. All patients were included in analysis of depression diagnosis.

Despite these limitations, our effort is the first large-scale investigation of its kind involving a predominantly AN sample and two depression outcomes. In our study, the presence of DM2 was not significantly associated with depression diagnosis or severity. Amongst AN/AIs with DM2, depression was not associated with DM2 complications, DM2 medication, or HbA1c levels. However, depression was associated with other chronic conditions including substance abuse and dependence and remains an important area for PCPs to assess and treat. Depression is a serious condition[34] and routine depression screening in primary care has been recommended since 2002, given its negative impact on health.[35] Future large scale studies are necessary to definitively determine the association between depression and DM2 among AN/AIs.

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REFERENCES

1. Wild S, Roglic G, Green A, Sicree R, King H. Global prevalence of diabetes: estimates for the year 2000 and projections for 2030. *Diabetes Care*. 2004;27(5):1047–1053.
2. Tann SS, Yabiku ST, Okamoto SK, Yanow J. triADD: the risk for alcohol abuse, depression, and diabetes multimorbidity in the American Indian and Alaska Native populations. *Am Indian Alsk Native Ment Health Res*. 2007; 14(1):1–23.
3. Narayanan ML, Schraer CD, Bulkow LR, et al. Diabetes prevalence, incidence, complications and mortality among Alaska Native people 1985–2006. *Int J Circumpolar Health*. 2010;69(3):236–252.
4. Schraer CD, Adler AI, Mayer AM, Halderson KR, Trimble BA. Diabetes complications and mortality among Alaska Natives: 8 years of observation. *Diabetes Care*. 1997;20(3):314–321.
5. Carter JS, Pugh JA, Monterrosa A. Non-insulin-dependent diabetes mellitus in minorities in the United States. *Ann Intern Med*. 1996;125(3):221–232.
6. Kessler RC, Berglund P, Demler O, et al. The epidemiology of major depressive disorder: results from the National Comorbidity Survey Replication (NCS-R). *JAMA*. 2003;289(23): 3095–3105.
7. Broadhead WE, Blazer DG, George LK, Tse CK. Depression, disability days, and days lost from work in a prospective epidemiologic survey. *JAMA*. 1990;264(19):2524–2528.
8. Wells KB, Stewart A, Hays RD, et al. The functioning and well-being of depressed patients. Results from the Medical Outcomes Study. *JAMA*. 1989;262(7):914–919.
9. Parker T, May PA, Maviglia MA, Petrakis S, Sunde S, Gloyd SV. PRIME-MD: its utility in detecting mental disorders in American Indians. *Int J Psychiatry Med*. 1997;27(2):107–128.
10. Wilson C, Civic D, Glass D. Prevalence and correlates of depressive syndromes among adults visiting an Indian Health Service primary care clinic. *Am Indian Alsk Native Ment Health Res*. 1995;6(2):1–12.
11. Manson SM, Walker RD, Kivlahan DR. Psychiatric assessment and treatment of American Indians and Alaska Natives. *Hosp Community Psychiatry*. 1987;38(2):165–173.
12. Duran B, Sanders M, Skipper B, et al. Prevalence and correlates of mental disorders among Native American women in primary care. *Am J Public Health*. 2004;94(1):71–77.
13. Anderson RJ, Freedland KE, Clouse RE, Lustman PJ. The prevalence of comorbid depression in adults with diabetes: a meta-analysis. *Diabetes Care*. 2001;24(6):1069–1078.
14. Nichols GA, Brown JB. Unadjusted and adjusted prevalence of diagnosed depression in type 2 diabetes. *Diabetes Care*. 2003;26(3): 744–749.
15. Ali S, Stone MA, Peters JL, Davies MJ, Khunti K. The prevalence of co-morbid depression in adults with Type 2 diabetes: a systematic review and meta-analysis. *Diabet Med*. 2006;23(11):1165–1173.
16. Knol MJ, Twisk JW, Beekman AT, Heine RJ, Snoek FJ, Pouwer F. Depression as a risk factor for the onset of type 2 diabetes mellitus. A meta-analysis. *Diabetologia*. 2006;49(5):837–845.
17. Brown LC, Majumdar SR, Newman SC, Johnson JA. History of depression increases risk of type 2 diabetes in younger adults. *Diabetes Care*. 2005;28(5):1063–1067.
18. Brown LC, Majumdar SR, Newman SC, Johnson JA. Type 2 diabetes does not increase risk of depression. *CMAJ*. 2006;175(1):42–46.
19. Sahota PK, Knowler WC, Looker HC. Depression, diabetes, and glycemic control in an American Indian community. *J Clin Psychiatry*. 2008;69(5):800–809.
20. Fisher L, Skaff MM, Mullan JT, et al. Clinical depression versus distress among patients with type 2 diabetes: not just a question of semantics. *Diabetes Care*. 2007;30(3):542–548.
21. Ciechanowski PS, Katon WJ, Russo JE. Depression and diabetes: impact of depressive symptoms on adherence, function, and costs. *Arch Intern Med*. 2000;160(21):3278–3285.
22. Lustman PJ, Clouse RE. Depression in diabetes: the chicken or the egg? *Psychosom Med*. 2007;69(4):297–299.
23. Calhoun D, Beals J, Carter EA, et al. Relationship between glycemic control and depression among American Indians in the Strong Heart Study. *J Diabetes Complicat*. 2010;24(4):217–222.
24. Bergus GR, Hartz AJ, Noyes R Jr, et al. The limited effect of screening for depressive symptoms with the PHQ-9 in rural family practices. *J Rural Health*. 2005;21(4):303–309.
25. Astle F. Diabetes and depression: a review of the literature. *Nurs Clin North Am*. 2007; 42(1):67–78, vii.
26. Pouwer F, Beekman AT, Nijpels G, et al. Rates and risks for co-morbid depression in patients with Type 2 diabetes mellitus: results from a community-based study. *Diabetologia*. 2003; 46(7):892–898.
27. Somervell PD, Beals J, Kinzie JD, Boehnlein J, Leung P, Manson SM. Criterion validity of the Center for Epidemiologic Studies Depression Scale in a population sample from an American Indian village. *Psychiatry Res*. 1993;47(3):255–266.
28. Ackerson LM, Dick RW, Manson SM, Baron AE. Properties of the Inventory to Diagnose Depression in American Indian adolescents. *J Am Acad Child Adolesc Psychiatry*. 1990; 29(4):601–607.
29. Dillard DA, Christopher D. The Southcentral Foundation depression collaborative. *Int J Circumpolar Health*. 2007;66 Suppl 1:45–53.
30. Grant BF, Harford TC. Comorbidity between DSM-IV alcohol use disorders and major depression: results of a national survey. *Drug Alcohol Depend*. 1995;39(3):197–206.
31. Pietraszek A, Gregersen S, Hermansen K. Alcohol and type 2 diabetes. A review. *Nutr Metab Cardiovasc Dis*. 2010;20(5):366–375.
32. Kao WH, Puddey IB, Boland LL, Watson RL, Brancati FL. Alcohol consumption and the risk

of type 2 diabetes mellitus: atherosclerosis risk in communities study. *Am J Epidemiol*. 2001;154(8):748–757.
33. Dillard DA, Muller CJ, Smith JJ, Hiratsuka VY, Manson SM. The Impact of Patient and Provider Factors on Depression Screening of American Indian and Alaska Native People in Primary Care. *J Primary Care & Comm Health*. 2012;3(2):120–124.
34. Fawcett J. The morbidity and mortality of clinical depression. *Int Clin Psychopharm*. 1993;84:217–220.
35. Screening for depression: recommendations and rationale. *Ann Intern Med*. 2002;136(10):760–764.

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