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Diabetes and Co-morbid Depression among Racially Diverse, Low-income Adults

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Abstract

Background—Research suggests individuals with diabetes are twice as likely as those without diabetes to be clinically depressed. Still unknown is the relationship between diabetes and depression in socioeconomically disadvantaged populations.

Purpose—We examined the relationship between diabetes and depressive symptoms in a large, racially diverse, low-income cohort in the southeastern United States.

Methods—69,068 adults were recruited from community health centers in the twelve southeastern states in the U.S. A fully adjusted polytomous logistic regression model tested the relationship between demographics, lifestyle behaviors, antidepressant use, body mass index, diabetes diagnosis, diabetes duration, diabetes medication compliance, and depressive symptoms using the Centers for Epidemiological Studies Depression scale.

Results—Diabetes was present in 21.7% of sample. While a diabetes diagnosis was associated with having severe depressive symptoms (AOR: 1.24, 95% CI: 1.14-1.34), demographics, lifestyle behaviors, antidepressant use, body mass index were more strongly associated with severe depressive symptoms than a diabetes diagnosis.

Conclusions—Having diabetes was associated with the presence and severity of depressive symptoms in a large, low-income sample of racially diverse adults. However, the relationship between diabetes and depressive symptoms was weaker than other studies with higher socioeconomic groups.

Keywords

depression; diabetes; disparities; income; education

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According to the World Health Organization, depression continues to be highly prevalent, accounts for more disability worldwide than any other psychiatric disorder, and is projected to be the second most prevalent medical condition by 2020.(1) Prospective, retrospective and meta-analytic studies highlight significantly higher rates of depression among persons with diabetes relative to the general population.(2,3) The most commonly cited statistic, based on a meta analysis of 42 studies, is that diabetes doubles the risk of depression.(4) Depression is an independent risk factor for poor health outcomes and increased mortality, even after controlling for diabetes status.(5,6) In a prospective cohort study, depression was associated with follow-up mortality, even after accounting for a history of diabetes.(6)

Individuals with diabetes and co-morbid depression have been shown to have poor adherence to diabetes medications (7), poor adherence to dietary recommendations (7), poor glycemic control (8), more diabetes-related complications (9), and a higher risk of mortality than individuals with diabetes who are not depressed.(10,11) In a large cohort study of insurance beneficiaries with diabetes, co-morbid depression was associated with a 36-38% increased risk of all-cause mortality compared to persons with diabetes only.(11) In a separate cohort study, co-morbid depression was associated with a 1.3-fold increased risk of all-cause mortality.(12) The human toll of diabetes and co-morbid depression translates into a 50% increase in health care costs compared to the cost of treating diabetes alone.(12) Integrating diabetes and depression treatment can improve health outcomes in individuals with both conditions (13), thereby reducing their human and economic burden.

Race/ethnicity and socioeconomic status (SES) may be risk factors for co-morbid depression among persons with diabetes. Racial and ethnic disparities in diabetes prevalence and complications are well documented in the literature.(14,15) However, less is known about disparities in the prevalence of co-morbid depression. In contrast to studies with predominantly White patients that find a positive association between diabetes and depression, one study showed no association in a sample of African American patients.(16) Other work has shown similar rates of depressive symptoms in African Americans and Whites with diabetes (17), including an association between depression and poor glycemic control in both groups.(18) Furthermore, SES has been related to both greater levels of depressive symptoms (19), and a greater risk of developing type 2 diabetes.(20) However, the relationship between SES, depression, and diabetes may not only exist at the lowest social strata; there is some evidence to suggest a graded relationship along the entire SES continuum.(21)

The objective of this study was to examine the relationship between diabetes and depressive symptoms in a large sample of racially diverse, low-income, older adults participating in the Southern Community Cohort Study.(22) We have previously reported that antidepressant medication use among persons with diabetes was inversely related to SES, but lower among African American than White Southern Community Cohort Study participants.(23) Herein we characterize the association between levels of depressive symptoms among individuals with vs. without diabetes after controlling for SES, lifestyle and other variables.

Methods

Recruitment of Participants

The Southern Community Cohort Study is a prospective cohort study designed to identify causes of health disparities between African Americans and Whites in the incidence and mortality rates of several cancers and other chronic diseases.(22) Participants were enrolled primarily in-person at public community health centers located in twelve southeastern states in the U.S. Trained study interviewers enrolled participants by approaching people entering the clinic (patients, persons accompanying patients, etc.) and screening them for eligibility

and interest in study participation. Participants were required to be between the ages of 40 and 79, English speaking, and not be treated for cancer (excluding non-melanoma skin cancer) within the past year. After providing informed consent, interviewers collected baseline data using a computer assisted personal interview. The baseline interview contained a battery of questions, including those which ascertained participants' demographics and lifestyle behaviors, depressive symptoms, and medical history.

The study was approved by the institutional review boards at Vanderbilt University and Meharry Medical College in Nashville, Tennessee, U.S.

Measures

Demographics—Demographics included age, gender, race/ethnicity, education, employment status, annual household income, marital status, health insurance status.

Lifestyle behaviors—Lifestyle behaviors included self-reported cigarette smoking status and alcohol consumption.

Antidepressant use—Participants were asked if they were taking any antidepressant medication, and then asked for the name(s) of all medications of this type being taken.

Body mass index—Body mass index (BMI = kg/m^2) was computed from self-reported height and weight. A categorical variable was created to represent underweight (BMI < 18.5), normal weight (18.5 ≤ BMI <25), overweight (25 ≤ BMI ≤30), and obese (30 <BMI).

Diabetes diagnosis—Participants with diabetes were identified using the question, "Has a doctor ever told you that you have diabetes?" Participants who answered "yes" to this question were selected as having a diabetes diagnosis. In two validation studies, one involving a review of medical records and the other involving an assessment of HbA1c percentages, the self-reported diagnoses of diabetes were confirmed for 96% of those reporting diabetes.(24)

Diabetes duration—Participants with a diabetes diagnosis were asked how many years they have had diabetes, and whether they are taking diabetes medications.

Diabetes medication compliance—Those taking diabetes medications were also asked, "During the past three months, how often did you take your diabetes medication as instructed by your doctor?" Response options were in 5-point Likert format, 1 = all the time, 2 = most of the time, 3 = sometimes, 4 = rarely, 5 = never. In our analysis, responses were recoded to 1 = excellent compliance, 2 = good compliance, ≥3 = poor compliance.

Depressive symptoms—Depressive symptoms were assessed using the 10-item version of the Centers for Epidemiological Studies Depression (CES-D) scale, a valid and reliable measure of the presence and severity of depressive symptoms.(25) Cutoffs of 10, 15, and 20 are used to define mild, moderate, and severe levels of depressive symptoms.(25)

Study Subject Exclusions

The initial data set consisted of 69,068 Southern Community Cohort Study participants. Individuals who were age < 40 years (n = 2), or had missing values for education (n = 45), annual household income (n = 736), marital status (n = 8), health insurance status (n = 336), cigarette smoking status (n = 100), alcohol consumption (n = 310), did not answer the question about antidepressant use (n = 37), BMI (n = 1575), did not answer the question

about having diabetes or hypertension (n = 53), depressive symptoms score (n = 99), were excluded, resulting in 65,767 participants selected for analyses.

Statistical Analyses

Descriptive statistics were performed to describe the distribution of each variable across participants reporting none, mild, moderate, and severe depressive symptoms. Means and SDs were computed for age, and frequencies and proportions were computed for the remaining variables. A bivariate unadjusted ANOVA model was performed to test the mean age difference across the levels of depressive symptoms. Bivariate chi-square tests examined differences on demographics (gender, race/ethnicity, education, employment status, annual household income, marital status, and health insurance status), lifestyle behaviors (cigarette smoking status and alcohol consumption), antidepressant use, BMI, diabetes diagnosis, diabetes duration, and diabetes medication compliance across the levels of depressive symptoms. A fully adjusted polytomous logistic regression model was performed to examine the associations (adjusted odds ratios and corresponding 95% confidence intervals) between levels of depressive symptoms and demographics (age, gender, race/ethnicity, education, employment status, annual household income, marital status, and health insurance status), lifestyle behaviors (cigarette smoking status and alcohol consumption), antidepressant use, BMI, and diabetes diagnosis. The Mantel-Haenszel test was used to examine the linear trend of the odds ratios across levels of depressive symptoms within each variable. Statistical analyses were performed using SAS version 9.2 (SAS Institute, Cary, NC). All statistical tests were based on two-tailed probability distributions.

Results

The presence and severity of depressive symptoms by participant characteristics are presented in Table 1. Reflecting the low socioeconomic groups community health centers typically serve, participants in the Southern Community Cohort Study tended to have low annual incomes (61% had below $15,000), less education (32% had less than a high school degree), and were currently unemployed (63%). The median age at enrollment was 52 years, 60% were female and 71% were African American. Overall 42% had CES-D scores indicative of mild (23%), moderate (12%) or severe (7%) depressive symptoms, but the percentages varied significantly by demographics, lifestyle behaviors, antidepressant use, BMI, and diabetes factors (diagnosis, duration, compliance). For each factor, the differences across categories were highly significant, ($p < .01$) because of the large sample sizes involved. Severe depressive symptoms were nearly twice as common in females as in males; in Whites as in African Americans; in those with incomes less than $15,000 than in those with incomes more than $25,000; in those with less than a high school education as in those with a college education; and in those who were unemployed as in those who were employed. Smaller yet still significant differences were also seen with other indicators, with a higher prevalence of depressive symptoms among current smokers and those who were underweight or obese compared to those who were normal or overweight.

Among participants with diabetes, 8.3% reported severe depressive symptoms and 12.8% reported moderate depressive symptoms, rates modestly higher than those without diabetes (6.9% and 11.7%). As shown in Table 1, rates of severe depressive symptoms tended to decline slightly with diabetes duration, and were considerably lower among participants who reported excellent medication compliance vs. poor medication compliance.

Table 2 illustrates a fully adjusted polytomous logistic regression model examining the association between depressive symptoms and demographics, lifestyle behaviors, antidepressant use, BMI, and diabetes diagnosis. Compared to participants between the ages of 40 and 49 years, the odds of having mild, moderate, and severe depressive symptoms

decreased markedly with advancing age. The bivariate associations suggested by the Chi-square tests in Table 1 generally remained intact after adjusting for covariates in the regression model. In particular, the odds of depressive symptoms were significantly elevated among females, Whites, those with lower incomes and less education, the unemployed, as well as the uninsured, smokers and those who were underweight.

As shown in Table 2, participants with diabetes were more likely than those without diabetes to report mild (AOR = 1.15; CI = 1.09-1.21), moderate (AOR = 1.17; 1.10-1.25), and severe depressive symptoms (AOR = 1.24; 1.14-1.34). However, based on an examination of the odds ratios in Table 2, demographics, lifestyle behaviors, antidepressant use, and BMI were more strongly associated with depressive symptoms than having a diabetes diagnosis. Participants with diabetes who reported “poor” medication compliance were more likely than those who reported excellent medication compliance to have mild (AOR = 1.60; 1.29-1.98), moderate (AOR = 2.03; 1.56-2.64), or severe depressive symptoms (AOR = 2.74; 2.04-3.70). Diabetes duration was unrelated to the presence and severity of depressive symptoms. In addition, there were no significant interactions between race/ethnicity and diabetes status, and between gender and diabetes status.

Discussion

We investigated the relationship between diabetes and co-morbid depression in a large, low-income cohort of racially diverse older adults at community health centers in the southeastern U.S. Our results deepen our understanding of the complex interplay between depression and diabetes, and challenge the conventionally accepted view that diabetes substantially increases the risk of depression. Consistent with other studies, a diabetes diagnosis was significantly associated with the presence and severity of depressive symptoms after adjustment for relevant demographics, lifestyle behaviors, antidepressant use, and BMI.(2,3) However, the relationship between diabetes status and depressive symptoms in our study was much weaker than has been previously reported.(4) Most studies report that a diabetes diagnosis doubles the risk of depression.(4) We found that demographics (age, gender, race/ethnicity, education, employment status, annual household income, marital status, and health insurance status), lifestyle behaviors (cigarette smoking status and alcohol consumption), antidepressant use, and BMI were more strongly associated with the presence and severity of depressive symptoms than a diabetes diagnosis. Factors unmeasured in this study, such as functional impairment (26), may be an even stronger predictor of depressive symptoms than having diabetes and/or having the other risk factors identified here.

Our results are in accord with a recently published study in which patients with diabetes had little or no increased risk of a new diagnosis of depression relative to patients without diabetes after controlling for the number of outpatient visits.(27) In our study, we found a weak relationship between a diabetes diagnosis and depressive symptoms among a cohort recruited from visitors to community health centers. There are several plausible explanations for why the relationship between diabetes and depression in the Southern Community Cohort Study may not be as strong as in other studies. Diabetes and co-morbid depression studies tend to employ different methods of recruiting subjects, with nearly all other studies including the use of smaller, racially/ethnically homogenous samples, generally from private clinics, hospitals, or an unspecified setting.(4) There are also variations in sources of data, severity indicators for depression and diabetes, and the ability to control for lifestyle behaviors and other factors which may influence both diabetes and depression.(27,28)

Overall, 42% of the total Southern Community Cohort Study sample reported mild, moderate, or severe depressive symptoms. In a meta-analysis of 42 studies, only a handful of

studies were performed in community settings and used a version of the CES-D to assess depression.(4) In those studies, 22-31% participants with diabetes and 13-24% participants without diabetes reported severe depressive symptoms.(29,30) In our low SES sample of older adults, the prevalence of severe depressive symptoms assessed by CES-D scores was modestly higher for those with diabetes (~8.3%) than those without diabetes (~6.9%). While it appears that the participants in our study regardless of diabetes diagnosis were less severely depressed than comparable studies reported in meta-analytic work, and restricted range or low levels of depression might be an alternative explanation for the findings, we caution readers about making one-to-one comparisons. Diabetes and co-morbid depression studies vary widely in their sampling approaches, sample characteristics (e.g., type of diabetes; racial/ethnic heterogeneity, SES variability, pediatric vs. adult), measures used to assess depression (e.g., there are twelve short forms of the CES-D (31)), and cutoff scores used to classify depression cases.(2,4) Furthermore, studies on community-dwelling older adults with diabetes published since the meta-analysis of 42 studies was performed have also documented lower rates of depression. For example, Bell et al. reported a rate of 15.8% (CES-D of ≥ 9) in an ethnically diverse, lower educated sample.(32) Black et al. reported a rate of 6.6% (CES-D of ≥16) in a Mexican American, lower educated sample. Thus, the extent to which our findings differ from others as a function of restricted range and low depression levels is unclear. Additional research is needed with comparable samples, same versions of the CES-D and cutoff scores used to classify depression in order to both determine this and understand reasons for lower or higher rates of depression reported across studies.

While there is a substantial body of research on diabetes and co-morbid depression, our findings help fill significant gaps in the literature about the association between diabetes and depression among socioeconomically disadvantaged populations.(16,17,32) It was unknown, prior to this study, whether a diabetes diagnosis might be more predictive of having depression in socioeconomically disadvantaged, predominately African American populations. Participants in the Southern Community Cohort Study had low annual incomes, less education, and were predominately unemployed and African American. In models predicting depression status and severity, these socioeconomic factors were strongly related to the presence and severity of depressive symptoms. This is consistent with other observations in ethnic minority samples with and without diabetes.(33,34) However, our findings take it one step further, suggesting low SES is a *stronger predictor* of depression than a diabetes diagnosis.

There are several study limitations to acknowledge. First, diabetes diagnosis was self-reported and not based on chart review or biological testing. However, in a separate validation study, 124 medical records of Southern Community Cohort Study participants reporting a prior diagnosis of diabetes were reviewed and 96% of the self-reports were validated based on criteria including the International Statistical Classification of Disease and Related Health Problems (ICD-9) codes, physician notes or prescriptions, and/or HbA1c or blood glucose measurements from the medical records.(24) Thus, a lack of validity of self-reported diabetes in this study is an unlikely explanation for the findings. A more plausible limitation is the underreporting of diabetes either because participants did not know their status or they were unwilling to report it, so that some participants we classified as not having diabetes may have actually had the disease. Such an effect, which would tend to dilute differences between participants with diabetes and those without diabetes and could lower the odds ratios, is common to other studies as well.

Second, we assessed diabetes medication compliance with a single, self-report item created for the study rather than a validated self-report measure or more objective measures of medication adherence such as refill adherence or electronic monitoring devices. While it is

possible participants under-reported non-adherence in response to this question, recent studies suggest brief self-report measures and single item measures can be viable and accurate measures of medication adherence.(35,36)

Third, while both the full-length 20-item CES-D and 10-item CES-D have been validated in various populations, including multi-ethnic groups with diabetes (37,38), the full-length version is not psychometrically equivalent across race/ethnicity or immigrant generations and has demonstrated false positive rates in some low-income settings.(39,40) Less is known about the psychometric equivalence of the 10-item CES-D across socioeconomic groups.

Fourth, the prevalence of depression varies systematically as a function of the method used to identify depression cases and the study design. Rates of depression have been shown to be two to three times higher in diabetes studies using self-report measures versus diagnostic interviews (4), as the two approaches identify somewhat different but overlapping samples of depressed individuals. Self-report measures identify most cases of major depressive disorder, whereas diagnostic interviews identify major depressive disorder but exclude other clinically relevant presentations. In this study, depressive symptoms were self-reported. Had we used diagnostic interviews to identify depression, the magnitude of the relationship between diabetes status and depressive symptoms in this study might have differed.

Finally, because this is a cross-sectional study, inferences regarding causal and temporal relationships cannot be made. Other limitations include the inability to distinguish between type 1 and type 2 diabetes in the Southern Community Cohort Study questionnaire, although the large majority reported adult-onset diabetes, and the inability to generalize to younger, more educated or more affluent populations. Our goal was to compose a sample of individuals arriving at community health centers (patients, persons accompanying patients, etc.) in twelve U.S. states, age 40-79 years, English speaking, who had not been treated for cancer (excluding non-melanoma skin cancer) within the past year. For practical reasons, we were unable to randomly select individuals arriving at community health centers, but we have no reason to suspect that participants who enrolled in the Southern Community Cohort Study differed substantially from the overall clinic population. Indeed, the low education and income status of the Southern Community Cohort Study participants coincides with the low SES status of the large majority of persons attending community health centers, and the male to female ratio of the cohort is similar to the male to female ratio of clinic patients. Nevertheless, we cannot rule out that some systematic differences of those volunteering to enter the Southern Community Cohort Study might have influenced the associations of interest.

Despite these limitations, our findings extend the spectrum of what is known about diabetes and co-morbid depression, as prior studies have been limited by higher SES and less racially diverse samples. Our study reports a significant association between co-morbid depression and a diabetes diagnosis in a large, low-income, predominantly African American sample, but with at a lower magnitude than seen elsewhere. While our findings suggest a weaker depression-diabetes association than previously reported, we cannot infer depression has any less of an impact on the health and well-being of these groups. In this study, we also found participants with diabetes and depressive symptoms had poor diabetes medication compliance than those without depressive symptoms, suggesting that the presence of depression at any degree might still be associated with poor diabetes self-care activities.

The mechanisms underlying the weaker association between diabetes and co-morbid depression cannot be drawn from the current results. Prospective studies with similar samples are needed to explore the causes and consequences of co-morbid depression on a

range of outcomes relevant to diabetes care in low SES groups (e.g., glycemic control, utilization of health care services, mortality). Extended follow up of the Southern Community Cohort Study participants offers great potential to provide a rich prospective dataset that will help in understanding societal and physiologic mechanisms underlying the causes and consequences of co-morbid depression in diabetes; and, most importantly, allow for identifying causal relationships in a lower SES population.

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Table 1

Demographics, lifestyle behaviors, body mass index, anti-depressant use, and diabetes diagnosis of the Southern Community Cohort Study population; diabetes duration and medication complication presented on the sub-sample with diabetes

	Depressive Symptoms			
Variables	**None n (%)**	**Mild n (%)**	**Moderate n (%)**	**Severe n (%)**
DEMOGRAPHICS				
Age, Mean (SD)	52.4 (9.3)	50.7 (8.3)	50.1 (7.6)	49.6 (6.9)
Gender				
Male	15924 (61.0)	6268 (24.0)	2707 (10.4)	1206 (4.6)
Female	21939 (55.3)	9054 (22.8)	5125 (12.9)	3544 (8.9)
Race/ethnicity				
White	9029 (53.6)	3609 (21.4)	2338 (13.9)	1865 (11.1)
African-American	27612 (59.3)	11158 (24.0)	5179 (11.1)	2615 (5.6)
Others/mixed race	1222 (51.7)	555 (23.5)	315 (13.3)	270 (11.4)
Education				
Less than high school	10357 (49.5)	5634 (26.9)	3083 (14.7)	1857 (8.9)
High school	15286 (57.8)	6255 (23.6)	3099 (11.7)	1825 (6.9)
Some college or junior college	7818 (62.5)	2593 (20.7)	1258 (10.1)	834 (6.7)
College higher	4402 (75.0)	840 (14.3)	392 (6.7)	234 (4.0)
Employment status				
No	21353 (51.8)	10265 (24.9)	5795 (14.1)	3815 (9.3)
Yes	16238 (67.9)	4875 (20.4)	1931 (8.1)	873 (3.7)
Annual household income				
< $15,000	20395 (50.9)	10426 (26.0)	5619 (14.0)	3598 (9.0)
$15,000 to <$25,000	9167 (62.7)	3261 (22.3)	1465 (10.0)	736 (5.0)
$25,000 to <$50,000	5674 (71.9)	1292 (16.4)	589 (7.5)	340 (4.3)
$50,000 +	2627 (82.0)	343 (10.7)	159 (5.0)	76 (2.4)
Marital status				
Married/cohabitate	13305 (64.2)	4189 (20.2)	2055 (9.9)	1174 (5.7)
Divorced	12294 (53.5)	5530 (24.1)	3022 (13.2)	2132 (9.3)
Widowed	3875 (59.5)	1488 (22.9)	703 (10.8)	443 (6.8)
Single	8389 (53.9)	4115 (26.5)	2052 (13.2)	1001 (6.4)
Health insurance status				
No	15499 (54.1)	7102 (24.8)	3670 (12.8)	2378 (8.3)
Yes	22364 (60.3)	8220 (22.2)	4162 (11.2)	2372 (6.4)
LIFESTYLE BEHAVIORS				
Cigarette smoking status				
Never	14198 (60.6)	4901 (21.6)	2291 (10.1)	1292 (5.7)
Former smoker	8651 (62.8)	2854 (20.7)	1432 (10.4)	835 (6.1)
Current smoker	15014 (51.2)	7567 (25.8)	4109 (14.0)	2623 (9.0)
Alcohol consumption				

Variables	Depressive Symptoms			
	None n (%)	Mild n (%)	Moderate n (%)	Severe n (%)
Non-drinker	18421 (59.1)	6970 (22.4)	3505 (11.2)	2284 (7.3)
< 1/day	11640 (57.9)	4543 (22.6)	2441 (12.1)	1493 (7.4)
≥ 1/day and < 4/day	4310 (56.9)	1924 (25.4)	882 (11.6)	465 (6.1)
4 or more/day	3492 (50.7)	1885 (27.4)	1004 (14.6)	508 (7.4)
BODY MASS INDEX (kg/m^2)				
Normal weight: 18.5 ≤ to < 25	9205 (57.2)	3929 (24.4)	1872 (11.6)	1084 (6.7)
Under weight: < 18.5	441 (50.3)	218 (24.9)	126 (14.4)	91 (10.4)
Overweight: 25 ≤ to ≤ 30	11456 (60.0)	4326 (22.7)	2113 (11.1)	1198 (6.3)
Obese: > 30	16761 (56.4)	6849 (23.1)	3721 (12.5)	2377 (8.0)
ANTI-DEPRESSANT USE				
No	33736 (63.2)	12034 (22.6)	5138 (9.6)	2434 (4.6)
Yes	4127 (33.2)	3288 (26.5)	2694 (21.7)	2316 (18.6)
DIABETES DIAGNOSIS				
No	30050 (58.4)	11870 (23.1)	6001 (11.7)	3567 (6.9)
Yes	7813 (54.7)	3452 (24.2)	1831 (12.8)	1183 (8.3)
DIABETES DURATION *				
year or less	1335 (54.2)	602 (24.4)	309 (12.5)	218 (8.9)
2-3 years	1231 (55.2)	503 (22.6)	309 (13.9)	188 (8.4)
4-10 years	2588 (55.1)	1124 (23.9)	591 (12.6)	395 (8.4)
more than 10 years	2565 (54.4)	1179 (25.0)	602 (12.8)	369 (7.8)
DIABETES MEDICATION COMPLIANCE *				
Excellent	5787 (57.2)	2381 (23.6)	1213 (12.0)	730 (7.2)
Good	705 (48.1)	390 (26.6)	219 (14.9)	152 (10.4)
Poor	233 (42.5)	150 (27.4)	92 (16.8)	73 (13.3)

* Only for participants with diabetes.

Table 2

Associations between depressive symptoms, demographics, lifestyle behaviors, anti-depressant use, body mass index, and diabetes diagnosis in the Southern Community Cohort Study population

	Depressive Symptoms			Trend Test*
	Mild	Moderate	Severe	
Variables	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)	P value
DEMOGRAPHICS				
Age groups				
40-49	1.00	1.00	1.00	
50-59	0.94 (0.90 0.98)	0.91 (0.86 0.96)	0.86 (0.80 0.92)	<0.001
60-69	0.60 (0.56 0.64)	0.47 (0.43 0.52)	0.32 (0.28 0.36)	<0.001
70 +	0.48 (0.43 0.54)	0.30 (0.25 0.36)	0.15 (0.11 0.20)	<0.001
Gender				
Male	1.00	1.00	1.00	
Female	1.15 (1.10 1.20)	1.49 (1.41 1.58)	2.15 (1.99 2.33)	<0.001
Race/ethnicity				
White	1.00	1.00	1.00	
African-American	0.99 (0.94 1.03)	0.79 (0.74 0.84)	0.59 (0.55 0.63)	<0.001
Others	1.18 (1.06 1.32)	1.09 (0.94 1.25)	1.22 (1.04 1.42)	0.37
Education				
less than high school	1.00	1.00	1.00	
High school	0.77 (0.73 0.80)	0.69 (0.65 0.73)	0.66 (0.61 0.71)	<0.001
Some college or junior college	0.64 (0.61 0.68)	0.54 (0.50 0.58)	0.55 (0.50 0.61)	<0.001
College higher	0.48 (0.44 0.52)	0.40 (0.35 0.45)	0.38 (0.33 0.45)	<0.001
Employment status				
No	1.00	1.00	1.00	
Yes	0.78 (0.74 0.81)	0.59 (0.56 0.63)	0.45 (0.41 0.49)	<0.001
Annual household income				
< $15,000	1.00	1.00	1.00	
$15,000 to <$25,000	0.84 (0.80 0.88)	0.78 (0.73 0.83)	0.65 (0.60 0.71)	<0.001
$25,000 to <$50,000	0.63 (0.59 0.68)	0.63 (0.57 0.69)	0.63 (0.56 0.72)	<0.001
$50,000 +	0.44 (0.39 0.50)	0.45 (0.38 0.54)	0.38 (0.30 0.49)	<0.001
Marital status				
Married/cohabitate	1.00	1.00	1.00	
Divorced	1.18 (1.12 1.24)	1.27 (1.19 1.36)	1.53 (1.41 1.66)	<0.001
Widowed	1.13 (1.05 1.22)	1.09 (0.99 1.21)	1.24 (1.10 1.41)	**
Single	1.20 (1.13 1.26)	1.25 (1.16 1.35)	1.17 (1.06 1.29)	<0.001
Health insurance status				
No	1.00	1.00	1.00	
Yes	0.93 (0.90 0.97)	0.88 (0.83 0.93)	0.72 (0.67 0.77)	<0.001
LIFESTYLE BEHAVIORS				

	Depressive Symptoms			Trend Test*
	Mild	Moderate	Severe	
Variables	**AOR (95% CI)**	**AOR (95% CI)**	**AOR (95% CI)**	**P value**
Cigarette smoking status				
Never	1.00	1.00	1.00	
Former smoker	0.93 (0.88 0.98)	0.98 (0.91 1.05)	0.99 (0.90 1.09)	**
Current smoker	1.15 (1.09 1.20)	1.27 (1.19 1.36)	1.43 (1.32 1.55)	<0.001
Alcohol consumption				
Non-drinker	1.00	1.00	1.00	
< 1/day	1.05 (1.00 1.10)	1.17 (1.10 1.24)	1.11 (1.03 1.20)	0.01
≥ 1/day and < 4/day	1.13 (1.06 1.21)	1.19 (1.08 1.30)	1.12 (1.00 1.26)	0.84
4 or more/day	1.26 (1.17 1.35)	1.57 (1.43 1.72)	1.47 (1.31 1.66)	<0.001
ANTI-DEPRESSANT USE				
No	1.00	1.00	1.00	
Yes	2.18 (2.07 2.30)	3.74 (3.51 3.98)	5.75 (5.35 6.19)	0.00
BODY MASS INDEX (kg/m^2)				
Normal weight:18.5 ≤ to < 25	1.00	1.00	1.00	
Under weight: < 18.5	1.04 (0.88 1.23)	1.17 (0.95 1.45)	1.38 (1.08 1.78)	**
Overweight: 25 ≤ to ≤ 30	0.98 (0.93 1.03)	1.01 (0.94 1.09)	0.98 (0.89 1.07)	**
Obese: ≥ 30	1.03 (0.98 1.09)	1.14 (1.06 1.22)	1.13 (1.04 1.23)	**
DIABETES DIAGNOSIS				
No	1.00	1.00	1.00	
Yes	1.15 (1.09 1.21)	1.17 (1.10 1.25)	1.24 (1.14 1.34)	<0.001

*Mantel-Haenszel linear trend test

**Cannot conduct trend test.