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Original article

Association between diagnosed diabetes and serious psychological distress among U.S. adults: the Behavioral Risk Factor Surveillance System, 2007

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Abstract

Objectives: To estimate the prevalence of serious psychological distress (SPD) according to diabetes status and to assess the association of diabetes-related risks and conditions with SPD among U.S. adults.

Methods: We analyzed data from the Behavioral Risk Factor Surveillance System, 2007. SPD was determined by a score of ≥13 on the Kessler-6 scale. We used log-binomial regression analysis to estimate prevalence ratios (PRs) and 95 % confidence intervals (CIs).

Results: We estimated the prevalence of SPD to be 7.6 % and 3.6 % among U.S. adults with and without diagnosed diabetes (unadjusted PR: 2.09; 95 % CI: 1.87, 2.34). The association of diagnosed diabetes with SPD was attenuated after adjustments for potential confounding effects of cardiovascular risk factors and cardiovascular comorbid conditions (adjusted PR, 1.12; 95 % CI: 0.99, 1.27). Significant correlates of SPD among persons with diagnosed diabetes were young age, low education levels, low household income, obesity, current smoking, no leisure-time physical activity, presence of one or more micro- or macro-vascular complications, and disability.

Conclusions: The crude prevalence of SPD among adults with diagnosed diabetes was twice as high as that among those without diabetes. The increased prevalence of SPD may be accounted for by the excessive rates of cardiovascular risks and comorbid conditions among people with diagnosed diabetes.

Keywords: Serious psychological distress – Diagnosed diabetes – Cardiovascular comorbidity – Diabetes-related complication.

Introduction

In 2007, approximately 23.5 million (10.7 %) U.S. adults aged 20 years or older had diabetes (including both diagnosed and undiagnosed), with 90 % to 95 % of all diagnosed cases being type 2 diabetes.[1] People with diabetes are twice as likely to have depression[2,3] and 1.4 times as likely to have anxiety as those without the condition.[4] Furthermore, longitudinal studies have shown that adults with depression have 37 % increased risk of developing type 2 diabetes mellitus.[5] Because of high concordance among depression, anxiety, and other common mental disorders in the general population,[6,7] and complexity in confirming a clinical diagnosis for a specific mental illness, a general measure of nonspecific psychological distress would be a simple and useful instrument for primary care physicians to assess the overall psychological state of people with and without diabetes.

The Kessler 6 (K6) scale was developed to monitor the prevalence rates and secular trends in the rates of nonspecific serious psychological distress (SPD) in the general population.[8,9] The K6 scale has the best predictive power among four major scales used to screen for SPD, the others being the Composite International Diagnostic Interview Short-Form, the World Health Organization Disability Assessment Schedule, and the Kessler 10 (K10) scale.[9] In addition, the K6 performs similarly to the K10, but better than the 12-item General Health Questionnaire, in screening for any DSM-IV mood or anxiety disorder.[10]

Data from the National Health Interview Survey show that the crude 30-day prevalence of SPD among U.S. adults was

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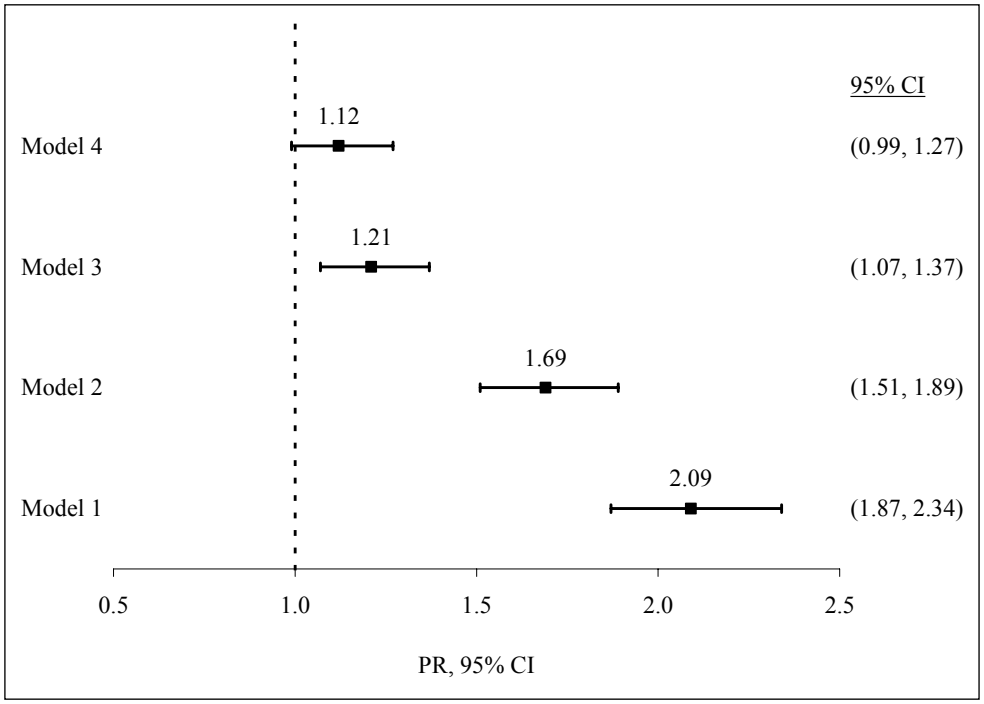

Figure 1. Prevalence ratios of diagnosed diabetes for SPD.

2.7 % in 2007.[11] Little is known about the prevalence of SPD in the diabetic population. Results from two studies based on local health survey data indicated that the prevalence of SPD among people with diabetes was 10.4 % in New York City in 2003[12] and 8.1 % in Los Angeles County in 2005.[13] However, a national prevalence estimate of SPD among people with diabetes is lacking. Our objective in this study was to estimate the prevalence of SPD among people with and without diagnosed diabetes and to assess the associations of demographic characteristics, socioeconomic status, and diabetes-related complications and comorbidities with SPD using data from the Behavioral Risk Factor Surveillance System (BRFSS) conducted in 2007.

Methods

Study design and population

The BRFSS collects data using standardized telephone surveys conducted monthly by trained interviewers from state and territorial health departments with assistance and support from the Centers for Disease Control and Prevention (CDC). These BRFSS survey data, obtained from an independent household probability sample drawn from the noninstitutionalized U.S. adult population (aged ≥ 18 years), are used to assess the prevalence of key behavioral risk factors and chronic disease conditions in all U.S. states and territories annually.[14] A detailed description of the BRFSS survey design and random-sampling procedures is available elsewhere.[14] The median BRFSS cooperation rate in 2007 was 72.1 %.[15] BRFSS data have consistently been found to provide valid and reliable estimates when compared with data from other national household surveys in the United States.[16–18]

Assessment of psychological distress

In 2007, the health departments of 35 U.S. states, the District of Columbia, and the territory of Puerto Rico, in collaboration with CDC and the Substance Abuse and Mental Health Services Administration (SAMHSA), implemented the Mental Illness and Stigma Module as part of the BRFSS survey. The K6 scale[8,9], which was the major part of the module, assessed participants' psychological distress on the basis of how frequently they reported having felt 1) nervous, 2) hopeless, 3) restless or fidgety, 4) so depressed that nothing could cheer them up, 5) that everything was an effort, and 6) worthless during the previous 30 days. A 5-point Likert scale was used to rank the frequency with which they reported experiencing these symptoms: 0 = "None of the time," 1 = "A little of the time," 2 = "Some of the time," 3 = "Most of the time," and 4 = "All of the time." Total scores thus could range from 0 to 24. Respondents were considered to have probable SPD if their total K6 score was 13 or above.[9]

Diabetes status and typology

Participants' diabetes status was determined by asking them, "Have you ever been told by a doctor that you have diabetes?"

Responses were coded as "yes," "yes, but female told only during pregnancy" (i.e., gestational diabetes), or "no." Gestational diabetes was considered as "no" diabetes. Respondents with diabetes were classified as having type 1 diabetes if their age at diagnosis was younger than 30 years and they used insulin currently. They were classified as having type 2 diabetes if their age at diagnosis was 30 years or older or if their age at diagnosis was younger than 30 years and they did not use insulin currently.[19]

Assessment of correlates

We examined the following variables as potential correlates of SPD: demographic and socioeconomic characteristics (sex, race/ethnicity, age, education, and annual household income), diabetes type (type 1, type 2 with use of insulin, and type 2 without use of insulin), diabetes duration, cardiovascular risk factors (obesity, current smoking, no leisure-time physical activity, high blood pressure, and high cholesterol), microvascular complications (foot sores and retinopathy), macrovascular complications (myocardial infarction, angina, and coronary heart disease), and disability status (limitation in activities and use of special equipment).

Statistical analysis

We estimated the prevalence of SPD among U.S. adults with and without diagnosed diabetes on the basis of data from all 37 jurisdictions that used the Mental Illness and Stigma Module. We also estimated the prevalence of SPD among U.S. adults with diagnosed diabetes according to demographic and socioeconomic characteristics, cardiovascular risk factors, diabetes-related micro- and macro-vascular complications, and disability status on the basis of data from 28 states, the District of Columbia, and Puerto Rico, which used both the Diabetes Module and the Mental Illness and Stigma Module.

We estimated the prevalence ratios (PRs) and their 95% confidence intervals (CIs) of each correlate for SPD using univariate and multivariable log–binomial models[20] that adjusted for the potential confounding effects of all selected correlates. We considered results to be statistically significant if $p \leq 0.05$. All of the analyses were conducted with the use of SAS (version 9.1) and SUDAAN software (Release 9.0; Research Triangle Institute, Research Triangle Park, NC) to account for the complex sampling design.

Results

Sample characteristics and the prevalence of SPD according to diabetes status

Among 220 235 participants aged ≥18 years, 24 039 (8.4%) reported having diagnosed diabetes (Table 1). The prevalence of diagnosed diabetes differed significantly by all demographic characteristics except sex and by the presence of all cardiovascular risk factors, cardiovascular diseases, disability, and SPD.

The prevalence of SPD was 7.6% (standard error [s.e.], 0.4) among people with diagnosed diabetes versus 3.6% (s.e., 0.1) among those without diagnosed diabetes, for an unadjusted PR of 2.09 (95% CI, 1.87–2.34; Figure 1; Model 1). The PR decreased after adjustments for demographic variables (Model 2) and cardiovascular risk factors (Model 3) but remained statistically significant (all p values <0.01). However, after further adjustments for history of myocardial infarction, angina, and stroke, the PR of diagnosed diabetes (1.12; 95% CI, 0.99–1.27; Model 4) for SPD did not reach the level of significance ($p = 0.07$). We found no significant interactions between diagnosed diabetes and sex ($p = 0.44$), age ($p = 0.59$), and race/ethnicity ($p = 0.28$) on the risk for SPD.

Table 1. Characteristics of U.S. adults by diagnosed diabetes status, BRFSS, 2007.

Characteristic	Total			Diabetes			No diabetes			P-value[a]
	n	%	s.e.	n	%	s.e.	n	%	s.e.	
All	220235	100.0	0.0	24039	8.4	0.1	196196	91.6	0.1	
Sex										0.71
Men	82137	48.8	0.2	9471	49.1	0.7	72666	48.8	0.3	
Women	138098	51.2	0.2	14568	50.9	0.7	123530	51.2	0.3	
Race/ethnicity										<0.001
Non-Hispanic white	170069	67.8	0.2	16726	61.6	0.7	153343	68.4	0.3	
Non-Hispanic black	16586	8.6	0.1	2991	13.0	0.4	13595	8.1	0.1	
Hispanic	17343	16.1	0.2	2302	17.5	0.7	15041	15.9	0.2	
Asian	4248	3.6	0.1	377	2.9	0.3	3871	3.7	0.1	
Native Americans	3277	1.2	0.1	489	1.8	0.2	2788	1.1	0.1	
Other	6489	2.8	0.1	784	3.2	0.3	5705	2.7	0.1	

Table 1. Continue.

Characteristic	Total			Diabetes			No diabetes			P-value[a]
	n	%	s.e.	n	%	s.e.	n	%	s.e.	
Age, years										<0.001
18 to 44	66563	51.0	0.2	2024	16.6	0.6	64539	54.1	0.2	
45 to 64	90835	33.0	0.2	10505	45.0	0.7	80330	31.8	0.2	
≥65	61179	16.1	0.1	11352	38.3	0.6	49827	14.0	0.1	
Education										<0.001
<High school	22562	12.0	0.2	4358	19.1	0.6	18204	11.3	0.2	
High school	65447	28.3	0.2	8207	32.3	0.6	57240	27.9	0.2	
Some college	57538	26.4	0.2	6126	25.1	0.5	51412	26.5	0.2	
College graduate	74074	33.4	0.2	5264	23.5	0.6	68810	34.3	0.2	
Annual household income, $										<0.001
<15000	21561	9.2	0.2	4371	16.3	0.5	17190	8.5	0.2	
15000 to <25000	31828	13.2	0.2	4939	19.2	0.5	26889	12.6	0.2	
25000 to <35000	23766	10.1	0.1	2831	12.0	0.4	20935	9.9	0.2	
35000 to <50000	30817	13.3	0.2	2984	12.5	0.4	27833	13.3	0.2	
50000 to <75000	32505	14.9	0.2	2553	12.1	0.4	29952	15.2	0.2	
≥75000	50647	27.5	0.2	2650	14.8	0.5	47997	28.7	0.2	
Unknown	29111	11.8	0.1	3711	13.1	0.4	25400	11.7	0.2	
BMI, kg/m^2										<0.001
<30	154085	73.8	0.2	10943	48.8	0.7	143142	76.1	0.2	
≥30	56511	26.2	0.2	11794	51.2	0.7	44717	23.9	0.2	
No smoking										<0.001
Not current smoker	179427	80.9	0.2	20370	85.1	0.5	159057	80.6	0.2	
Current smoker	39925	19.1	0.2	3561	14.9	0.5	36364	19.4	0.2	
Leisure time physical activity										<0.001
Any	163273	76.2	0.2	14255	62.9	0.6	149018	77.4	0.2	
None	56748	23.8	0.2	9752	37.1	0.6	46996	22.6	0.2	
Hypertension										<0.001
No	142009	72.5	0.2	7027	32.7	0.6	134982	76.2	0.2	
Yes	77856	27.5	0.2	16943	67.3	0.6	60913	23.8	0.2	
High cholesterol										<0.001
No	107709	63.0	0.2	8076	36.6	0.6	99633	66.0	0.2	
Yes	78097	37.0	0.2	14517	63.4	0.6	63580	34.0	0.2	
Myocardial infarction										<0.001
No	206755	96.0	0.1	19976	84.8	0.5	186779	97.0	0.1	
Yes	12409	4.0	0.1	3797	15.2	0.5	8612	3.0	0.1	
Angina										<0.001
No	205655	95.9	0.1	19704	84.4	0.5	185951	97.0	0.1	
Yes	12573	4.1	0.1	3771	15.6	0.5	8802	3.0	0.1	
Stroke										<0.001
No	211493	97.4	0.1	21560	90.8	0.4	189933	98.0	0.1	
Yes	8123	2.6	0.1	2348	9.2	0.4	5775	2.0	0.1	
Limitation in activities										<0.001
No	164851	81.4	0.2	13451	60.7	0.6	151400	83.3	0.2	
Yes	51742	18.6	0.2	10143	39.3	0.6	41599	16.7	0.2	
Use of special equipments										<0.001
No	196291	93.2	0.1	17865	78.2	0.5	178426	94.5	0.1	
Yes	20877	6.8	0.1	5821	21.8	0.5	15056	5.5	0.1	
Serious psychological distress										<0.001
K6 score ≥13	8235	3.9	0.1	1608	7.6	0.4	6627	3.6	0.1	
K6 score <13	194687	96.1	0.1	20158	92.4	0.4	174529	96.4	0.1	

[a]Results of Chi-square tests for differences in the proportion of diabetic and non-diabetic group members with each characteristic.

Prevalence and correlates of SPD among adults with diagnosed diabetes

By states, the prevalence of SPD among U.S. adults with diagnosed diabetes ranged from 2.6 % (s.e., 0.8) in Iowa to 15.8 % (s.e., 2.1) in Kentucky (Table 2). By the correlate categories shown in Table 3, the prevalence of SPD was highest among Hispanics (11.8 %) and Native Americans (14.7 %), people with less than a high school education (15.6 %), people with an annual household income < $15000 (17.3 %), people with type 1 diabetes (11.1 %), people with type 2 diabetes who were currently using insulin (11.5 %), people who were currently smoking (15.9 %), people who engaged in no leisure-time physical activity (11.6 %), people with one (11.1 %) or two (18.8 %) microvascular complications, and people with one (12.3 %) or two or more (11.5 %) macrovascular complications. After full adjustments (i.e., the adjustments made by Model 4), independent correlates of SPD consisted of young age, low level of education, low annual household income, obesity, current smoking, no leisure-time physical activity, the presence of one or more micro-vascular complications, and the presence of one or more macro-vascular complications.

Disability and SPD among adults with diagnosed diabetes

As shown in Table 4, the prevalence of SPD was more than five times higher among people with activity limitations than among those without ($p < 0.0001$), and three times higher among those who used special equipment than among those who did not ($p < 0.0001$). After adjustments for demographic variables, cardiovascular risk factors, and micro- and macrovascular complications, the differences in SPD prevalence associated with these disability variables decreased but remained significant (all $p < 0.0001$), indicating an independent association between disability and SPD among people with diagnosed diabetes.

Discussion

Our results, based on a large population sample, indicated that the prevalence of SPD among U.S. adults with diagnosed diabetes was 7.6 %, about twice the prevalence among those without diagnosed diabetes (3.6 %). However, the prevalence ratio of SPD between people with and without diagnosed diabetes was greatly attenuated after adjustments for all correlates. In addition, we found that the following factors were independent correlates of SPD among people with diagnosed diabetes: young age, low education level, low annual household income, obesity, current smoking, no leisure-time physical activity, the presence of one or more micro- or macro-vascular complications, and disability.

Table 2. Prevalence of serious psychological distress among U.S. adults with diagnosed diabetes, by state, BRFSS, 2007.

State or Territory	*n*	%	s.e.[a]
Total	21766	7.6	0.4
Alabama	–[b]	–	–
Alaska	133	4.4[c]	2.3
Arizona	–	–	–
Arkansas	603	7.8	1.4
California	486	6.1	1.6
Colorado	367	4.2	1.2
Connecticut	650	4.0	0.8
Delaware	–	–	–
District of Columbia	316	5.3	1.5
Florida	–	–	–
Georgia	932	9.8	1.7
Hawaii	533	4.2	1.2
Idaho	–	–	–
Illinois	558	4.9	1.0
Indiana	629	6.3	1.4
Iowa	431	2.6	0.8
Kansas	379	6.6	1.5
Kentucky	801	15.8	2.1
Louisiana	718	11.2	1.4
Maine	351	4.8	1.3
Maryland	–	–	–
Massachusetts	482	8.8	2.1
Michigan	516	7.3	1.6
Minnesota	351	4.4[c]	1.3
Mississippi	1100	9.3	1.1
Missouri	535	9.0	1.5
Montana	500	5.7	1.3
Nebraska	472	6.3[c]	2.3
Nevada	376	9.2	2.5
New Hampshire	539	5.2	1.0
New Jersey	–	–	–
New Mexico	601	8.5	1.4
New York	–	–	–
North Carolina	–	–	–
North Dakota	–	–	–
Ohio	653	7.1	1.4
Oklahoma	847	9.4	1.3
Oregon	172	5.9[c]	1.9
Pennsylvania	–	–	–
Rhode Island	407	9.5	1.8
South Carolina	1206	8.4	1.5
South Dakota	–	–	–
Tennessee	–	–	–
Texas	1020	10.1	1.3
Utah	–	–	–
Vermont	571	9.6[c]	3.6
Virginia	681	5.1	0.9
Washington	1253	5.1	1.1
West Virginia	–	–	–
Wisconsin	411	6.0‡	2.0
Wyoming	514	6.4	1.6
Guam	–	–	–
Puerto Rico	672	10.9	1.4
Virgin Islands	–	–	–

[a] s.e. = standard error
[b] No data available.
[c] Does not meet the standard of statistical reliability and precision (i.e., relative s.e. >30%).

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Table 3. Prevalence of serious psychological distress by various characteristics and prevalence ratios among U.S. adults with diagnosed diabetes, BRFSS, 2007.

Characteristic	Prevalence			Unadjusted PR[a]			Adjusted PR[b]		
	n	%	s.e.	PR	95% CI		PR	95% CI	
All	21766	7.6	0.4						
Sex									
Men	8547	6.5	0.5	1.0	1.0				
Women	13219	8.6	0.5	1.3	1.1	1.6	1.2	0.9	1.5
Race/ethnicity									
Non-Hispanic white	15386	6.0	0.3	1.0					
Non-Hispanic black	2571	9.6	1.2	1.6	1.2	2.1	0.7	0.6	1.0
Hispanic	2055	11.8	1.5	2.0	1.5	2.6	1.0	0.7	1.5
Asian	336	5.4	2.9	0.9	0.3	2.6	1.4	0.4	4.6
Native Americans	423	14.7	3.8	2.4	1.5	4.1	1.0	0.6	1.8
Other	716	6.4	1.3	1.1	0.7	1.6	0.7	0.4	1.3
Age, years									
18 to 44	1853	9.5	1.1	2.3	1.6	3.1	2.8	1.7	4.5
45 to 64	9699	9.6	0.6	2.3	1.7	3.0	2.5	1.7	3.8
≥65	10106	4.2	0.5	1.0					
Education									
<High school	3672	15.6	1.5	4.4	3.2	6.1	1.8	1.1	2.7
High school	7453	6.8	0.5	1.9	1.4	2.6	0.9	0.7	1.4
Some college	5660	6.6	0.6	1.8	1.3	2.6	1.0	0.7	1.5
College graduate	4940	3.6	0.5	1.0					
Annual household income, $									
<15000	3889	17.3	1.4	7.7	4.8	12.3	3.6	2.0	6.5
15000 to <25000	4489	9.8	1.0	4.4	2.7	7.1	2.6	1.4	4.6
25000 to <35000	2615	6.8	1.1	3.0	1.8	5.2	2.3	1.2	4.4
35000 to <50000	2812	4.0	0.6	1.8	1.1	3.0	1.2	0.7	2.3
50000 to <75000	2420	1.9	0.4	0.8	0.5	1.5	0.6	0.3	1.4
≥75000	2517	2.3	0.5	1.0	1.0				
Unknown	3024	8.4	1.1	3.7	2.2	6.2	2.4	1.2	4.6
Type of diabetes									
Type 1	713	11.1	2.4	1.9	1.3	3.1	1.0	0.5	1.9
Type 2, no use of insulin	11534	5.7	0.4	1.0	1.0				
Type 2, use of insulin	3358	11.5	1.5	2.0	1.5	2.7	1.3	0.7	2.4
Duration of diabetes, years									
<3	3467	7.4	0.8	1.0	1.0				
3 to 5	2985	5.0	0.7	0.7	0.5	1.0	0.8	0.5	1.1
6 to 9	2548	6.6	1.0	0.9	0.6	1.3	0.8	0.5	1.1
10 to 14	2461	6.9	1.6	0.9	0.6	1.6	0.9	0.6	1.5
≥15	4106	9.4	1.1	1.3	0.9	1.7	1.1	0.7	1.5
BMI, kg/m^2									
<30	9881	5.8	0.5	1.0	1.0				
≥30	10879	8.9	0.6	1.5	1.3	1.9	1.4	1.1	1.7
Smoking status									
Not current smoker	18437	6.1	0.4	1.0	1.0				
Current smoker	3247	15.9	1.3	2.6	2.1	3.2	1.8	1.4	2.3
Leisure time physical activity									
Any	13077	5.2	0.5	1.0	1.0				
None	8666	11.6	0.7	2.2	1.8	2.7	1.6	1.3	2.1
High blood pressure									
No	6364	6.0	0.6	1.0	1.0				
Yes	15355	8.3	0.5	1.4	1.1	1.7	1.1	0.8	1.5

Table 3. Continue.

Characteristic	Prevalence			Unadjusted PR[a]			Adjusted PR[b]		
	n	%	s.e.	PR	95% CI		PR	95% CI	
High cholesterol									
No	7335	4.9	0.4	1.0	1.0				
Yes	13248	8.5	0.5	1.7	1.4	2.1	1.3	1.0	1.6
Microvascular complications[c]									
0	11722	5.2	0.5	1.0	1.0				
1	3684	11.1	1.2	2.1	1.6	2.8	1.5	1.1	1.9
2	674	18.8	2.4	3.6	2.6	4.9	1.9	1.3	2.7
Macrovascular complications[d]									
0	15677	5.9	0.4	1.0	1.0				
1	3723	12.3	1.4	2.1	1.6	2.7	1.9	1.5	2.5
≥2	2360	11.5	1.1	2.0	1.6	2.4	1.5	1.1	2.0

[a]PRs and 95% CIs were estimated from univariate analyses.
[b]PRs and 95% CIs were estimated from multivariable log-binomial analyses adjusting for all variables listed in this table.
[c]Microvascular complications include foot ulcers and retinopathy.
[d]Macrovascular complications include myocardial infarction, angina, and stroke.
SPD = serious psychological distress; PR = prevalence ratio; CI = confidence interval.

Table 4. Prevalence of serious psychological distress among U.S. adults with diagnosed diabetes, by disability status, BRFSS, 2007.

Disability	Status	Prevalence			Unadjusted PR[a]		Adjusted PR[b]	
		n	%	s.e.	PR	95% CI	PR	95% CI
Limitation in activities	Yes	9304	14.9	0.8	5.2	4.1, 6.7	3.5	2.5, 4.9
	No	12356	2.9	0.3	1.0	Referent	1.0	Referent
Requires special equipment								
	Yes	5217	15.5	0.9	2.9	2.4, 3.5	2.3	1.8, 3.0
	No	16522	5.4	0.4	1.0	Referent	1.0	Referent

[a]PR and 95% CI were estimated from univariate analyses.
[b]PR and 95% were estimated from multivariable log-binomial analyses adjusting for sex, race/ethnicity, age, education, annual income, diabetes types, diabetes duration, obesity, current smoking, no leisure-time physical activity, high blood pressure, high cholesterol, microvascular complications, and macrovascular complications.
SPD = serious psychological distress; PR = prevalence ratio; CI = confidence interval.

In assessments of the results based on data from New York City in 2003 (10.4%)[12] and Los Angeles County in 2005 (8.1%),[13] prevalence estimates of SPD were slightly higher than in our study, possibly because of geographic variations in the prevalence rates. Because BRFSS used K6 as a screening tool for SPD for the first time in 2007, our results can be used as baseline for monitoring future secular trends in SPD prevalence at the national level.

Many studies have shown that the prevalence of depression is twice as high among people with diabetes as among those without.[2] However, these studies only performed minimal adjustments for demographic characteristics and lifestyle variables. After adjusting more fully for a combination of socioeconomic, behavioral, and disease variables, we found that the association between diagnosed diabetes and SPD was considerably attenuated. Our results were similar to that of a recent study in which people with diagnosed diabetes were found to be at 1.69 times greater risk for depressive symptoms (95% CI, 1.06–2.72) than those without diabetes after adjustments for demographic and lifestyle variables but at only 1.36 times greater risk (95% CI, 0.83–2.23) after additional adjustments for several chronic diseases.[21] Indeed, multiple cardiovascular risk factors have been associated with severe mental distress,[22] and cardiovascular disease has been associated with depression and anxiety.[23] Furthermore, cardiovascular risk factors have been associated with an increased risk of developing diabetes,[24] and the prevalence of cardiovascular disease has been shown to be higher among people with diabetes than among those without.[25] Therefore, the elevated prevalence of SPD among people with diagnosed diabetes may be mainly the result of their relatively low socioeconomic status and relatively high rate of cardiovascular comorbidities.

Previous studies have shown that female sex, young age, low education level, low family income, perceived poor physical health, smoking, a body mass index (BMI) ≥30, an elevated glycosylated hemoglobin A1C concentration, and diabetes complications were significantly associated with an increased risk for major depression.[26–30] Our finding of a similar set of correlates for SPD is perhaps not surprising given the strong association between K6 scores used to assess SPD and DSM-IV scores used to assess mood and anxiety disorders.[10] It remains unclear, however, whether major depression or anxiety may serve as the main contributor of SPD.

A previous study has shown that people with diabetes and major depression are about seven times more likely to have overall functional disability than those with neither condition.[31] It has been proposed that psychological distress causes immunosuppression, which in turn leads to decreased physical functioning.[32] On the other hand, physical disability has been shown to predict the onset of depressive disorders and symptoms.[33] Therefore, psychological distress and disability may reinforce each other and exacerbate the overall health problems of people with diagnosed diabetes.

Our results are subject to at least three limitations. First, diagnosed diabetes was self-reported by BRFSS participants. Although a previous study has shown a substantial agreement in determinations of diabetes status based on self-reports and those based on actual diagnoses (kappa = 0.76; sensitivity = 75 %),[34] misclassification of the diabetes status of survey participants with undiagnosed diabetes could have resulted in a bias toward the null. About 25 % of total cases of diabetes are undiagnosed in the United States.[1] As results from a recent study showed no association between undiagnosed diabetes and depressive symptoms,[21] the impact of diabetes misclassification on our results could be minimal. Second, the BRFSS survey excludes people with no landline telephones. To the extent that these people are more likely to be of low socioeconomic status, to have severe physical or mental illness, or to have been institutionalized or hospitalized, this exclusion may have led us to underestimate the true prevalence of SPD among U.S. adults. Third, we are unable to establish temporal relations between diabetes and SPD given the cross-sectional nature of the survey.

Despite these limitations, we found that SPD was highly prevalent among people with diagnosed diabetes. We also found that the association between diagnosed diabetes and SPD was largely accounted for by the combination of socioeconomic status, multiple cardiovascular risk factors, and major cardiovascular diseases and events, indicating that intensive treatment for or interventions targeting these risks and diseases may reduce levels of psychological distress among people with diagnosed diabetes. Our findings also suggest that people with both diagnosed diabetes and disability should be routinely assessed for psychological distress in clinical settings and that those found to have psychological distress should be provided with appropriate medical, rehabilitative, and psychosocial care.

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Appendix A

In 2007, the following 42 states, 3 territories, and the District of Columbia administered the BRFSS Diabetes Module: Alabama, Alaska, Arizona, Arkansas, California, Colorado, Connecticut, Delaware, District of Columbia, Florida, Georgia, Hawaii, Idaho, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Michigan, Minnesota, Missouri, Montana, Nebraska, Nevada, New Jersey, New Mexico, North Carolina, North Dakota, Ohio, Oregon, Pennsylvania, South Carolina, South Dakota, Tennessee, Utah, Vermont, Virginia, Washington, West Virginia, Wisconsin, Wyoming, Guam, Puerto Rico, Virgin Islands.

The following 35 states, the District of Columbia, and Puerto Rico administered the BRFSS Mental Illness and Stigma Module: Alaska, Arkansas, California, Colorado, Connecticut, District of Columbia, Georgia, Hawaii, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Mexico, Ohio, Oklahoma, Oregon, Rhode Island, South Carolina, Texas, Vermont, Virginia, Washington, Wisconsin, Wyoming, and Puerto Rico.

Note: Model 1: unadjusted, i.e., dependent variable was dichotomized SPD (1 = yes, 0 = no) and independent variable was diagnosed diabetes (1 = yes, 2 = no) only; Model 2: based on Model 1 and further adjusted for age, sex, race/ethnicity, education levels, and annual household income; Model 3: based on Model 2 and further adjusted for high blood pressure, high cholesterol, obesity, current smoking, and no leisure-time physical activity; Model 4: based on Model 3 and further adjusted for selected cardiovascular diseases or events (myocardial infarction, angina, and stroke).

SPD = serious psychological distress; PR = prevalence ratio; CI = confidence interval.

Abbreviations: BRFSS = Behavioral Risk Factor Surveillance System; CDC = Centers for Disease Control and Prevention; CI = confidence interval; DSM-IV = Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition; K6 = Kessler 6; PR = prevalence ratio; SPD = serious psychological distress.

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