Depressive states among adults with diabetes: Findings from the National Health and Nutrition Examination Survey, 2007–2012

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Abstract

Aims—To determine (1) the prevalence of SubD states among adults with diabetes, and (2) whether evidence exists of an independent association between diabetes status and SubD, controlling for selected confounders.

Methods—Data from the 2007–2012 National Health and Nutrition Examination Surveys were combined to estimates of depressive states by diabetes status among the noninstitutionalized U.S. adult population, and to assess the association of diabetes status and depressive states using a polytomous logistic regression model.

Results—An estimated 17%, or 3.7 million, of U.S. adults with diabetes (diagnosed and undiagnosed) met criteria for either mD or ssD. The majority of SubD cases with diabetes were found to be ssD (10.1%) compared with mD (6.9%). After controlling for the effects of age, sex, race and ethnicity, education, body mass index, and poverty as covariates, an independent association persists between diagnosed diabetes and each SubD grouping (ssD: OR = 1.82, CIs

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1.33, 2.47; mD: OR = 1.95, CIs 1.39, 2.74) compared with respondents having no diabetes. No association was found between depression and undiagnosed diabetes or prediabetes compared with those having no diabetes.

Conclusion—Milder forms of depression such as ssD and mD are more extant than major depressive episodes among adults with diabetes. The odds that an adult with diagnosed diabetes meets the criteria for ssD or mD are higher by 80% and 95%, respectively, after controlling for age, sex, race and ethnicity, education, body mass index, and poverty factors when compared against adults with no diabetes.

Keywords

Subthreshold depression; Diabetes; Adults; NHANES; Subsyndromal depression; Minor depression

1. Introduction

Diabetes has been linked with depression in a series of cross-sectional [1–3], observational cohort studies [4–6], and the association has been acknowledged in systematic reviews and meta-analysis [7–11]. Those with diabetes are at higher risk for depression [11], and those with depression are at higher risk of developing diabetes relative to those with no depression [12]. However, a direct association does not appear when confounding factors are taken into consideration, according to some studies [5,13]. The interdependence of depressive states and diabetes is generally understood to worsen the conditions' comorbidity. This creates a challenge for both primary doctors encountering such cases in their practice [14,15], and for public health because a certain degree of comorbidity is expected among the general population [14].

Studies have long shown recognition of the interdependence between unipolar major depressive episodes (MDE) and diabetes. For example, Li et al. [3], using data from the Behavioral Risk Factor Surveillance System, estimates that in the United States (U.S.), the prevalence of MDE among adults with diabetes is approximately 8% of the adult population. In a clinical setting study, Ludmant et al. [16] found the MDE–diabetes symptom association to be stronger than the association of diabetes symptoms with measures of glycemic control. Overall, such findings prevail in systematic reviews regarding the association of diabetes and depression [8,9,11]. A thorough review of the scientific literature in other countries reveals the work being done on the association between diabetes and milder forms of depressive states that do not fulfill the criteria for MDE, known collectively as subthreshold depressive states (SubD). Using data from the German National Health Interview and Examination, Kruse et al. [1] found that dysthymia, amild-to-moderate form of depression which lingers for an extended period of time, is the most prevalent affective disorder among German adults with diabetes. In Spain, Campayo et al. [17] examined data from a community sample of adults to study whether clinically significant depression is associated with the risk of diabetes.

While our understanding of the interdependence of MDE and diabetes at the population level in the U.S. has improved, little attention has been given to the examination of milder

forms of depression [12,13]. The paucity of research is occurring despite the American Diabetes Association standards recognize the benefit of early management of milder forms of depression among persons with diabetes [15]. The limited research available does not provide representative estimates of the prevalence of milder forms of depression and diabetes among adults in the U.S.

Population-based studies already have provided an ideal platform to further extend our understanding of the association between diabetes and severe forms of depression [1–6,12,18–20]. Therefore, an analytical examination of a population-based data set to consider the association of diabetes and specifically SubD may prove equally worthwhile. To the best of our knowledge, none of the current U.S. research efforts have been comprehensive enough to explicitly examine SubD status among adults by diabetes states and to generalize the results to the larger population. Past work on depression and diabetes in the U.S. has provided some national prevalence estimates [3,20]. However, these estimates have been limited in their scope due to (a) omission of the clinical SubD criteria along with the recognition of MDE, (b) absence of the full ambit of diabetes status, (c) data collection bias [3], and (d) use of clinical samples that limit generalization [20]. Thus, the empirical identification of milder forms of depressive states among the general adult population by diabetes status remains an important topic for research. The aim of this study is to address this gap by examining (1) whether evidence exists of an independent association between subD states and diabetes among the adult population, and (2) whether the proposed association persists after adjustment for selected covariates. For a better understanding of the current public health burden, weighted prevalence and population counts of depressive states by diabetes status based on the 2007–2012 U.S. noninstitutionalized adult population are also presented.

2. Materials and methods

2.1. Study design

2.1.1. Data source—The National Health and Nutrition Examination Survey (NHANES) is a multipurpose cross-sectional health survey that measures the health and nutritional status of the U.S. civilian noninstitutionalized household population. NHANES uses a stratified, multistage probability cluster design to select a representative sample of the population. The uniqueness of NHANES rests in its collection protocol, in which the standardized collection of self-reported health information along with clinical physical examination and laboratory data allows the identification of both diagnosed and undiagnosed conditions [21]. On the other hand, one relevant restraint of the NHANES cross-sectional survey design is that causality cannot be inferred.

NHANES data collection is completed in two phases. The first phase is a face-to-face interview in the participant's household. The second phase consists of a series of private interviews, and physical and laboratory examinations held in a mobile examination center (MEC). Both the household and MEC interviews are performed using a standardized protocol with trained staff and recorded using computer-assisted personal interviewing (CAPI). NHANES data collection protocol has been approved by the National Center for Health Statistics Research Ethics Review Board. All of the participants provided written

informed consent. More information about NHANES collection protocols can be found elsewhere [22–24].

Analyses were performed using NHANES public-use data files. NHANES data files are based on an independent two-year cycle. For the development of an analytical study, NHANES guidelines recommend combining two or more cycles to increase sample size, subsequently increasing the statistical power, generalizability, and precision of the subdomain of interest [23]. Following this strategy, three NHANES data cycles were merged for this study (i.e., 2007–2008, 2009–2010, and 2011–2012). However, before the data were merged, we examined the weighted prevalence of depression and diabetes by each NHANES cycle separately. The prevalence of both conditions presented slight differences across survey cycles. However, such variability was found to be within the expected range of possible variations due to sampling and does not directly affect the final estimates (results not shown).

2.1.2. Sampling weights—*To* ensure that statistical estimates of desired parameters would be nationally representative of the subpopulation of interest (i.e., adults ages 20 years and older who have diabetes and depression), self-reported diabetes and fasting sampling weights computed by the National Center for Health Statistics (NCHS) were incorporated by (1) following NHANES guidelines [23,24], and (2) integrating preceding strategies used in analytical NHANES studies for diabetes data [25,26]. To calculate nationally representative estimates, the sampling weights were adjusted so that estimates would represent the full 6-year time period, instead of 2- or 4-year periods.

2.2. Measures

2.2.1. Outcome measure—The outcome measure was determined using the Personal Health Questionnaire (PHQ–9) [27]. PHQ–9 is a dual-purpose instrument for screening, diagnosing, monitoring, and measuring the severity of depression [28] that can be scored in two ways: by applying the Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM–IV–TR) criteria algorithm to derive a provisional clinical diagnosis, or by calculating a summed score of the nine questions (ranging from 0 to 27) to establish a depression severity index. For this study, the DSM–IV–TR criteria-based algorithm was selected as the more conventional method to reflect a provisional clinical diagnosis.

PHQ-9 was administered in the MEC by trained interviewers. PHQ–9 consists of nine questions that ask participants to indicate how often, during the past two weeks, they had been affected by symptoms such as depressed mood, anhedonia, hopelessness, tiredness, poor appetite, moving or speaking slowly, trouble concentrating or sleeping, or suicidal thoughts (Supplemental Table S1). These questions are mapped to the nine depressive symptoms described on the DSM–IV–TR [29]. The response options for each question are, "Not at all" (score: 0), "Several days" (score: 1), "More than half the days" (score: 2), and "Nearly every day" (score: 3). Depression was indicated if the response to each PHQ-9 question was affirmative for more than half the days (i.e., score: 2) or nearly every day (i.e., score: 3).

Depressive states were divided into 4 mutually exclusive categories. A major depressive episode (MDE) is when a positive response is given for one of the two core symptoms of the DSM–IV–TR criterion A (depressed mood or loss of interest), and a total of five or more symptoms exist for more than half the days in the past two weeks. In addition, one of the nine symptom criteria—"thoughts that you would be better off dead or of hurting yourself in some way"—counts if present at all (i.e., score: 1, 2, or 3), regardless of duration [29,30]. Minor depression (mD) is defined using the provisional DSM–IV–TR research appendix [29]: mD is present when at least 1 core symptom (depressed mood or loss of interest) exists, and 2 to 4 depressive symptoms are present in the past two weeks. Subsyndromal symptomatic depression (ssD) is defined based on the work by Judd and colleagues [31]: ssD is present when 2 to 4 depressive symptoms exist in the past two weeks in survey respondents who do not meet criteria for either MDE or mD. Respondents who did not meet the criteria for MDE, mD, or ssD were listed as not having depression (reference category). For this study, subthreshold depressive states (SubD) include ssD and mD cases.

The PHQ–9 has extensively been used as a surveillance instrument to identify persons at risk of depression in a variety of settings, making it one of the most widely used tools to determine self-reported depressive states [32]. Analytical, as well as systematic, reviews [32] have documented that PHQ–9 has a sound internal consistency for use in clinical and nonclinical settings.

2.2.2. Main exposure—Diabetes status was based on self-reported physician diagnosis and MEC laboratory measures. Physician-diagnosed diabetes was obtained during the household interview by self-report. Identification of survey respondent may include adults with type 1 and type 2 diabetes. To identify persons with undiagnosed diabetes or prediabetes, levels of fasting plasma glucose and glycated hemoglobin (A1c) were obtained from participants who had a MEC examination. For these measures, the sample was limited to respondents who had fasted for at least 8 h but less than 24 h, and who did not report a previous medical diagnosis of diabetes. Definition of undiagnosed diabetes and prediabetes were based on American Diabetes Association guidelines [15]. Undiagnosed diabetes was defined based on fasting plasma glucose (FPG) of at least 126 mg/dL, or an A1c of at least 6.5%, and no self-reported medical history of diabetes. Prediabetes was based on an FPG value of 100–125, or an A1c of greater than 5.7% but less than 6.5%, with no self-reported medical history of diabetes. Diabetes categories were mutually exclusive. Women who had diabetes only during pregnancy were not included in the diabetes category. In this report, unless otherwise specified, respondents with diabetes refers to persons with either diagnosed or undiagnosed diabetes.

2.2.3. Covariates—Covariate selection was performed *a priori* based on the existing scientific literature review concerning diabetes and depression. Selected covariates in this study include sex, age (grouped as 20–39, 40–59, and 60 and over), and race and Hispanic origin (non-Hispanic white, non-Hispanic black, all Hispanic, and Mexican-American). Poverty status was defined based on the poverty income ratio (PIR) index defined by the U.S. Department of Health and Human Service [33]. Three PIR categories were used: poor (less than 100% of the poverty level); near poor or low income (at 100% to less than 200%

of poverty level), and middle and high income (at 200% of poverty level or above). Educational attainment was defined as no high school diploma or general educational development (GED) equivalency; high school diploma or GED; some college but no bachelor's degree; and bachelor's degree or higher. Body mass index (BMI) was based on anthropometric measures collected in the MEC and calculated as weight in kilograms divided by height in meters squared, rounded to one decimal. BMI was defined as underweight (BMI < 18.4 kg/m^2), healthy weight (BMI = 18.5–24.9 kg/m^2), overweight (BMI = 25.0–29.9 kg/m^2), and obese (BMI   30.0 kg/m^2).

2.3. Statistical analysis

NHANES guidelines [24] were followed to calculate weighted prevalence and population counts. Taylor series linearization was used to compute design-based variance estimation represented as 95% confidence intervals (CIs). A relative standard error (RSE) of greater than 30% was adopted to identify unreliable statistics. All estimates shown in this report have an RSE less than or equal to 30%.

Bivariate and polytomous logistic regression models were used to estimate the association between depressive states and diabetes status. For all analyses, a cutoff p-value of less than 0.05 was used to infer statistical significance. All statistical analyses were performed using Stata software and "svy commands" that accounted for the survey's complex sample design (version 12, StataCorp, College Station, Texas).

2.4. Subpopulation considerations

For 2007–2012, 24,731 persons ages 20 years and older were eligible to participate in NHANES, 17,713 completed the interview, and 17,085 were examined, resulting in an overall response rate of 69.1%. For this analytical study, subgroup analysis was conducted on eligible adults ages 20 and older who visited the MEC and provided complete information on diabetes and depression (n = 7717). Responses such as "refused," "not ascertained," and "don't know" were set to missing values.

2.5. Missing data

Multiple imputations chained equations (MICE) was implemented to address the overall percentage of missing data found at the selected covariates of the subgroup analysis (8% of the missing data belong to income, and 8% is scattered among the other covariates). Following MICE guidelines for the optimal overall number of imputations [34,35], we generated 20 complete data sets with all missing values imputed. The imputed data sets were then combined to produce an overall set of multiple imputation estimates for each analysis, reflecting both within- and between-imputation variance in the statistical estimates. More information on how MICE works can be found elsewhere [34,36]. To determine whether the results change substantially after the imputations took place, a sensitivity analysis based on the final version of the multiple imputations was compared with the complete-case (non-missing data) regression model (Supplemental Table S2).

2.6. Statistical model

2.6.1. Premodel assessment—Bivariate analyzes were performed to examine the association between the outcome variable and each selected covariate. The design-based analysis revealed that BMI was not associated with depressive status (Wald test, $p = 0.39$). However, because previous research suggested that BMI is a relevant predictor for both diabetes and depression in adults [38], a decision was made to keep it in the final model.

2.6.2. Interactions assessment—Before the establishment of the final model, effect modification was investigated by examining interactions among the covariates. Interactions between sex and race, and education and poverty were evident. The selected interaction terms were further examined individually and jointly against the final model. Further analysis of the interaction terms based on Wald statistics did not show a substantial change in the exposure-adjusted odds ratio (Supplemental Table S3). Therefore, interaction terms were not retained in the final model to simplify their interpretation.

2.6.3. Final model specification—The association between diabetes and depressive states as an outcome was examined by fitting an unadjusted and adjusted polytomous logistic regression model using the subgroup analysis. The adjusted odds ratio (AOR) can be interpreted as the main effect while controlling for the effect of the selected covariates. Data assumptions for the implementation of polytomous statistical models were met [36].

3. Results

3.1. SubD prevalence

During 2007–2012, an estimated 17.0% or 3.7 million of the adult population with diabetes (diagnosed and undiagnosed) met clinical criteria for any milder form of depressive state (Table 1). Among adults with diabetes, 10.1% (2.2 million) met criteria for ssD, 6.9% (1.5 million) met criteria for mD, while 5.1% (1.1 million) met criteria for MDE.

SubD prevalence among adults with no diabetes (11.2%), undiagnosed diabetes (10.2%, $p = 0.58$), and prediabetes (11.8%, $p = 0.63$) were comparable. However, SubD was found to be more prevalent among those with diagnosed diabetes (19.9%) than in another diabetes status under examination. Specifically, the percentage of adults with diagnosed diabetes who met clinical ssD criteria was higher (11.4%, or 2.5 million) than the percentage of adults with no diabetes and ssD (7.3%, or 1.6 million, $p < 0.01$), adults with undiagnosed diabetes and ssD (7.0%, 1.52 million, $p < 0.01$), or adults with prediabetes and ssD (6.2%, 1.3 million, $p < 0.01$). Higher prevalence of mD was also seen among adults with diagnosed diabetes (8.5%, or 1.8 million) compared with adults with mD and prediabetes (5.6%, $p < 0.01$, 1.2 million), or adults having mD and no diabetes (3.9%, 0.8 million, $p < 0.01$).

3.2. Statistical modeling results

3.2.1. Unadjusted model—Table 2 presents results from fitting the unadjusted and adjusted polytomous regression models using the imputed data. Evidence from the unadjusted model shows an independent association between diagnosed diabetes and milder forms of depressive states. The odds of an adult with diagnosed diabetes having ssD is 80%

higher (OR = 1.80, 95% CIs 1.44, 2.25) than the odds of an adult with no diabetes (referent group). Adults with diagnosed have a higher odds of meeting clinical criteria for mD (OR = 2.38; 95% CIs 1.78, 3.19) and MDE (OR = 2.81, 95% CIs 1.92, 4.11) compared to those without diabetes. Statistical evidence was found of an unadjusted association between MDE and adults with undiagnosed diabetes (OR = 1.77; 95% CIs 1.05, 2.98), and mD and prediabetes (OR = 1.37; 95% CIs 1.00, 1.88). No evidence of an association was found for undiagnosed diabetes and ssD (OR = 0.95; 95% CIs 0.61, 1.50) or mD (OR = 0.80 95% CIs 0.47, 1.36).

3.2.2. Adjusted model—Table 2 also presents the AOR of each depressive state by diabetes status. After correcting for the effect of selected confounders (age, sex, race and ethnicity, education, BMI, and poverty), evidence of an independent association between adults with diagnosed diabetes and ssD remains significant (AOR = 1.82; 95% CIs 1.34, 2.47). The AOR of adults with diabetes having mD or MDE were reduced due to the adjustment of the confounders but remained statistically significant (mD: AOR = 1.95; 95% CIs 1.39, 2.74, and MDE: AOR = 2.28; 95% CIs 1.45, 3.57). The association between MDE and undiagnosed diabetes (AOR = 1.42; 95% CIs 0.71, 2.84), as well as the association of prediabetes and mD (AOR = 1.39, 95% CIs 0.99–1.97), was partially explained when the effect of the preceding covariates was controlled. Consistent with the unadjusted findings presented in Table 2, there is evidence of no association between undiagnosed diabetes and ssD (OR = 0.95, 95% CIs 0.61, 1.50) or mD (OR = 0.69, 95% CIs 0.39, 1.20)

The adjusted results presented in Table 2 suggest other associations. The odds of an adult female fulfilling clinical criteria for each depressive state were more than 55% to 65% higher than the odds of a male doing so. Lower education increases the odds of mD and MDE being present, but not ssD. A similar trend was found with income. Adults who are poor or have low income have higher odds of meeting the criteria for any depressive state than adults who have middle or high income. The odds of adults who are poor meeting the criteria for ssD (AOR = 2.07; CIs 1.47, 2.90) or mD (AOR = 2.36; CIs 1.68, 3.31) were more than twice the odds of adults with middle or high income doing so, and more than four times the odds of meeting MDE criteria (AOR = 4.29; CIs 2.37, 7.80). In contrast to previous studies [3,5,18], this analysis did not find evidence of an association between depressive states and age, race and ethnicity, or BMI.

In sensitivity analysis we contrasted the imputed model (Table 2) against the complete case model (Supplemental Table S2) and found that the general pattern, the direction, and the magnitude of the AOR were generally similar (data not shown).

4. Discussion

Based on a nationally representative sample, the results of this analytical study suggest that milder forms of depressive states are more prevalent among adults with diagnosed diabetes and are independently associated with diagnosed diabetes than adults with no diabetes in the U.S. Regardless of age, sex, race and ethnicity, education, BMI, and poverty status, the odds of an adult with diagnosed diabetes meeting clinical criteria for SubD such as ssD or mD increased by 80% or 95%, respectively, compared to no diabetes. Consistent with earlier

research, sex [1,13,20], poverty [9,14,19], and low educational attainment [4,5] were found to be predictors of depressive states. No evidence of statistical association between milder forms of depressive states and undiagnosed or prediabetes compared to not having diabetes was found. To our knowledge, our work is the first to explicitly examine the association of milder forms of depressive states and the full range of diabetes status using a nationally representative sample.

5. Strengths and limitations

5.1. Strengths

Strengths of this study include the use of a complex survey design that allows for (1) the generalizability of our findings to the U.S. civilian household noninstitutionalized adult population, and (2) the examination of diabetes based on validated examination measures not confounded by treatment-seeking status [37] or selection bias (Berkson's bias)—two fundamental limitations that were likely to be present in diabetes treatment sample-related studies. A major strength is the use of an integrated data collection system that allowed the identification and further statistical control of selected covariates that might cofound the depression effect. Another strength is the utilization of a standardized assessment protocol of depressive symptoms that allowed the formation of a provisional clinical diagnostic criteria for MDE, mD, and ssD, based on the DSM–IV–TR. Finally, the use of combined data from three survey cycles permitted the calculation of statistics with a high degree of precision, yielding stable parameters.

5.2. Limitations

This study has several limitations. One of the most salient limitations is that due to the NHANES cross-sectional design, we cannot rule out that the clinical manifestation of SubD can be perceived as either the outcome of a prodromal state, or the product of a partial remission of a more severe mood state such as MDE. One limitation is that the NHANES interview data (questionnaire) are based on self-reports, therefore, may be subject to misunderstanding of the question or recall problems. Another possible limitation is that we were not able to distinguish between adults with diabetes type 1 and type 2. However, due to the vast majority of work have found that type 2 diabetes is more predominant [7,26], the findings of this work would most likely to be representative of U.S. adults with type 2 diabetes. Other possible limitation can be that persons with depression may not have participated in this survey due to the inherent limitation imposed by their emotional condition, in turn affecting the prevalence. And finally, NHANES results are limited to the U.S. civilian household noninstitutionalized adult population. Institutionalized population (e.g. inmates of penal or correctional facilities; long-term hospitalized population) as well as homeless may be more likely to present mood disorders as well of adverse health conditions.

Despite these methodological limitations, the results of our study provide the most up-to-date estimates of the prevalence of depressive states among adults with diabetes in the U.S., which can be valuable for future health initiatives. The findings presented are also consistent with the outcomes found in another country [1,12,38],. However, distinct from previous

efforts, these findings expand on the concept of portraying depression beyond a dichotomous state and encourage the examination of depressive states as a more complex phenomenon.

6. Conclusion

In conclusion, consistent with previous research [12,17], the measured effect presented in this analytical study adds to the growing evidence that upholds the clinical, epidemiological, and scientific value of reexamining the occurrence of milder forms of depression among the adult population with diabetes. Information on adults with diabetes and milder forms of depression may prove to be valuable for implementing early disease management strategies that are supported by the medical care community [15] to reduce the burden and the reappearance of incipient forms of mood disorders such as MDE.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.diabres.2017.02.031.

Table 1

Percentage and population estimates (in millions) of adults with depressive states by diabetes status and selected variables, 2007–2012 NHANES.

	Subthreshold depressive state (ssD + mD)				Subsyndromal symptomatic depression				Minor depression				Major depressive episode			
	Prevalence	Population estimates			Prevalence	Population estimates			Prevalence	Population estimates			Prevalence	Population estimates		
	Percent (SE)	In Millions	LB	UB	Percent (SE)	In Millions	LB	UB	Percent (SE)	In Millions	LB	UB	Percent (SE)	In Millions	LB	UB
Diabetes status																
Total diabetes[a] (*n* = 2236)	17.0(0.93)	3.72	3.3	4.2	10.1(0.74)	2.21	1.9	2.6	6.9(0.65)	1.51	1.3	1.8	5.1(0.53)	1.11	.9	1.4
Diagnosed diabetes[b] (*n* = 1900)	19.9(1.19)	4.36	3.9	4.9	11.4(0.82)	2.51	2.2	2.9	8.5(0.86)	1.86	1.5	2.3	5.5(0.61)	1.21	1.0	1.5
Undiagnosed diabetes[c,d] (*n* = 336)	10.2(1.67)	2.24	1.6	3.1	7.0(1.39)	1.52	1.0	2.3	3.3(0.79)	.71	.4	1.2	4.0(0.90)	.87	.6	1.4
Pre-diabetes[d,e] (*n* = 2024)	11.8(1.06)	2.59	2.2	3.1	6.2(0.69)	1.37	1.1	1.7	5.6(0.65)	1.23	1.0	1.5	2.9(0.41)	.64	.5	.9
No diabetes (*n* = 3457)	11.2(0.66)	2.45	2.2	2.8	7.3(0.55)	1.60	1.4	1.9	3.9(0.39)	.85	.7	1.0	2.3(0.31)	.51	.4	.7
Total sample (*n* = 7717)	12.1(0.60)	2.65	2.4	2.9	7.3(0.43)	1.60	1.4	1.8	4.8(0.30)	1.05	.9	1.2	2.8(0.25)	.62	.5	.7
Age groups																
20–39 (*n* = 2244)	12.2(0.83)	.99	.9	1.1	8.3(0.59)	.67	.6	.8	4.0(0.51)	.32	.2	.4	2.5(0.32)	.20	.2	.3
40–59 (*n* = 2522)	12.3(0.89)	1.03	.9	1.2	6.9(0.63)	.58	.5	.7	5.4(0.59)	.45	.4	.6	3.9(0.47)	.32	.3	.4
60+ (*n* = 2951)	11.5(1.07)	.63	.5	.8	6.4(0.66)	.35	.3	.4	5.1(0.63)	.28	.2	.4	1.8(0.24)	.10	.1	.1
Sex																
Male (*n* = 3805)	9.7(0.80)	1.02	.9	1.2	5.8(0.65)	.61	.5	.8	3.9(0.39)	.41	.3	.5	2.3(0.31)	.24	.2	.3
Female (*n* = 3912)	14.4(0.81)	1.64	1.5	1.8	8.8(0.62)	1.00	.9	1.1	5.7(0.46)	.64	.5	.8	3.4(0.40)	.38	.3	.5
Race-ethnicity																
Non-Hispanic White (*n* = 3438)	11.6(0.76)	1.74	1.5	2.0	7.5(0.55)	1.12	1.0	1.3	4.2(0.39)	.62	.5	.8	2.7(0.33)	.40	.3	.5
Non-Hispanic Black (*n* = 1623)	15.2(1.08)	.38	.3	.4	8.0(0.78)	.20	.2	.2	7.2(0.74)	.18	.1	.2	4.1(0.58)	.10	.1	.1
All Hispanics[f] (*n* = 2065)	12.2(0.70)	.37	.3	.4	6.2(0.70)	.19	.1	.2	6.0(0.60)	.18	.1	.2	3.1(0.50)	.09	.1	.1

	Subthreshold depressive state (ssD + mD)				Subsyndromal symptomatic depression				Minor depression				Major depressive episode			
	Prevalence	Population estimates			Prevalence	Population estimates			Prevalence	Population estimates			Prevalence	Population estimates		
	Percent (SE)	In Millions	LB	UB	Percent (SE)	In Millions	LB	UB	Percent (SE)	In Millions	LB	UB	Percent (SE)	In Millions	LB	UB
Mexican-Americans (n = 1214)	11.8(0.91)	.22	.2	.3	5.5(0.81)	.10	.1	.1	6.3(0.77)	.12	.1	.2	2.0(0.48)	.04	.0	.1
Educational attainment																
Less than high school (n = 2188)	18.3(1.24)	4.01	3.5	4.6	8.6(0.92)	1.88	1.5	2.3	9.7(0.78)	2.13	1.8	2.5	4.9(0.66)	1.08	.8	1.4
HS or GED equivalent (n = 1755)	13.5(1.33)	2.96	2.4	3.6	8.1(1.05)	1.78	1.4	2.3	5.4(0.71)	1.19	.9	1.5	3.3(0.52)	.71	.5	1.0
Some college (n = 2116)	13.0(0.88)	2.84	2.5	3.3	9.0(0.72)	1.98	1.7	2.3	4.0(0.53)	.87	.7	1.1	3.0(0.56)	.65	.4	.9
BS or higher (n = 1648)	6.3(0.84)	1.38	1.1	1.8	4.1(0.64)	.90	.7	1.2	2.2(0.49)	.48	.3	.7	1.1(0.27)	.25	.2	.4
BMI																
Healthy weight (n = 1897)	11.4(1.03)	2.51	2.1	3.0	6.9(0.79)	1.52	1.2	1.9	4.51(0.57)	.99	.8	1.3	2.0(0.48)	.44	.3	.7
Overweight (n = 3039)	13.6(0.85)	2.98	2.6	3.4	8.5(0.74)	1.87	1.6	2.2	5.1(0.46)	1.11	.9	1.3	4.2(0.43)	.92	.7	1.1
Obese (n = 2462)	10.5(0.90)	2.31	1.9	2.7	6.2(0.67)	1.37	1.1	1.7	4.3(0.6)	.94	.7	1.2	2.2(0.49)	.48	.3	.8
Poverty index																
Poor (n = 1521)	21.2(1.42)	4.65	4.1	5.3	12.3(1.38)	2.70	2.1	3.4	8.9(0.84)	1.95	1.6	2.3	6.6(0.79)	1.44	1.1	1.8
Low income (n = 1973)	15.6(1.40)	3.43	2.9	4.1	8.2(1.06)	1.81	1.4	2.3	7.4(0.73)	1.62	1.3	2.0	4.2(0.55)	.91	.7	1.2
Middle & High Income (n = 3550)	8.6(0.64)	1.89	1.6	2.2	5.7(0.50)	1.24	1.0	1.5	3.0(0.37)	.65	.5	.8	1.6(0.29)	.34	.2	.5

SE – Standard error.

LB = Lower bound. UB = Upper bound.

SOURCE: CDC/NCHS, National Health and Nutrition Examination Survey. Public use-data file 2007–2012.

[a] Total diabetes = includes diagnosed and undiagnosed diabetes.

[b] Diagnosed/Physician-diagnosed diabetes was obtained by self-report and excludes women who reported having diabetes only during pregnancy.

[c] Undiagnosed diabetes is defined as a fasting plasma glucose (FPG) of at least 126 mg/dL or a hemoglobin A1c of at least 6.5% and no reported physician diagnosis.

[d]Respondents had fasted for at least 8 h and less than 24 h.

[e]Prediabetes is defined as a fasting plasma glucose (FPG) of at least 100–126 mg/dL or a hemoglobin A1c of (5.7% with less than 6.5%) and no reported physician diagnosis.

[f]Persons of All-Hispanic origin may be of any race.

Table 2

Unadjusted and adjusted odds ratio[a] an design-based 95% CI's, 2007–2012 NHANES, imputed data. Source: CDC/NCHS, National Health and Nutrition Examination Survey. Public use-data file 2007–2012.

	Subsyndromal symptomatic depression		Minor depression		Major depressive episode	
	Unadjusted OR [95% CI]	Adjusted OR [95% CI]	Unadjusted OR [95% CI]	Adjusted OR [95% CI]	Unadjusted OR [95% CI]	Adjusted OR [95% CI]
Main exposure						
No diabetes	1.00 REF	1.00 REF	1.00 REF	1.00 REF	1.00 REF	1.00 REF
Prediabetes	0.86 [0.67, 1.12]	0.93 [0.70, 1.26]	1.37 [1.00, 1.88]	1.39 [0.99, 1.97]	1.29 [0.92, 1.82]	1.26 [0.83, 1.93]
Undiagnosed diabetes	0.95 [0.61, 1.50]	1.01 [0.62, 1.60]	0.80 [0.47, 1.36]	0.69 [0.39, 1.20]	1.77 [1.05, 2.98]	1.42 [0.71, 2.84]
Diagnosed diabetes	1.80 [1.44, 2.25]	1.82 [1.34, 2.47]	2.38 [1.78, 3.19]	1.95 [1.39, 2.74]	2.81 [1.92, 4.11]	2.28 [1.45, 3.57]
Covariates						
Sex						
Male		1.00 REF		1.00 REF		1.00REF
Female		1.56[1.20, 2.03]		1.55 [1.17, 2.05]		1.65 [1.09, 2.49]
Age groups						
20–39 yrs		1.00 REF		1.00 REF		1.00 REF
40–59 yrs		0.89 [.692, 1.14]		1.42 [0.98, 2.05]		1.65 [1.22, 2.24]
60+ yrs		0.67 [.502,.887]		1.00 [0.68, 1.50]		0.58 [0.39, 0.85]
Education						
BS or higher		1.00 REF		1.00 REF		1.00 REF
Some college		2.05 [1.44, 2.91]		1.67 [0.99, 2.79]		2.08 [1.10, 3.94]
HS or GED		1.86 [1.18, 2.91]		2.06 [1.15, 3.70]		2.11 [0.99, 4.48]
Less HS		1.95 [1.36, 2.78]		3.30 [1.93, 5.63]		2.70 [1.19, 6.16]
Race-ethnicity						
Non-Hispanic-White		1.00 REF		1.00 REF		1.00 REF
Non-Hispanic Black		0.77 [0.61, 0.99]		1.32 [0.98, 1.77]		0.94 [0.63, 1.39]
All Hispanics		0.61 [0.45, 0.83]		0.85 [0.63, 1.15]		0.60 [0.39, 0.93]
Mexican-American		0.499 [0.34,.729]		0.79[0.54, 1.17]		0.36 [0.21, 0.63]
Poverty income ratio						

	Subsyndromal symptomatic depression		Minor depression		Major depressive episode	
	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted
	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]
Middle & high income		1.00 REF		1.00 REF		1.00 REF
Low income		**1.42 [1.10, 1.99]**		**2.05 [1.45, 2.91]**		**2.59 [1.63, 4.13]**
Poor		**2.07 [1.47, 2.90]**		**2.36 [1.68, 3.31]**		**4.29 [2.37, 7.80]**
Body mass index (BMI)						
Healthy weight		1.00 REF		1.00 REF		1.00 REF
Overweight		1.19 [0.91, 1.57]		0.88 [0.601, 1.29]		1.71 [0.91, 3.23]
Obese		0.91 [0.64, 1.31]		0.81 [0.54, 1.20]		1.05 [0.91, 3.24]

Bold type indicates a significant odds ratio. P value <0.05 for statistical significance.

Odds ratio; 95% confidence intervals in brackets.

REF = Referent category.

Sample $n = 7717$.

[a] Adjusted to age, sex education, race-ethnicity, poverty, and BMI.